

# **Journal of Clinical and Nursing Research**

Honorary Editor-in-Chief

**Linda Rykkje**

*VID Specialized University Faculty of Health, Norway*

Editor-in-Chief

**Feng Hui**

*Xiangya School of Nursing, Central South University, China*

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD

(619 649 400)

Level 10

50 Clarence Street

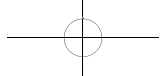
SYDNEY NSW 2000

Copyright © 2024. Bio-Byword Scientific Publishing Pty Ltd.

Complimentary Copy







ISSN (ONLINE): 2208-3693

ISSN (PRINT): 2208-3685



## Journal of Clinical and Nursing Research

### Focus and Scope

Journal of Clinical and Nursing Research (JCNR) is an international, peer reviewed and open access journal that seeks to promote the development and exchange of knowledge which is directly relevant to all clinical and nursing research and practice. Articles which explore the meaning, prevention, treatment, outcome and impact of a high standard clinical and nursing practice and discipline are encouraged to be submitted as original article, review, case report, short communication and letters.

Topics covered by not limited to:

- Development of clinical and nursing research, evaluation, evidence-based practice and scientific enquiry
- Patients and family experiences of health care
- Clinical and nursing research to enhance patient safety and reduce harm to patients
- Ethics
- Clinical and Nursing history
- Medicine

### About Publisher

Bio-Byword Scientific Publishing is a fast-growing, peer-reviewed and open access journal publisher, which is located in Sydney, Australia. As a dependable and credible corporation, it promotes and serves a broad range of subject areas for the benefit of humanity. By informing and educating a global community of scholars, practitioners, researchers and students, it endeavors to be the world's leading independent academic and professional publisher. To realize it, it keeps creative and innovative to meet the range of the authors' needs and publish the best of their work.

By cooperating with University of Sydney, University of New South Wales and other world-famous universities, Bio-Byword Scientific Publishing has established a huge publishing system based on hundreds of academic programs, and with a variety of journals in the subjects of medicine, construction, education and electronics.

### PublisherHeadquarter

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD

Level 10

50 Clarence Street

Sydney NSW 2000

Website: [www.bbwpublisher.com](http://www.bbwpublisher.com)

Email: [info@bbwpublisher.com](mailto:info@bbwpublisher.com)

## Table of Contents

- 1 Observation on the Clinical Effect of Traditional Chinese Medicine Fuzheng Quxie Tea Drinking Package in Treating Cancer of Zhengxu Xielian Type**  
*Yongfu Dai, Ke Ma, Shaojun Li, Qingyin Fan , Yuan'e Wang, Fan Yang*
- 9 Correlation of Serum 25-hydroxyvitamin D Levels with Senile Hypertension and Its Stroke**  
*Shasha Zang, Qing Zhao , ShaLiu , ZheLi*
- 15 Observation on the Preventive Effect of Traditional Chinese Medicine Sachets on Influenza**  
*Baijing Guo, Yuwei Jiang*
- 22 Study on the Correlation Between Night ECG Parameters and Sleep Quality in Elderly Patients with Atrial Premature Beat**  
*Yaqian Huang*
- 30 Analysis of Adverse Reactions Caused by Antibiotics and Rational Drug Use in Clinical Practice**  
*Hongyan Zhang, Juntao Zhang*
- 37 In-depth Analysis of the Pathogenesis and Research Progress in Cutting-edge Treatment of Type III Acute Acquired Comitant Esotropia**  
*Ling Jin*
- 43 Fluid Dynamics Research on Erbium Laser-Assisted Chemical Preparation for Root Canal Therapy: A Review**  
*Kedi Jihu, Xinyu He, Jizhi Zhao*
- 50 Parameter Estimation of a Tumor Growth Model under Data-driven Approach and Its Numerical Solution in Matlab**  
*Zhuo Chen, Yihan Zeng, Wei Chen, Ruixian Zheng, Zejun Du, Meibao Ge*
- 57 Empirical Study and Optimization Strategies of Psychological Support Measures for Psychiatric Medical Staff**  
*Fengxia Qu, Xianghong Yin, Nanyun Li, Yuxia Gao*

- 66 New Theories for Dental Disease Prevention and Treatment and Innovative Oral Products**  
*Zhigang Hu, Junfeng Liu, Liran Xu, Wei Jiang, Xiangbo Yu*
- 74 An Investigation of the Effect of Visceral Acupressure Technique Combined with Physical Training on Improving Physical Anxiety in Adolescents**  
*Jie Zheng*
- 80 Treatment of One Case of Pediatric Hand-Foot-Mouth Disease with Spleen Dampness-Heat Syndrome Using Acupoint Application Therapy to Disperse Dampness, Expel Heat, and Unblock the Fu Organs**  
*Wangsen Zhao, Ziqing Wu, Ziqing Wu*
- 84 Research on the Pre-test Time Variable in Peripheral Blood Routine Analysis**  
*Wei Li, Zhaoyi Guo, Zihan Xiu, Wenkai Lü, Juan Liu, Yuchen Chen, Sifan Zeng, Peng Sun*
- 91 Application of Modified Endoscopic Mucosal Resection and Endoscopic Submucosal Dissection in Treating Rectal Neuroendocrine Tumors and Prognostic Analysis**  
*Yan Chen, Ying Chang*
- 97 Research on the Application Value of the Extended Nursing Intervention Model in Senile Dementia Patients**  
*Fang Yu, Xiaoxiao Wang*
- 104 Evaluation of the Efficacy of Endoscopic Submucosal Dissection for the Treatment of  $\geq 40$  mm Protruding Colorectal Tumors**  
*Yan Chen, Ying Chang*
- 110 Exploring the Effectiveness of a Rapid Diagnostic Kit for Identifying Snake Venom Types in Blood Tests**  
*Linfeng Zheng, Ming Liu, Ying Gao, Biao Wu*
- 116 Correlation between Disease Uncertainty and Psychological Distress in Hospitalized Patients with Primary Liver Cancer**  
*Dezhen Cui, OuYang Shan, Peixiang Chen*
- 121 Exploration of the Application of Remote Ischemic Conditioning in Nursing of Cardiac Arrest**  
*Yi-maizi Xu, Mingyue Yang, Fangchi Liu, Chao Zhang, Yimeng Yan, Zhixian Feng*
- 130 Predictive Modeling of Comorbid Anxiety in Young Hypertensive Patients Based on a Machine Learning Approach**  
*Haiyan Xiao, Aide Fan, Zhiyong Liu, Keping Yang*

- 137 The Effect of the Medical and Nursing Integration Model in the Care of Patients Undergoing Inguinal Hernia Surgery**  
*Qian Sun, Weihua Liu, Yinghui Hou, Jingyan Wang*
- 144 Research on the Role of Ezrin in Glucose and Lipid Metabolism**  
*Ruyuan Zhang, Zhixiong Liu, Huimin Su*
- 149 Application Value of Bundle Management in Safe Nursing Care for Patients with Autoimmune Encephalitis**  
*Ying Cui*
- 155 Real-world Clinical Study of Recombinant Human Growth Hormone in the Treatment of Idiopathic Short Stature**  
*Jianhua Liu, Jin Shi*
- 161 Nursing Effects of Routine Care and Specialized Nursing Intervention on Patients with Dysphagia during Acute Stroke**  
*Dandan Shi*
- 168 A Study on Balancing the Demands of Patients' Families and the Responsibilities of Medical Staff in Medical Emergencies: Starting from the Xiao Zhijun Case and the Yulin Pregnant Woman Case**  
*Yuji Lin, Yurou Zhang*
- 177 Progress in Interventional and Surgical Treatment of Obstructive Hypertrophic Cardiomyopathy**  
*Youjin Qiao*
- 183 The Clinical Application Value of Bundled Nursing Care in Postoperative Recovery of Lung Cancer Patients**  
*Cuifang Liu, Yaqian Li, Kun Wang, Pei Liu, Hongyu Liang, Xiaoxue Huang*
- 190 Study on Synergistic Effect of Eye Care and Drug Therapy in Patients with Dry Eye**  
*Hui Guo, Dandan Liu*
- 197 Exploring the Relationship between Obesity, Body Fat Percentage, Abnormal Blood Lipid Levels, and Prediabetes**  
*Zhuangzhuang Luo, Donglai Bao*
- 203 Advances in Research on the Use of ICU Diaries in Post-ICU Syndrome**  
*Mingyue Yang, Qian Guo, Na Gao, Xuwei Chen, Ying Yang, Ying Zhang*

- 211 Investigation and Analysis of Professional Identity and Research on Influencing Factors of Nursing Students before and after Clinical Practice**  
*Junfan Liu, Zhiyu Niu, Longning Sun, Yue Du*
- 218 Visual Analysis of Postoperative Nursing Research of Ureterocutaneostomy based on CiteSpace**  
*Yan Lu, Jie Lu, Beibei Chen*
- 226 Application and Practice of Characteristic Traditional Chinese Medicine Nursing Techniques in the Colorectal Department**  
*Xifeng Li*
- 234 Practical Analysis of the Matrix Medical Administration Model to Improve Medical Safety Level**  
*Wei Yang*
- 240 Application of Full Disease Course Management via Internet Platform in Rehabilitation Management of Patients with Depression**  
*Yuqing Yao, Minyan Yu*
- 247 The Association between Cardiometabolic Multimorbidity and Frailty among Middle-Aged and Older Adults in China**  
*Qinrou Yu, Yuexian Tao, Qi Zhou*
- 256 Effects of 0.01% Atropine Eye Drops on Horizontal Meridian Choroidal Thickness Profile in Low to Moderate Myopic Children**  
*Yun Tang, Xufei Chen, Xiaofeng Deng, Junna Zhang, Liping Liu, Chixin Du*
- 265 Observation on the Intervention Effect of Emergency Rescue Capability Among College Students**  
*Beiyan Zhang*
- 273 Development of a Disposable Care Package for PICC Disinfection in Postoperative Clinical Surgical Patients**  
*Peili Shi, Kezhu Luo, Hui Yao, Bingxue Liu, Xiaowei Su*
- 280 Exploration on the Chemical Constituents and Pharmacological Effects of Korla Fragrant Pears**  
*Ping Cheng, Chunmei Shi, Xinyu Dai, Hengbo Li, Cunfei Lv, Mingjie Qiu, Wenpin Xu*

- 286 Integrating Ideological and Political Education into the Pathogen Biology Curriculum: Promoting the All-Round Development of Nursing Students through Diversified Teaching**  
*Wenzhen Wang, Hengbo Li, Xinyu Dai, Cunfei Lv, Mingjie Qiu, Qingyao Wang*
- 291 Construction of a Clinical Path Discrimination Model for Stroke Patients Based on the XGBoost Integrated Learning Algorithm and Its Application Analysis in the MOP under the DIP Payment Model**  
*Huisi Hong, Yiming Yuan, Jianlong Huang, Liqun Zheng, Wentao Guo, Bingteng Sun, Xiaoxing Huang*
- 299 Clinical Observation on the Treatment of Brain Atrophy and Senile Dementia with Yizhi Xingnao Decoction Combined with Yizhi Pill**  
*Jianzhong Tang, Zhiqiang Li*
- 306 Alleviative Treatments for Alzheimer's Disease and Early Ecological Intervention Strategies in the Community**  
*Peihua Zhuang, Dongxing Wang, Shuyu Zhao, Peifang Lu*
- 319 Research Progress of MAPK Signaling Pathway in Colorectal Cancer**  
*Panpan Mao, Weiyun Wu*
- 325 Multidimensional Roles of Pears in Pear Paste: A Systematic Analysis from Molecular Mechanisms to Clinical Translations**  
*Ping Cheng, Qingyao Wang, Mingjie Qiu, Cunfei Lv, Xinyu Dai, Hengbo Li, Wenpin Xu*
- 331 Research Report on Cell Quantum Medicine: Theory, Practice, and Prospects**  
*Zhigang Hu, Liran Xu, Xiaohong Lv, Xiangbo Yu*
- 343 A Study on Modified Endoscopic Mucosal Resection in Rectal Neuroendocrine Tumors**  
*Yan Chen, Ying Chang*
- 349 The Application Effect of Cardiac Rehabilitation Therapy in Patients with Chronic Heart Failure and Its Impact on Pulse Wave Velocity**  
*Xin Huo, Nanhua Yang, Donglai Li, Jianfeng Zhang, Hui Huang, Shengyong Yang*
- 356 Study on the Immune Activity of Mice In Vitro and In Vivo with Nano-Material Adjuvant**  
*Qiran Wang*
- 363 Transcatheter Embolization Combined with Surgical Resection for Traumatic Middle Meningeal Artery-vein Fistula: A Case Report**  
*Shengshan Li, Shuzhi Li, Guohua Liu, Yong Zhang, Bin Wang, Jiawei Chai, Dawei Ren, Dunyong Mou, Xin Xu*

**370 Clinical Application of Imaging Navigation Technology in the Treatment of Pulmonary Tuberculosis**

*Yanju Su, Peng Wang, Hui Jiang, Dianhai Zhong, Qiuye Ma, Mingjun Huang*

**377 To Explore the Application Effect of Bird's Nest Nursing in Neonatal Nursing**

*Xiaoling Liu*





# Observation on the Clinical Effect of Traditional Chinese Medicine Fuzheng Quxie Tea Drinking Package in Treating Cancer of Zhengxu Xielian Type

Yongfu Dai\*, Ke Ma, Shaojun Li, Qingyin Fan, Yuan'e Wang, Fan Yang

Affiliated Hospital of Traditional Chinese Medicine, Ningxia Medical University, Wuzhong 751100, Ningxia, China

\*Corresponding author: Yongfu Dai

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the clinical efficacy of traditional Chinese medicine Fuzheng Quxie tea drinking package in the treatment of Zhengxu Xielian type cancer. *Methods:* In this study, 50 cases of Zhengxu Xielian type cancer admitted to our hospital from January 2020 to December 2021 were selected. They were divided into a control group (n = 25) and a treatment group (n = 25) according to the random number table method. The control group received conventional symptomatic treatment plus adjuvant therapy for cancer while the treatment group received traditional Chinese medicine Fuzheng Quxie tea drinking package plus conventional symptomatic treatment and adjuvant cancer therapy. Tumor marker indexes, quality of life scores, and fatigue scores before and after treatment were compared and analyzed between the two groups. *Results:* After treatment, the CEA, CA125, and NSE indexes in the treatment group were lower than those in the control group, and the differences were statistically significant ( $P < 0.05$ ). After treatment, the quality of life scores of the treatment group were better, and the data between the two groups were statistically significant ( $P < 0.05$ ). After treatment, the fatigue score of the observation group was significantly lower at  $67.56 \pm 4.69$  compared to  $110.59 \pm 10.59$  in the control group ( $t = 18.576$ ,  $P < 0.05$ ). *Conclusion:* The treatment of Zhengxu Xielian type cancer patients with traditional Chinese medicine Fuzheng Quxie tea drinking package can significantly reduce tumor marker indexes, improve patients' quality of life, and reduce fatigue, which has clinical significance.

**Keywords:** Traditional Chinese medicine Fuzheng Quxie tea drinking package; Zhengxu Xielian type cancer; Quality of life; Tumor markers

**Online publication:** April 18, 2025

## 1. Introduction

Cancer is one of the major threats to human health, and treatment methods include surgery, chemotherapy,

radiotherapy, and comprehensive supportive therapy. Surgery is significantly effective for early-stage cancer, while chemotherapy is often used for post-surgical and advanced-stage patients <sup>[1]</sup>. However, the drug resistance and side effects of chemotherapy limit its application. Therefore, Chinese and Western medications are often combined to reduce toxic side effects and enhance efficacy. The “Yellow Emperor’s Inner Canon” states, “When the righteous Qi is sufficient, external pathogens are difficult to invade; where pathogens invade, the righteous Qi must decline.” According to Chinese medicine theory, cancer patients often suffer from spleen deficiency, leading to a lack of Qi and blood generation, which causes Qi and blood deficiency <sup>[2]</sup>. At the same time, the loss of kidney essence, insufficient nourishment of the essence, and inadequate blood transformation exacerbate the state of Qi and blood deficiency. Patient symptoms include fatigue, weakness, shortness of breath, lack of desire to speak, shortness of breath, loss of appetite, spontaneous sweating, pale and swollen tongue with tooth marks, and deficient pulse, as well as clinical manifestations such as bone marrow suppression, anemia, and decreased white blood cells and platelets. Long-term immunosuppression severely affects patients’ quality of life and shortens their survival time <sup>[3]</sup>. Modern clinical studies have confirmed that the combined application of traditional prescriptions such as Si Jun Zi Tang, Er Xian Tang, Liu Wei Di Huang Tang, and Xue Fu Zhu Yu Tang with chemotherapy drugs can effectively prevent the recurrence and metastasis of colorectal cancer and prolong the survival time of patients with advanced cancer. For patients with advanced cancer who often experience weakened righteous Qi and abundant pathogenic Qi after surgery or radiotherapy and chemotherapy, the Chinese medicine tea drinking package selects *Astragalus*, *Pseudostellaria* Root, *Scutellaria barbata*, and *Salvia chinensis*. This tea drinking package focuses on strengthening the body’s resistance and eliminating pathogens as a supplementary treatment. After processing by the pharmacy, it can be used for long-term use by cancer patients as an adjuvant treatment with good results. Therefore, this study selected 50 patients with Zhengxu Xielian type cancer admitted to our hospital from January 2020 to December 2021 and explored the clinical efficacy of traditional Chinese medicine Fuzheng Quxie tea drinking package.

## 2. Materials and methods

### 2.1. General information

Fifty patients with Zhengxu Xielian type cancer admitted to our hospital were selected and divided into a control group and a treatment group using the random number method, with 25 patients in each group. The control group consisted of 11 males and 14 females, aged between 36 and 79 years, with an average age of  $(69.58 \pm 4.11)$  years. The treatment group consisted of 12 males and 13 females, aged between 35 and 80 years, with an average age of  $(69.41 \pm 4.12)$  years. All participants and their families were informed of the study protocol and signed consent forms. There were no significant differences in the basic characteristics between the two groups ( $P > 0.05$ ). This study was approved by the ethics committee of the hospital.

### 2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Patients meet the UICC tumor diagnostic criteria and have been confirmed as having cancer through pathological or cytological examination; (2) Meet the diagnostic criteria of “Zhengxu Xielian Syndrome” in traditional Chinese medicine <sup>[4]</sup>; (3) Patients have no intellectual disabilities or mental illnesses and have the cognitive ability to evaluate their overall health status; (4) Age range is limited to 18 to 80 years old, and patients must voluntarily participate in the study and sign an informed consent form; (5) The estimated

survival period must exceed 3 months.

Exclusion criteria: (1) Patients with severe cardiovascular and cerebrovascular diseases, liver and kidney dysfunction, and primary diseases of the hematopoietic system; (2) Women who are pregnant or breastfeeding; (3) Patients who are allergic to the medications used in this study.

## 2.3. Methods

The control group received conventional symptomatic treatment plus adjuvant therapy for cancer, with a treatment course of 15 days, and was observed for two courses.

The treatment group was given traditional Chinese medicine Fuzheng Quxie tea drinking package plus conventional symptomatic treatment and adjuvant cancer therapy. The prescription included: *Astragalus* 9g, *Pseudostellaria* Root 6g, *Scutellaria barbata* 3g, and *Salvia chinensis* 3g. All were prepared by the Pharmaceutical Center of Hui Medical Traditional Chinese Medicine Hospital Affiliated to Ningxia Medical University. Each tea drinking package contained approximately 3g of the original medicinal herbs. One packet was taken at a time, twice a day, brewed with boiling water, and taken warm. The treatment course was 15 days, with a total of two courses.

## 2.4. Observation indicators

The tumor marker indicators, quality of life scores, and fatigue scores of the two groups of patients before and after treatment were compared and analyzed.

- (1) Tumor marker indicators: The tumor marker indicators of the two groups of patients before and after treatment were analyzed and compared, including carcinoembryonic antigen (CEA), cancer antigen 125 (CA125), and neuron-specific enolase (NSE). Venous blood samples of 3 to 4 milliliters were drawn from the patients, followed by serum separation processing. The ZC-32301 detection kit from Shanghai Zhuocai Biotechnology Co., Ltd. was used to perform professional detection for the aforementioned test items.
- (2) Quality of life score: The quality of life scores of the two groups of patients before and after treatment were analyzed and compared using the SF-36 scale<sup>[5]</sup>. The Cronbach's  $\alpha$  coefficient of the scale reached 0.845, covering physiology, emotion, spirit, vitality, social function, and overall health. A higher score indicated better nursing intervention effects and better quality of life.
- (3) Fatigue score: The fatigue scores of the two groups of patients were analyzed and compared using the Fatigue Assessment Instrument (FAI)<sup>[6]</sup>. The Cronbach's  $\alpha$  coefficient of the scale was 0.886. The scale contained 29 items, using a 1–7 rating system, with a total score ranging from 29 to 203. A higher score indicated a higher degree of fatigue.

## 2.5. Statistical methods

The data obtained in this study, including normally distributed measurement data ( $t$ ) and count data ( $X^2$ ), were analyzed using SPSS 24.0 statistical software. Measurement data were expressed as ( $X \pm s$ ), and count data were expressed as ( $n, \%$ ). If  $P < 0.05$ , the results were considered statistically significant.

### 3. Results

#### 3.1. Comparison of tumor marker indicators before and after treatment between the two groups

After treatment, the tumor marker indicators such as CEA, CA125, and NSE in the observation group were better than those in the control group ( $P < 0.05$ ), as shown in **Table 1**.

**Table 1.** Comparison of tumor marker indicators before and after treatment between the two groups ( $\bar{x} \pm s$  false)

Group	<i>n</i>	CEA(ng/ml)		CA125(U/ml)		NSE(ng/ml)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Control group	25	25.29 ± 3.21	6.44 ± 1.98*	89.49 ± 2.11	64.29 ± 3.21*	29.01 ± 0.21	16.38 ± 1.21*
Treatment group	25	25.23 ± 3.22	3.98 ± 1.57*	89.44 ± 2.10	53.59 ± 2.19*	29.02 ± 0.22	13.55 ± 1.09*
<i>t</i>		0.066	4.868	0.084	13.768	0.164	8.658
<i>p</i>		0.948	< 0.001	0.933	< 0.001	0.870	< 0.001

Note: Compared with before treatment in the same group, \* $P < 0.05$

#### 3.2. Comparison of quality of life scores before and after treatment between the two groups

After treatment, the quality of life scores in the observation group were significantly better ( $P < 0.05$ ), as seen **Table 2**.

**Table 2.** Comparison of quality of life scores before and after treatment between the two groups (, scores)

Group	<i>n</i>	Quality of life	
		Before treatment	After treatment
Control group	25	59.39 ± 4.21	72.58 ± 2.19*
Treatment group	25	59.33 ± 4.15	78.51 ± 2.22*
<i>t</i>		0.051	9.508
<i>p</i>		0.960	< 0.001

Note: Compared with before treatment in the same group, \* $P < 0.05$

#### 3.3. Comparison of fatigue scores before and after treatment between the two groups

After treatment, the fatigue score of patients in the observation group was significantly lower at  $67.56 \pm 4.69$  compared to  $110.59 \pm 10.59$  in the control group ( $t = 18.576$ ,  $P < 0.05$ ), as seen in **Table 3**.

**Table 3.** Comparison of fatigue scores before and after treatment between the two groups (, scores)

Group	<i>n</i>	Fatigue score	
		Before treatment	After treatment
Control group	25	142.45 ± 5.12	110.59 ± 10.59*
Treatment group	25	142.39 ± 4.07	67.56 ± 4.69*
<i>t</i>		0.046	18.576
<i>p</i>		0.964	< 0.001

Note: Compared with before treatment in the same group, \* $P < 0.05$

## 4. Discussion

Cancer is a common disease that poses a serious threat to human health. Cancer cells exhibit vigorous metabolic activity, consuming vast resources. Simultaneously, the infiltration and compression effects of cancerous tissues, along with the damage caused by radiotherapy and chemotherapy, as well as the potential toxic side effects of targeted immunotherapy drugs, collectively impact the patient's immune system, leading to impaired or weakened function, and ultimately resulting in a significant reduction in immune function<sup>[7]</sup>. Cancer is a common disease in China with a high fatality rate. Western medicine treatment methods include surgery, chemotherapy, radiotherapy, targeted therapy, and immunotherapy, but the efficacy in advanced stages is often unsatisfactory.

Traditional Chinese medicine (TCM) can improve patients' symptoms and prolong survival, making the integration of Chinese and Western medicine and multidisciplinary collaboration a trending treatment approach. The causes of malignant tumors are classified into internal factors, external factors, and non-internal-non-external factors. Internal factors primarily involve deficiency of healthy Qi and inadequate defense against external pathogens; external factors include invasion by pathogenic factors such as the six exogenous pathogens, carcinogen-induced pathogenic toxins, and imbalance of Yin and Yang; non-internal-non-external factors encompass inappropriate diet, excessive physical or mental exertion, and decline of healthy Qi due to aging, leading to insufficient generation of Qi and blood, deficiency of healthy Qi, and accumulation of pathogenic toxins<sup>[8]</sup>. Scholars have pointed out that the imbalance of Qi movement is a fundamental mechanism in tumor formation, involving liver dysfunction, poor blood circulation, spleen dysfunction, resulting in blood stasis, phlegm nodules, and the formation of cancerous masses. Long-term immunosuppression not only reduces patients' quality of life but also shortens their survival. Therefore, improving the quality of life of cancer patients while extending their survival has garnered significant social attention.

The "Yellow Emperor's Inner Canon" discusses the theory of healthy Qi and pathogenic Qi, stating that "when healthy Qi is preserved internally, pathogenic Qi cannot invade," indicating a dynamic balance between healthy Qi and pathogenic Qi within the body. Healthy Qi encompasses defensive Qi, organ and meridian functions, etc. When it is abundant, the body functions normally and has a strong ability to adapt to the external environment. Pathogenic Qi includes disease-causing factors such as phlegm, dampness, toxins, and blood stasis. When healthy Qi is strong, pathogenic Qi is less likely to invade, maintaining a stable physiological balance in the body; damage to healthy Qi and retention of pathogenic Qi can lead to tumor formation, causing imbalance of Yin and Yang, blood stasis, and accumulation of phlegm and dampness. The theory of healthy Qi and pathogenic Qi bears similarities to modern medical immunology theories. Human immune cells exist in a dynamic balance, resembling the balance between healthy Qi and pathogenic Qi. Tumor immunotherapy microenvironment emphasizes holism and multi-target approaches, aligning with the principles of TCM treatment. Immunosuppression is a crucial characteristic of the tumor microenvironment, and tumor cells exploit the negative regulatory mechanisms of the immune system to form an immunosuppressive network<sup>[9]</sup>.

In TCM, the spleen and kidneys are closely related to immune function, with the spleen controlling blood and the kidneys storing essence, which are essential nutrients for immune regulation. The "Jingyue Quanshu" highlights that insufficiency of the spleen and kidneys can lead to the accumulation of diseases. Modern pharmacological research suggests that TCM herbs that tonify healthy Qi and eliminate pathogenic Qi can regulate macrophages, improve the immunosuppressive state of the tumor microenvironment, and thus control cancer cell proliferation. Consequently, the approaches of tonifying healthy Qi and eliminating pathogenic Qi



in tumor treatment, and immune regulation share similar goals, aiming to achieve immune balance and enhance immune function<sup>[10]</sup>.

The TCM herbal tea formula targets the pathogenesis of cancer patients in the middle and late stages after surgery or radiotherapy, and chemotherapy, specifically addressing the imbalance of healthy Qi and pathogenic Qi. It carefully selects herbs such as *Astragalus*, *Pseudostellaria* Root, *Scutellaria barbata*, and *Salvia chinensis*, with the primary focus on tonifying healthy Qi and the secondary focus on eliminating pathogenic Qi. Processed by our hospital's pharmacy, it is intended for long-term adjuvant therapy for patients and has received positive clinical feedback. As a unique formulation of TCM, herbal teas are easy to consume, highly targeted, and effective in preventing and treating diseases, strengthening the body, and promoting longevity. They maintain the remarkable effectiveness of decoctions while avoiding tedious preparation and wastage of medicinal materials. Long-term consumption of herbal teas often yields better results than ready-made Chinese medicines. In this study, after treatment, the CEA, CA125, and NSE indicators in the treatment group were lower than those in the control group, with a statistically significant difference ( $P < 0.05$ ).

Additionally, the quality of life scores in the treatment group were better after treatment, showing a statistically significant difference between the two groups ( $P < 0.05$ ). Furthermore, the fatigue score in the observation group was significantly lower at  $67.56 \pm 4.69$  compared to  $110.59 \pm 10.59$  in the control group ( $t = 18.576$ ,  $P < 0.05$ ). This suggests that the active components of *Astragalus*, including polysaccharides, flavonoids, saponins, amino acids, and trace elements, can promote metabolism, reduce fatigue, stimulate serum and liver protein renewal, induce tumor cell apoptosis by regulating the cell cycle, modulate the tumor microenvironment, inhibit tumor angiogenesis, enhance immune function to reduce inflammatory factor levels, induce tumor cell autophagy, effectively inhibit tumor growth and metastasis, reverse multidrug resistance in chemotherapy, enhance the sensitivity of tumor cells to chemotherapeutic drugs, and reduce toxic side effects of chemotherapy<sup>[11]</sup>.

*Pseudostellaria* Root is a tonic medicine that nourishes Qi and strengthens the spleen, and its polysaccharide components exhibit anti-inflammatory, hypoglycemic, and antitumor activities. *Scutellaria barbata*, recorded in the "Chinese Pharmacopoeia," possesses the functions of clearing heat, detoxifying, and promoting blood circulation. Pharmacological studies have demonstrated its significant antitumor, anti-inflammatory, and immune-modulating effects<sup>[12]</sup>. *Scutellaria barbata* inhibits tumor cell growth, and its flavonoid monomers significantly suppress SKOV3 cell proliferation. Scutellarin inhibits MCF-7 cell proliferation, upregulates miRNA-15a and miRNA-16 expression, downregulates CDC25A and AURKA genes, blocks the cell cycle, and inhibits tumorigenesis by reactivating HMOX1 and HSPA1A genes and blocking the NF- $\kappa$ B pathway. Additionally, scutellarin exhibits antitumor activity in colorectal cancer by inhibiting autophagy<sup>[13]</sup>.

*Salvia chinensis* inhibits the proliferation and metastasis of various tumor cells by regulating signaling pathways and proteins. The combination of these four herbs aligns with the approaches of tonifying healthy Qi, eliminating pathogenic Qi, and immune regulation in tumor treatment, aiming to achieve immune balance. This effectively reduces patients' tumor marker indicators, improves their quality of life, and reduces fatigue scores, thereby demonstrating clinical significance.

## 5. Conclusion

In summary, the treatment of Zhengxu Xielian type cancer patients with traditional Chinese medicine Fuzheng

Quxie tea drinking packets can significantly reduce tumor markers, improve quality of life, and reduce fatigue, which has clinical significance.

## Funding

Dai Yongfu's Observation on the Clinical Effect of Traditional Chinese Medicine Fuzheng Quxie Tea Drinking Package in Treating Cancer of Zhengxu Xielian Type- A Key Scientific Research Project of the Ningxia Health and Family Planning Commission (Project No.: 2019-NW-004).

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Wang X, Jiao Y, Liu Y, et al., 2024, Clinical Observation on the Adjuvant Treatment of Chemotherapy-Related Peripheral Neuropathy in Digestive Tract Tumors with Traditional Chinese Medicine Fumigation and Moxibustion. *Journal of Practical Traditional Chinese Medicine*, 40(11): 2304–2306.
- [2] Xu M, Jiang M, Zheng Y, 2024, Clinical Study on the Treatment of Intestinal Obstruction in Advanced Cancer with Enema of Yiqi Yangyin Formula. *New Journal of Traditional Chinese Medicine*, 56(11): 161–165.
- [3] Zhang Y, Wu S, Zheng L, 2022, Clinical Study on the Treatment of Intestinal Obstruction in Patients with Advanced Cancer by Traditional Chinese Medicine Enema Combined with Acupoint Application. *Chinese Journal of Health Care Medicine*, 24(1): 44–47.
- [4] Zheng X, 2002, *Guiding Principles for Clinical Research of New Chinese Medicines (Trial)*. China Medical Science and Technology Press, Beijing: 361–367, 376–380, 385–392.
- [5] Li L, Wang H, Shen Y, 2002, Development and Performance Test of the Chinese Version of the SF-36 Health Survey Scale. *Chinese Journal of Preventive Medicine*, 2002(2): 38–42.
- [6] Xiong B, Liu T, Si Y, 2011, Application Concept of Fatigue Rating Scale in Special Service Recuperation. *Chinese Journal of Convalescent Medicine*, 20(1): 27.
- [7] Jiao H, Peng H, 2024, Discussion on the Treatment Principles and Methods of Primary Liver Cancer Based on the Liver's Function of Dispersing and Discharging. *Guangming Journal of Chinese Medicine*, 39(7): 1322–1325.
- [8] Yuan M, Luo W, Donggui W, 2021, Experience in Treating Brain Metastasis of Breast Cancer Based on “Internal Wind Secretly Swirling”. *Global Traditional Chinese Medicine*, 14(4): 714–717.
- [9] Yang N, Wu L, Liu X, et al., 2019, Research Progress on the Regulation of Tumor Immune Microenvironment by Traditional Chinese Medicine. *Journal of Liaoning University of Traditional Chinese Medicine*, 21(8): 164–167.
- [10] Liu Y, Wu Y, Liu J, et al., 2021, Discussion on the Pathogenesis and Treatment of Tumors from the Transformation of Healthy Qi and Pathogenic Qi. *Journal of Beijing University of Traditional Chinese Medicine*, 44(2): 183–187.
- [11] Wu X, Deng H, 2022, Theory and Research Progress of Strengthening Healthy Qi to Treat Lung Cancer. *Journal of Integrated Traditional Chinese and Western Medicine*, 14(1): 45–47.
- [12] Pan Y, Yu Y, Wang X, et al., 2020, Tumor-Associated Macrophages in Tumor Immunity. *Front Immunol*, 11: 583084.
- [13] Zhu X, Zheng Y, Liu Z, et al., 2020, Network Pharmacology Analysis of the Synergistic Anticancer Mechanism of

Major Flavonoids in *Scutellaria Barbata*. *Traditional Chinese Drug Research and Clinical Pharmacology*, 31(9): 1037–1044.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



# Correlation of Serum 25-hydroxyvitamin D Levels with Senile Hypertension and Its Stroke

Shasha Zang<sup>1</sup>, Qing Zhao<sup>1</sup>, Sha Liu<sup>2</sup>, Zhe Li<sup>3,4\*</sup>

<sup>1</sup>Department of Geriatrics/Special Needs Ward, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

<sup>2</sup>Department of Cardiovascular Medicine, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

<sup>3</sup>Department of Nephrology, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

<sup>4</sup>Key Laboratory of Bone Metabolism and Physiology in Chronic Kidney Disease of Hebei Province, Baoding 071000, Hebei, China

\*Corresponding author: Zhe Li, 92013lizhe@163.com

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* Correlation of serum 25-hydroxyvitamin D level with senile hypertension and its stroke. *Methods:* Two hundred hypertensive patients admitted to the hospital from February 2022 to December 2023 were classified as study subjects. They were divided into grade 2 hypertension group and grade 3 hypertension group, and 100 healthy medical checkups admitted during the same period were analyzed as study subjects. *Results:* Comparison of diagnostic results between grade 2 hypertension and grade 2 hypertensive stroke patients, there was a difference in 25(OH)D, ( $P < 0.05$ ). Comparison of test results between grade 3 hypertension and grade 3 hypertensive stroke patients, there was a difference in age, BMI, 25(OH)D, GLU, LDL-C, ( $P < 0.05$ ). Serum 25-hydroxyvitamin D level is a high-risk factor for the occurrence of stroke in elderly hypertensive patients, so the probability of risk is higher, where 25(OH)D (ng/mL), GLU (mmol/L), there is a difference, ( $P < 0.05$ ). *Conclusion:* There is a greater relationship between the occurrence of stroke and serum 25-hydroxyvitamin D level in elderly hypertensive patients. The occurrence of the disease has a greater relationship with this indicator in patients and is also a high-risk factor that affects the patients' morbidity, so it is necessary to pay attention to the monitoring of this indicator after the onset of the disease in patients.

**Keywords:** Serum 25-hydroxyvitamin D level; Geriatric hypertension; Stroke; Correlation

**Online publication:** April 29, 2025

## 1. Introduction

Hypertension, as an important disease influenced by a combination of environmental and genetic constraints, has received much attention in recent years. Among them, the incidence of cardiovascular disease in the elderly in China is increasing year by year. Hypertension or stroke will lead to the patient's organ structure and function

being affected and may eventually occur as organ failure. At the same time, hypertensive patients are easily combined with cerebrovascular disease after the onset of the disease, although the difference in the overall prevalence of patients is less than. Among them, the incidence of women among elderly patients is higher <sup>[1]</sup>. The occurrence of stroke in hypertensive patients has a greater relationship with the serum 25-hydroxyvitamin D level of patients. In the clinical analysis, doctors can use serum 25-hydroxyvitamin D level to analyze the prognostic value of the patients, to explore the seasonal factors of the patients suffered from the impact of in-depth research. Choosing 200 cases of hypertension patients admitted into the hospital from February 2022 to December 2023 as research subjects, divided into grade 2 hypertension group and grade 3 hypertension group, and 100 cases of healthy medical checkups admitted by ventilation as research subjects, the patients' data and report are analyzed.

## **2. Information and methodology**

### **2.1. General information**

The 200 hypertensive patients admitted to the hospital from February 2022 to December 2023 were divided into the study population, which was divided into the group of grade 2 hypertension and grade 3 hypertension, and the 100 health check-ups admitted by ventilation were the study population, and the patient data were analyzed.

### **2.2. Inclusion criteria**

- (1) Consent to participate in the study
- (2) Complete pathological data
- (3) Normal cognitive function.

### **2.3. Exclusion criteria**

- (1) Natural loss of visitation
- (2) Infectious diseases
- (3) Cognitive impairment
- (4) Liver and kidney impairment
- (5) Blood disorders

## **2.4. Methodology**

### **2.4.1. Blood pressure monitoring**

Hospitalized patients are monitored using a blood pressure monitor, and the nursing staff helps the patient with the test, which requires ten minutes of rest before the test. The patient's arm should be at the same height as the heart and the femoral artery blood pressure should be measured three times at one-minute intervals <sup>[2]</sup>.

### **2.4.2. Biochemical tests**

The obtained blood pressure samples were sorted for serum > 1 ml and stored in freezer tubes at a temperature of 20°. Triacylglycerol (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and fasting glucose (GLU) indices were monitored <sup>[3]</sup>.

### 2.4.3. Serum 25-hydroxyvitamin D test methods

Serum 25-hydroxyvitamin D was monitored using a fully automated blood test, and serum 25-hydroxyvitamin D was examined using an immuno emulsion turbidimetric method <sup>[4]</sup>.

## 2.5. Observation indicators and assessment criteria

- (1) Analysis of the basic data and biochemical indexes of the three groups of patients
- (2) Compare the diagnostic results of grade 2 hypertension with grade 2 hypertensive stroke patients
- (3) Comparison of test results between grade 3 hypertension and grade 3 hypertensive stroke patients
- (4) Serum 25-hydroxyvitamin D levels and regression of hypertensive stroke in the elderly

## 2.6. Statistical treatment

The study used SPSS 25.0 statistical software to analyze all the data where ( $\bar{x} \pm s$ ) was tested using t-tool to compare the data differences. And data expressed in (%) were tested using  $\chi^2$  tool. Data less than 0.05 were significantly different.

## 3. Results

### 3.1. Analysis of basic data and biochemical indexes of the three groups of patients

The basic data and biochemical indicators of the three groups of patients are shown in **Table 1**.

**Table 1.** Comparison of basic data and biochemical indices of the three groups of patients ( $\bar{x} \pm s$ )

Sports event	Grade 2 hypertension group (n=100)	Grade 3 hypertension group (n=100)	Control group (n=100)
Age (years)	69.54 $\pm$ 6.32	68.54 $\pm$ 6.32	66.32 $\pm$ 6.35
BMI (kg/m <sup>2</sup> )	24.31 $\pm$ 3.62	24.32 $\pm$ 3.42	22.31 $\pm$ 3.13
Pulse pressure difference (mmHg)	64.57 $\pm$ 12.32	72.31 $\pm$ 19.45	52.32 $\pm$ 12.32
25(OH)D (ng/mL)	17.63 $\pm$ 5.24	16.32 $\pm$ 7.25	21.12 $\pm$ 6.65
GLU (mmol/L)	5.13 $\pm$ 0.67	5.36 $\pm$ 0.89	5.32 $\pm$ 0.42
TC (mmol/L)	4.26 $\pm$ 0.56	4.64 $\pm$ 1.06	5.34 $\pm$ 1.15
TG (mmol/L)	1.64 $\pm$ 1.13	1.87 $\pm$ 1.32	1.35 $\pm$ 0.97
HDL-C (mmol/L)	1.27 $\pm$ 0.34	1.14 $\pm$ 0.34	1.54 $\pm$ 0.36
LDL-C (mmol/L)	2.63 $\pm$ 0.78	3.85 $\pm$ 0.97	3.68 $\pm$ 1.05

### 3.2. Comparison of diagnostic findings in stroke patients with grade 2 hypertension versus grade 2 hypertension

There was a difference in 25(OH)D between the diagnostic results of grade 2 hypertension compared to grade 2 hypertensive stroke patients, ( $P < 0.05$ ). See **Table 2**.

**Table 2.** Comparison of diagnostic outcomes in patients with grade 2 hypertension and grade 2 hypertensive stroke ( $\bar{x} \pm s$ )

Sports event	Grade 2 hypertension group (n=62)	Grade 2 hypertensive stroke group (n=38)	t	P
Age (years)	69.45 $\pm$ 5.96	69.65 $\pm$ 6.35	0.212	0.913
BMI (kg/m <sup>2</sup> )	24.12 $\pm$ 4.25	23.64 $\pm$ 2.45	1.245	0.212
Pulse pressure difference (mmHg)	63.12 $\pm$ 12.35	65.32 $\pm$ 14.12	0.532	0.675
25(OH)D (ng/mL)	19.57 $\pm$ 4.75	14.45 $\pm$ 5.32	10.212	0.001
GLU (mmol/L)	4.85 $\pm$ 0.75	5.23 $\pm$ 0.45	0.981	0.115
TC (mmol/L)	4.53 $\pm$ 0.85	4.24 $\pm$ 0.94	0.975	0.164
TG (mmol/L)	1.67 $\pm$ 1.32	1.56 $\pm$ 0.52	0.401	0.854
HDL-C (mmol/L)	1.25 $\pm$ 0.31	1.16 $\pm$ 0.31	0.584	0.612
LDL-C (mmol/L)	2.78 $\pm$ 0.78	2.43 $\pm$ 0.75	0.934	0.169

### 3.3. Comparison of test results in stroke patients with grade 3 hypertension vs. grade 3 hypertensive stroke patients

Comparison of test results between grade 3 hypertension and grade 3 hypertensive stroke patients showed differences in age (years), BMI (kg/m<sup>2</sup>), 25(OH)D (ng/mL), GLU (mmol/L), and LDL-C (mmol/L), ( $P < 0.05$ ). The details are shown in **Table 3**.

**Table 3.** Test results comparing grade 3 hypertension with grade 3 hypertensive stroke patients ( $\bar{x} \pm s$ )

Sports event	Grade 2 hypertension group (n=75)	Grade 2 hypertensive stroke group (n=25)	T-value	P-value
Age (years)	67.54 $\pm$ 6.32	69.65 $\pm$ 6.32	8.645	0.003
BMI (kg/m <sup>2</sup> )	24.31 $\pm$ 3.12	23.21 $\pm$ 2.32	10.326	0.001
Pulse pressure difference (mmHg)	72.32 $\pm$ 20.31	73.52 $\pm$ 17.52	0.432	0.785
25(OH)D (ng/mL)	17.64 $\pm$ 7.63	14.52 $\pm$ 6.32	9.235	0.002
GLU (mmol/L)	5.13 $\pm$ 0.52	5.32 $\pm$ 1.24	10.645	0.001
TC (mmol/L)	4.78 $\pm$ 0.94	4.45 $\pm$ 1.16	0.437	0.784
TG (mmol/L)	2.13 $\pm$ 1.25	1.45 $\pm$ 0.52	0.975	0.102
HDL-C (mmol/L)	1.12 $\pm$ 0.24	1.25 $\pm$ 0.45	0.758	0.463
LDL-C (mmol/L)	2.98 $\pm$ 0.85	2.65 $\pm$ 1.02	7.409	0.006

### 3.4. Regression analysis of serum 25-hydroxyvitamin D levels and hypertensive stroke in the elderly

Serum 25-hydroxyvitamin D level is a high-risk factor for stroke in elderly hypertensive patients, so the probability of risk is higher, where 25(OH)D (ng/mL) and GLU (mmol/L), there is a difference, ( $P < 0.05$ ), as shown in **Table 4**.

**Table 4.** Serum 25-hydroxyvitamin D levels and regression of hypertensive stroke in the elderly [n (%)]

Variant	Statistic	P-value	OR value
Age (years)	0.005	0.841	0.945–1.026
BMI (kg/m <sup>2</sup> )	0.124	0.352	0.852–1.564
Height (cm)	0.235	0.241	0.532–1.187
Weight (kg)	0.421	0.425	0.545–4.258
Systolic blood pressure (mmHg)	0.022	0.038	0.965–0.944
Diastolic blood pressure (mmHg)	0.008	0.467	0.984–1.034
25(OH)D (ng/mL)	0.097	0.001	0.841–0.061
GLU (mmol/L)	0.903	0.001	1.421–4.135
TC (mmol/L)	0.201	0.612	0.351–1.845
TG (mmol/L)	0.356	0.185	0.475–1.156
HDL-C (mmol/L)	0.341	0.485	0.264–1.947
LDL-C (mmol/L)	0.251	0.574	0.304–1.854
constant	17.321	0.476	

## 4. Discussion

Vitamin D acts as a form of hormone that regulates calcium and phosphorus metabolism in the body, and it can undergo a series of transformations as a result of sun exposure. Among them, serum 25-hydroxy levels are seasonally altered, with significantly higher levels in summer and significantly lower levels in winter and spring, and with the changes in hormone levels, the body also experiences a variety of diseases <sup>[5, 6]</sup>. The results were analyzed, and there was a difference in 25(OH)D between the diagnostic results of patients with grade 2 hypertension compared with those with grade 2 hypertensive stroke. There was a difference in age (years), BMI (kg/m<sup>2</sup>), 25(OH)D (ng/mL), GLU (mmol/L), and LDL-C (mmol/L) in the comparison of the test results of patients with grade 3 hypertension compared with those with grade 3 hypertensive stroke.

Serum 25-hydroxyvitamin D level is a high-risk factor for stroke in elderly hypertensive patients, and therefore, the probability of risk is higher, with differences in 25(OH)D (ng/mL), GLU (mmol/L) <sup>[7]</sup>. Vitamin D varies with changes in serum 25-hydroxy levels, especially for cardiovascular disease, and there is the potential for a variety of conditions. The more severe the patient's hypertension, the lower the patient's serum 25-hydroxy and the greater the impact on the patient. Although it does not lead to the patient's morbidity, it is a risk factor for the patient's morbidity.

Vitamin D is a key predictor of stroke and is an independent factor in patient morbidity <sup>[8]</sup>. The occurrence of stroke in elderly hypertensive patients is affected by a variety of factors. Serum 25-hydroxyvitamin D level has a greater relationship with the patient, and from the results of clinical research and the results of a number of foreign studies, this indicator is the most important factor in determining the onset of the patient's disease. The patient's situation can be judged through this way, and in the clinic to strengthen the management of the patient, control the changes in this indicator <sup>[9, 10]</sup>.

## 5. Conclusion

In summary, the occurrence of stroke in elderly hypertensive patients has a greater relationship with serum 25-hydroxyvitamin D levels, and the occurrence of the disease has a greater relationship with this indicator in patients. It is also a high-risk factor that affects the morbidity of the patients, so it is necessary to pay attention to the monitoring of this indicator after the onset of the disease in the patients.

## Funding

Analysis of a Clinical Study of Vitamin D Supplementation in Improving the Prognosis of H-type Hypertension in the Elderly (Project No.: 2341ZF140)

## Disclosure statement

The authors declare no conflict of interest.

## References:

- [1] Zhao Q, Zhu Y, Chen Z, et al., 2023, Correlation Analysis of Serum 25-Hydroxyvitamin D, Cystatin-C, Homocysteine and Hypertension Combined with Osteoporosis. *Journal of Naval Medicine*, 44(9): 990–994.
- [2] Hu Z, Wang J, Zhang Y, et al., 2023, A Cohort Study of Serum 25-Hydroxyvitamin D Levels and Risk of Hypertension in Adults. *Abstract Book of the 14th Asian Congress of Nutrition*. Asian Federation of Nutrition Societies, Chinese Society of Nutrition.
- [3] Yuan Y, Kong F, Chi L, et al., 2023, Correlation Study of Serum 25-Hydroxyvitamin D Level with Senile Hypertension and Its Stroke. *Marker Immunoassay and Clinics*, 30(4): 568–572.
- [4] Yang S, Jiang G, Yang L, et al., 2022, Correlation of Blood Lipids, Blood Uric Acid and Serum 25-Hydroxyvitamin D Levels with Hypertension and Its Disease Grading in the Elderly. *Chinese Journal of Gerontology*, 42(20): 4915–4917.
- [5] Dai C, Li X, Zhao Y, et al., 2019, Study on the Change of Serum 25-Hydroxyvitamin D Level in Hypertension and Its Correlation with Lipid-Related Indexes. *Journal of Harbin Medical University*, 53(3): 306–309.
- [6] Chen K, Ge L, Lin X, 2021, Research Progress of Serum 25-Hydroxyvitamin D and Hypertension. *Xinjiang Traditional Chinese Medicine*, 39(5): 107–109.
- [7] Zeng J, Xiao C, Feng L, 2021, Relationship Between Serum 25-Hydroxyvitamin D Level and Blood Pressure Stratification and Lipid Metabolism Abnormalities in Elderly Hypertensive Patients. *Famous Doctors*, 2021(10): 122–124.
- [8] Ren B, Gao J, 2021, Clinical Significance of Serum 25-Hydroxyvitamin D Test in Patients with Gestational Hypertension. *Chinese Drugs and Clinics*, 21(5): 806–808.
- [9] Shen D, Chen M, Cheng M, et al., 2020, Correlation Study of Serum 25-Hydroxyvitamin D with Hypertension and Its Risk Stratification in the Elderly. *Chinese Journal of Geriatric Cardiovascular and Cerebrovascular Disease*, 22(9): 983–985.
- [10] Liu X, Gong N, 2020, Changes of Serum 25-Hydroxyvitamin D in Patients with Gestational Hypertension and Its Clinical Significance. *Journal of Practical Clinical Medicine*, 24(9): 66–68, 72.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



# Observation on the Preventive Effect of Traditional Chinese Medicine Sachets on Influenza

Baijing Guo<sup>1</sup>, Yuwei Jiang<sup>2\*</sup>

<sup>1</sup>Clinical Medical College of Jiamusi University, Jiamusi 154007, Heilongjiang, China

<sup>2</sup>Rehabilitation Medical College of Jiamusi University, Jiamusi 154007, Heilongjiang, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To analyze the preventive effect of traditional Chinese medicine sachets on influenza. *Methods:* A total of 100 subjects meeting the inclusion criteria were recruited in a certain area based on population characteristics (age, occupation, gender). The subjects were divided into a sachet group (50 cases) and a control group (50 cases). The sachet group was given traditional Chinese medicine sachets with epidemic prevention and infection prevention effects (recommended to carry along or sniff intermittently, at least 3 times a day, each time not less than 1 minute. Replace the sachet medicine after one month when the scent disappears, and continue to use for 2 months). The control group did not receive any intervention measures. After the experiment, subjects filled out a questionnaire and an efficacy evaluation form. *Results:* Comparing the baseline data of the two groups, there was no statistical significance ( $P > 0.05$ ). Comparing the symptoms of colds between the two groups, there was no significant difference in nasal congestion, rhinorrhea, and fatigue symptoms between the two groups ( $P > 0.05$ ). However, the possibility of fever in the sachet group was much lower than that in the control group ( $P < 0.05$ ). Comparing the immunoglobulins (IgA, IgM, and IgG) of the two groups before and after intervention, it was found that before the intervention,  $P > 0.50$ ; after the intervention, the immunoglobulin levels of both groups increased, and the increase in the sachet group was much higher than that in the control group ( $P < 0.05$ ). Comparing the occurrence of side effects in the two groups, it was found that the incidence of allergies in the sachet group was 4.00%. Due to allergies, two subjects withdrew from the study halfway ( $P > 0.05$ ). *Conclusion:* In influenza, wearing traditional Chinese medicine sachets can effectively prevent colds and reduce the incidence of colds, but those who are allergic to sachets should use them with caution.

**Keywords:** Traditional Chinese medicine sachets; Influenza; Preventive effect

**Online publication:** April 29, 2025

## 1. Introduction

Influenza is an acute respiratory infectious disease caused by influenza viruses. It is a common disease in winter and spring, with high infectivity, and is one of the factors that induce other diseases. It seriously affects the quality of life of patients, causing symptoms such as fever, nasal congestion, and sore throat. Studies have shown <sup>[1]</sup> that most adults are not vaccinated against influenza, and anti-influenza drugs may pose serious risks of complications and drug resistance. In addition, the large-scale spread of influenza can cause social panic. Therefore, it is particularly important to find effective methods to prevent influenza to protect people's health. The fragrant sachet therapy is a treatment method derived from traditional Chinese medicine. The volatile scent of the medicine circulates through the body's qi and blood meridians, regulating the balance of yin and yang, and improving the body's resistance to disease. Studies have shown <sup>[2]</sup> that using anti-influenza sachets can prevent colds, enhance immune function, and have potential application value in preventing colds and healthcare. Although some studies have introduced the mechanism of traditional Chinese medicine sachets, supported by a certain history and some basic research, there is still a lack of systematic clinical research on their effectiveness in preventing influenza.

This project included 100 subjects for research, aiming to improve the immunity of susceptible populations, reduce the risk of infection, and provide a convenient, economical, and daily life-friendly preventive device, especially for elderly people, children with cerebral palsy, medical workers, and other groups with low resistance or long-term exposure to danger.

## 2. Materials and methods

### 2.1. General information

In a certain area, 100 subjects meeting the inclusion criteria were recruited based on population characteristics (age, occupation, gender). The 100 subjects were divided into a sachet group (50 cases) and a control group (50 cases). The sachet group was provided with traditional Chinese medicine sachets for epidemic prevention and infection resistance (recommended to carry with them or sniff intermittently, at least 3 times a day, each time not less than 1 minute. Replace the sachet medicine after one month when the scent disappears, and continue to use for 2 months). The control group did not receive any intervention measures. After the experiment, subjects filled out a questionnaire and an efficacy evaluation form. This study has been approved by the ethics committee, and there was no statistically significant difference in baseline data between the two groups.

### 2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Informed consent to participate in this research; (2) Individuals not wearing traditional Chinese medicine sachets; (3) For children or elderly, informed consent signed by a family member is required. Exclusion criteria: (1) Presence of other chronic respiratory diseases; (2) Comorbidity with hypertension; (3) History of allergy to traditional Chinese medicine; (4) Currently participating in other clinical trials; (5) Women who are breastfeeding, pregnant, or planning to conceive; (6) Accompanied by other malignancies; (7) Poor compliance; (8) Presence of mental health disorders.

### 2.3. Research methods

The control group did not receive any intervention measures, while the sachet group was provided with traditional Chinese medicine sachets for epidemic prevention and infection resistance. The sachets were



recommended to be carried or sniffed intermittently, at least 3 times a day, each time not less than 1 minute. The sachet medicine was replaced after one month when the scent disappeared, and continued to be used for 2 months. The efficacy of the traditional Chinese medicine sachets was analyzed using an efficacy evaluation form. During use, the sachets should be placed close to the nose and mouth. At home, they can be hung in the living space. Before bedtime, they can be placed beside the pillow, where the aromatic scent can soothe the mind and promote tranquility. Generally, it is recommended to place 2–3 sachets in an area of 10–20 square meters. When going out, the sachets can be worn on the chest, tied to the wrist, or hung in the car for easy sniffing. After one week of use, the sachets can be gently shaken or tapped to distribute the scent more evenly and intensely. The effective period of one sachet is approximately one month. After use, they can be boiled for bathing or soaking feet, which can help prevent heat rash, especially for children. It should be noted that pregnant women and patients with asthma should avoid using them. The general information questionnaire for subjects was designed by the researchers.

(1) General questionnaire: This includes basic information about the subjects (age, occupation, gender, etc.) and their subjective feelings (level of preference for traditional Chinese medicine sachets, perception of their preventative abilities, intention to continue using them, etc.). (2) Traditional Chinese Medicine Sachet Efficacy Evaluation Form: This assesses the physical condition of the subjects, records experimental data, determines the efficacy of the sachets, and derives relevant results based on comparing the two experimental groups and evaluating the immune status of the sachet group.

## 2.4. Observation indicators

The cold prevention effects, immunoglobulin levels before and after intervention, and any side effects of the traditional Chinese medicine sachets were observed in both groups.

## 2.5. Statistical methods

SPSS 26.0 software was used for statistical analysis of the data. Measurement data were expressed as mean  $\pm$  standard deviation (SD) and analyzed using the *t*-test. Count data were expressed as percentages and analyzed using  $\chi^2$  test.  $P < 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Comparison of baseline data between the two groups

There was no statistically significant difference in baseline data between the two groups ( $P > 0.05$ ). See **Table 1**.

**Table 1.** Comparison of baseline data between the two groups

Group	Number of cases	Average age (years)	Gender	
			Male	Female
Control group	50	48.23 $\pm$ 6.10	19	31
Sachet group	50	47.65 $\pm$ 7.04	23	27
$\chi^2/t$		0.440		0.657
<i>P</i>		0.661		0.418

### 3.2. Comparison of cold symptoms between the two groups

Upon analyzing the tabular data in **Table 2** and comparing the occurrence of cold symptoms between the two groups of subjects, it was found that there was no significant difference in the symptoms of nasal congestion, rhinorrhea, and fatigue between the two groups ( $P > 0.05$ ). However, the likelihood of fever occurrence in the sachet group was significantly lower than that in the control group ( $P < 0.05$ ).

**Table 2.** Comparison of cold symptoms between the two groups

Group	Number of cases	Fever	Nasal obstruction	Runny nose	Fatigue
Control group	50	4	7	2	0
Sachet group	50	0	2	0	1
$\chi^2$		4.167	3.053	2.041	1.010
$P$		0.041	0.081	0.153	0.315

### 3.3. Comparison of immunoglobulins before and after intervention between the two groups

Upon analyzing the tabular data in **Table 3** and comparing the immunoglobulins (IgA, IgM, and IgG) of the two groups of subjects before and after intervention, it was observed that before the intervention, there was no significant difference ( $P > 0.50$ ). However, after the intervention, the immunoglobulin levels increased in both groups, with the sachet group showing a significantly higher increase compared to the control group ( $P < 0.05$ ).

**Table 3.** Comparison of immunoglobulins before and after intervention between the two groups

Group	Number of cases	IgA		IgM		IgG	
		Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Control group	50	2.51 ± 0.46	2.52 ± 0.78*	1.74 ± 0.95	1.74 ± 0.16*	10.54 ± 2.37	11.12 ± 3.12*
Sachet group	50	2.49 ± 0.52	2.61 ± 0.17*	1.75 ± 0.78	1.95 ± 0.23*	11.01 ± 2.79	14.39 ± 2.67*
$t$		0.204	1.709	0.058	4.543	0.908	5.631
$P$		0.839	0.028	0.954	0.000	0.366	0.000

Note: Compared with before treatment, \* $P < 0.05$ .

### 3.4. Occurrence of side effects in the two groups

Upon analyzing the tabular data in **Table 4** and comparing the occurrence of side effects between the two groups of subjects, it was found that the incidence of allergies in the sachet group was 4.00%. Due to the presence of allergies, two subjects withdrew from the study midway, with  $P > 0.05$  indicating no statistically significant difference in the overall occurrence of side effects between the two groups.

**Table 4.** Occurrence of side effects in the two groups

Group	Number of cases	Allergy (cases)	Total incidence rate (%)
Control group	50	0	0.00
Sachet group	50	2	4.00
$\chi^2$			
$P$			

## 4. Discussion

Influenza, known as “seasonal flu” in traditional Chinese medicine, is a prevalent disease. In recent years, global climate warming and changes in the disease spectrum have led to a year-by-year increase in the incidence of influenza<sup>[3]</sup>. In China, there is a close relationship between climate and influenza across regions. Studies have found that due to differences in climatic conditions, the peak periods of influenza also vary between the north and south. Temperature plays a significant role in the high incidence of influenza during winter and spring, while humidity has a greater impact on influenza in the south during summer and autumn<sup>[4]</sup>. Additionally, research has indicated that atmospheric pressure, pressure difference, wind speed, and rainfall also affect the occurrence of influenza. The influenza virus can undergo mutation, with significant antigenic variants emerging every 2–3 years for type A influenza. Influenza is seasonal, typically stopping after 3–4 weeks of circulation. Adolescents have the highest infection rate, while elderly and chronically ill individuals are at high risk of infection. After each influenza epidemic, people generally lack immunity.

Although anti-influenza drugs are effective, they can easily lead to drug resistance. The World Health Organization recommends influenza vaccination as the most effective method to prevent influenza, with a vaccine protection rate reaching 70% to 90%<sup>[5]</sup>. However, due to insufficient public awareness of influenza vaccines and factors such as vaccine safety, efficacy, supply capacity, and cost, the influenza vaccination rate remains low in China.

Traditional Chinese medicine has played a significant role in preventing and treating infectious diseases, and many people prefer its preventive methods. Current research indicates that using traditional Chinese medicine bagged tea can reduce the incidence and duration of influenza and alleviate symptoms such as fever, nasal congestion, rhinorrhea, and pharyngeal congestion<sup>[6]</sup>. Therefore, traditional Chinese medicine has a solid public foundation in preventing influenza. Sachets, as traditional Chinese accessories, feature a refreshing aroma, high safety, easy portability, and low cost, with a history of thousands of years in China. Wearing sachets is an external treatment method in traditional Chinese medicine. By grinding medicines and placing them in a cloth bag worn on the chest, waist, or in a close-fitting pocket, the medicinal aroma is absorbed through the nasal cavity, skin pores, and meridian acupoints. This method has the effects of regulating qi, dredging meridians, promoting smooth qi and blood circulation, balancing yin and yang, and harmonizing internal organs. It can enhance the body's resistance, prevent and treat certain diseases by removing dampness, clearing heat, detoxifying, and dispelling evil spirits<sup>[7]</sup>.

In this study, comparing the symptoms of cold occurrence between the two groups of subjects revealed no significant difference in nasal congestion, rhinorrhea, and fatigue symptoms ( $P > 0.05$ ). However, the possibility of fever occurrence in the sachet group was significantly lower than that in the control group ( $P < 0.05$ ). This suggests that traditional Chinese medicine sachets can reduce the incidence of colds and have a certain preventive effect. Comparing the immunoglobulins (IgA, IgM, and IgG) before and after intervention between the two groups showed that before the intervention, there was no significant difference ( $P > 0.50$ ). However, after the intervention, the immunoglobulin levels increased in both groups, with a significantly higher increase in the sachet group compared to the control group ( $P < 0.05$ ). This indicates that wearing traditional Chinese medicine sachets can significantly increase immunoglobulin levels, thereby enhancing immunity and preventing colds. Regarding side effects, the incidence of allergies in the sachet group was 4.00%. Due to allergic reactions, two subjects withdrew from the study midway ( $P > 0.05$ ). This suggests that wearing traditional Chinese medicine sachets may cause allergies in different populations, and immediate discontinuation should

be considered in case of adverse reactions.

Besides wearing sachets, other measures can also be taken to prevent influenza, such as frequent handwashing and ventilation, which are among the most basic and important preventive measures. Maintaining clean hands and indoor air circulation can effectively reduce the risk of virus transmission. Wearing masks and avoiding crowds can prevent the spread of viruses through respiratory droplets, and minimizing unnecessary gatherings is advisable. Adopting a balanced diet rich in seasonal fruits and vegetables, drinking sufficient water, and engaging in suitable physical activities like running, brisk walking, or swimming can also contribute to good health. Maintaining adequate sleep and a regular sleep schedule, avoiding smoking and excessive stress, and fostering a positive mood are essential for enhancing the body's resistance to viruses.

## 5. Conclusion

In summary, this study provides preliminary clinical evidence supporting the preventive effect of sachets on influenza, laying a foundation for future large-scale, high-quality clinical research. The findings of this study pave the way for further exploration of the effectiveness and safety of medicinal prevention methods against influenza.

## Funding

National College Student Innovation Training Program (Project No.: 202010222048)

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Yu X, Zhang L, Wang Z, et al., 2023, Study on the Change of Odor Components During the Placement of Traditional Chinese Medicine Sachet Based on Ultra-fast Gas Chromatography Electronic Nose Technology. *China Pharmacy*, 34(03): 339–344.
- [2] China Maternal and Child Health Association Neonatal Health Professional Committee, Zhang X, Shi Y, 2024, Expert Suggestions on Prevention of Common Respiratory Virus Infections in Neonates. *Chinese Journal of Contemporary Pediatrics*, 26(8): 789–794.
- [3] Du S, Jiang B, Jin G, et al., 2022, Data Mining Research on the Prevention and Treatment of Viral Pneumonia with Traditional Chinese Medicine Sachets. *Journal of Emergency in Traditional Chinese Medicine*, 31(6): 945–949.
- [4] Dong Y, Zhang Y, Li H, et al., 2022, Discussion on the Application and Prospect of External Application of Traditional Chinese Medicine in the Prevention of Influenza from the Perspective of Nasal Mucosal Immunity. *Journal of Nanjing University of Traditional Chinese Medicine*, 38(11): 1009–1014.
- [5] Shi Y, Xuan Y, Wang L, et al., 2022, Changes in the Pandemic of Influenza. *International Journal of Epidemiology and Infectious Diseases*, 49(1): 1–5.
- [6] Liu Y, Huang Q, Zhang L, et al., 2023 Spatial and Temporal Analysis of Influenza Incidence in China from 2004 to 2018 and Its Prediction Model. *Chinese Journal of Disease Control & Prevention*, 27(2): 176–183,190.

- [7] Wang Y, 2023, Research Progress of Influenza B Virus. International Journal of Laboratory Medicine, 44(12): 1517–1521.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Study on the Correlation Between Night ECG Parameters and Sleep Quality in Elderly Patients with Atrial Premature Beat

Yaqian Huang\*

<sup>1</sup>Department of Cardiology, Yichang Central People's Hospital, The First College of Clinical Medical Science, China Three Gorges University, Yichang 443003, China

<sup>2</sup>Hubei Key Laboratory of Ischemic Cardiovascular Disease, Yichang 443003, China

<sup>3</sup>Hubei Provincial Clinical Research Center for Ischemic Cardiovascular Disease, Yichang 443003, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the correlation between night ECG parameters and sleep quality in elderly patients with atrial premature beat (PAC). *Methods:* A total of 307 elderly patients with PAC were selected from March 2022 to March 2024. The parameters of room morning load and heart rate variability (HRV) at night (22:00–6:00) were collected by 24h holter electrocardiogram, and the sleep quality of PAC patients was evaluated by Pittsburgh Sleep Quality Index (PSQI). Multiple regression analysis was used to explore the correlation between night ECG parameters and sleep quality. *Results:* The incidence of sleep disorder in 307 elderly PAC patients was 62.54%. Univariate analysis showed that there were no statistically significant differences in gender, BMI and education level ( $P > 0.05$ ), but there were statistically significant differences in age, disease course, underlying diseases, atrial morning load, SDNN, RMSSD, LF, HF, LF/HF and TP ( $P < 0.05$ ). Multivariate Logistic regression analysis showed that atrial morning load, SDNN, RMSSD, LF and LF/HF were independent influencing factors of sleep disorder in elderly PAC patients ( $P < 0.05$ ). Patients with sleep disorders were divided into mild group, moderate group and severe group according to PSQI score, and there were statistically significant differences in the indexes of atrial morning load, SDNN, LF, LF/HF and TP among the three groups (all  $P < 0.05$ ). Spearman correlation analysis showed that room morning load, LF, LF/HF and TP were positively correlated with the degree of sleep disorder, while SDNN parameters were negatively correlated with the degree of sleep disorder (all  $P < 0.05$ ). *Conclusion:* There is a significant correlation between night ECG parameters and sleep disorders in elderly patients with PAC. It is possible to prevent and treat sleep disorders by monitoring ECG abnormalities and improve the reliability of treatment.

**Keywords:** Atrial premature beat; Elderly patients; Nocturnal electrocardiogram; Sleep quality

**Online publication:** April 29, 2025



# 1. Introduction

Premature atrial contraction (PAC) is one of the most common types of clinical arrhythmia, which is not only an important sign of cardiac structural abnormalities but also increases the risk of sudden cardiac death. With the acceleration of the aging process of our population, cardiovascular health of the elderly has gradually become a hot topic of social concern, and PAC has become a new health killer with an incidence rate of more than 25% among the elderly ( $\geq 65$  years old) <sup>[1]</sup>. Previous clinical studies have mostly focused on the pathophysiological mechanisms of PAC on left atrial enlargement, decreased cardiac output and atrial fibrillation conversion risk in patients, ignoring the two-way interaction of sleep disorders in elderly PAC patients. Epidemiological data show that the incidence of sleep disorders in elderly PAC patients is about 68%, which is significantly higher than 45% in normal elderly population <sup>[2, 3]</sup>. It has been reported that sleep disorders in elderly PAC patients have obvious circadian rhythm characteristics, and hologram monitoring has found that there is a positive correlation between premature beats at night and the number of awakenings <sup>[4]</sup>, suggesting that sleep quality may become a new target for alleviating arrhythmia. This study investigated the correlation between night ECG parameters and sleep quality in elderly patients with PAC, aiming to provide theoretical basis for individualized treatment of PAC patients based on sleep regulation.

## 2. Data and methods

### 2.1. Research object

A total of 307 elderly patients with PAC were selected from March 2022 to March 2024 for clinical trial, including 175 males and 132 females. The patients ranged from 65 to 78 years old, with an average age of  $(70.4 \pm 4.2)$  years. BMI ranged from 18.9 to 25.3kg/m<sup>2</sup>, with an average of  $(21.34 \pm 1.45)$  kg/m<sup>2</sup>; The course of disease ranged from 6 months to 4 years, with an average of  $(2.03 \pm 0.78)$  years; Basic diseases: 194 cases of hypertension, 78 cases of coronary heart disease, 24 cases of chronic heart failure, 11 cases of heart valve disease; Education level: junior high school and below 157 cases, senior high school/technical secondary school 86 cases, junior college and above 64 cases.

### 2.2. Nanorow standard

Inclusion criteria: (1) age  $\geq 65$  years; (2) Those who meet the diagnostic criteria for PAC established by the European Society of Cardiology (ESC) <sup>[5]</sup>; (3) 24h holter ECG confirmed atrial premature beat ( $\geq 30$  times /h), and night ECG monitoring can identify atrial premature beat events; (4) Clear consciousness can cooperate with medical staff to complete sleep assessment; (5) Knowledge of this clinical trial and signed the authorization letter; (6) Approved by the hospital Ethics Committee, approval number [KY2022-015].

Exclusion criteria: (1) Patients with acute coronary syndrome and severe heart failure (NYHA grade III–IV); (2) Patients who have received heart surgery or interventional surgery in the past 3 months; (3) Those who have used antiarrhythmic and antipsychotic drugs within the past month; (4) Patients with basic diseases such as hyperthyroidism, hypothyroidism and COPD induced sleep disorders; (5) There are cognitive dysfunction, mental illness.

### 2.3. Observing indicators

- (1) ECG parameter detection: All patients were treated with Philips Holter system (PHILIPS DigiTrak 24h ECG monitoring (operating frequency 1000Hz) was performed for XT type, and the time domain parameters of atrial morning load (number of premature beats/total number of beats  $\times 100\%$ ), heart rate variability

(HRV) [standard deviation of R-R interval (SDNN)] and the square sum of the difference between adjacent R-R intervals were collected from 22:00 to 6:00 the next day (RM) SSD)] and HRV frequency domain parameters [LF power (LF), HF power (HF), LF/HF power ratio (LF/HF), total power (TP)].

- (2) Sleep quality assessment: The Chinese version of the Pittsburgh Sleep Quality Index (PSQI) scale was used to evaluate the sleep quality of patients with early room hours <sup>[6]</sup>. The scale was scored from seven dimensions, including subjective sleep quality, time to fall asleep, sleep efficiency, sleep disorders, hypnotic drugs, and daytime dysfunction, with the score ranging from 0 to 21 points, and the total score  $\geq 7$  points was diagnosed as sleep disorder.

## 2.4. Statistical treatment

SPSS28.0 statistical software was used to process the test data. Continuous variables were represented by ( $\pm$ s), and an independent sample t-test was used for comparison between groups.  $\chi^2$  test was used to describe categorical variables by frequency (%). Stepwise regression method was used to analyze the correlation between night ECG parameters and sleep quality in multivariate analysis.  $P < 0.05$  was used to indicate the difference and statistical significance.

## 3. Result

### 3.1. Sleep status of elderly patients with PAC

A total of 307 patients were divided into two groups according to the basis of PSQI scale score 7:192 (62.54%) with  $\geq 7$  points and 115 (37.46%) with  $< 7$  points.

### 3.2. Univariate affecting sleep quality in elderly PAC patients

Univariate analysis was conducted on whether they were elderly PAC patients with sleep disorders (sleep disorder group =1, non-sleep disorder group = 0) as dependent variable and basic data, atrial early load indicators, HRV time domain parameters and frequency domain parameters as independent variables. The results showed no significant differences in gender, BMI and education level ( $P > 0.05$ ), and age, disease course, underlying disease, atrial premature load, SDNN, RMSSD, LF and LF / HF ( $P < 0.05$ ), as shown in **Table 1**.

**Table 1.** Univarifactors affecting sleep quality in elderly PAC patients

Item		Sleep disorder group(192)	Non-sleep disorder group(115)	$t/\chi^2$	$P$
Gender (Male)		104(54.17)	71(61.74)	1.848	$> 0.05$
Age (years)		$72.06 \pm 5.28$	$68.53 \pm 4.70$	6.082	$< 0.05$
BMI(kg/m <sup>2</sup> )		$20.80 \pm 1.43$	$21.07 \pm 1.67$	1.450	$> 0.05$
Disease course (year)		$2.62 \pm 0.78$	$1.89 \pm 0.64$	8.904	$< 0.05$
Underlying disease	hypertension	128	64	2.086	$> 0.05$
	Coronary heart disease	52	26		
	Chronic heart failure	16	8		
	Valvular heart disease	6	5		



**Table 1 (Continued)**

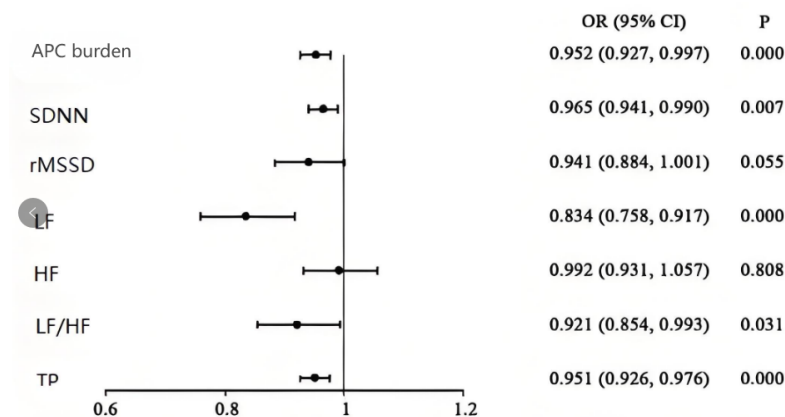
Item		Sleep disorder group(192)	Non-sleep disorder group(115)	$t/x^2$	$P$
Educational level	Junior high school and below	108	49		
	High school/technical secondary school	63	23	1.857	> 0.05
	College or above	51	13		
APC burden(%)		5.63 ± 1.28	2.14 ± 0.64	31.730	< 0.001
SDNN(ms)		86.23 ± 17.24	101.03 ± 13.67	8.313	< 0.001
RMSSD(ms)		34.36 ± 7.25	53.28 ± 6.47	23.680	< 0.001
LF(ms <sup>2</sup> )		1072.50 ± 89.20	834.45 ± 36.23	32.744	< 0.001
HF(ms <sup>2</sup> )		496.79 ± 56.23	546.59 ± 49.62	49.802	< 0.001
LF/HF		2.16 ± 0.34	1.53 ± 0.28	17.506	< 0.001
TP		1569.29 ± 187.35	1381.04 ± 103.23	207.390	< 0.001

### 3.3. Logistic regression analysis of HRV parameters and the occurrence of sleep disorders in elderly PAC patients

With sleep disorder as the dependent variable, binary Logistic regression analysis was performed after adjusting for independent variables such as age, course of disease, underlying disease, atrial morning load, SDNN, RMSSD, LF, and LF/HF. The results showed that early room load, SDNN, LF, LF/HF, and TP were independent influencing factors of sleep disorder in elderly PAC patients ( $P < 0.05$ ). See **Table 2** and **Figure 1**.

**Table 2.** Logistic regression analysis of HRV parameters and the occurrence of sleep disorders in elderly PAC patients

Item	$\beta$	SE	Wald	$P$	OR	95% CI	
						Lower limit	Upper limit
APC burden	-0.049	0.014	13.126	0.000	0.952	0.927	0.978
SDNN	-0.036	0.013	7.688	0.007	0.965	0.942	0.990
RMSSD	-0.061	0.032	3.639	0.055	0.941	0.884	0.937
LF	-0.182	0.049	13.865	0.000	0.834	0.758	0.918
HF	-0.008	0.032	0.062	0.808	0.992	0.931	1.057
LF/HF	-0.082	0.039	4.561	0.031	0.921	0.854	0.993
TP	-0.050	0.014	13.664	0.000	0.951	0.926	0.977
constant	1.402	1.204	23.033	0.004	-	-	-



**Figure 1.** Forest plot of the correlation between nocturnal ECG parameters and sleep disturbance in elderly PAC patients

### 3.4. Correlation between nocturnal ECG parameters and the degree of sleep disturbance in elderly PAC patients

#### 3.4.1. Comparison of nighttime ECG parameters in different elderly patients with PAC with sleep disorders

According to the score of PSQI scale, the elderly patients with PAC with sleep disorder were divided into 3 subgroups: mild sleep disorder group (PSQI score 7–10 points), moderate sleep disorder group (PSQI score 11–15 points) and severe sleep disorder group (PSQI score > 15 points). The indexes of chamber early load, LF, LF/HF and TP in severe sleep disorder group were significantly higher than those in moderate and mild groups ( $P < 0.05$ ), and the indexes of chamber early load, LF, LF/HF and TP in moderate sleep disorder group were higher than those in control group ( $P < 0.05$ ), while the indexes of SDNN in severe sleep disorder group were significantly lower than those in mild and moderate group. Variance test showed that the difference among the three groups was statistically significant ( $P < 0.05$ ). See **Table 3**.

**Table 3.** Night ECG parameters of elderly PAC patients with different degrees of sleep disorders in the 3 groups

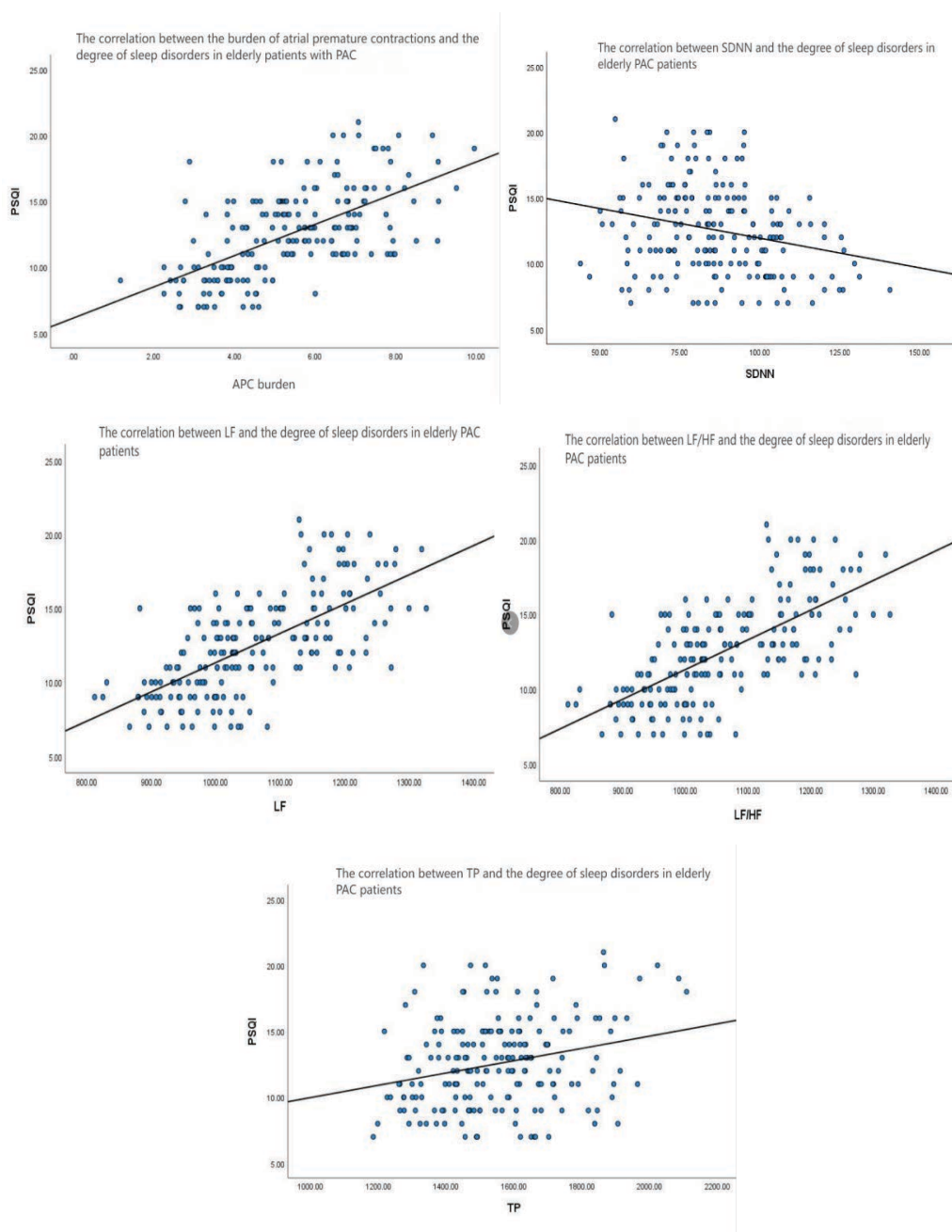
Index	Mild group (56)	Moderate group (96)	Severe group(40)	<i>F</i>	<i>P</i>
APC burden(%)	3.64 ± 1.04	5.63 ± 1.28	7.34 ± 1.54	101.699	< 0.001
SDNN(ms)	90.36 ± 20.13	85.73 ± 18.04	78.90 ± 17.47	4.449	0.013
LF(ms <sup>2</sup> )	944.71 ± 56.49	1072.50 ± 89.20	1203.46 ± 76.43	128.914	< 0.001
LF/HF	1.85 ± 0.44	2.10 ± 0.52	2.56 ± 0.75	19.238	< 0.001
TP	1472.34 ± 193.45	1569.29 ± 187.39	1684.53 ± 231.42	13.312	< 0.001

#### 3.4.2. Correlation between night ECG parameters and the degree of sleep disorder in elderly PAC patients

Spearman correlation analysis was used to analyze the correlation between atrial morning load, SDNN, LF, LF/HF, TP, and the degree of sleep disorder in elderly PAC patients. The results showed that the indexes of atrial morning load, LF, LF/HF, and TP were positively correlated with the degree of sleep disorder ( $P < 0.05$ ). SDNN parameters were negatively correlated with the degree of sleep disorder ( $P < 0.05$ ), as shown in **Table 4** and **Figure 2**.

**Table 4.** Correlation between night ECG parameters and the degree of sleep disorder in elderly PAC patients

Parameter	Degree of sleep disturbance		
	<i>r</i>	<i>P</i>	<i>OR</i> (95% <i>CI</i> )
APC burden	0.744	< 0.001	0.671–0.803
SDNN	-0.346	< 0.001	-0.379– -0.104
LF	0.735	< 0.001	0.659–0.795
LF/HF	0.497	< 0.001	0.379–0.599
TP	0.363	< 0.001	0.122–0.394



**Figure 2.** Correlation between night ECG parameters and the degree of sleep disorder in elderly PAC patients

## 4. Discussion

PAC is one of the most common types of clinical arrhythmia, and its pathological characteristics are characterized by the interaction between abnormal atrial myoelectric activity and autonomic nervous dysfunction<sup>[7]</sup>. Data have shown that frequent PAC triggers the imbalance of atrial and cellular calcium homeostasis by activating the intracardial electrical feedback mechanism, resulting in atrial structural remodeling<sup>[8]</sup>. It is worth noting that this pathological process is more pronounced at night when vagal tone is elevated, thus increasing the risk of paroxysmal atrial fibrillation. Sleep disorders are common comorbidities in elderly patients with PAC. Traditional theories generally believe that autonomic nervous dysfunction is the main reason for the destruction of patients' sleep system, but some patients with normal autonomic nervous function still have sleep disorders. Based on this, this study explored the correlation between nocturnal ECG parameters and sleep disorders in elderly patients with PAC, providing a new target for precision treatment strategies for such patients.

The results of this study showed that the incidence of sleep disorders in 307 elderly PAC patients was 62.54%, which was basically consistent with the results of Zhang *et al.*, indicating that elderly PAC patients had more prominent sleep disorders<sup>[9]</sup>. Univariate and multivariate Logistic analysis showed that atrial morning load, SDNN, RMSSD, LF, and LF/HF were independent influencing factors of sleep disorder in elderly PAC patients.

Atrial premature load is an index reflecting the overall cardiac load of patients with atrial premature beat. Frequent atrial premature beat at night may cause heart discomfort such as palpitations and palpitation, and pathological discomfort will destroy the continuity of sleep and affect the quality of sleep. The HRV parameter reflects the regulatory function of the cardiac autonomic nervous system, and the decrease of SDNN indicates the impaired regulatory function of the cardiac autonomic nervous system and the imbalance of sympathetic and parasympathetic nerves<sup>[10]</sup>. The abnormal excitation of sympathetic nerve will cause the patient's body to be in a state of stress and increase the heart rate, which will affect the normal rhythm of the heart during sleep and lead to the decrease of sleep efficiency.

RMSSD mainly reflects the functional activity of vagus nerve, and the decrease of RMSSD means that vagus nerve has a weakened regulatory effect on the heart, which further affects the stability of heart rhythm and sleep quality<sup>[11]</sup>. LF and LF/HF are also important factors affecting sleep quality. LF represents the result of the joint action of sympathetic and parasympathetic nerves. If the low-frequency (LF) component increases, both the LF/HF ratio and total power (TP) will also rise, indicating heightened sympathetic nerve activity while parasympathetic nerve activity remains relatively suppressed. This disruption leads to an imbalance in the autonomic nervous system, interfering with normal electrophysiological functions and the neuroregulatory mechanisms of sleep<sup>[12]</sup>. Prolonged excitation of the patient's system can significantly impair sleep quality.

In this study, a total of 192 elderly patients with PAC were divided into 3 subgroups according to the degree of sleep disorder. The comparison showed that the atrial morning load, LF, LF/HF, and TP of patients with severe sleep disorder were significantly higher than those of the other two groups, while the SDNN parameters were significantly lower than those of the other two groups. Spearman correlation analysis showed that room morning load, LF, LF/HF, and TP parameters were positively correlated with PSQI, while SDNN was negatively correlated with PSQI. It suggests that severe sleep disorders may negatively affect the heart health of older patients with PAC, leading to increased atrial load and an imbalance in autonomic nervous function, potentially increasing the risk of heart attack or other heart problems.

## 5. Conclusion

To sum up, there is a significant correlation between abnormal cardiac activity at night and decreased sleep quality in elderly patients with PAC. Clinicians should pay attention to sleep problems in elderly patients with PAC, comprehensively evaluate ECG parameters and sleep quality, and take targeted treatment measures to improve patient prognosis.

## Disclosure statement

The author declares no conflict of interest.

## References

- [1] Chinese Medical Association Electrophysiology and Pacing Branch, Chinese Medical Association Arrhythmia Professional Committee, 2023, Atrial Fibrillation: Current Understanding and Treatment Recommendations. *Chinese Journal of Arrhythmias*, 27(05): 377–481.
- [2] Meng Y, Nie C, Zhang Y, et al., 2024, Relationship Between Premature Atrial Beats and New Atrial Fibrillation After Hypertrophic Cardiomyopathy. *Chinese Journal of Molecular Cardiology*, 24(3): 6076–6082.
- [3] Chen L, Gong Y, Dai F, et al., 2022, Clinical Study on the Evaluation of Early Left Atrial Remodeling in Patients with Diabetes Mellitus by Four-Dimensional Automatic Left Atrial Quantitative Technique. *Journal of Cardio-Cerebrovascular Diseases of Integrated Chinese and Western Medicine*, 20(13): 2428–2431.
- [4] Xiang J, Ye L, Chen Y, 2021, The Mechanism and Significance of Atrial Premature Beat Index in the Onset of Paroxysmal Atrial Fibrillation. *Chinese Journal of Cardiac Pacing and Electrophysiology*, 35(2): 134–138.
- [5] Calvo D, Arbelo E, Arribas F, et al., 2021, Comments on the 2020 ESC/EACTS Guidelines for the Management of Atrial Fibrillation. *Rev Esp Cardiologia*, 74(5): 378–383.
- [6] Gu W, Zhang L, Guo Z, et al., 2024, The Mediating Effect of Mental Resilience on Job Stress and Sleep Quality in Psychiatric Nurses. *Chinese Journal of Modern Nursing*, 30(12): 1638–1642.
- [7] Zhao D, Wang X, Zhang Z, et al., 2021, Relationship Between Frequent Atrial Precontraction and New Atrial Fibrillation in Elderly Patients with Acute ST-Segment Elevation Myocardial Infarction and Its Predictive Value. *Journal of Clinical Cardiology*, 37(1): 57–61.
- [8] Liao J, Yang S, Lu K, et al., 2012, Oral TRPV4 Inhibitors Improve Atrial Calcium Homeostasis in Aseptic Pericarditis Rats. *Acta Physiologica Sinica*, 74(2): 188–190.
- [9] Zhang X, Miao T, Zhan S, 2023, Epidemiological Characteristics and Psychological Factors of Elderly Arrhythmias in Xining Area. *Public Health and Preventive Medicine*, 34(1): 105–108.
- [10] Qi Y, Jiang Z, 2023, Effect of Pingmaiding Palpitum Prescription on Serum IL-1 $\beta$ , NF- $\kappa$ B and Heart Rate Variability in Patients with Tachyarrhythmia. *Chinese Emergency Medicine*, 32(11): 2005–2008.
- [11] Wang J, Yook Y, 2020, Occupational Stress and Its Association with Cardiopulmonary Function, Arterial Stiffness, Heart Rate Variability and Sleep Quality in Firefighters. *Chinese Journal of Preventive Medicine*, 54(11): 1196.
- [12] Feng J, 2024, Study on Sleep Structure, Heart Rate Variability and Intervention Therapy in Patients with Postural OSAS, thesis, Second Military Medical University.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



# Analysis of Adverse Reactions Caused by Antibiotics and Rational Drug Use in Clinical Practice

Hongyan Zhang, Juntao Zhang\*

Aviation Industry Xiangyang Hospital, Xiangyang 441000, Hubei, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the adverse reactions associated with antibiotics and analyze strategies for their rational use. *Methods:* A retrospective analysis was conducted on 60 patients who experienced adverse reactions to antibiotics between August 2021 and August 2023. The types of antibiotics that caused adverse reactions were analyzed, and the symptoms of adverse reactions and measures for rational use of antibiotics were summarized. *Results:* Among the analyzed cases of adverse reactions to antibiotics, the highest rate was observed in patients aged 61–75 years, accounting for 38.33%, followed by patients aged 51–60 years, accounting for 20.00%. In terms of the types of antibiotics that caused adverse reactions, cephalosporins were the most common, accounting for 40.00%, followed by penicillins, accounting for 18.33%. Analysis of the systems involved in adverse reactions showed that skin and appendage disorders were the most common, accounting for 36.67%, followed by the digestive system, accounting for 28.33%. *Conclusion:* Irrational use of antibiotics can lead to adverse drug reactions. Therefore, it is necessary to analyze strategies for the rational use of antibiotics to reduce adverse drug reactions and ensure the safety of antibiotic use.

**Keywords:** Antibiotics; Rational drug use; Adverse reactions

**Online publication:** April 29, 2025

## 1. Introduction

Antibiotics refer to secondary metabolic substances produced during the life processes of pathogenic bacteria, plants, or animals. They exhibit anti-pathogen activity or other active characteristics and are widely used in the treatment of diseases caused by infectious pathogens, with excellent efficacy<sup>[1]</sup>. However, with the continuous enrichment of antibiotic types, the rate of irrational antibiotic use has increased, resulting in drug-related adverse reactions in some patients treated with antibiotics. These adverse reactions can damage the skin and cause dysfunction of multiple systems such as respiratory, nervous, digestive, and cardiovascular systems, and even lead to death<sup>[2]</sup>. Therefore, it is necessary to conduct an in-depth analysis of antibiotic use, identify issues with irrational antibiotic use, and explore targeted solutions. In this study, 60 patients who experienced adverse reactions to antibiotics between August 2021 and August 2023 were selected as samples to investigate the adverse

reactions and summarize strategies for rational drug use.

## 2. Materials and methods

### 2.1. Materials

A retrospective analysis was conducted on the data of 60 patients who experienced adverse reactions to antibiotics between August 2021 and August 2023. Among them, 34 were males and 26 were females, with an age range of 12 to 73 years and a mean age of  $(44.26 \pm 3.25)$  years. Patients and their families provided informed consent for the use of antibiotic treatment. At the time of enrollment, patients had no organ lesions or cardio-cerebrovascular diseases.

### 2.2. Methods

A retrospective analysis of case data was performed to collect information on the types of adverse reactions, categories of antibiotic drugs, and general data of patients taking the medications. A comprehensive analysis of rational drug use strategies was conducted.

- (1) The adverse reactions were analyzed based on age, and the adverse reaction rates were calculated for different age groups.
- (2) The adverse reactions were analyzed based on drug categories, and the adverse reaction rates were calculated for different types of drugs.
- (3) The adverse reaction symptoms were analyzed, and the incidence rates of different system lesions were calculated.

### 2.3. Statistical analysis

The data were processed using SPSS 21.0 software. Chi-square test and percentage (%) were used to describe counting indicators, while the t-test and mean  $\pm$  standard deviation ( $\pm s$ ) were used to describe measurement indicators. Statistical significance was set at  $P < 0.05$ .

## 3. Results

### 3.1. Analysis of adverse reactions to antibiotics

The analysis of adverse reactions to antibiotics showed that the highest adverse reaction rate occurred in the age group of 61–75 years, accounting for 38.33%, followed by the age group of 51–60 years, accounting for 20.00%. The results are presented in **Table 1**.

**Table 1.** Analysis of adverse reactions to antibiotics (n,%)

Age	Number of Cases	Incidence Rate
12–20 years old	9	15.00
21–30 years old	9	15.00
31–40 years old	3	5.00
41–50 years old	4	6.67
51–60 years old	12	20.00
61–75 years old	23	38.33



### 3.2. Analysis of types of antibiotic drugs

An analysis of the types of antibiotic drugs that caused adverse reactions showed that cephalosporins were the most common, accounting for 40.00%, followed by penicillins, accounting for 18.33%. The results are presented in **Table 2**.

**Table 2.** Analysis of types of antibiotic drugs (n,%)

Type of Antibiotics	Number of Cases	Incidence Rate
Cephalosporins	24	40.00
Penicillins	11	18.33
Macrolides	7	11.67
Aminoglycosides	6	10.00
Quinolones	6	10.00
Tetracyclines	6	10.00

### 3.3. Analysis of systems involved in adverse reactions

An analysis of the systems involved in adverse reactions showed that skin and appendage disorders were the most common, accounting for 36.67%, followed by the digestive system, accounting for 28.33%. The results are presented in **Table 3**.

**Table 3.** Analysis of systems involved in adverse reactions to antibiotics (n,%)

Affected system	Number of cases	Incidence rate
Skin and Appendages	22	36.67
Digestive System	17	28.33
Nervous System	10	16.67
Respiratory System	6	10.00
Cardiovascular System	5	8.33

## 3. Discussion

Antibiotics have been widely used in clinical treatment to fight pathogens in humans or animals, and are suitable for diseases caused by microbial infections <sup>[3]</sup>. However, selecting the appropriate antibiotic for treatment remains a hot topic in clinical research, as it aims to ensure efficacy while reducing adverse drug reactions. During clinical treatment, improper use of antibiotics can damage patients' physiological functions and even pose a threat to their lives. To summarize, common adverse drug reactions during antibiotic treatment are as follows:

(1) Allergic reactions

- (a) Shock: For example, some patients may experience an allergic reaction when taking cephalosporins, and severe cases can lead to shock. Therefore, before selecting cephalosporins, patients should undergo a sensitivity test to ensure they are not allergic to the medication.
- (b) Anemia: The most common type is hemolytic anemia, characterized by a decrease in blood cell count.
- (c) Drug-induced fever and serum sickness: Manifestations include joint pain, edema, and high fever.

(d) Others: During treatment with tetracyclines and penicillins, apart from the aforementioned common adverse reactions, unclassified allergic symptoms such as erythroderma, erythema, and urticaria may also occur.

(2) Toxic reactions

Different types of antibiotics can cause different toxic reactions, especially those with a low therapeutic index, which have a higher rate of adverse reactions. Additionally, among various antibiotic toxic reactions, neurotoxicity such as nerve function impairment has a higher incidence.

(3) Idiosyncratic reactions

Patients taking antibiotics may develop idiosyncratic reactions, although the incidence is low. The inducement of these reactions is associated with multiple factors such as genetics and constitution. Antibiotics that are prone to cause idiosyncratic reactions mainly include benign mycin and chloramphenicol, as their components can exert effects within red blood cells, thereby affecting the body's metabolism.

(4) Re-infection reactions

Excessive or prolonged use of antibiotics can affect their efficacy, limiting their antibacterial effect and failing to inhibit bacterial reproduction, thus increasing the risk of reinfection<sup>[4]</sup>. In clinical cases where irrational use of antibiotics leads to reinfection, the antibiotics are mainly broad-spectrum antibiotics. Furthermore, excessive use of antibiotics can also disrupt the balance of the patient's internal flora, further affecting the efficacy of the medication.

Based on the data analysis in this study, the highest adverse reaction rate was observed in the 61–75 age group, accounting for 38.33%, followed by the 51–60 age group at 20.00%. This suggests that adverse reactions to antibiotics are not uncommon during clinical treatment, and among patients aged 13–75, the elderly population is more prone to adverse drug reactions. This is attributed to factors such as:

- (1) Degenerative changes in liver and kidney function in the elderly, which can affect drug metabolism and excretion, leading to altered pharmacokinetic parameters. Long-term medication use can result in drug accumulation, triggering adverse effects.
- (2) Reduced drug sensitivity in the elderly, as the body's sensitivity to medications decreases with age. Therefore, increased drug dosages and prolonged treatment durations can increase the risk of adverse reactions.
- (3) The presence of multiple comorbidities requiring concomitant use of various medications, which may interact with each other, elevating the risk of adverse drug reactions.
- (4) Poor stability of the elderly's bodily functions, making them more susceptible to adverse reactions under the influence of exogenous factors such as medications. Another set of data indicates that cephalosporins were the most common type of antibiotics causing adverse reactions, accounting for 40.00%, followed by penicillins at 18.33%.

The reasons for these adverse reactions include: (a) Allergic reactions such as skin rashes and shock; (b) Hepatorenal toxicity symptoms like disordered liver and kidney function; (c) Gastrointestinal symptoms including discomfort, nausea, and vomiting; (d) Disulfiram-like reactions manifesting as hypotension and flushing. The final set of data reveals that skin and appendage disorders were the most common system involved in adverse reactions, accounting for 36.67%, followed by the digestive system at 28.33%. Skin and appendage disorders are often related to irritation from the active ingredients, such as the presence of allergens that trigger immune responses,

leading to skin irritation manifesting as redness, bumps, and itching. Patient's own allergic constitution is also a factor. Adverse reactions in the digestive system can be attributed to: (a) Stimulation by active ingredients, such as taking medications that stimulate gastric acid secretion, which can cause gastrointestinal reactions like nausea and vomiting; (b) Dietary influences, such as consuming spicy, cold, or greasy foods during medication, which can increase the burden on the stomach and intestines, slow down gastrointestinal motility, and induce indigestion; (c) Psychological factors, where patients may experience prolonged anxiety and stress due to their illnesses, activating the sympathetic nervous system and leading to indigestion<sup>[5]</sup>.

Therefore, medical institutions should properly manage antibiotic control, conduct in-depth analysis of patient data on adverse reactions caused by antibiotics, standardize antibiotic use from the source, and reduce irrational antibiotic use to minimize adverse drug reactions. Based on a summary analysis, adverse antibiotic reactions can be reduced in the following ways:

(1) Condition analysis

Before starting antibiotic treatment, it is essential to comprehensively analyze the patient's physical state and carefully study their medical history, medication history, allergy history, and other relevant information. Additionally, patients should be guided to undergo relevant examinations, and symptoms of antibiotic discomfort, types of pathogenic bacteria, antimicrobial spectrum, and infection location should be recorded. Safe and efficient drugs should be selected to ensure the antibacterial and bacteriostatic effects of antibiotics.

(2) Strict control of indications

When selecting antibiotic drugs, physicians and pharmacists should strictly control the indications for antibiotics, choosing drugs based on the patient's symptoms, condition, and bacterial test results to increase the blood drug concentration in the target tissue and enhance the efficacy of the medication. For patients with potential allergic risks, drug sensitivity tests should be actively carried out to avoid adverse drug reactions as much as possible.

(3) Improving the review system

After a physician issues an antibiotic prescription, a pharmacist should review the prescription, comprehensively understand the patient's disease condition, evaluate the rationality of the prescription, and focus on reviewing the type, dosage, and precautions of antibiotics. Once the prescription is approved, antibiotic drugs can be dispensed to the patient. During the dispensing process, medical staff should repeatedly emphasize the importance of following medical advice on medication use, patiently inform patients about the dosage and frequency of medication, and provide instructions on correct medication methods. Patients should also be advised to observe any physical discomfort or adverse reactions during medication and report them immediately. The physician can then redevelop the treatment plan to ensure the safe use of antibiotics.

(4) Principles of combined antibiotic use

When two or more antibiotics are used in combination, they can have a synergistic effect and enhance efficacy. However, it is essential to pay attention to the antimicrobial spectrum characteristics of the combined drugs, master the indications for combination therapy, and avoid negative reactions between different drugs. In clinical practice, when a single antibiotic is not effective in antibacterial treatment, combination therapy can be used to enhance efficacy, such as in the treatment of severe or mixed infections.

(5) Principles of antibiotic dosage control

Compared to other clinical therapies, antibiotic drugs have more drug-resistant strains and fewer adverse reactions. Therefore, during combined drug administration, the type of antibiotic should be selected based on the patient's infection site and disease progression, and the antibiotic dosage should be reasonably planned to avoid problems such as low blood drug concentration due to too small a dosage or toxic reactions due to too large a dosage, thereby enhancing the efficacy of antibiotics and optimizing the patient's prognosis.

(6) Principles of antibiotic administration time and route control

To ensure the efficacy of antibiotics, patients should be provided with sufficient medication, and the route of administration and time interval between administrations should be clarified. For example, when using medium-efficacy sulfonamides, medication should be discontinued for one day after one day of use, with a time interval of one day between administrations. If the time interval is too long, the medicinal effect cannot be maintained. Additionally, when using cephalosporins and penicillins for sterilization, the active ingredients are quickly absorbed and can reach the expected blood drug concentration in a short period, exerting a bactericidal effect. Moreover, the half-life of penicillin drugs is about 0.7 hours, and the metabolic rate of active ingredients is about 90% after 3–4 hours of administration. After 6 hours, the blood drug concentration in the body is no longer effective in antibacterial activity, i.e., it is below the minimum inhibitory blood drug concentration <sup>[6]</sup>. Therefore, when using penicillin drugs, intermittent administration should be followed according to medical advice, with a recommended frequency of 2–3 times per day.

(7) Implementation of reward and punishment measures

Medical institutions should regularly conduct spot checks on antibiotic prescriptions, summarize the frequency of antibiotic drug use, and evaluate whether prescriptions comply with clinical antibiotic use rules based on clinical diagnosis, frequency of medication, and dosage. Additionally, the proportion of various antibiotic drugs should be counted, and case information and symptoms of adverse reactions of patients with antibiotic adverse reactions should be summarized. Departments that use antibiotics rationally should be rewarded, and departments that use antibiotics irrationally should be criticized and notified to stimulate the sense of responsibility of medical staff and improve the rational use of antibiotics.

(8) Opening an antibiotic medication consulting hotline

Professional personnel should be assigned to answer the hotline, patiently answer patients' medication questions, and guide patients to deeply understand the precautions and medication plans for antibiotic use. They should also inquire whether patients experience any discomfort to reduce irrational antibiotic use <sup>[7]</sup>. However, it is important to note the following during antibiotic treatment: (a) Adequate medication: During antibiotic use, patients should follow medical advice and take adequate dosages. Otherwise, if the dosage is too low, it may not kill the bacteria, leading to disease recurrence and prolonging the patient's course of disease. (b) Avoiding self-discontinuation: Patients should not stop taking antibiotic drugs by themselves even if their condition improves. Otherwise, it may lead to disease recurrence and affect drug efficacy.

## 4. Conclusion

In summary, adverse reactions to antibiotics occur frequently during antibiotic use, especially among the elderly population. Cephalosporins and penicillins are more prone to adverse reactions, with a high proportion of skin and appendage reactions and digestive system reactions. Therefore, it is crucial to explore rational drug use strategies to enhance the safety of antibiotic use.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Feng Z, 2023, Analysis of 112 Cases of Adverse Reactions Caused by Cephalosporin Antibiotics and Their Clinical Rational Use. *Contemporary Medicine Forum*, 21(12): 110–113.
- [2] Ou X, 2022, Analysis of Adverse Reactions Caused by Antibiotics and Clinical Rational Drug Use. *Chinese Scientific Journal Database Medicine*, 2(2): 46–48.
- [3] Liu J, 2021, Analysis of Adverse Reactions Caused by Antibiotics and Clinical Rational Drug Use. *Capital Food and Medicine*, 28(8): 92–93.
- [4] Guo X, Guo Y, 2022, Analysis of Adverse Reactions Caused by Antibiotics and Medicine and Health, 3(11): 90–93.
- [5] Xu Y, 2023, Analysis of Adverse Reactions Caused by Commonly Used Antibacterial Drugs in Clinical Practice and Rational Drug Use. *Journal of Clinical Rational Drug Use*, 16(35): 164–167.
- [6] Wang L, 2023, Clinical Exploration of Adverse Reactions and Rational Use of Antibiotic Drugs. *Chinese Scientific Journal Database Medicine*, 3(12): 70–72.
- [7] Lv X, Zhang Y, Luo Z, et al., 2023, Analysis of 103 Cases of Adverse Drug Reactions and Rational Drug Use of Risperidone. *Journal of Clinical Rational Drug Use*, 16(4): 12–14.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



# In-depth Analysis of the Pathogenesis and Research Progress in Cutting-edge Treatment of Type III Acute Acquired Comitant Esotropia

Ling Jin\*

Nanjing Medical University Eye Hospital, Nanjing 210003, Jiangsu, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** Type III acute acquired comitant esotropia (AACE) is a special type of binocular coordination disorder with sudden onset characteristics, but its pathogenesis and treatment strategies remain unclear. This article analyzes the incidence and classification characteristics of Type III AACE, and explores its pathogenesis from multiple perspectives including clinical medicine, neuroscience, and neuro-ophthalmology. It is found that this disease is associated with factors such as decompensation of phoria, dysfunction of the visual center, abnormalities in the physiological and anatomical structure of extraocular muscles, accommodative factors, and disorders of convergence and divergence. The prognosis of Type III AACE is excellent with treatments such as botulinum toxin injection and surgery, and adjunctive therapies like prism adaptation test and visual function training can enhance the management effect. This article provides an in-depth analysis of the pathogenesis and cutting-edge treatment techniques for patients with Type III AACE, which can offer guidance for the subsequent diagnosis and treatment of such patients.

**Keywords:** Type III acute acquired comitant esotropia; Treatment progress; Pathogenesis

**Online publication:** April 29, 2025

## 1. Introduction

Acute acquired comitant esotropia (AACE) is a special type of esotropia, often characterized by sudden onset of esotropia, which may be accompanied by diplopia. The diplopia presents with horizontal ipsilateral features. Patients have the same angle of deviation when gazing in different directions, without symptoms such as ocular movement disorders or extraocular muscle paralysis, but there is a risk of potential binocular single vision dysfunction. Type III AACE may initially present with intermittent eye position deviation and diplopia. Most patients experience binocular single vision when viewing near objects and diplopia when viewing distant objects, while a few patients have diplopia issues when viewing both near and distant objects. Type III AACE does not have self-limiting properties. For a few patients with mild strabismus, reducing the amount of time spent on

electronic devices or avoiding close work for extended periods can decrease the degree of strabismus and alleviate diplopia symptoms. Additionally, some patients with Type III AACE may not show significant signs or symptoms at the onset of the disease, leading to a delay in initial diagnosis that may span months or even years. This study provides a deep interpretation of the pathogenesis of Type III AACE and analyzes cutting-edge treatment options to guide future clinical diagnosis and treatment.

## 2. Incidence and classification

In the context of changing reading habits, the susceptible population for AACE has increased. Coupled with the prolonged home office hours for adults and extended learning time on electronic devices for children during the pandemic, the time spent on close-up eye use has increased, leading to a rise in the incidence of Type III AACE, especially in intermittent esotropia with small angles and myopia<sup>[1]</sup>. Based on Burian and Miller's research on AACE classification<sup>[2]</sup>, it can be divided into the following types:

- (1) Swan type AACE, which commonly occurs in infants and children, with or without hyperopia, and can be triggered by monocular vision loss or monocular patching that disrupts binocular fusion.
- (2) Burian-Franceschetti type AACE, which is prevalent in children and adolescents, may be associated with mild hyperopia, and has a large esotropia angle, often related to psychological stress and physical fatigue.
- (3) Bielschowsky type AACE, which commonly affects adults and older children, is associated with varying degrees of myopia.

Additionally, some patients may present with complications such as optic disc edema or nystagmus, or experience failure to restore binocular vision after treatment, or recurrent AACE after treatment, requiring vigilance for intracranial pathologies<sup>[3]</sup>.

## 3. Pathogenesis

### 3.1. Decompensation of phoria

Before the onset of Type III AACE, patients may experience intermittent binocular diplopia, which progresses to persistent diplopia as the disease advances. In the initial stage of phoria, it relies on fusion reserve for compensation. However, under the influence of multiple factors such as aging, increased physical and psychological stress, and illnesses, the degree of phoria increases while the fusion reserve decreases. If the phoria cannot be compensated, it may suddenly transition into manifest esotropia.

### 3.2. Dysfunction of visual cortex

Prolonged exposure to screens such as mobile phones and computers late at night can continuously stimulate the visual cortex, disrupting biological rhythms and impairing brain function. Acute circadian rhythm disorders and reduced sleep can lead to uncoordinated eye movements, triggering AACE. fMRI technology enables qualitative analysis of functional brain regions, exhibiting advantages in displaying fine structures. It assists doctors in understanding the composition of visual information processed by the cerebral cortex and provides feedback on the neural mechanisms underlying visual formation. In a study conducted by Wang *et al.*, fMRI technology was used to aid in the diagnosis of AACE patients<sup>[4]</sup>. The results revealed that AACE patients had higher activation intensity in the middle frontal gyrus and right lingual gyrus compared to healthy individuals, while activation



intensity in other regions was lower. Future research can further explore the application of fMRI technology to assist doctors in analyzing the etiology of Type III AACE and assess changes in the visual cortex of patients.

### **3.3. Abnormal physiological and anatomical structure of extraocular muscles**

Tightness of the medial rectus muscle and relaxation of the lateral rectus muscle can both induce Type III AACE. Prolonged close-up eye use in daily life, combined with biochemical and mechanical stimuli, can lead to skeletal muscle pathologies, resulting in disordered muscle strength of the medial and lateral rectus muscles, ultimately manifesting as eye position deviation. Additionally, anterior displacement of the insertion of the medial rectus muscle can cause the converging power of both eyes to be stronger than the diverging ability, triggering AACE. Especially for those who frequently engage in close-up vision tasks, multiple factors can strengthen the medial rectus muscles of both eyes, leading to a disturbance in the balance between convergence and divergence.

### **3.4. Accommodative factors**

Most patients with Type III AACE suffer from myopia, and those with a higher degree of myopia tend to have more lagged accommodative ability compared to those with lower myopia or non-myopic individuals. Furthermore, people with myopia often have poor eye usage habits. The closer the viewing distance, the more severe the accommodation lag becomes. Under the influence of accommodation lag, hyperopic defocus may occur, causing the patient to enter a hyperopic state and leading to increased convergence. However, it's important to note that presbyopic and pseudophakic individuals, who have no accommodative ability, may also develop esotropia.

### **3.5. Convergence and divergence disorders**

In a study by Huang *et al.*, it was found that over 70.51% of patients with Type III AACE spent more than 7 hours per day on close-up eye use<sup>[5]</sup>. According to a study by Zheng *et al.*, long-term viewing of electronic screens is associated with a higher risk of developing video terminal syndrome, which can induce ocular discomfort and extraocular symptoms, including dry eyes, blurred vision, and musculoskeletal disorders<sup>[6]</sup>. As the course of video terminal syndrome progresses, it can impair ocular accommodative ability and trigger diplopia. Evidently, excessive close-up eye use is a high-risk factor for the development of Type III AACE, leading to increased muscle strength of the medial rectus and stimulating spasms, thereby disrupting the balance between divergence and convergence of both eyes. Additionally, electronic displays possess unique characteristics, especially when viewing 3D displays. To achieve a stereoscopic visual effect, crossover and non-crossover parallax techniques are employed, which can cause fatigue in both eyes more easily. During crossover parallax viewing, images formed on the screen induce binocular convergence, but the accommodation focus of both eyes remains on the screen, resulting in disordered binocular convergence and accommodation, thereby exacerbating ocular discomfort and fatigue. Therefore, prolonged viewing of electronic screens, coupled with disordered convergence and divergence, can further disrupt binocular fusion function and increase the risk of diplopia.

## **4. Treatment methods**

### **4.1. Botulinum toxin treatment for Type III AACE**

Some patients with Type III AACE exhibit large deviation angles, and conventional conservative treatments may not be effective. In such cases, botulinum toxin type A can be injected into the extraocular muscles to enhance the

management of Type III AACE. Botulinum toxin is a neurotoxin that acts on cholinergic motor nerve endings. It antagonizes calcium ions and blocks the release of acetylcholine from nerve endings, preventing muscle fibers from contracting and, thus paralyzing the muscles. The injected toxin can maintain its efficacy for up to three months. Stimulated by its active ingredients, binocular single vision function can be rebuilt, reducing the risk of strabismus recurrence after discontinuation.

In a study by Zhang *et al.*, patients with AACE who had onset within six months were treated with botulinum toxin injections, while those with onset exceeding six months underwent extraocular muscle transposition surgery<sup>[7]</sup>. The results indicated that both botulinum toxin injections and extraocular muscle transposition surgery were effective treatments for AACE, with significant outcomes. Botulinum toxin injection can be considered as a preferred treatment option for early-stage AACE patients.

In a study by Cui *et al.*, eleven AACE patients were treated with botulinum toxin type A injections and followed up for half a year<sup>[8]</sup>. The results showed that diplopia symptoms resolved within 1 to 2 months after injection, and there was no recurrence during the follow-up period. Shi's study found that surgery and botulinum toxin treatment had similar effects on AACE, with low recurrence rates for both<sup>[9]</sup>. Compared to surgical methods, botulinum toxin injection is easier to perform, reduces medical expenses, and shortens anesthesia time, providing a new approach for the treatment of Type III AACE.

#### **4.2. Prism treatment for Type III AACE**

Type III AACE often presents with the issue of “eating prisms.” Conventional prism treatment based on past experience may increase the risk of under correction. Prism adaptation tests can improve the success rate of treatment for patients with Type III AACE, but the treatment cycle is long. Additionally, some patients have large strabismus angles, making it impractical to wear prisms continuously. However, prisms can be used for preoperative and postoperative correction in patients with Type III AACE to improve visual acuity, near stereoscopic sensitivity, and restore binocular visual function. In a study by Zhou *et al.*, 47 patients undergoing bilateral lateral rectus muscle recession surgery were subjected to prism adaptation tests<sup>[10]</sup>. The results indicated that prism tests can enhance surgical safety for AACE patients. Therefore, for AACE patients undergoing surgery, it is recommended to perform prism adaptation tests to ensure surgical safety.

#### **4.3. Surgical treatment for Type III AACE**

It is recommended that surgical treatment for Type III AACE patients be performed after six months of onset. Early treatment, when the strabismus angle is unstable, can increase surgical risks. In a study by Qiang *et al.*, patients with AACE were treated with unilateral medial rectus muscle recession and bilateral medial rectus muscle recession<sup>[11]</sup>. The results showed that unilateral medial rectus muscle recession could improve the orthophoria rate and optimize visual function in AACE patients. In a study by Xu *et al.*, modified Parks incision combined with rectus muscle folding surgery was used to treat AACE. This approach could restore the tear film function, enhance surgical effects, reduce postoperative pain, and improve ocular aesthetics<sup>[12]</sup>. In a study by Chao *et al.*, rectus muscle marginal myotomy was used to treat AACE, which could optimize binocular visual function, reduce surgical complications, and demonstrate high safety<sup>[13]</sup>.

## 5. Visual function training

Visual function training, combined with surgical treatment, can assist patients in rebuilding visual function and reducing the risk of AACE recurrence. In a study by Wu *et al.*, the first stage of training focused on expanding the negative fusion range at near distances and optimizing monocular accommodation amplitude, using methods such as polarized vector diagrams and lens reading <sup>[14]</sup>. The second stage centered on expanding the negative fusion range at intermediate and far distances and improving monocular flexibility, utilizing tools like stereoscopes and flippers. Personalized visual function training can alleviate AACE symptoms and enhance binocular visual function.

## 6. Conclusion

The incidence of Type III AACE is increasing year by year, and treatments such as botulinum toxin injections and surgery are commonly used to improve patient outcomes. However, many patients with Type III AACE also suffer from myopia, which can affect the onset and progression of the condition through indirect and direct pathways. Additionally, long-term poor eye usage habits can alter brain region function, affecting binocular visual and motor functions. Therefore, future research should focus on exploring the impact of myopia on visual pathways and visual centers. Currently, most studies on the pathogenesis and treatment of Type III AACE by scholars are retrospective analyses. Prospective studies can be actively conducted in the future to deeply analyze the pathogenesis and cutting-edge treatment options for Type III AACE patients, aiming to improve their prognosis.

## Disclosure statement

The author declares no conflict of interest.

## References

- [1] Shen J, Hua C, Lou H, et al., 2022, Changes in the Proportion of Hospitalizations for Acute Comitant Esotropia and Intermittent Exotropia Before and After the COVID-19 Epidemic. *Ophthalmology*, 31(6): 454–457.
- [2] Burian HM, Miller JE, 1958, Comitant Convergent Strabismus with Acute Onset. *Am J Ophthalmol*, 45(4 Pt 2): 55–64.
- [3] Rutstein RP, Lee SD, Zimmerman DR, 2017, Atypical Presentation of Acute Acquired Comitant Esotropia. *Clin Exp Optom*, 100(2): 192–194.
- [4] Wang X, Xie Q, Lu H, et al., 2015, Functional Magnetic Resonance Study on Cortical Activation Intensity in Patients with Comitant Strabismus. *Recent Advances in Ophthalmology*, 35(3): 258–262.
- [5] Huang X, Meng Y, Hu X, et al., 2022, The Effect of Different Treatment Methods on Acute Acquired Comitant Esotropia. *Comput Math Methods Med*, 2022: 5001594.
- [6] Zheng W, Zhang J, Chen J, et al. 2022, Independent Risk Factors of Type II Acute Acquired Concomitant Esotropia: A Matched Case-Control Study. *Indian J Ophthalmol*, 70(9): 3382.
- [7] Zhang G, Zhang L, Zhao R, et al., 2023, Efficacy Analysis of Botulinum Toxin Type A Injection and Extraocular Muscle Transposition for Patients with Acute Comitant Esotropia at Different Stages. *Recent Advances in Ophthalmology*, 43(4): 303–307.
- [8] Cui Q, Wang Z, Ma H, 2021, Short-Term Observation of the Effect of Botulinum Toxin Microinjection in the Treatment of Acute Comitant Esotropia. *Ningxia Medical Journal*, 43(4): 370–372.

- [9] Shi M, Zhou Y, Qin A, et al., 2021, Treatment of Acute Acquired Comitant Esotropia. *BMC Ophthalmol*, 21(1): 9.
- [10] Zhou S, Jin H, Li L, et al., 2017, Efficacy Analysis of Prism Adaptation Test Combined with Bilateral Lateral Rectus Muscle Recession in the Treatment of Basic Intermittent Exotropia. *Jiangxi Medical Journal*, 52(10): 969–971.
- [11] Qiang J, Huang J, Liu M, et al., 2024, Comparison of the Efficacy of Unilateral Medial Rectus Muscle Recession and Bilateral Medial Rectus Muscle Recession in the Treatment of Acute Comitant Esotropia in Adolescents. *Chinese Journal of Aesthetic Medicine*, 33(3): 29–32.
- [12] Xu X, Fu X, Lu L, 2022, Modified Parks Incision Combined with Rectus Muscle Linear Plication for the Treatment of Adult Comitant Strabismus. *International Eye Science*, 22(10): 1712–1716.
- [13] Chao X, 2020, Binocular Visual Analysis After Rectus Muscle Marginal Incision for the Correction of Comitant Esotropia. *Capital Food and Medicine*, 27(10): 16–16.
- [14] Wu X, Li Z, Gao M, 2024, Case Analysis of the Treatment of Acute Comitant Esotropia Using Full Refractive Correction and Visual Function Training. *Glass, Enamel & Spectacles*, 52(1): 14–16.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Fluid Dynamics Research on Erbium Laser-Assisted Chemical Preparation for Root Canal Therapy: A Review

Kedi Jihu, Xinyu He, Jizhi Zhao\*

Department of Stomatology, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing 100730, China

\*Corresponding Author: Jizhi Zhao, [zhaojizhi@126.com](mailto:zhaojizhi@126.com)

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** Microbial infection is a principal etiological factor in pulp and periapical diseases, necessitating effective root canal therapy (RCT) for thorough decontamination of the root canal system. However, conventional mechanical and chemical preparation methods remain inadequate, often leaving significant portions of the canal uncleaned and contributing to persistent infection. The advent of erbium laser-assisted chemical preparation has demonstrated significant potential in enhancing root canal disinfection through advanced fluid dynamics mechanisms, particularly cavitation and photoacoustic streaming. This review explores the fundamental principles governing fluid dynamics in erbium laser-assisted irrigation, with a focus on primary and secondary cavitation effects. The interaction between erbium laser energy and water generates vapor bubbles that induce dynamic fluid movement, enhancing the penetration and distribution of irrigants deep within the root canal system. Key factors influencing fluid dynamics intensity, including laser parameters, working tip design, and water medium confinement, are critically analyzed. Furthermore, recent advancements such as Photon-Initiated Photoacoustic Streaming (PIPS), Photoacoustic Synchronized Transients (PHAST), and Shock Wave Enhanced Emission Photoacoustic Streaming (SWEPS) are reviewed in the context of their ability to improve fluid motion and irrigation efficacy. While these laser-assisted techniques offer promising improvements over traditional methods, challenges remain in optimizing energy parameters and mitigating the constraints imposed by confined root canal environments. Future research should focus on refining fluid dynamics models and conducting clinical studies to validate the efficacy of these innovations. This review aims to provide a comprehensive overview of current developments in fluid dynamics research related to erbium laser-assisted chemical preparation, offering insights into its potential as an advanced modality for root canal disinfection.

**Keywords:** Root canal therapy; Laser adjunctive therapy; Erbium Laser; Fluid dynamics; Infection control

**Online publication:** April 30, 2025

## 1. Introduction



Microbial infection is one of the primary etiological factors in pulp and periapical diseases. Root canal therapy (RCT) is the preferred treatment modality for pulp and periapical pathologies, with the core objective being the thorough debridement of the infected pulp tissue and contaminants within the root canal system, including residual pulp tissue, biofilms, and microbial toxins <sup>[1]</sup>. Due to the complex anatomical structure of the root canal system, conventional mechanical preparation alone is insufficient, often leaving approximately 35% to 53% of the canal walls uncleaned <sup>[2]</sup>. Additionally, mechanical instrumentation can create a smear layer, which hinders the efficacy of disinfection <sup>[3]</sup>. Regardless of the mechanical preparation system used, significant amounts of dentin tissue along the canal walls are left uncut, with a pronounced limitation of self-limiting cleaning in the apical region <sup>[2-6]</sup>. Traditionally, chemical preparation has been employed to remove the smear layer and further eliminate infection within the root canal. However, current research indicates that conventional chemical disinfection methods still fall short of completely eradicating the infection. The unique wavelength and tissue interaction properties of the erbium laser (Er:YAG) have demonstrated great potential in root canal cleaning and disinfection. In particular, the application of erbium laser in fluid dynamics, through phenomena such as cavitation and photoacoustic streaming, offers a promising means of enhancing penetration and distribution of irrigants deep within the root canal system. This fluid dynamic enhancement not only improves the flow of irrigants but also significantly boosts the effectiveness of chemical preparation in root canal therapy. This review aims to provide an overview of the advancements in the fluid dynamics of erbium laser-assisted chemical preparation for root canal therapy.

## **2. Mechanisms of fluid dynamics generation**

The fluid dynamics in erbium laser-assisted chemical preparation for root canal therapy are primarily driven by cavitation effects, which involve a series of distinct physical stages.

### **2.1. Primary cavitation effect**

The primary cavitation effect follows the optical physics principles governing the interaction between laser energy and water <sup>[7]</sup>. The wavelength of the Er:YAG laser allows it to be readily absorbed by hydroxyl (OH<sup>-</sup>) groups ( $\mu_a = 1.247 \times 10^6 \text{ m}^{-1}$ ) <sup>[8]</sup>. When the erbium laser emits energy, approximately 70% of the pulse energy is absorbed within a thin layer of water molecules ( $\leq 1 \text{ }\mu\text{m}$ ) surrounding the fiber tip. This rapid energy absorption leads to an instantaneous conversion of optical energy into thermal energy, causing the water to reach its boiling point almost immediately. This results in the formation of vapor bubbles at the tip of the working fiber, initiating the primary cavitation effect <sup>[9]</sup>.

The core principle behind fluid dynamic generation is the difference in compressibility between gases and liquids, meaning that under identical pressure conditions, gas volume changes significantly, whereas liquid volume remains relatively stable. Once a vapor bubble forms, its volume fluctuates in response to internal pressure changes. The surrounding liquid, however, does not exhibit a corresponding volume change but instead undergoes displacement, leading to the first phase of fluid flow.

When the internal pressure of the vapor bubble equilibrates with the surrounding liquid pressure, the bubble enters a collapse phase. During this process, the rapid reduction in vapor bubble pressure causes the surrounding liquid to rush into the previously occupied space. This inward movement of liquid generates a secondary inward flow toward the bubble center. When the inflowing liquid converges, it creates a shock wave, which propagates outward and results in the second phase of fluid flow <sup>[10]</sup>.

## 2.2. Secondary cavitation effect

Following the initiation of fluid motion by the primary cavitation effect, the generated liquid flow attains a certain velocity and momentum within the pulp chamber and root canal. According to Bernoulli's equation:

$$p + \frac{1}{2}\rho v^2 + \rho gh = C$$

Where,  $p$  is the fluid pressure at a given point,  $v$  is the velocity,  $\rho$  is the fluid density,  $g$  is gravitational acceleration,  $h$  is the height at that point, and  $C$  is a constant.

When the local pressure drops below the static separation pressure of dissolved gases, gas molecules within the liquid are released, forming observable microbubbles. This phenomenon is termed the secondary cavitation effect<sup>[11]</sup>. Unlike primary cavitation, secondary cavitation bubbles may adhere to the dentinal walls of the pulp chamber or root canal before imploding. This process generates a higher instantaneous shear force on the canal walls, potentially enhancing the decontamination effect. Some researchers hypothesize that the secondary cavitation effect may play an even more critical role in infection removal due to this intensified mechanical impact.

## 3. Factors influencing fluid field intensity

The intensity of the fluid field during laser-assisted root canal chemical preparation determines the effectiveness of the procedure. Therefore, it is essential to control the factors that influence fluid field intensity. These factors can be summarized into three main aspects:

### 3.1. Laser parameters

The parameters of pulsed erbium lasers primarily include pulse width, single pulse energy, and frequency. Pulse width determines the peak power and is one of the most crucial factors affecting vapor bubble dynamics. Under constant conditions, a shorter pulse width results in higher peak power, leading to larger vapor bubbles and a stronger induced fluid field. Single pulse energy and frequency jointly determine output power but influence fluid field intensity from different perspectives. Higher single pulse energy generates larger vapor bubbles in free water, increasing fluid movement velocity upon bubble collapse<sup>[12]</sup>. However, studies have reported that increasing single pulse energy does not enhance fluid field intensity in the root canal system. Frequency does not directly affect vapor bubble formation but can enhance fluid field intensity within a certain range. Research has confirmed that fluid movement velocity in lateral root canals differs significantly between erbium laser pulses at 3 Hz and 4 Hz<sup>[13]</sup>.

### 3.2. Shape and position of the working tip

During erbium laser-assisted chemical preparation, the shape and position of the working tip play a crucial role in vapor bubble formation and fluid field dynamics<sup>[14]</sup>. When the pulse width is set between 50–80  $\mu$ s, a flat-end working tip produces elongated vapor bubbles (channel-like bubbles), whereas a conical working tip (with a taper angle of 34°) forms spherical vapor bubbles<sup>[15]</sup>. Multiple studies have indicated that conical working tips synchronize the vaporization of surrounding thin-layer water molecules, achieving higher energy conversion efficiency, which allows more optical energy to be converted into kinetic energy under the same parameters<sup>[13]</sup>. The difference in energy conversion efficiency among different working tips may be due to variations in the thickness of water molecules absorbing the energy. If some laser energy is converted into the internal energy of water molecules without causing vaporization, the efficiency of optical-to-kinetic energy conversion decreases.



When peak power remains constant, the influence of working tip shape on vapor bubble morphology diminishes as pulse width shortens. When the pulse width is set to 1  $\mu\text{s}$ , a flat-end working tip can also generate spherical vapor bubbles, which may be related to the increased concentration of output energy with shorter pulse width<sup>[9]</sup>. The activation position of the working tip directly affects the constraint imposed by rigid root canal walls on fluid movement. When the working tip is placed within the root canal, the liquid exerts high pressure on the apical region, and fluid exchange in this area is limited, making it less effective for apical cleaning<sup>[16]</sup>. Placing the laser tip in the apical region can lead to apical extrusion of the irrigant<sup>[17, 18]</sup>. Consequently, researchers have proposed activating the working tip in the pulp chamber, and further studies have confirmed that pulp chamber activation can also achieve effective cleaning of the apical region.

### 3.3. Confinement of the water medium

The cavitation effect and fluid field formation in the pulp chamber and root canal system are more complex than in free water. Factors such as the volume of the pulp chamber, the diameter and morphology of the main root canal, and the position of lateral root canals all influence the overall physical process<sup>[19]</sup>. Initially, researchers aimed to simplify laser-assisted chemical preparation models by selecting free water environments to isolate the effects of laser parameters, protocols, and working tip types on vapor bubbles and fluid motion. However, with further studies, it became evident that the confined space within the pulp chamber and root canal system significantly affects the cavitation effect and fluid field, bringing increased attention to the issue of water medium confinement. Early research primarily focused on differences in bubble formation between free water and confined water environments. In root canal models, lateral expansion of bubbles is restricted by the pulp chamber walls, apical expansion is hindered by liquid resistance, and coronal expansion is obstructed by the optical fiber tip, causing the internal bubble pressure to remain elevated for an extended period<sup>[20]</sup>. Therefore, under the same energy output conditions, bubbles in confined water environments exhibit slower expansion and collapse rates, longer oscillation cycles, and smaller vapor bubble volumes<sup>[21]</sup>. In 2011, Matsumoto's experimental results demonstrated that bubble expansion and collapse dynamics in root canals were three times lower than in free water<sup>[16]</sup>, a finding corroborated by Lakuc in 2020<sup>[21]</sup>. Subsequent studies compared the effects of different root canal morphologies on vapor bubble formation and fluid movement, revealing that while root canal morphology influences vapor bubble volume, it has minimal impact on bubble oscillation cycles<sup>[13]</sup>. This may be because changes in pulp chamber and root canal morphology are insufficient to cause a fundamental transformation in water confinement.

## 4. Practical applications of fluid dynamics

According to research on fluid dynamics, in 2011, DiVito *et al.* improved the working mode of laser-activated irrigation by using ultra-short pulse width erbium lasers to increase peak power. They also adopted a conical working tip to modify vapor bubble morphology and enhance the efficiency of energy conversion between light and heat. Furthermore, they moved the laser activation site from the apical region to the pulp chamber, alleviating some of the water medium confinement effects, and coined this erbium laser-assisted chemical preparation technique as Photon-Initiated Photoacoustic Streaming (PIPS), which they patented in collaboration with Fotona<sup>[22]</sup>. In 2013, Zhang *et al.* from the University of Hong Kong evaluated PIPS technology and found it to be superior to conventional needle irrigation in cleaning smear layers<sup>[23]</sup>. In 2019, Korkut *et al.* also confirmed the effectiveness of PIPS in smear layer removal in their study on extracted mandibular molars<sup>[24]</sup>. Traditional needle

irrigation often struggles to clean the apical region, lateral root canals, and isthmus, especially in curved root canals. PIPS technology improves the efficiency of irrigant cleaning and addresses these clinical challenges <sup>[25, 26]</sup>. Other studies have also applied different erbium laser irrigation techniques, such as the work by Guidotti *et al.* in 2014, who used the Preciso working tip and achieved similar results <sup>[27]</sup>. This invention marked a significant milestone, and subsequent research showed that PIPS-generated fluid movement velocities were ten times faster than those produced by ultrasonic tips and many times faster than those by conventional needle irrigation <sup>[28]</sup>.

However, the placement of the working tip in the pulp chamber under the PIPS design did not fully eliminate the effects of water medium confinement on vapor bubbles and fluid movement, and its ability to control infection in the apical region was insufficient for clinical needs. To further improve the efficiency of PIPS, Gregorcic *et al.* in 2014 proposed introducing a second pulse of energy at the moment of collapse of the initial vapor bubble formed by the erbium laser pulse. This dual-pulse approach was intended to create a cumulative effect, enhancing the fluid field intensity within the root canal system without significantly altering the vapor bubble volume, thus addressing the problem of inadequate fluid dynamics in confined spaces. Gregorcic's experiments confirmed that, at ultra-low pulse energies (2 mJ), the fluid field enhancement caused by this dual-pulse technique was especially notable, which they termed Photoacoustic Synchronized Transients (PHAST) <sup>[9, 29]</sup>.

In 2018, engineers from Fotona proposed the concept of Shock Wave Enhanced Emission Photoacoustic Streaming (SWEEPS) <sup>[30]</sup>. The primary goal of SWEEPS was to further improve the restriction of vapor bubbles by the rigid walls of the pulp chamber. The core technology of SWEEPS is a two-pulse erbium laser emission sequence. Current research suggests that the timing of the second pulse should occur before or after the collapse of the vapor bubble formed by the first pulse. Existing studies have confirmed that SWEEPS technology can increase the fluid field intensity within the root canal system. However, there is still debate regarding the mechanism by which the second pulse enhances the fluid field. Three theories have been proposed:

- (1) If the second pulse is delivered before the vapor bubble formed by the first pulse has completely collapsed, the second pulse's energy accelerates the collapse speed of the first pulse's vapor bubble, shortening its collapse cycle and intensifying the fluid field formed by the first pulse <sup>[10]</sup>.
- (2) If the second pulse is delivered after the first pulse's vapor bubble has collapsed, the fluid dynamics from the first pulse enhance the formation of the second pulse's vapor bubble, increasing its volume and producing a stronger fluid field during its collapse.
- (3) The fluid fields generated by the first and second pulses may overlap within the root canal system, independent of the vapor bubble formation process <sup>[10]</sup>.

## 5. Conclusion

Erbium laser-assisted chemical preparation is a newly emerging laser-based infection control technology developed over the past decade. The laser working tip, placed in the pulp chamber, generates intense cavitation effects, inducing strong agitation of the irrigating fluid. This process effectively cleanses the pulp chamber, root canal walls, and apical regions from infection. Currently, the study of fluid dynamics in erbium laser-assisted chemical preparation remains in its early stages, with numerous physical and engineering challenges yet to be addressed. The development of SWEEPS technology has provided a new perspective for erbium laser applications, and it may represent a promising direction for future research. However, further experimental studies in physics and additional clinical evidence are needed to fully validate its efficacy.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Basmadjian-Charles C L, et al., 2002, Factors Influencing the Long-Term Results of Endodontic Treatment: A Review of the Literature. *Int Dent J*, 52(2): 81–86.
- [2] Peters O A, Schonenberger K, Laib A, 2001, Effects of Four Ni-Ti Preparation Techniques on Root Canal Geometry Assessed by Micro Computed Tomography. *Int Endod J*, 34(3): 221–230.
- [3] Yin X, et al., 2010, Micro-Computed Tomographic Comparison of Nickel-Titanium Rotary Versus Traditional Instruments in C-Shaped Root Canal System. *J Endod*, 36(4): 708–712.
- [4] Paque F, Ganahl D, Peters O A, 2009, Effects of Root Canal Preparation on Apical Geometry Assessed by Micro-Computed Tomography. *J Endod*, 35(7): 1056–1059.
- [5] Fornari V J, et al., 2010, Histological Evaluation of the Effectiveness of Increased Apical Enlargement for Cleaning the Apical Third of Curved Canals. *Int Endod J*, 43(11): 988–994.
- [6] Paque F, et al., 2009, Hard-Tissue Debris Accumulation Analysis by High-Resolution Computed Tomography Scans. *J Endod*, 35(7): 1044–1047.
- [7] Blanken J, et al., 2009, Laser Induced Explosive Vapor and Cavitation Resulting in Effective Irrigation of the Root Canal. Part 1: A Visualization Study. *Lasers Surg Med*, 41(7): 514–519.
- [8] Vogel A, Venugopalan V, 2003, Mechanisms of Pulsed Laser Ablation of Biological Tissues. *Chem Rev*, 103(2): 577–644.
- [9] Gregori P, Jamek M, Luka M, et al., 2014, Synchronized Delivery of Er:YAG-Laser-Pulse Energy During Oscillations of Vapor Bubbles, 2014(1): 1–6.
- [10] Lukac N, Jezersek M, 2018, Amplification of Pressure Waves in Laser-Assisted Endodontics with Synchronized Delivery of Er:YAG Laser Pulses. *Lasers Med Sci*, 33(4): 823–833.
- [11] Macedo R, et al., 2014, Cavitation Measurement During Sonic and Ultrasonic Activated Irrigation. *J Endod*, 40(4): 580–583.
- [12] De Moor R J, et al., 2009, Laser Induced Explosive Vapor and Cavitation Resulting in Effective Irrigation of the Root Canal. Part 2: Evaluation of the Efficacy. *Lasers Surg Med*, 41(7): 520–523.
- [13] Lukac N, et al., 2016, Wavelength Dependence of Photon-Induced Photoacoustic Streaming Technique for Root Canal Irrigation. *J Biomed Opt*, 21(7): 75007.
- [14] Mrochen M, et al., 2001, Erbium: Yttrium-Aluminum-Garnet Laser Induced Vapor Bubbles as a Function of the Quartz Fiber Tip Geometry. *J Biomed Opt*, 6(3): 344–350.
- [15] Gregorcic P, Jezersek M, Mozina J, 2012, Optodynamic Energy-Conversion Efficiency During an Er:YAG-Laser-Pulse Delivery Into a Liquid Through Different Fiber-Tip Geometries. *J Biomed Opt*, 17(7): 075006.
- [16] Matsumoto H, Yoshimine Y, Akamine A, 2011, Visualization of Irrigant Flow and Cavitation Induced by Er:YAG Laser Within a Root Canal Model. *J Endod*, 37(6): 839–843.
- [17] Yost R A, et al., 2015, Evaluation of 4 Different Irrigating Systems for Apical Extrusion of Sodium Hypochlorite. *J Endod*, 41(9): 1530–1534.

- [18] Arslan, H., et al., Effect of PIPS technique at different power settings on irrigating solution extrusion. *Lasers Med Sci*, 2015. 30(6): p. 1641-5.
- [19] Lukac N, Gregoric P, Jezersek M, 2016, Optodynamic Phenomena During Laser-Activated Irrigation Within Root Canals. *Int J Thermophys*, 37(7): 1–8. DOI:10.1007/s10765-016-2071-z.
- [20] De Groot S D, et al., 2009, Laser-Activated Irrigation Within Root Canals: Cleaning Efficacy and Flow Visualization. *Int Endod J*, 42(12): 1077–1083.
- [21] Lukac M, Lukac N, Jezersek M, 2020, Characteristics of Bubble Oscillations During Laser-Activated Irrigation of Root Canals and Method of Improvement. *Lasers Surg Med*, 52(9): 907–915.
- [22] Cheng X, et al., 2017, Erbium:Yttrium Aluminum Garnet Laser-Activated Sodium Hypochlorite Irrigation: A Promising Procedure for Minimally Invasive Endodontics. *Photomed Laser Surg*, 35(12): 695–701.
- [23] Akcay M, et al., 2017, Effect of Photon-Initiated Photoacoustic Streaming, Passive Ultrasonic, and Sonic Irrigation Techniques on Dentinal Tubule Penetration of Irrigation Solution: A Confocal Microscopic Study. *Clin Oral Investig*, 21(7): 2205–2212.
- [24] Korkut E, et al., 2018, Antibacterial and Smear Layer Removal Efficacy of Er:YAG Laser Irradiation by Photon-Induced Photoacoustic Streaming in Primary Molar Root Canals: A Preliminary Study. *Photomed Laser Surg*, 36(9): 480–486.
- [25] Wang QQ, Zhang CF, Yin XZ, 2007, Evaluation of the Bactericidal Effect of Er,Cr:YSGG, and Nd:YAG Lasers in Experimentally Infected Root Canals. *J Endod*, 33(7): 830–832.
- [26] Yao N, Zhang C, Chu C, 2012, Effectiveness of Photoactivated Disinfection (PAD) to Kill *Enterococcus Faecalis* in Planktonic Solution and in an Infected Tooth Model. *Photomed Laser Surg*, 30(12): 699–704.
- [27] Guidotti R, et al., 2014, Er:YAG 2,940-nm Laser Fiber in Endodontic Treatment: A Help in Removing Smear Layer. *Lasers Med Sci*, 29(1): 69–75.
- [28] Koch J D, et al., 2016, Irrigant Flow During Photon-Induced Photoacoustic Streaming (PIPS) Using Particle Image Velocimetry (PIV). *Clin Oral Investig*, 20(2): 381–386.
- [29] Stojicic S, Shen Y, Haapasalo M, 2013, Effect of the Source of Biofilm Bacteria, Level of Biofilm Maturation, and Type of Disinfecting Agent on the Susceptibility of Biofilm Bacteria to Antibacterial Agents. *J Endod*, 39(4): 473–477.
- [30] George R, Meyers IA, Walsh LJ, 2008, Laser Activation of Endodontic Irrigants with Improved Conical Laser Fiber Tips for Removing Smear Layer in the Apical Third of the Root Canal. *J Endod*, 34(12): 1524–1527.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Parameter Estimation of a Tumor Growth Model under Data-driven Approach and Its Numerical Solution in Matlab

Zhuo Chen, Yihan Zeng, Wei Chen, Ruixian Zheng, Zejun Du, Meibao Ge\*

School of Medical Imaging, Hangzhou Medical College, Hangzhou 311399, Zhejiang, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** This paper focuses on the numerical solution of a tumor growth model under a data-driven approach. Based on the inherent laws of the data and reasonable assumptions, an ordinary differential equation model for tumor growth is established. Nonlinear fitting is employed to obtain the optimal parameter estimation of the mathematical model, and the numerical solution is carried out using the Matlab software. By comparing the clinical data with the simulation results, a good agreement is achieved, which verifies the rationality and feasibility of the model.

**Keywords:** MATLAB; Tumor growth model; Data-driven approach; Ordinary differential equation

**Online publication:** April 28, 2025

## 1. Introduction

Malignant tumors, as major diseases that pose a serious threat to human health, have long been a key research focus in the medical field. In today's era, with the continuous progress and rapid development of science and technology, tumor treatment methods are becoming increasingly diverse. Surgical treatment has become more precise and efficient, enabling the maximum resection of tumor tissues while minimizing damage to surrounding normal tissues. Radiotherapy technology has been constantly innovating, evolving from traditional radiotherapy methods to more precise intensity-modulated radiotherapy, proton and heavy ion radiotherapy, etc., which significantly enhances the lethality to tumor cells and reduces the side effects on normal tissues. Chemotherapy has also achieved numerous breakthroughs. New types of chemotherapy drugs keep emerging, not only improving the treatment effect but also alleviating the pain of patients to a certain extent. These advancements have significantly extended the survival period of tumor patients and remarkably improved their quality of life.

However, the survival mechanism of tumors is extremely complex, involving numerous factors from multiple disciplinary fields such as cell biology, molecular biology, and immunology. Tumor cells have abnormal



proliferation ability, can escape the immune surveillance of the body, and can also induce angiogenesis through various pathways to provide nutrients and channels for their own growth and metastasis. In addition, the genetic mutations of tumor cells are diverse and complex, and there may be differences between different tumor cells in different patients or even within the same patient. Due to the intertwined influence of these complex factors, there is still no complete model that can accurately explain the occurrence and evolution laws of tumors.

In order to overcome this challenge, researchers from multiple fields are actively exploring and constructing various basic models to simulate the characteristics of tumors. Among them, mathematical models, with their unique advantages, have become an important branch in the study of tumors. Mathematical models can quantitatively describe various phenomena in the tumor growth process by establishing mathematical equations, thus revealing the internal laws of tumor growth. For example, differential equations are used to describe the proliferation and migration processes of tumor cells, and probability models are applied to analyze the risk of tumor occurrence<sup>[1-6]</sup>.

Tumors are formed by tumor cells with genetic mutations. These tumor cells are significantly different from normal cells. The division and proliferation of normal cells are strictly regulated to maintain the normal functions and structures of body tissues and organs. However, the genetic mutations in tumor cells disrupt this regulatory mechanism, enabling their division and proliferation rate to far exceed that of normal cells. This rapid division and proliferation cause the continuous growth of tumor tissues, which exerts pressure on surrounding tissues and organs, affects their normal functions, and thus triggers a series of serious health problems. In this study, based on the clinical cases of a certain X tumor, its growth data were collected and collated. These data record the changes in the size of the tumor at different time points in detail, providing valuable information for studying the growth law of tumors. The aim of this study is to attempt to use these growth data and mathematical methods to construct a mathematical model that can accurately describe the growth law of tumors, providing theoretical support for a deeper understanding of the tumor growth process, prediction of tumor development trends, and formulation of more effective treatment plans.

## 2. Mathematical model of tumor growth based on data drive

Regression analysis was used to explore the changes in tumor size over time as shown in **Table 1**.

**Table 1.** Clinical data of X tumor growth over time

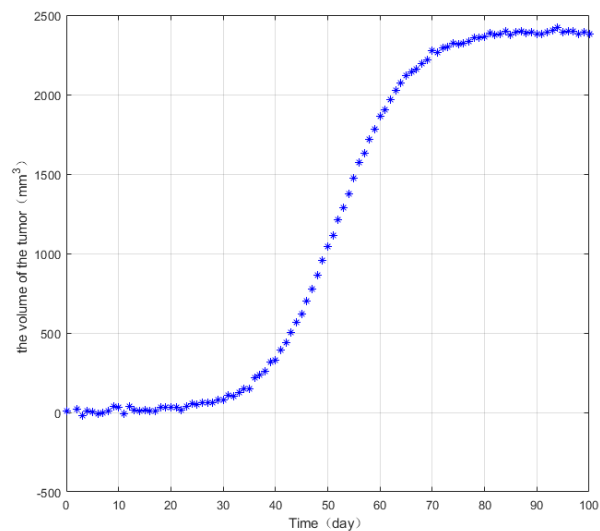
Time (day)	The volume of the tumor (mm <sup>3</sup> )	Time (day)	The volume of the tumor (mm <sup>3</sup> )	Time (day)	The volume of the tumor (mm <sup>3</sup> )	Time (day)	The volume of the tumor (mm <sup>3</sup> )
0	1.0	26	48.4	51	1120.4	76	2337.2
2	1.3	27	56.1	52	1210.3	77	2345.8
3	1.6	28	64.9	53	1300.1	78	2353.3
4	1.8	29	75.1	54	1388.7	79	2359.6
5	2.1	30	86.8	55	1475.3	80	2365.1
6	2.5	31	100.3	56	1559.1	81	2396.9
7	2.9	32	115.7	57	1638.0	82	2374.1
8	3.3	33	133.4	58	1714.7	83	2377.6
9	3.9	34	153.6	59	1785.7	84	2380.7

**Table 1 (Continued)**

Time (day)	The volume of the tumor (mm <sup>2</sup> )	Time (day)	The volume of the tumor (mm <sup>2</sup> )	Time (day)	The volume of the tumor (mm <sup>2</sup> )	Time (day)	The volume of the tumor (mm <sup>2</sup> )
10	4.5	35	176.6	60	1851.8	85	2383.2
11	5.2	36	202.7	61	1912.6	86	2385.7
12	6.0	37	232.3	62	1968.3	87	2387.7
13	7.0	38	265.9	63	2018.9	88	2389.3
14	8.1	39	303.5	64	2064.5	89	2390.8
15	9.5	40	345.5	65	2105.5	90	2391.1
16	10.9	41	392.3	66	2142.2	91	2393.2
17	12.7	42	444.0	67	2174.7	92	2394.2
18	14.8	43	500.9	68	2203.5	93	2394.9
19	17.2	44	562.9	69	2229.2	94	2395.7
20	19.9	45	630.1	70	2251.3	95	2396.3
21	23.1	46	702.2	71	2270.8	96	2396.9
22	26.8	47	779.0	72	2288.0	97	2397.2
23	31.1	48	859.9	73	2303.0	98	2397.6
24	36.1	49	944.3	74	2316.1	99	2397.9
25	41.8	50	1031.4	75	2327.4	100	2398.4

First, draw the scatter diagram of the data, as shown in **Figure 1**. The scatter diagram of the specific data is drawn in Matlab code:

```
data=xlsread('data1.xlsx');Time=data(:,1);
Num=data(:,2);plot(Time,Num,'bo'); grid on
xlabel('Time(day)'); ylabel('the volume of the tumor(mm^3)')
```

**Figure 1.** Scatter plot of clinical data



The trend of tumor size change over time can be visually seen from **Figure 1**, but the law of tumor change cannot be accurately obtained. The scatter points in the figure show a general upward trend, indicating that the tumor is growing over time, but this trend only provides a vague overall impression. Due to the dispersion of the scatter point distribution, the spacing between the points is not uniform, and there is no obvious linear or simple curve relationship, it is impossible to determine the specific growth rate change of the tumor at each stage and whether there is a turning point in the growth pattern based on these scattered points.

The mechanism analysis and data regression analysis were combined to build a mathematical model of tumor change over time. Mechanism analysis can start from the biological principles of tumor growth, such as considering the effects of internal factors, such as the division mechanism of tumor cells and the supply and consumption of nutrients on tumor growth. Data regression analysis can use mathematical methods to dig deep into a large number of existing clinical data and find the mathematical relationship behind the data <sup>[7]</sup>. The two complement each other, and it is expected to build a mathematical model that accurately reflects the law of tumor growth.

It can be seen from **Figure 1** that in the process of rapid tumor growth, when the tumor volume reaches a certain level, the growth rate slows down and becomes stable due to the limited supply of nutrients. This change rule is consistent with the characteristics of Logistic model, which can be described by the ordinary differential equation model as follows:

$$\begin{cases} \frac{dX(t)}{dt} = aX(t) - bX^2(t), \\ X(t_0) = X_0, \end{cases} \quad (1)$$

Where  $X=X(t)$  represents the volume of the tumor ( $mm^3$ ),  $t$  is time(day),  $a$  is the growth rate of the tumor per unit time,  $b = \frac{a}{K}$ ,  $K$  is the maximum tumor volume,  $X_0$  is the volume of the tumor at the initial moment  $t=t_0$ .

Transform the equation into  $\frac{dX}{dt} = aX(1 - \frac{X}{K})$ , and the analytical solution of the model can be obtained by using the method of separating variables

$$X(t) = \frac{K}{1 + Ce^{-a(t-t_0)}}, \quad (2)$$

$$\text{Where } C = \frac{K - N_0}{N_0}.$$

### 3. MATLAB numerical simulation and result visualization

To fit the model parameters more easily, take  $t_0 = 0$ , further deform the model:

$$X(t) = \frac{K}{1 + e^{\ln C - at}} = \frac{K}{1 + e^{-(\ln C + at)}} = \frac{\beta_1}{1 + e^{-(\beta_2 + \beta_3 t)}}, \quad (3)$$

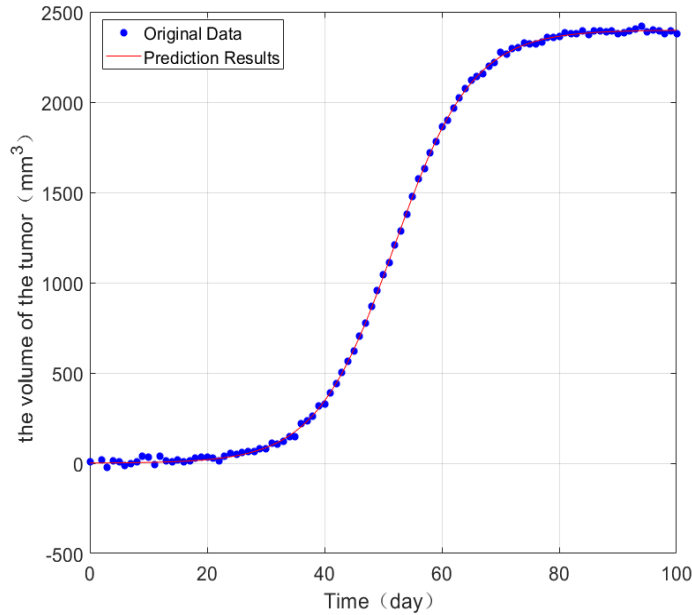
Where  $\beta_1 = K, \beta_2 = -\ln C = -\ln \frac{K - X_0}{X_0} = \ln \frac{X_0}{K - X_0}, \beta_3 = a$ . Part of the Matlab code of the numerical solution is as follows <sup>[7]</sup>:

```
beta1=2400;logist=@(p)log(p./(1-p));
fitlm(x,logist(y/beta1));
beta0 = [2400, -7.7831, 0.14999];
fun = @(phi,t) phi(1) ./ ( 1 + exp(-(phi(2) + phi(3) * t)));
[beta, errs] = nlinfit(x, y, fun, beta0);
pred = fun(beta, x);
plot(x,y,'bo'); grid on
xlabel('Time(day)'); ylabel('the volume of the tumor(mm^3)'); hold on
plot(x, pred, 'r*'); legend('Original Data', 'Prediction Results')
```

Estimation of these three parameters  $\beta_1, \beta_2, \beta_3$ , requires the use of nonlinear fitting methods, which are more sensitive to the selection of initial values. The appropriate initial value can make the fit converge to the optimal estimate quickly, otherwise, it may not reach the optimal after many iterations. Final run result  $\beta_1=2400, \beta_2=-7.7, \beta_3=0.11$  Thus, the tumor model was obtained:

$$X(t) = \frac{2400}{1 + e^{-(7.7+0.11t)}}. \quad (4)$$

The fitting results of the mathematical model obtained through numerical simulation are shown in **Figure 2**.



**Figure 2.** Fitting results

It can be clearly seen from **Figure 2** that the clinical data is in good agreement with the results simulated according to the mathematical model. Each clinical data point is tightly wrapped around the simulation curve, and the two trends are almost exactly the same, which intuitively demonstrates the reliability of the model. Through

the nonlinear fitting method of Matlab software, the researchers were able to fit the optimal estimates of these three key parameters. In the fitting process, the powerful computing power of Matlab plays a key role. After several iterations of calculation, the most suitable parameter combination is finally determined. After these optimal estimates are obtained, a mathematical model suitable for tumor growth data can be obtained. With this model, doctors can scientifically predict and accurately make decisions on tumor growth in combination with the actual situation of patients, providing a strong basis for the formulation of follow-up treatment plans.

## 4. Conclusion

The data-driven tumor growth model constructed in this study, combined with Matlab numerical solution, showed significant advantages. Researchers dig deep into tumor clinical data and build models based on reasonable assumptions. Matlab numerical solution with powerful computing power and visualization function, efficiently solve and optimize the model parameters. The combination of the two can accurately fit tumor growth data, covering all stages of tumor growth.

With the help of this model and solution, researchers can deeply explore the law of tumor growth from a mathematical point of view and understand the influence mechanism of various factors on tumor growth. This provides support for medical experts to develop personalized treatment plans, which helps to predict tumor development in advance and improve the cure rate of patients.

In the field of cancer research, this achievement has both theoretical and practical value. Theoretically, it enriches the theoretical system of mathematical modeling. In practice, it provides strong technical support for tumor diagnosis, treatment evaluation and prognosis prediction, promotes tumor research and development, and brings new hope for overcoming tumor problems.

## Disclosure statement

The authors declare no conflict of interest.

## Funding

National Natural Science Foundation of China (Project No.: 12371428); Projects of the Provincial College Students' Innovation and Training Program in 2024 (Project No.: S202413023106, S202413023110)

## References

- [1] Sheema S, Roberto B, Paolo M, et al., 2016, Mathematical Modeling of Drug Resistance Due to KRAS Mutation in Colorectal Cancer. *J Theoret Biol*, 389(1): 263–273.
- [2] Nitish P, Feba S, Wayne C, et al., 2016, A Three Dimensional Micropatterned Tumor Model for Breast Cancer Cell Migration Studies. *Biomaterials*, 81(3): 72–83.
- [3] Cui S, 2009, The Free Boundary Problem of Tumor Growth. *Advances in Mathematics*, 38(1): 1–18.
- [4] Xu Y, 2004, A Free Boundary Problem Model of Ductal Carcinoma in Situ. *Discrete and Continuous Dynamical Systems Series, B*4(1): 337–348.
- [5] Liu K, Xu Y, Xu D, 2020, Numerical Algorithms for a Free Boundary Problem Model of DCIS and a Related Inverse

Problem. *Applicable Analysis*, 99: 1181–1194.

- [6] Ge M, Xu D, 2022, Biparametric Identification for a Free Boundary of Ductal Carcinoma in Situ. *Applicable Analysis*, DOI:10.1080/00036811.2022.2038786.
- [7] Si S, Sun Y, 2021, *Algorithms and Applications of Mathematical Modeling* (3rd Edition). Beijing: National Defense Industry Press, China.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Empirical Study and Optimization Strategies of Psychological Support Measures for Psychiatric Medical Staff

Fengxia Qu\*, Xianghong Yin, Nanyun Li, Yuxia Gao

Hainan Vocational University of Science and Technology, Haikou 570100, Hainan, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* This study adopts empirical research methods to analyze the impact of intervention measures such as psychological counseling, team building, and stress management training on the mental health of psychiatric medical staff. *Methods:* This study selected 211 medical staff (including doctors, nurses, and psychotherapists) from the psychiatric department of a tertiary hospital as research subjects. They were divided into an experimental group (receiving psychological support measures) and a control group (not receiving psychological support measures) according to whether they received psychological support measures. Among them, the experimental group was divided into a total of 106 patients, while the control group was divided into a total of 105 patients. After the implementation of psychological support measures, the work efficiency of both groups of patients was evaluated from three aspects: psychological health level, occupational burnout level, and job satisfaction. *Results:* After intervention with psychological support measures, the experimental group patients showed significantly higher levels of mental health, occupational burnout, and job satisfaction than the control group, and the above differences were statistically significant ( $P < 0.05$ ). *Conclusion:* For psychiatric medical staff, the regular implementation of psychological support measures can significantly improve their mental health level, and on the basis of psychological support, the professional enthusiasm and job satisfaction of medical staff have been significantly improved.

**Keywords:** Psychiatry; Medical staff; Mental health; Support measures

**Online publication:** April 28, 2025

## 1. Introduction

Medical staff engaged in psychiatry are exposed to high-intensity pressure in a medical environment for a long time, and they need to face various mental illness behaviors, unexpected events, and other diverse, heavy, and complex doctor-patient relationships with patients with mental illnesses<sup>[1]</sup>. Stress is a high psychological burden and a triggering factor for occupational burnout that they commonly experience. Unlike medical staff in

other departments, psychiatric medical staff need to have the ability to withstand huge psychological loads and regulate emotions, as they often exhibit impulsive, aggressive, self-harming, and other behaviors. The service recipient is prone to recurrent attacks due to illness and long treatment time. Medical staff need to engage in long-term communication and interaction with service recipients and their families, which can result in significant psychological burden. However, the condition of service recipients is prone to relapse, leading to a significant decrease in their ability to cooperate. Additionally, the families of service recipients do not fully understand the responsibilities of medical staff, believing that they intentionally prolong the condition and increase the burden and expectations of their families. However, in the current medical work process, in addition to focusing on the mental health of the serviced, the mental health of psychiatric medical staff is often overlooked. They are often in a state of excessive psychological pressure for a long time, and lack effective ways to vent and release psychological pressure<sup>[2]</sup>. They are in a highly tense emotional state for a long time, which can easily lead to anxiety, depression, occupational burnout and other problems among medical staff, further affecting the quality of psychiatric nursing services and the completion of work, which is not conducive to the completion of nursing work and effective treatment of patients<sup>[3]</sup>.

## **2. Data and methods**

### **2.1. General information**

A total of 211 psychiatric medical staff from tertiary hospitals were selected as the research subjects, with 105 in the experimental group and 105 in the control group. There were 33 males and 73 females in the experimental group, aged 25-59 years, with an average of  $(41.92 \pm 10.60)$  years. The daily working hours were 6.03–11.94 hours, with an average of  $(9.25 \pm 1.45)$  hours. There were 35 males and 76 females in the control group, aged 22–55 years, with an average age of  $(42.36 \pm 9.18)$  years. Among them, doctors account for 40.3% of the total medical staff, or about 85 cases, while nurses account for 59.7% of the total number, or about 126 cases. Among doctors, there are 34 resident physicians, accounting for 40.0% of the total number of doctors; The number of attending physicians is 30, accounting for 35.0%; 13 cases were deputy chief physicians, accounting for 15.0%; There were 8 chief physicians, accounting for 10.0%. Among nurses, there are 63 nurses, accounting for 50.0% of the total number of nurses; There were 19 cases of supervisor nurses, accounting for 15.0%; There were 15 cases of deputy chief nurses, accounting for 12.0%; There were 10 chief nurses, accounting for 8.0%. These data demonstrate the professional title structure and proportion distribution of medical staff.

All patients in this experiment were medical staff who had been working in psychiatric wards for a long time and had rich clinical experience. However, they were in a state of high workload for a long time, so they had varying degrees of occupational burnout and mental health problems. The experimental group implemented psychological support strategies such as counseling, team building, and stress management training during the experiment, while the control group did not receive any psychological support interventions during the experiment.

All patients were evaluated for their general mental state, job burnout, job satisfaction, and other conditions after the intervention was completed. The general information of the research subjects is balanced and reasonable, meeting the requirements of the design of this study, which helps to ensure the objectivity and scientificity of the research results. The sample structure is reasonable, and the proportion of medical staff at different levels is basically in line with the actual situation of psychiatric departments in tertiary hospitals. It can comprehensively reflect the impact of psychological support interventions on psychiatric medical staff.



## **2.2. Methods**

The medical staff in the experimental group received one-on-one psychological counseling and group psychological counseling once a month, conducted by a psychological counselor. One-on-one psychological counseling lasts about 30 minutes each time, mainly including regulating emotions, relieving tension, and learning ways and methods to regulate stress. Group psychological counseling lasts about 60 minutes each time, with 6–8 people per session. Group sharing, role-playing, scenario simulation, etc. guide medical staff to vent their emotions and cultivate psychological resilience. The psychological hotline is open 24 hours a day, and medical staff can consult at any time.

The team building activity is held once a month for 2–3 hours, mainly including medical communication training, medical cooperation games, team discussion meetings. The specific activities of team building are as follows. Medical communication training: By setting up medical communication training activities, typical psychiatric cases are brought into the context of the training room, and medical staff are adapted to high-pressure states through case reproduction; Medical cooperation games: By participating in team cooperation games (such as ice breaking games, cooperative games, etc.), medical staff can effectively improve the tacit understanding of the medical team, thereby enhancing their ability to cooperate; Team discussion: The medical team conducts communication and sharing activities based on clinical cases and practical work experience, aiming to cultivate a sense of collaboration among the medical team. At the same time, a psychological mutual aid group will be established, with senior medical staff hired as group leaders to assist group members in conducting psychological communication and exchange work <sup>[4]</sup>.

Stress management training is conducted twice a week for 1.5 hours each time, mainly including mindfulness meditation training, time management skills, and cognitive-behavioral therapy. Mindfulness meditation training is conducted by professional psychologists, and medical staff should meditate for at least 10 minutes every day to relax their body and mind; The training of time management skills mainly involves setting work plans, arranging learning and life tasks, adjusting task priorities appropriately, and other measures to improve work efficiency and reduce unnecessary pressure; The training of cognitive-behavioral therapy mainly helps medical staff identify their own negative thinking patterns, adjust the intensity and duration of emotions, in order to improve their ability to resist stress <sup>[5]</sup>. The daily relaxation time is 30 minutes, including doing relaxing stretching exercises, deep breathing exercises, etc.

All intervention measures will last for 3 months, during which they will be supervised and adjusted by psychological experts to ensure the effectiveness of the intervention and the continued participation of medical staff.

## **2.3. Observation indicators**

### **2.3.1. Assessment of mental health level**

Evaluate the mental health status of medical staff before and after intervention using the Self rating Anxiety Scale (SAS) and the Self rating Depression Scale (SDS). The self-assessment scales for anxiety and depression are standardized questionnaires that medical staff fill out before and after intervention, using a four point scoring system. The higher the score, the more severe the level of anxiety or depression.

### **2.3.2. Measurement of occupational burnout level**

The Maslach Burnout Inventory (MBI) was used for testing, which is divided into three aspects: emotional

exhaustion, dehumanization, and reduced personal achievement. It consists of 22 questions and is scored on a 7-point scale.

### 2.3.3. Job satisfaction survey

Using our hospital's medical staff job satisfaction survey scale, it is divided into 5 areas, including working conditions, salary and benefits, doctor-patient communication, work team, and self-development, with 30 items, and scored on a 5-point scale (1 point is the worst, 5 points are the best).

## 2.4. Statistical methods

SPSS statistical software was used to perform statistical analysis on the obtained data, and normality tests (Kolmogorov-Smirnov test) were performed on all continuous data (SAS, SDS, MBI scores, and job satisfaction scores). If the data conforms to a normal distribution, independent sample t-test was used to test the differences between the experimental group and the control group before and after intervention; If it does not meet the requirements, Mann Whitney U test will be used for non parametric testing, all expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ), and  $P < 0.05$  is considered statistically significant.

## 3. Results

### 3.1. Assessment results of psychological health levels of two groups of patients

The results of the assessment of mental health level are shown in **Table 1**.

**Table 1.** Assessment of mental health level

Group	SAS score before intervention	Post intervention SAS score	SDS score before intervention	SDS score after intervention
Experimental group	55.42	42.36	58.64	44.57
Control group	56.38	54.72	59.21	58.95
<i>t</i>	2.381	3.231	1.284	2.983
<i>P</i>	> 0.05	< 0.05	> 0.05	< 0.05

Before implementing the intervention, the SAS of the observation group was  $55.42 \pm 6.38$ , and the SAS of the control group was  $56.38 \pm 6.12$ ; After intervention, the SAS of the observation group was  $42.36 \pm 5.95$ , while the SAS of the control group was  $54.72 \pm 6.25$ ; Before implementing the intervention, the SDS of the observation group was  $58.64 \pm 7.14$ , and the SDS of the control group was  $59.21 \pm 7.28$ ; After the intervention, the SDS of the observation group was  $44.57 \pm 6.83$ , while the SDS of the control group was  $58.95 \pm 7.31$ ; The anxiety and depression levels in the observation group after intervention were significantly lower than those in the control group ( $P < 0.05$ ), indicating that implementing psychological counseling and corresponding measures can improve the psychological condition of psychiatric nursing workers.

### 3.2. Assessment results of occupational burnout levels in two groups of patients

The assessment results of occupational burnout levels for two groups of patients are shown in **Table 2**.

**Table 2.** Assessment results of occupational burnout levels in two groups of patients

Group	Emotional exhaustion before intervention	Emotional exhaustion after intervention	Personalization before intervention	Depersonalization after intervention	Personal sense of achievement before intervention	Personal sense of achievement after intervention
Experimental group	32.78	21.45	15.23	10.58	27.82	35.47
Control group	33.61	32.92	15.78	15.61	28.15	28.24
<i>t</i>	1.283	2.383	3.231	0.233	2.372	1.982
<i>P</i>	> 0.05	< 0.05	> 0.05	< 0.05	> 0.05	< 0.05

The three factors of occupational burnout, including negative emotional exhaustion, depersonalization, and personal achievement, were effectively improved in the experimental group ( $P < 0.05$ ), while there was no change in the control group, indicating that psychological support can alleviate occupational burnout and enhance personal achievement.

### 3.3. Results of job satisfaction assessment for two groups of patients

The results of job satisfaction assessment for two groups of patients are shown in **Table 3**.

**Table 3.** Results of job satisfaction evaluation for two groups of patients

Group	Post intervention work environment	Salary and benefits after intervention	Team collaboration after intervention	Post intervention doctor-patient relationship	Post intervention career development
Experimental group	4.32	3.78	4.51	4.24	3.98
Control group	3.25	2.95	3.45	3.28	2.91
<i>t</i>	2.382	5.423	2.331	4.982	3.244
<i>P</i>	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

There was a significant difference in the evaluation of the work environment, with the experimental group outperforming the control group in indicators such as salary and benefits, team spirit, doctor-patient relationship, and career development prospects.

## 4. Discussion and suggestions

### 4.1. Discussion

The results of this study showed that an effective psychological support model has a good effect on promoting the mental health of psychiatric medical staff, reducing occupational burnout, and enhancing job satisfaction. In terms of mental health level, the SAS and SDS scores of the research group significantly decreased after intervention, indicating that counseling, team building, and stress management training can effectively alleviate negative anxiety and depression, and enhance the “psychological resilience” of medical staff<sup>[6]</sup>. The control group did not receive psychological intervention, and there was no significant change in anxiety and depression, which further illustrates the importance of psychological support models.

In terms of occupational burnout, the intervention group of medical staff showed a significant decrease in

emotional exhaustion and depersonalization levels, and a significant increase in personal achievement <sup>[7]</sup>. This indicates that their use of group counseling, team building, mindfulness meditation, and other methods can effectively alleviate the pressure of emotional exhaustion and lack of release in high-pressure work environments <sup>[8]</sup>. They also recognize the importance of being affirmed in the group, which can increase their occupational satisfaction.

However, the control group showed no significant change in burnout, which may be due to the fact that medical staff who were not intervened have more occupational stress and urgently need effective psychological support. The improvement of job satisfaction further proves the effectiveness of psychological intervention measures. The satisfaction of the research group in terms of work environment, teamwork, and career development has significantly increased, which may be related to the effectiveness of cognitive behavior training in teamwork. However, there was no increase in the control group, indicating that stress positions cannot be significantly improved by self adjustment alone<sup>[9]</sup>. Therefore, medical institutions should regularly carry out psychological health support models to promote the physical and mental health development and career happiness of industry professionals.

## **4.2. Suggestions**

### **4.2.1. Building a personalized psychological support system to improve intervention accuracy**

This study shows that psychological support, group building, and stress management training have a very positive effect on improving the mental health level of psychiatric medical staff. However, currently, psychological support is mostly carried out in a standardized form, lacking a certain degree of personalization. Therefore, how to improve the system of psychological support and enhance personalized psychological support has become the focus of this study <sup>[10]</sup>. It is necessary to adopt differentiated strategies according to the different levels, years of work, and psychological conditions of medical staff in various medical institutions and job positions <sup>[11]</sup>. For example, mental health check-ups can be conducted regularly for psychiatric medical staff based on psychological scales such as the Self Rating Anxiety Scale, Self Rating Depression Scale, Work Burnout Scale, etc., and different levels of psychological intervention plans can be developed accordingly; Doctors who have been in a high-pressure state for a long time can receive regular psychological intervention to alleviate their occupational burnout; Young nurses can be improved through psychological resilience and vocational adaptation education <sup>[12]</sup>. At the same time, psychological health records can be established in hospitals to achieve sustained attention to the psychological level of medical staff, improve the efficiency of psychological health interventions, and scientifically implement psychological health interventions. The purpose is to enhance the effective acceptance of psychological support measures by psychiatric medical staff, improve the actual intervention effect of psychological support, and truly alleviate their anxiety, depression, and work fatigue.

### **4.2.2. Enhance organizational support and establish a long-term mechanism for the mental health of medical staff**

The above results also indicate that team collaboration and organizational atmosphere play a significant role in the mental health and job satisfaction of medical staff. Therefore, another key point in improving relevant psychological support measures is to strengthen organizational support and establish a long-term psychological support guarantee mechanism. Firstly, hospitals should establish psychological support centers or equip dedicated psychological staff to provide professional psychological counseling services for medical staff, which can

ensure that medical staff can receive psychological adjustment at any time under high-pressure work conditions. Secondly, hospitals should strengthen the reform of the work system for medical staff, minimize their overloaded working hours as much as possible, such as adjusting the shift duty system and planning reasonable rest periods to ensure that medical staff have sufficient energy<sup>[13]</sup>.

A mutually supportive work model can also be established to encourage experience sharing and psychological support among them, such as building peer support platforms, setting up psychological support groups in hospitals, regularly engaging in medical care work with medical staff, creating a collective force of medical staff, and enabling them to form a proactive unity, enhancing overall coordination and cooperation. Furthermore, hospital management personnel should strengthen their attention to their mental health, and regularly organize various mental health training and psychological workshops on how to regulate emotions on the premise of regular development, in order to normalize and institutionalize psychological support in daily work<sup>[14]</sup>. By implementing long-term psychological support with the advantage of long-term sustainability, we can ensure that the work psychological state of medical staff can be improved from a deep level, and stimulate their sense of pride and joy in loving their job more<sup>[15]</sup>.

#### **4.2.3. Promote information-based psychological support methods and improve the accessibility of psychological interventions**

In traditional psychological support measures, including psychological counseling, training lectures, and other forms, face-to-face interviews are mostly used offline, which have certain time and space limitations, resulting in some staff being unable to fully accept psychological support due to busy work and other factors. Therefore, another important means of optimizing psychological support measures is to scientifically guide information-based psychological intervention methods at the hospital level, thereby improving the accessibility of psychological support measures<sup>[16]</sup>. For example, building a mental health app in hospitals or establishing a mental health online platform in hospital related networks to provide online assessments, psychological adjustment skills courses, psychological counseling services, etc. to meet the needs of psychological support, so that medical staff can receive psychological intervention services freely and at any time<sup>[17]</sup>. Developing a mental health intelligent assistant through intelligent and artificial intelligence methods to achieve scientific analysis of the psychological adjustment of medical staff based on psychological data<sup>[18]</sup>. At the same time, hospitals can use relevant social media platforms or other hospital work platforms to regularly provide popular science knowledge, psychological relaxation techniques, case sharing, etc., related to mental health, and provide corresponding mental health publicity and education to hospital staff, guiding the development of relevant awareness<sup>[19]</sup>. By utilizing information platform technology, it is beneficial to increase the coverage of psychological intervention and actively explore in this area, so that hospital medical staff can receive psychological support at any time and with them, which is conducive to promoting the continuous improvement of the psychological health level and professional satisfaction of medical staff<sup>[20]</sup>.

## **5. Conclusion**

For psychiatric medical staff, who routinely face high-stress environments, emotional exhaustion, and the psychological toll of caring for patients with complex mental health conditions, the regular implementation of structured psychological support measures is crucial. Research indicates that interventions such as peer support



groups, mindfulness-based stress reduction (MBSR) programs, individual counseling sessions, and resilience training can significantly alleviate symptoms of burnout, anxiety, and depression. By fostering emotional regulation and enhancing coping mechanisms, these measures lead to a marked improvement in overall mental well-being.

Beyond mental health benefits, psychological support also has a profound impact on professional engagement. When healthcare workers feel psychologically supported, their motivation, job satisfaction, and sense of professional fulfillment increase. This, in turn, strengthens team cohesion, reduces turnover rates, and improves the quality of patient care. A positive feedback loop emerges: well-supported staff provide better care, leading to improved patient outcomes, which further reinforces their sense of purpose and job satisfaction. Therefore, integrating systematic psychological support into the routine care framework for psychiatric medical professionals is not only a protective measure for their well-being but also a strategic investment in sustaining a resilient and effective mental healthcare workforce.

This approach ensures long-term benefits for both healthcare providers and the patients they serve, creating a more sustainable and compassionate mental health system.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Zhang Q, Shi W, Yu L, et al., 2024, Analysis of the Current Status and Influencing Factors of Occupational Quality of Life Among Psychiatric Medical Staff. *China Health Standards Management*, 15(24): 50–55.
- [2] Wan Q, Hu S, 2024, Exploration of Medical Technology Strategies for Psychiatric Specialized Hospitals: A Case Study of the Third People's Hospital Project in Ganzhou City. *China Hospital Architecture and Equipment*, 25(12): 42–46.
- [3] Guo Hao, Shi Peifang, Liu Huan The predictive value of machine learning early warning models for psychiatric violence [J]. *Shanxi Medical Journal*, 2024, 53 (18): 1395-1399.
- [4] Zhao X, Zhu J, Luo P, 2024, On the Advantages of Traditional Chinese Medicine in the Management of Psychiatric Wards from the Perspective of Scientific Development. *Journal of Traditional Chinese Medicine Management*, 32(17): 82–84.
- [5] Zhang S, Shi K, Qi Y, 2024, The Application of Traditional Chinese Medicine Cultural Concepts in Psychiatric Management. *Journal of Traditional Chinese Medicine Management*, 32(16): 244–246.
- [6] Zheng W, Zhao Y, Sun H, et al., 2024, Analysis of the Psychological Health Status and Influencing Factors of Medical Staff in Mental Health Specialized Hospitals after Sudden Public Health Emergencies. *Psychology Monthly*, 19(15): 215–217.
- [7] Han L, Huang J, Chen Y, 2024, Reflections on Traditional Chinese Medicine Culture and Technology Popularization from the Perspective of New Media. *Journal of Traditional Chinese Medicine Management*, 32(15): 250–252.
- [8] Liu R, Wu Y, 2024, Research Progress on Mental Health Literacy of Medical Staff. *Occupational and Health*, 40(17): 2444–2448.
- [9] Ma M, 2024, The Relationship Between Challenging Obstructive Stressors and Depression Among Healthcare Workers, thesis, Northwest Normal University.



- [10] Xu J, Huang L, Wang J, et al., 2024, Meta Integration of Qualitative Research on Shared Decision-Making Promotion and Obstacle Factors Among Psychiatric Medical Staff. *Journal of Nursing*, 31(10): 53–58.
- [11] Zhang Z, 2024, Research on the Mechanism of Psychological Health Risk Formation and Risk Management of Medical Staff, thesis, Huazhong University of Science and Technology
- [12] Cao T, Ding X, Wu S, et al., 2024, The Influencing Factors of Health Risk Stress and Prevention Measures for Injuries Among Frontline Psychiatric Medical Staff. *Injury Medicine (Electronic Version)*, 13(01): 38–43.
- [13] Cai Y, Jiang Q, 2024, Research Progress on Attitudes of Clinical Medical Staff Towards Non-Suicidal Self-Injury Patients. *Journal of Fujian Medical University (Social Sciences Edition)*, 25(01): 54–61, 72.
- [14] Zheng S, 2023, Research on the Evolution and Optimization Path of Mental Health Policies in China, thesis, Shandong University.
- [15] Cai Q, Ma Y, Zheng L, et al., 2023, Analysis of the Current Status of Mental Health Literacy Among Medical Staff in Jilin Province. *Psychology Monthly*, 18(21): 207–209.
- [16] Li L, Li S, Sun Y, et al., 2023, The Impact of Online Barinte Group on Occupational Burnout and Emotions of Psychiatric Nurses. *China Medical News*, 20(29): 161–165.
- [17] Sun Y, Zhiyuan S, 2023, The Relationship Between Subjective Well-Being and Depressive Symptoms Among Psychiatric Healthcare Workers. *Occupational and Health*, 39(19): 2668–2671.
- [18] Huang B, Lu H, 2023, How to Break Through the Dilemma of Talent Introduction in Specialized Hospitals. *Human Resources*, (14): 108–110.
- [19] Cao T, 2023, A Study on the Impact of Occupational Stress on Occupational Burnout Among Psychiatric Healthcare Workers: The Moderating Effects of Empathy and Personality Traits, thesis, Shenzhen University.
- [20] Gu L, Tang S, 2023, Application of Traditional Chinese Medicine Mental Health Service Management Model in Psychiatry. *Journal of Traditional Chinese Medicine Management*, 31(11): 191–193.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# New Theories for Dental Disease Prevention and Treatment and Innovative Oral Products

Zhigang Hu\*, Junfeng Liu, Liran Xu, Wei Jiang, Xiangbo Yu

Jingfang Baofei (Ningbo) Biopharmaceutical Technology Co., Ltd., Ningbo 315000, Zhejiang, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** Dental diseases, especially dental caries, are significant issues affecting population health worldwide. Dental caries has been listed by the World Health Organization as one of the three key diseases to be prevented and treated, following cardiovascular diseases and cancer. It has a high incidence rate and a wide distribution, posing a serious threat to people's oral health and quality of life<sup>[1-5]</sup>. With the intensification of the global aging population and changes in dietary habits, the incidence of dental diseases is on the rise, becoming a public health problem that cannot be ignored. Therefore, exploring new theories for dental disease prevention and treatment, such as the bioelectrochemical theory and the mineralization and anti-electricity new theory, and discussing their application prospects can provide more effective scientific bases and methods for the prevention and treatment of dental diseases, which is of great practical significance, especially for children and the elderly.

**Keywords:** Dental diseases; Dental caries; Prevention and treatment

**Online publication:** April 28, 2025

## 1. Introduction

Traditional theories for dental disease prevention and treatment and their limitations

The traditional theory for dental disease prevention and treatment is based on the four-factor theory proposed by American scientist Miller 150 years ago. This theory holds that the occurrence of dental diseases, especially dental caries, is the result of the combined action of four factors: bacteria, the oral environment, the host, and time. Bacteria are a prerequisite for the occurrence of dental caries. The main cariogenic bacteria include *Streptococcus mutans* and *Lactobacillus*. These bacteria multiply in large numbers in dental plaque on the tooth surface. Dental plaque is an ecological environment with bacteria as the main body living on the tooth surface. The deep part of it is hypoxic, resulting in incomplete metabolism of carbohydrates. When sugary foods are decomposed by cariogenic bacteria, acidic substances such as lactic acid, acetic acid, propionic acid, and other lower-fatty acids are produced. Under the long-term action of these acidic substances, the hard tissues of the teeth are decalcified,

and the tissue gradually disintegrates, forming dental caries<sup>[6, 7]</sup>.

## **2. Limitation analysis**

The traditional theory for dental disease prevention and treatment has guided the research and development of dental disease prevention and treatment drugs and products to a certain extent, but it has limited effectiveness in practical applications and has many limitations. From a theoretical perspective, although the four-factor theory takes into account the four factors of bacteria, the oral environment, the host, and time, the occurrence and development of dental diseases are extremely complex processes involving the interaction of multiple factors. A single-perspective theory is difficult to comprehensively explain and address these issues. This theory fails to fully consider the roles of bioelectrochemistry, free radicals, and other factors in the pathogenesis of dental diseases. Research has found that there is a bio-current phenomenon in carious teeth, and high-concentration superoxide anion radicals play a key role in the occurrence of dental caries, but the traditional theory does not cover these aspects, resulting in an incomplete and in-depth understanding of the pathogenesis of dental diseases.

In terms of product research and development, due to the complexity of the pathogenesis of dental diseases, the specific drug targets for all dental diseases have not been clearly identified. This makes it difficult for researchers to design drugs accurately according to the pathogenesis of dental diseases, leading to low research and development efficiency and a prolonged research and development cycle. During the drug research and development process, it is often necessary to balance the efficacy and side effects of drugs. Some drugs can relieve toothache symptoms but may cause other adverse reactions, such as oral mucosal damage and tooth discoloration. These side effects not only affect the patient's treatment experience but also limit the application and promotion of the drugs.

The research and development of dental disease prevention and treatment drugs and products involve multiple disciplinary fields, such as chemistry, biology, and medicine. Currently, there are still some technical bottlenecks in these fields. For example, in the development of drug delivery systems, how to accurately and effectively deliver drugs to the diseased site while avoiding damage to normal tissues remains an urgent problem to be solved. The improvement of drug stability is also a key issue. Some drugs are prone to degradation or inactivation during storage or use, affecting their efficacy. These technical bottlenecks limit product innovation and development, making it difficult for traditional dental disease prevention and treatment products to meet clinical needs.

## **3. Exploration of new theories for dental disease prevention and treatment**

### **3.1. Bioelectrochemical theory**

In 1987, Professor Huang Lizi from the School of Stomatology of the Fourth Military Medical University discovered an important clinical fact using a tooth-surface potential tester<sup>[1]</sup>. He found that the potential of the carious tooth surface in the patient's oral cavity is lower than that of the normal tooth surface of the same tooth, and an electrochemical redox potential (Eh) appears between them. Based on this discovery, Professor Huang Lizi proposed a new hypothesis that the electro-corrosion effect of bio-electron flow forms dental caries.

Subsequently, with the support of the National Natural Science Foundation, Professor Huang Lizi led a postgraduate team to carry out a 12-year clinical experimental verification. First, they successfully created artificial dental caries similar to those in clinical practice using electrochemical methods in the laboratory. This

experimental result provided an important physical model for subsequent research, enabling researchers to deeply study the pathogenesis of dental caries in a controllable experimental environment. To explore the material basis for the generation of bio-electricity in carious lesions, the research team further studied in carious tissues and dental plaque that cause caries and finally discovered high-concentration superoxide anion radicals.

The bioelectrochemical theory holds that free radicals have unpaired electrons, which is the material basis for the formation of a negative Eh potential. In carious lesions and local dental plaque, the presence of superoxide anion radicals forms a redox potential, generating an electron flow. This electron flow corrodes the tooth surface and dental pulp. As the corrosion intensifies, dental caries are finally formed, and in severe cases, the dental pulp may even be penetrated. The proposal of this theory modifies the “chemico-bacterial theory” proposed by Miller in 1890, explaining the pathogenesis of dental caries from a new perspective and providing a new perspective for the prevention and treatment of dental caries.

This new theory can explain many clinical and pathological phenomena of dental caries that cannot be explained by traditional theories. The traditional theory believes that dental caries are mainly caused by tooth demineralization due to acid production by bacteria, but it cannot explain why teeth may still develop caries even in some cases where oral hygiene is good. The bioelectrochemical theory can explain that even if the number of bacteria in the oral cavity is small, if there are other factors leading to the generation of superoxide anion radicals, dental caries may still occur. In terms of developing new methods for preventing and treating dental caries, this theory also has great guiding significance. Based on this theory, researchers can explore the development of new prevention and treatment products, such as oral care products that can scavenge superoxide anion radicals or materials that can block bioelectrochemical corrosion, bringing new hope for humans to overcome dental caries in the future.

## **3.2. Mineralization and anti-electricity new theory**

### **3.2.1. Theory proposal and basis**

The mineralization and anti-electricity new theory was proposed by Professors Hu Zhigang, Liu Junfeng, and Xu Liran. This theory is based on the concept of using minerals to treat diseases in Huangdi Neijing (Inner Canon of Huangdi) and the ore-forming theory of ore deposits. As a classic of traditional Chinese medicine, Huangdi Neijing's concept of using minerals to treat diseases has laid a profound theoretical foundation for the development of traditional Chinese medicine, emphasizing the regulatory effect of minerals on human health. The ore-forming theory of ore deposits expounds the formation and distribution laws of minerals from a geological perspective, providing a scientific basis for the selection and utilization of specific minerals.

Combining these traditional theories with modern dental disease prevention and treatment aims to explore new methods for dental disease prevention and treatment. This theory believes that teeth are composed of calcium, with a layer of enamel on the surface. With daily chewing and brushing, the enamel is continuously worn, and tooth calcium is lost, making the tooth structure change from tight to loose, with numerous small gaps. At this time, when exposed to stimuli such as cold, heat, acid, sweet, and hard substances, tooth sensitivity occurs. In this process, food produces bacteria, forming dental plaque. The plaque generates a redox negative potential (En), creating a bio-current field that continuously corrodes the teeth day and night. Due to the reduction of enamel and the loss of tooth calcium, dental caries are formed at the sites where teeth are susceptible to bacteria and gradually develop into moderate and deep caries. In severe cases, it may further develop into pulpitis and periapical periodontitis, ultimately destroying the entire tooth.

### 3.2.2. Theory advantages

Compared with the traditional anti-acid theory, the mineralization and anti-electricity new theory has many advantages. From a theoretical perspective, the traditional anti-acid theory mainly focuses on the erosion of teeth by acid produced by bacteria, while the mineralization and anti-electricity theory further considers the mineralization state of teeth, electrolyte balance, and the potential impact of bio-current on teeth. This comprehensive perspective helps to understand the complex causes of dental diseases more accurately. Instead of being limited to a single factor, it comprehensively considers the interaction of multiple factors, providing a more comprehensive framework for in-depth research on dental diseases.

In terms of solutions, the mineralization and anti-electricity theory proposes innovative ideas. By enhancing the mineralization degree of teeth, using alkaline mineral ions such as potassium, calcium, and sodium to mineralize teeth, these ions can penetrate deep into the teeth and react with the components in the teeth to generate new minerals, strengthening the tooth structure, making it more compact, and increasing tooth hardness. The mineralization and anti-electricity theory also emphasizes blocking bio-electrochemical corrosion. By forming a protective layer on the tooth surface, it is like turning off a switch for the teeth, blocking the corrosion of bio-current on the teeth and eliminating the negative potential (En), fundamentally preventing the occurrence and development of dental caries.

Products developed based on this theory, such as “Good Teeth Mouthwash”, are highly effective. This product can mineralize the teeth deeply and simultaneously play the roles of anti-inflammation, pain relief, mineralization, desensitization, and dual-bactericidal effects. The design of this multi-effect-in-one product gives it significant advantages in dental disease prevention and treatment. Compared with traditional dental disease prevention and treatment products, it can not only solve surface inflammation and pain problems but also fundamentally improve the mineralization state of teeth, enhance tooth resistance, and prevent the recurrence of dental diseases.

## 4. Dental disease prevention and treatment products based on new theories and their applications

### 4.1. Lifelong protection of teeth by “Good Teeth Mouthwash”

“Good Teeth Mouthwash” is an innovative dental disease prevention and treatment product developed based on the mineralization and anti-electricity new theory. This theory emphasizes the roles of tooth mineralization, anti-electricity, and bio-electrochemical processes in the occurrence of dental diseases, subverting the traditional anti-acid theory.

The main components of “Good Teeth Mouthwash” include alkaline mineral ions such as potassium, calcium, and sodium. These ions are extremely small and can penetrate deep into the teeth for alkaline mineralization. During the mineralization process, these ions react chemically with the components in the teeth to generate new minerals, strengthening the tooth structure, making it more compact, and increasing tooth hardness. This mineralization effect can not only repair damaged tooth structures but also form a strong protective layer on the tooth surface, effectively blocking the process of bioelectrochemical corrosion of teeth<sup>[8-12]</sup>.

Bio-extracts and sodium ions are also important components of this product. They jointly play the roles of anti-inflammation, pain relief, mineralization, desensitization, and bactericidal effects. Bio-extracts have natural anti-inflammatory and antibacterial properties, which can effectively reduce gingival inflammation and swelling and relieve pain symptoms. Sodium ions play a key role in mineralization and desensitization. They can adjust



the potential of the tooth surface, reducing the impact of external stimuli on tooth nerves and thus relieving tooth sensitivity symptoms. This product can effectively kill *Streptococcus mutans*, which causes dental caries, preventing and treating dental caries at the source.

## 4.2. Analysis of practical application cases

In practical applications, “Good Teeth Mouthwash” has shown good results. The Russian Journal of Stomatology introduced a case of applying a bacteriostatic solution containing minerals to the tooth surfaces of children. The results showed that this method can accelerate enamel maturation and prevent the occurrence of dental caries. In an experiment on children in a kindergarten, the children were divided into an experimental group and a control group. The children in the experimental group used “Good Teeth Mouthwash” for oral care, while the children in the control group used ordinary oral care products. After a period of observation, it was found that the incidence of dental caries in the experimental group was significantly lower than that in the control group. The tooth surfaces of the children in the experimental group were smoother, and the accumulation of dental plaque was less, indicating that “Good Teeth Mouthwash” can effectively inhibit the growth and reproduction of bacteria and reduce the risk of dental caries<sup>[13–15]</sup>.

There are also many successful cases in the treatment of adult dental diseases. A patient with severe periodontitis had long been troubled by gingival bleeding, swelling and pain, and bad breath. After using “Good Teeth Mouthwash” for a period of treatment, the symptoms of gingival bleeding and swelling, and pain were significantly relieved, and the bad breath problem was also improved. Through oral examinations, it was found that the patient’s gingival inflammation was effectively controlled, the depth of the periodontal pocket was reduced, and the degree of tooth loosening was also alleviated. This shows that “Good Teeth Mouthwash” can not only prevent dental caries but also has a certain therapeutic effect on other dental diseases such as periodontitis, effectively improving the patient’s oral health.

Therefore, the formula of the anti-electricity component mouthwash for new technologies is the basis of “Good Teeth Mouthwash”. It contains components such as purified water, glacial acetic acid, citric acid, lactic acid, sodium benzoate, a small amount of potassium, calcium carbonate, sodium bicarbonate, chlorhexidine, and mint water (or oil). Glacial acetic acid has anti-inflammatory and bactericidal effects, which can effectively inhibit the growth and reproduction of bacteria in the oral cavity and reduce the erosion of bacteria on teeth. Citric acid and lactic acid can adjust the pH value of the mouthwash, making the oral environment unfavorable for the survival of bacteria and also playing a role in cleaning teeth. Sodium benzoate is a preservative that can extend the shelf life of the mouthwash. Components such as a small amount of potassium, calcium carbonate, and sodium bicarbonate may participate in the mineralization process of teeth, strengthening the tooth structure and improving the acid-resistance of teeth. Chlorhexidine has antibacterial and anti-inflammatory effects, further enhancing the bactericidal effect of the mouthwash. Mint water (or oil) can bring a fresh taste to users and relieve bad breath. Through the synergistic effect of multiple components, this anti-electricity component mouthwash can play an important role in dental disease prevention and treatment, providing a new option for oral care.

## 5. Conclusions and prospects

The reasons for the large number of dental disease patients cover many aspects, including bad living habits, age factors, genetic factors, and environmental factors. Bad living habits such as dietary habits, oral hygiene



habits, and usage habits, such as a preference for spicy and greasy foods, careless brushing, and smoking, create conditions for the occurrence of dental diseases. Physiological changes in oral tissues with age make the elderly prone to periodontal diseases, and bad habits in children and adolescents increase the risk of dental caries. Genetic factors affect tooth structure and the oral microbial community, making individuals have different susceptibilities to dental diseases. Environmental factors such as head-and-neck radiotherapy and viral infections disrupt the oral ecological balance and affect oral health.

The traditional theory for dental disease prevention and treatment is based on the theory of four factors. Although it has guided prevention and treatment work to a certain extent, it has limitations such as a single-perspective theory, neglect of individual differences, unclear drug targets, drug side effects, and technical bottlenecks. The emergence of new theories for dental disease prevention and treatment, such as the bioelectrochemical theory and the mineralization and anti-electricity new theory, has brought new ideas and methods for dental disease prevention and treatment. The bioelectrochemical theory reveals the relationship between the occurrence of dental caries and bio-current and free radicals, modifying the traditional theory. The micro-ecological theory of dental caries emphasizes maintaining the balance of the oral micro-ecosystem to prevent dental caries. The mineralization and anti-electricity new theory comprehensively explains the causes of dental diseases from the perspectives of tooth mineralization, anti-electricity, and bioelectrochemistry and proposes innovative solutions.

“Good Teeth Mouthwash”, which was developed based on the mineralization and anti-electricity new theory, has achieved good results in practical applications. It can effectively prevent and treat dental diseases, bringing good news to dental disease patients. In terms of dental disease prevention and treatment strategies, measures such as improving living habits, regular examinations and treatments, and the application of new technologies are of great significance for reducing the incidence of dental diseases and improving oral health.

Dental disease prevention and treatment, driven by new theories, is expected to witness more technological innovations and product research and development breakthroughs. In terms of technological innovation, digital technologies will play a more important role in dental disease prevention and treatment. Digital intra-oral scanning technology can quickly and accurately obtain patients’ tooth models, avoiding the cumbersome process and errors of traditional plaster model making and improving the accuracy and efficiency of treatment. Computer-aided design (CAD) and computer-aided manufacturing (CAM) technologies will enable the personalized customization of dental restorations. According to patients’ oral conditions and needs, more suitable and comfortable restorations can be made. Artificial intelligence (AI) and machine-learning algorithms will be widely used in the diagnosis and treatment planning of dental diseases. By analyzing a large amount of oral health data, AI can help doctors more accurately diagnose oral diseases, predict the development trend of diseases, and provide personalized treatment plans, improving the success rate and effectiveness of treatment.

The application of 3D printing technology in dental disease prevention and treatment will also become more widespread. It can not only quickly produce precise dental restorations such as crowns, bridges, and dentures but also achieve personalized design to meet the oral needs of different patients. 3D printing technology can also be used to make surgical guides, helping doctors perform precise operations in complex oral surgeries and reducing surgical risks.

In terms of product research and development, more emphasis will be placed on developing materials with biocompatibility and regenerative properties in the future. These materials can promote the natural repair process of teeth and gingival tissues, reducing the reliance on traditional restorations. Bioactive materials can chemically

react with tooth tissues, promoting the remineralization of teeth, strengthening the tooth structure, and enhancing their resistance. Degradable materials can naturally degrade after completing the repair task, avoiding long-term burdens on the oral environment.

Dental disease prevention and treatment products based on new theories will continue to be optimized and innovated. In addition to existing products such as “Good Teeth Bacteriostatic Solution”, more targeted products will be developed, such as specialized oral care products for different age groups and different types of dental diseases. These products will combine new technologies and ingredients to improve the effectiveness and convenience of dental disease prevention and treatment.

The field of dental disease prevention and treatment will also strengthen its cross-integration with other disciplines. Collaborations with disciplines such as materials science, biology, and medical imaging will bring more innovative ideas and methods to dental disease prevention and treatment. By cooperating with materials science, more advanced dental materials can be developed; by collaborating with biology, in-depth research on the oral microbial community and the pathogenesis of dental diseases can be carried out; and by working with medical imaging, the diagnostic accuracy of dental diseases can be improved.

The future of the field of dental disease prevention and treatment is full of promise. Under the guidance of new theories, through technological innovation and product research and development, it will provide people with higher-quality and more effective dental disease prevention and treatment services, reduce the incidence of dental diseases, and improve people’s oral health and quality of life.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Huang L, 2006, The Mysteries of Dental Plaque, Dental Caries, and Periodontal Diseases-The Oral Bioelectrochemical Theory. Scientific Chinese, 2006(9): 6. DOI: 10.3969/j.issn.1005-3573.2006.09.040.
- [2] Hu D, 2014, New Progress and Applications of Oral Prevention Technologies and Oral Care Products. China International Dental Equipment Exhibition and Academic Symposium, China.
- [3] Zhang D, Zhang H, Zhu W, 2002, Practice and Effects of New Models in Dental Disease Prevention and Treatment. Journal of Dental Diseases Prevention and Treatment, 2002(3): 11. DOI: 10.3969/j.issn.1006-5245.2002.03.017.
- [4] Wang W, 2001, Vigorously Implementing Dental Disease Prevention and Treatment Work to Achieve Universal Access to Oral Health Care. Chinese Rural Health Service Administration, 2001, 21(1): 2. DOI: CNKI:SUN:ZNWS.0.2001-01-022.
- [5] Lin P, 2003, Oral Health Care and Dental Disease Prevention and Treatment. Jiangxi Science and Technology Press, China. DOI: 12.3767/j.issn.1006-3483.2003.05.071.
- [6] Wang J, 1999, Oral Health Care and Dental Disease Prevention and Treatment. Jiangxi Science and Technology Press, China. DOI: 11.3559/j.issn.1004-3673.1999.06.088.
- [7] Zhuang Z, Liu C, Xu H, et al., 2010, Clinical Characteristics and Diagnosis and Treatment Analysis of 9 Cases of Curved Central Incisors. Journal of Dental Diseases Prevention and Treatment in Guangdong, 2010, 18(11): 8. DOI:

CNKI:SUN:GDYB.0.2010-11-007.

- [8] Zhou D, Fu Z, 1994, Selection of Commonly Used Antibacterial Drugs in the Stomatology Clinic. *Journal of Dental Disease Prevention and Treatment*, 1994, 2(3): 45–46.
- [9] Zhuang Z, Li Y, 2003, Investigation of Dental Anxiety in Adolescent Dental Patients. *Journal of Dental Diseases Prevention and Treatment in Guangdong*, 2003, 11(4): 2. DOI: CNKI:SUN:GDYB.0.2003-04-014.
- [10] National Dental Disease Prevention and Treatment Guidance Group and Its Professional Committees, 2005, (10): 4. DOI: 14.3467/j.issn.1004-3983.2005.03.052.
- [11] Li S, Liu Y, 2020, Discussion on the Advantages of Traditional Chinese Medicine in the Prevention and Treatment of Oral Diseases Based on Literature, Theory, and Clinical Evidence. *World Journal of Integrated Traditional and Western Medicine*, 2020, 15(11): 4. DOI: 10.13935/j.cnki.sjzx.201137.
- [12] Gu Y, 1986, Actively Promote the Prevention and Treatment of Dental Diseases and Develop the Oral Health Care Industry. *Chinese Rural Medicine*.
- [13] Lan Z, 2022, Cover, Back Cover, and Table of Contents of the 2nd Issue of *Journal of Dental Diseases Prevention and Treatment in Guangdong* in 2022. *Journal of Dental Diseases Prevention and Treatment in Guangdong*, 2022(2): 27.
- [14] Ding X, Rong W, Bian J, et al., 2001, Observation on the Effect of Atraumatic Restorative Treatment for Primary Teeth One Year after Restoration. *Journal of Modern Stomatology*, 2001, 15(5): 3. DOI: 10.3969/j.issn.1003-7632.2001.05.024.
- [15] Lan Z, 2022, Cover, Back Cover, and Table of Contents of the 2nd Issue of *Journal of Dental Diseases Prevention and Treatment in Guangdong* in 2022. *Journal of Dental Diseases Prevention and Treatment in Guangdong*, 2022(2): 31.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# An Investigation of the Effect of Visceral Acupressure Technique Combined with Physical Training on Improving Physical Anxiety in Adolescents

Jie Zheng\*

Department of Forward-Deaching Dehabilitation, Taihe Hospital, Hubei University of Medicine, Shiyan 442000, Hubei, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Purpose:* To investigate the clinical effects of improving adolescents' form anxiety after the intervention of visceral massage technique and form training. *Methods:* A total of 80 adolescent patients with scoliosis abnormalities were selected for this experiment, and they were intervened with form and body training and form and body training + visceral body acupressure techniques, and the anxiety and depression scores, spinal Cobb angle, vertebral body rotation of the parietal vertebrae, and the treatment efficiency were compared between the groups after the clinical interventions. *Results:* The anxiety and depression scores of patients in the form group were significantly higher than those of the combined group,  $P < 0.05$ ; the improvement of the Cobb angle and vertebral rotation of the parietal vertebrae of patients in the combined group was better than that of the form group,  $P < 0.05$ ; and the total effective rate of the treatment of patients in the form group was significantly lower than that of the combined group,  $P < 0.05$ . *Conclusion:* After intervening in adolescents' abnormalities of form, patients were treated with a combination of the internal organs and body acupressure techniques and form training methods, and the results were compared between groups. After the joint intervention of the visceral massage technique and physical training, the patients' scoliosis and other physical problems were positively improved, and the psychological status of the patients was relatively adjusted to ensure their physical and mental health.

**Keywords:** Visceral acupressure techniques; Combined; Form training; Improvement; Adolescents; Form anxiety

**Online publication:** April 28, 2025

## 1. Introduction

In the process of growth and development, adolescents are affected by a variety of factors, inducing physical problems, common diseases are scoliosis, shoulder asymmetry, pterygoid shoulder armor, etc., and adolescents are

in an extremely sensitive stage, which can cause anxiety, depression, low self-esteem, lack of self-confidence, etc., which need to be actively intervened in the physical abnormalities, to promote the normal growth and development of the body<sup>[1, 2]</sup>. In the clinic, physical problems can be intervened through surgery, conservative treatment, in which surgery is more traumatic, more postoperative complications, mostly for patients with severe physical abnormalities; for mild physical abnormalities, physical training and visceral massage techniques can be taken to intervene<sup>[3, 4]</sup>. This paper mainly focuses on the clinical intervention effect of the above joint intervention methods for in-depth investigation.

## **2. Materials and methods**

### **2.1. General materials**

The experiment was carried out between March 2022 and August 2024, the number of participants totaled 80 cases, the method of group division is parity grouping method, the group is expressed by using the form group (form training) and the joint group (form training + visceral body massage technique), each group has 40 cases, of which there are 47 cases of males and 33 cases of females; age distribution of the form group is 12–15 years old, with a median value of  $13.65 \pm 0.65$  years; the joint group age range is 11–15 years old, with a median value of  $13.52 \pm 0.49$  years; comparing the above data statistics results, it shows a small difference between the groups. ; the age range of the combined group was 11–15 years old, with a median value ( $13.52 \pm 0.49$ ) years old; comparing the statistical results of the above data, the groups showed smaller data differences.

Inclusion criteria: (1) Adolescent patients did not combine problems such as congenital developmental anomalies class scoliosis; (2) Adolescents did not have a combination of diseases such as ankylosing spondylitis.

Exclusion criteria: (1) Adolescent patients with osteosarcoma disease; (2) The adolescent has poor compliance and does not cooperate with form-training instructions.

### **2.2. Methodology**

#### **2.2.1. Physical group**

Physical training was implemented for patients in this group, with the following training contents:

- (1) Lateral lying side body up. Instruct the patient to lie on the side of the bed, hold the head with both hands, and raise the upper body upward, and the clinician will assist the patient to hold down the feet, and this action training is 3–4 groups per day, 7 times per group.
- (2) Weight transfer. The clinician instructs the patient to take the kneeling position posture, both arms bent at the elbow holding the weight-bearing apparatus, respectively, to the left and right sides of the rotation, daily training of 3 groups, each group of 10 times, during which the clinician needs to adjust the patient's breathing.
- (3) Kneeling lateral pull-down. The patient takes a kneeling position, holds the pulling rope with both hands, pulls down with force, and needs to stay in the tolerated position for 10s, three groups per day, 10 times per group.
- (4) Holding the wall and pressing the shoulder. Treatment of patients with legs together, leave 50 cm width between the two feet, arms straight upward, and keep the same width as the shoulder and then pressed hard to the wall, during this time the waist force back up, chest forward, this process lasts for 10s, 5–10 minutes of daily training can be.



- (5) Standing with the back against the wall. Instruct the patient to keep both legs together, keep the body upright, straighten the hands on both sides of the body, lean the back against the wall, and keep the head close to the wall, and maintain this process for 10 minutes.

### **2.2.2. Joint group**

By incorporating the visceral massage technique alongside the physical training regimen, the massage procedures are as follows: Professional massage clinicians perform the techniques, instructing patients to lie in the prone position. The massage focuses on the solar bladder meridian near specific acupoints such as the pinch point and dorsal Yu point. The techniques include pressure and kneading, pushing, wrenching, and pressing at targeted points. Each massage session lasts between 15 to 30 minutes. During the process, the clinician should adjust the force applied based on the patient's skin tolerance, ensuring the massage is not painful to the extent that it may reduce the patient's compliance with the treatment.

## **2.3. Observation indicators**

### **2.3.1. Anxiety and depression scores**

In this experiment, patients' anxiety and depression were assessed using the SAS and SDS scales, and higher scores indicated poorer psychological status.

### **2.3.2. Cobb angle of the spine**

The spinal images were obtained from the patients' X-ray films, with the vertebra exhibiting the greatest scoliosis curvature serving as the reference standard. The upper and lower edges of this vertebra were identified, and two perpendicular lines were drawn. The intersection of these lines determined the Cobb angle. Additionally, the vertebral body rotation of the parietal vertebrae was assessed using the Nash method. The statistical comparison of these measurements between groups was conducted by analyzing the mean differences.

### **2.3.3. Treatment effectiveness**

In this experimental group, the treatment demonstrated clear effectiveness: the Cobb angle of the patients was reduced to 5 degrees or less. For those with a general positive response, the Cobb angle was reduced by 5 degrees or more, and the patients showed good recovery. In cases where the treatment was ineffective, the Cobb angle was reduced by less than 5 degrees, with no significant difference observed in the scoliosis compared to the patients' condition before treatment.

## **2.4. Statistical methods**

SPSS 23.0 software was used to calculate the statistical data information of this experiment,  $\chi^{(2)}$  was used to test the data information in the form of percentages, and t-test was used to indicate the measurement information using ( $\bar{x} \pm s$ ),  $P < 0.05$ , which is statistically significant.

## **3. Results**

### **3.1. Comparison of anxiety and depression scores between groups**

There was no difference in the psychological state assessment scores of the two groups of patients before



treatment,  $P > 0.05$ ; after comparing the anxiety and depression scores after treatment, it was found that the statistical indexes of the patients in the combined group were lower than those in the form group,  $P < 0.05$ , and the results of the comparison of the data between the groups are shown in **Table 1**.

**Table 1.** Anxiety and depression scores between comparison groups ( $\bar{x} \pm s$ , points)

Groups	Number of cases (n)	Anxiety Score (SAS)		Depression Score (SDS)	
		Pretreatment	Post-treatment	Pre-treatment	Post-treatment
CGU	40	40.35 $\pm$ 2.35	32.52 $\pm$ 2.52	41.62 $\pm$ 2.55	32.52 $\pm$ 2.58
physiognomy	40	41.24 $\pm$ 3.68	35.26 $\pm$ 2.67	42.56 $\pm$ 3.65	34.26 $\pm$ 2.45
<i>t</i>		1.2891	4.7200	1.3352	3.0930
<i>P</i>		0.2012	0.0000	0.1857	0.0027

### 3.2. Statistical analysis of the distribution of spinal Cobb angle and vertebral body rotation of the parietal vertebrae in the two groups of patients

Comparing the data of spinal Cobb angle and parietal vertebral body rotation before treatment of the two groups of patients, the statistical results showed that there was no obvious difference in comparison,  $P > 0.05$ ; after treatment: the improvement of spinal Cobb angle and parietal vertebral body rotation of the patients in the shape group was worse than that of the joint group,  $P < 0.05$ , and the calculated results are shown in **Table 2**.

**Table 2.** Statistical analysis of the distribution of spinal Cobb angle and vertebral rotation of the parietal vertebrae in the two groups ( $\bar{x} \pm s$ , °)

Groups	Number of cases (n)	Cobb's angle of the spine		Vertebral body rotation in the parietal spine	
		Pre-treatment	Post-treatment	Pretreatment	Post-treatment
CGU	40	16.65 $\pm$ 2.35	7.26 $\pm$ 1.26	1.89 $\pm$ 0.54	1.25 $\pm$ 0.25
physiognomy	40	17.12 $\pm$ 1.35	10.36 $\pm$ 1.56	1.92 $\pm$ 0.49	1.75 $\pm$ 0.35
<i>t</i>		1.0968	9.7771	0.2602	7.3521
<i>P</i>		0.2761	0.0000	0.7954	0.0000

### 3.3. Intergroup statistics effective rate of treatment in two groups

Comparison of intergroup data on the treatment efficiency of the two groups of patients, the statistical results show that the joint data is better than the shape group,  $P < 0.05$ , the comparison results are shown in **Table 3**.

**Table 3.** Intergroup statistics effective rate of treatment in both groups (n%)

Groups	Number of cases (n)	Efficacy of treatment	General effect	Futile treatment	Treatment efficacy rate
CGU	40	24 (60.00%)	14 (35.00%)	2 (5.00%)	38 (95.00%)
physiognomy	40	20 (50.00%)	12 (30.00%)	8 (20.00%)	32 (80.00%)
$\chi^2$					4.1143
<i>P</i>					0.0425

## 4. Conclusion

Adolescent bone development is not yet complete, when subjected to external factors or bad habits and other factors, it is very easy to induce its scoliosis and other conditions, which in turn cause physical changes, over time the spinal curvature parts will oppress the patient's spinal cord and other physiological structures, but also induces the formation of other diseases, the physical and mental health of the development of its extremely unfavorable<sup>[5, 6]</sup>. Based on the above situation, it is essential to actively intervene in patients' physical abnormalities. This paper selects physical training and visceral massage techniques for intervention. The physical training primarily aims to correct patients' poor posture, achieved through repetitive exercises designed to help them develop a proper body shape and alignment. The physical training regimen includes exercises such as side-lying lateral raises, weight-bearing rotations, kneeling lateral pull-downs, shoulder presses while holding the wall, and standing with the back against the wall, among others. Each training content has a strong relevance and can positively adjust the patient's bad body shape<sup>[7, 8]</sup>. Tui Na therapy stimulates the body's meridians and acupoints to enhance bodily functions. It involves techniques such as pushing, holding, lifting, pinching, kneading, and others to stimulate local blood circulation, clear blockages in the meridians, balance Yin and Yang, and promote the flow of Qi, all of which help alleviate pain. In this study, various Tui Na techniques, including kneading, pushing, wrenching, and pressing, were applied to treat adolescent scoliosis.

The kneading technique primarily uses the thumb to apply pressure and knead the muscle groups on either side of the patient's spine. This repeated kneading can reduce local pain and relax tense muscles. The pushing technique, a commonly used method, employs the palm of the hand to push upward along the muscles beside the spine, effectively promoting local blood circulation and clearing any blockages in the meridians. Wrenching involves one-handed manipulation of the muscles to adjust the spinal curves. The pressing technique focuses on pressing acupoints along the spine, providing beneficial stimulation that not only helps regulate scoliosis but also adjusts the spinal curve. Stimulating the acupoints promotes the circulation of Qi and blood, relieving clinical discomfort and contributing positively to the intervention's effectiveness. In addition, acupoint stimulation can also help to alleviate patients' anxiety by inducing their negative emotions<sup>[9, 10]</sup>.

The data from this study indicate that the anxiety and depression scores of patients in the joint group are significantly lower than those in the form group, with  $P < 0.05$ . Additionally, there is a noticeable difference in the improvement effects on Cobb's angle and parietal vertebral rotation between the two groups, with  $P < 0.05$ . The total effective treatment rate for patients in the joint group is also higher than that of the form group, with  $P < 0.05$ .

Based on these statistical results, the following conclusions can be drawn: First, in the joint group, the combination of physical training and Tui Na therapy further stimulated the muscles on both sides of the spine. Additionally, Tui Na's meridian-dredging effects, including regulating the liver and Qi, played a crucial role. As negative emotions are often associated with liver stagnation, dredging the liver helped alleviate these emotions, reducing harm to the body and facilitating emotional release. Second, Tui Na therapy proved effective in treating spinal issues, contributing to the overall positive outcomes observed in the joint group. Furthermore, Tui Na technique can adjust the physiological curve of the spine by applying external force, so it has a significant effect on the Cobb angle and vertebral rotation of the parietal vertebrae. Thirdly, based on the significant improvement of scoliosis, it is fully proved that the combined treatment has a positive effect on the patients, and therefore the treatment efficiency is relatively improved.

To summarize, after the use of physical training and visceral massage techniques to intervene in adolescent physical problems, the patients' poor body image was positively intervened and adjusted, and the therapeutic

effect was remarkable, thus reducing the patients' psychological burden and effectively reducing the generation of negative emotions.

## Disclosure statement

The author declares no conflict of interest.

## References

- [1] Liu M, Ma Z, Xu Q, et al., 2024, The Role of Suspension Push-up Exercise Technique in Improving Paraspinal Muscle Asymmetry in Adolescent Idiopathic Scoliosis Patients. *Journal of Rehabilitation*, 34(3): 262–269
- [2] Guo J, 2024, Research on the Intervention and Correction of Adolescent Scoliosis by Dance Form Training, thesis, Guangxi Normal University.
- [3] Luo R, 2023, A Controlled Study of the Efficacy of Physical Training for Adolescent Idiopathic Scoliosis in Two Testing Tools, thesis, Guangzhou Medical University.
- [4] Li J, Sha G, Zhang J, 2022, Effect of Massage Combined with Mulligan Technique in Treating Adolescent Patients with Cervical Spondylosis. *Medical Equipment*, 35(15): 72–74.
- [5] Zhu Y, 2025, Building an Integrated Mental Health Education System for Adolescents Through Five Education Programs—A Discussion on Mental Health Education for Adolescents. *Journal of Suzhou University (Educational Science Edition)*, 13(01): 1–12.
- [6] Liu W, Zhang K, Xu X, et al., 2025, Study and Correlation Analysis of Sleep Characteristics in Adolescent Patients with Epilepsy Co-morbid Anxiety and Depression. *Journal of Epilepsy and Neurophysiology*, 34(01): 27–32.
- [7] Wei D, 2023, Analyzing the Influence of Aerobics on the Physical and Mental Health of Adolescents. *Sports World*, (06): 142–144.
- [8] Chen C, 2022, Research on Abnormal Body Postures of Adolescents and Suggestions for Prevention and Control Policies. *China Sports Science and Technology*, 58(10): 35–39.
- [9] Pan Q, Li H, 2021, Physical and Mental Health Status of Children and Adolescents and Approaches to School Health Promotion. *People's Education*, 2021(Z2): 59–61.
- [10] Yin S, Zhu W, 2020, Research on Body Morphology Characteristics of Excellent Junior Female Badminton Players in China. *Journal of Guangzhou Sports Institute*, 40(06): 83–85.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Treatment of One Case of Pediatric Hand-Foot-Mouth Disease with Spleen Dampness-Heat Syndrome Using Acupoint Application Therapy to Disperse Dampness, Expel Heat, and Unblock the Fu Organs

Wangsen Zhao<sup>1\*</sup>, Ziqing Wu<sup>2</sup>

<sup>1</sup>Heze Medical College, Heze 274009, Shandong, China

<sup>2</sup>Shandong Provincial Hospital Heze Hospital, Heze 274009, Shandong, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** The high incidence of hand, foot, and mouth disease (HFMD) in children, coupled with improper management, can lead to complications, causing significant distress to both patients and their parents. This article reports on the successful treatment of a case of HFMD with dampness-heat accumulation in the spleen type using a therapeutic approach of applying herbal patches to acupoints to disperse dampness, promote heat dissipation, and unblock the fu organs. The herbs selected primarily include honeysuckle, *Forsythia*, and mint to relieve the exterior and promote heat dissipation; *Agastache* and magnolia bark to transform and dry dampness; *Scutellaria*, blackberry lily, and licorice to clear heat, detoxify, and benefit the throat; and magnolia bark and bitter orange to unblock the fu organs and purge heat. The flexible combination of these herbs with acupoints such as Shenque, Zhongwan, Tiantu, and Feishu fully leverages the synergistic effects of both the herbs and acupoints, resulting in a significant therapeutic effect. This approach provides valuable insights and methodologies for the prevention and treatment of HFMD in children.

**Keywords:** Pediatric hand-foot-mouth disease, Spleen dampness-heat syndrome, Acupoint application therapy, Disperse dampness and expel heat to unblock the fu organs

**Online publication:** April 28, 2025

## 1. Introduction

Hand, Foot, and Mouth Disease (HFMD) is an acute infectious disease caused by enteroviruses (such as Coxsackievirus A16 and EV71) that primarily affects children under the age of 5. It is characterized by fever, oral

ulcers, and skin rashes on the hands, feet, and buttocks <sup>[1]</sup>. Western medicine mainly focuses on symptomatic and supportive treatment, and there is no specific antiviral drug available. In Chinese medicine, this disease falls under the category of “warm diseases” and the core pathogenesis is the accumulation of damp-heat and epidemic toxins in the spleen and stomach. Clinically, the damp-heat accumulating in the spleen syndrome is commonly seen, and treatment should focus on eliminating dampness, promoting heat dissipation, and detoxifying the bowels.

In recent years, external therapies in Chinese medicine have become a research hotspot in pediatrics due to their simple operation and high compliance. Acupoint application therapy, which combines transdermal drug absorption with meridian conduction, can directly target the diseased area and avoid the limitations of oral medications <sup>[2]</sup>. This article reports a case of damp-heat accumulating in the spleen syndrome of HFMD in a child treated with acupoint application therapy to dissipate dampness, promote heat dissipation, and detoxify the bowels. The mechanism of action is analyzed to provide a reference for clinical practice.

## 2. Case report

Patient Lee, male, 3 years old, presented in June 2022 with “fever and oral, hand, and foot herpes for 2 days.” His temperature fluctuated between 37.8°C and 38.8°C, with scattered herpes in the oral cavity and red papules on the hands, feet, and buttocks. He also experienced loss of appetite, drooling, and mild nausea. Physical cooling measures taken by the parents were ineffective. Current symptoms include fever, oral herpes with significant red halo, red and rashy hands and feet, poor appetite and drooling, yellow and turbid urine, sticky and foul-smelling stool, red tongue with yellow and greasy coating, and slippery and rapid pulse. The diagnosis in Chinese medicine was HFMD (damp-heat accumulating in the spleen syndrome), while the diagnosis in Western medicine was HFMD (common type).

The treatment plan includes: Single-herb powders were combined and mixed with *Artemisia desertorum* spreading liquid to form a paste for application at corresponding acupoints. Specifically, 0.5g/acupoint of *Forsythia*, 0.5g/acupoint of *Agastache*, 0.3g/acupoint of magnolia bark, 0.3g/acupoint of bitter orange, and 0.3g/acupoint of *Scutellaria* were applied to the Zhongwan and Shenque acupoints. Additionally, 0.5g/acupoint of *Forsythia*, 0.5g/acupoint of honeysuckle, 0.3g/acupoint of mint, 0.3g/acupoint of blackberry lily, and 0.3g/acupoint of licorice were applied to the Tiantu and Feishu acupoints. The applications were performed once a day, with each application lasting for 6–8 hours.

On the first day of treatment, the patient’s temperature maintained between 37.5°C and 38.2°C, and the nausea symptoms were reduced. However, he still had a poor appetite, and there was no significant change in oral pain, herpes, or skin rashes. On the third day of treatment, the temperature returned to normal, oral pain was relieved, herpes and ulcers began to gradually heal, drooling decreased, appetite improved, and the color of the skin rashes on the hands, feet, and buttocks became lighter. By the fifth day of treatment, oral herpes and ulcers were basically healed, skin rashes on the hands, feet, and buttocks had subsided with only minor pigmentation remaining. The patient’s mental state was good, appetite had returned to normal, and bowel and bladder functions had also normalized. Treatment was continued for another 2 days for consolidation, and no recurrence was observed during a 1-week follow-up.

## 3. Discussion and analysis

In the prescription of acupoint application therapy for this disease, *Agastache* has a fragrant aroma that can



eliminate dampness, awaken the spleen, dispel filth, and harmonize the middle, thus relieving the syndrome of dampness stagnating the spleen. Magnolia bark, with its bitter and warm properties, can dry dampness, disperse and eliminate accumulation, and promote Qi circulation to eliminate fullness. The combination of *Agastache* and magnolia bark can aromatically transform dampness and warmly penetrate the exterior. Honeysuckle, with its cold and sweet properties, has the effect of clearing heat and detoxifying, dispersing wind-heat, and is effective in treating heat-toxin induced bloody dysentery and wind-heat induced common cold. *Forsythia*, with its cool and bitter taste, can clear heat, detoxify, reduce swelling, and disperse nodules, earning it the reputation of being a “sacred medicine for sores.” When combined, these two herbs can effectively clear and penetrate heat toxin, providing an outlet for heat pathogen and reducing symptoms such as fever and skin rashes. Magnolia bark transforms dampness and promotes qi circulation, while bitter orange regulates Qi, widens the middle, promotes Qi circulation, and eliminates distension. The combination of these two herbs promotes the excretion of waste, allowing damp-heat pathogen in the body to be expelled through defecation, thereby reducing symptoms of damp-heat accumulation. Blackberry lily, with its bitter and cold properties, can clear heat, detoxify, resolve phlegm, and soothe the throat, while licorice, with its sweet taste and neutral properties, can clear heat, detoxify, eliminate phlegm, and relieve coughing. When combined, these two herbs can detoxify and soothe the throat, effectively relieving oral pain and promoting the healing of oral herpes and ulcers. *Scutellaria*, with its bitter and cold properties, is skilled in clearing damp-heat from the upper jiao, purging fire, and detoxifying. It targets the pathogenesis of damp-heat accumulation in damp-heat accumulating in the spleen syndrome of HFMD. When combined with herbs that transform dampness, promote heat dissipation, such as *Agastache*, magnolia bark, honeysuckle, and *Forsythia*, it facilitates the clearance and penetration of accumulated damp-heat<sup>[3]</sup>.

In the selection of acupoints for application, the Zhongwan acupoint is the front-Mu point of the stomach and the converging point of the Fu organs. It can dredge the Qi mechanism of the middle Jiao, harmonize the stomach, and transform dampness. The Shenque acupoint is located on the abdomen. These two acupoints, when combined with herbs that transform dampness, clear heat, and facilitate bowel function, can promote gastrointestinal function, eliminate dampness and heat, and effectively relieve gastrointestinal symptoms. The Feishu acupoint is the back-Shu point of the lung, which has the effect of facilitating lung Qi, relieving exterior syndromes, and reducing fever. When combined with herbs that penetrate the exterior and expel pathogens such as *Forsythia* and mint, it can regulate lung function, disperse lung Qi, and promote the external penetration of heat toxin and the dissipation of herpes. The Tiantu acupoint is selected locally, where the skin is thin and delicate, and the subcutaneous venous circulation is rich. When combined with herbs that clear heat, soothe the throat, and penetrate the exterior, it can effectively promote the resolution of oral and throat herpes.

## 4. Conclusion

Hand, foot, and mouth disease (HFMD) in children is a common and frequently occurring pediatric disease. Currently, modern medicine does not have specific antiviral drugs and mainly focuses on symptomatic treatment. Traditional Chinese medicine (TCM) has advantages such as syndrome differentiation and flexible medication in treating this disease, but most children have low compliance during oral medication. Acupoint application therapy has unique advantages in the treatment of HFMD in children due to its flexibility, convenience, painlessness, non-invasiveness, minimal impact on daily life, and ability to avoid oral medication<sup>[4]</sup>.

Although acupoint application therapy has opened up a new path for the treatment of HFMD in children,



showing significant advantages and broad prospects, there are still some areas that urgently need to be expanded and improved. Firstly, multi-center, large-sample clinical studies should be continued through collaboration between different regions and medical institutions to continuously optimize the compatibility of medications and the selection of acupoints, as well as the corresponding relationship between medications and acupoints. Secondly, the modern mechanism of acupoint application therapy needs to be further clarified, and the synergistic mechanism between medications and acupoints also needs further exploration. Modern scientific techniques, such as molecular biology, immunology, and other cutting-edge methods, can be used to deeply explore the pathway of medication penetration through acupoints, revealing the interaction between medications and acupoints, thus providing a more solid modern theoretical support for this therapy <sup>[5]</sup>. Furthermore, exploring combined treatment strategies is also a major trend. By organically combining acupoint application therapy with traditional Chinese medicine internal medication, pediatric massage, scraping, and other TCM therapies, the comprehensive treatment advantages of TCM can be leveraged to holistically regulate the child's bodily state. Flexibly selecting relevant therapies for combined treatment based on the child's condition, with each therapy complementing each other, will further enhance the treatment effect of HFMD in children, shorten the course of the disease, and reduce the incidence of complications.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] National Health Commission of the People's Republic of China, 2022, Guidelines for the Diagnosis and Treatment of Hand, Foot, and Mouth Disease (2022 Edition). *Chinese Journal of Pediatrics*, 60(4): 289–294.
- [2] Zhang XX, Li XX, 2021, Research Progress on Acupoint Application Therapy for Respiratory Diseases in Children. *Journal of Emergency in Traditional Chinese Medicine*, 30(5): 876–879.
- [3] Huang D, 2019, Research Progress on the Treatment of Hand, Foot, and Mouth Disease in Children with Traditional Chinese Medicine. *World Latest Medicine Information*, 19(92): 116–117.
- [4] Liu M, Yang Y, 2019, Research Progress on the Epidemic, Prevention, and Treatment of Hand, Foot, and Mouth Disease. *Journal of Community Medicine*, 17(10): 619–622.
- [5] Zhang W, Han W, Wang M, 2003, Exploration of the Research on the Treatment of Hand, Foot, and Mouth Disease with Traditional Chinese Medicine. *Journal of Traditional Chinese Medicine*, (11): 1868–1869.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Research on the Pre-test Time Variable in Peripheral Blood Routine Analysis

Wei Li, Zhaoyi Guo, Zihan Xiu, Wenkai Lü, Juan Liu, Yuchen Chen, Sifan Zeng, Peng Sun\*

Maternal and Child Health Hospital of Nanshan, Shenzhen 518000, Guangdong, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the accuracy and stability of the results of peripheral blood routine tests at different time points after anticoagulation and standing, providing a scientific basis for actual clinical work. *Methods:* In this study, 30 patients who visited the hospital in October 2023 were randomly selected and divided into two groups (15 cases in each group). The same collection method was used for routine blood tests. The tests were performed after anticoagulation and standing for 5 minutes, 1 hour, and 5 minutes, 2 hours respectively, and the routine blood test indicators at different time points were compared. *Results:* After comparison, there were no significant differences in the results of routine blood tests at 5 minutes after mixing, anticoagulating, and standing peripheral blood and those at 1 hour and 2 hours ( $P > 0.05$ ). *Conclusion:* The results of peripheral blood after mixing, anticoagulating, and standing for 5 minutes are stable compared with those after standing for 1 hour and 2 hours. In actual work, the pre-test turnaround time can be appropriately extended.

**Keywords:** Peripheral blood; Routine blood test; Accuracy

**Online publication:** April 30, 2025

## 1. Introduction

The routine blood test is an important blood test method. By analyzing the number and proportion of different types of cells in the blood, it can assist in the diagnosis and treatment of diseases. Peripheral blood, as a collection method, is often used for children and patients who are difficult to have venous blood drawn due to its convenience and less pain<sup>[1,2]</sup>.

The results of peripheral blood routine tests are affected by many factors<sup>[3]</sup>. Immediate testing after sampling may lead to false elevation of white blood cells and false reduction of platelets, and the results can return to normal after 5 minutes of anticoagulation and standing<sup>[4]</sup>. Therefore, it is crucial to follow the correct operation process to reduce errors. However, in clinical work, unexpected situations such as laboratory equipment failures, insufficient reagents, and excessive specimens may all extend the test turnaround time.

To explore the impact of anticoagulation and standing time after peripheral blood collection on the results of routine blood tests, our hospital randomly selected 30 patients for comparative analysis.

## 2. Materials and methods

### 2.1. Specimen source

In this study, 30 patients who underwent health examinations in our hospital in October 2023 were randomly selected. None of them had blood or coagulation disorders, and they all voluntarily signed the “Informed Consent Form.” The samples included 15 males and 15 females, aged 6 months to 12 years old. There were no significant differences in age and disease types.

### 2.2. Instruments and equipment

In this study, a fully automated blood cell analyzer (BC-5390 CRP) was used to detect routine blood test indicators. The instrument had undergone regular maintenance, the quality control substances were qualified, the performance met the standards, and it was operating normally. The reagents used were all matched and within the expiration date, and the anticoagulation tube contained 5% EDTA-K2.

### 2.3. Detection method

A disposable blood collection tube was used to draw peripheral blood and inject it into an anticoagulation tube. After thorough mixing, the sample was allowed to stand, then tested on the machine, and the results of the routine blood test were recorded.

### 2.4. Observation indicators

In this study, the results of routine blood tests of two groups of patients were compared. Through statistical analysis, the differences in various blood parameters were evaluated<sup>[3,4]</sup>.

### 2.5. Statistical methods

The 24-item blood test data of the two groups of patients were organized using Excel, and analyzed using statistical software (SPSS 27.0). Measurement data were expressed as mean  $\pm$  standard deviation (SD) and the *t*-test was used. A difference with  $P < 0.05$  was considered statistically significant, and a difference with  $P > 0.05$  was considered not statistically significant.

## 3. Results

### 3.1. Comparison of the results of each test index at 5 minutes and 1 hour

There were no significant statistical differences in the 24 routine blood test indicators after collecting peripheral blood and anticoagulating and standing for 5 minutes and 1 hour<sup>[5,6]</sup>. The statistical results are shown in **Table 1** and **Figure 1**<sup>[7,8]</sup>.

**Table 1.** Comparison of the results of each test index at 5 minutes and 1 hour (mean  $\pm$  SD)

Observation index	5 minutes	1 hour	<i>P</i> -value
White blood cell count ( $10^9/L$ )	$9.48 \pm 6.66$	$9.53 \pm 6.65$	0.983
Red blood cell count ( $10^{12}/L$ )	$4.86 \pm 0.50$	$4.85 \pm 0.51$	0.974
Hemoglobin (g/L)	$136.53 \pm 24.10$	$137.73 \pm 24.16$	0.893
Hematocrit (%)	$42.07 \pm 6.65$	$41.86 \pm 6.78$	0.931

Table 1 (Continued)

Observation index	5 minutes	1 hour	P-value
Mean corpuscular volume (fL)	86.46 ± 7.53	86.14 ± 7.81	0.910
Mean corpuscular hemoglobin (pg)	28.02 ± 2.84	28.35 ± 2.93	0.759
Mean corpuscular hemoglobin concentration (g/L)	324.07 ± 7.76	328.87 ± 7.42	0.094
Platelet count (10 <sup>9</sup> /L)	227.33 ± 60.73	228.00 ± 60.16	0.976
Mean platelet volume (fL)	9.03 ± 0.83	9.11 ± 0.81	0.791
Platelet distribution width (fL)	15.91 ± 1.13	15.99 ± 0.35	0.795
Plateletcrit (%)	0.20 ± 0.05	0.21 ± 0.05	0.891
Large platelet ratio (%)	20.93 ± 5.62	21.26 ± 5.71	0.873
Absolute neutrophil count (10 <sup>9</sup> /L)	5.95 ± 5.89	5.91 ± 5.79	0.983
Neutrophil percentage (%)	56.01 ± 19.73	55.25 ± 19.32	0.916
Absolute lymphocyte count (10 <sup>9</sup> /L)	2.63 ± 1.60	2.68 ± 1.59	0.933
Lymphocyte percentage (%)	33.39 ± 18.02	33.70 ± 18.08	0.962
Absolute monocyte count (10 <sup>9</sup> /L)	0.63 ± 0.42	0.68 ± 0.43	0.754
Monocyte percentage (%)	7.59 ± 3.41	8.13 ± 3.42	0.668
Absolute eosinophil count (10 <sup>9</sup> /L)	0.25 ± 0.27	0.25 ± 0.25	0.955
Eosinophil percentage (%)	2.86 ± 2.84	2.69 ± 2.62	0.869
Absolute basophil count (10 <sup>9</sup> /L)	0.01 ± 0.01	0.02 ± 0.01	0.334
Basophil percentage (%)	0.16 ± 0.17	0.23 ± 0.15	0.230
Red blood cell distribution width-CV	0.13 ± 0.01	0.13 ± 0.01	1.00
Red blood cell distribution width-SD (fL)	41.99 ± 5.48	41.95 ± 5.57	0.984

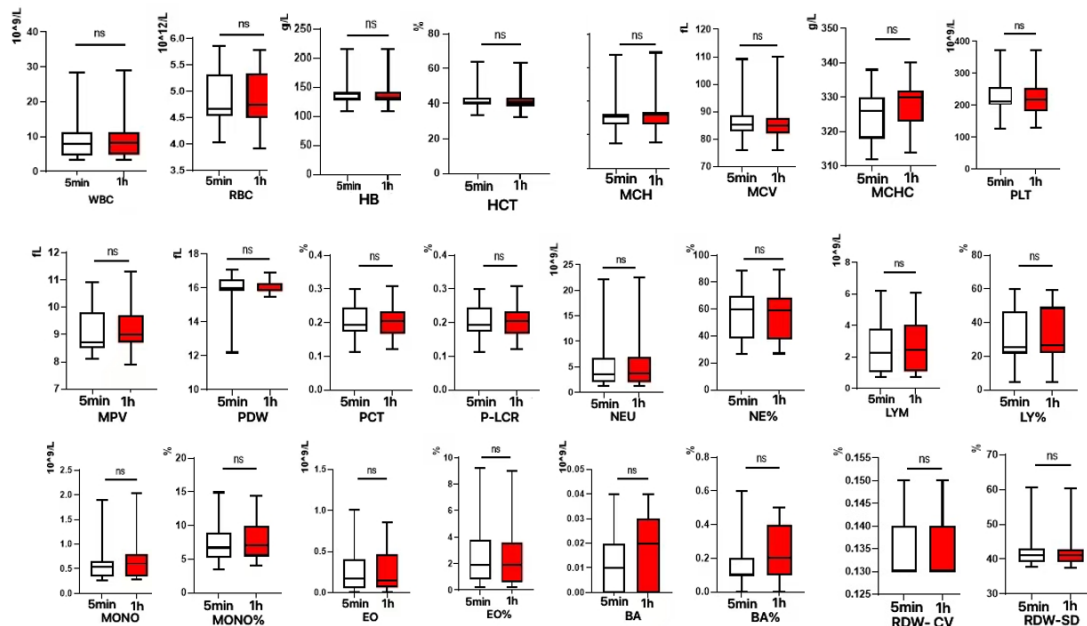


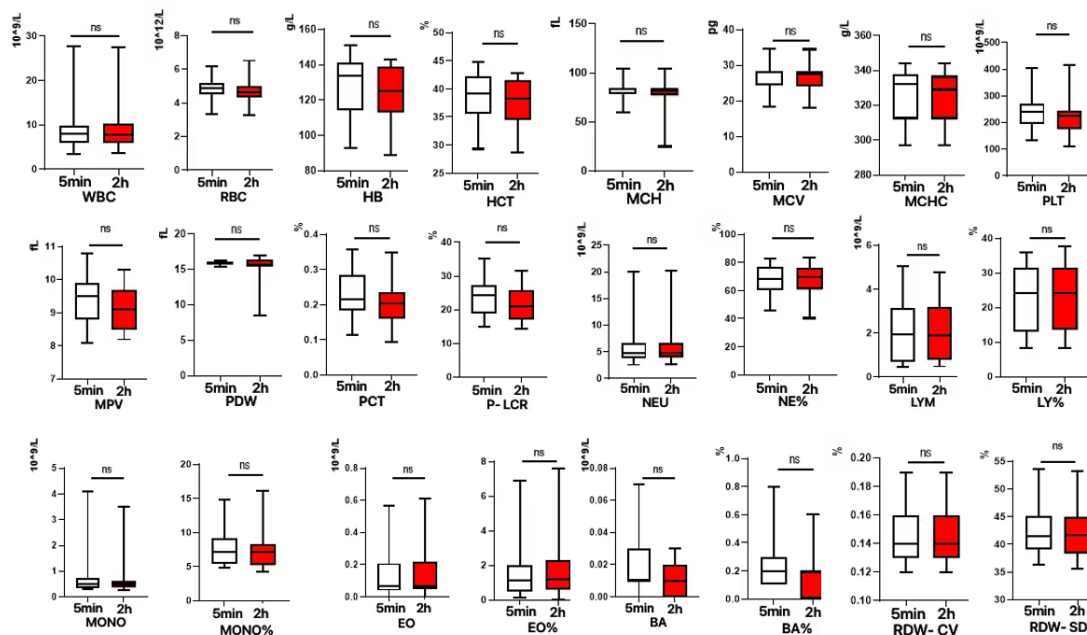
Figure 1. Comparison of the results of each test index after anticoagulation and standing for 5 minutes and 1 hour

### 3.2. Comparison of the results of each test index at 5 minutes and 2 hours

There were no significant statistical differences in the 24 routine blood test indicators after collecting peripheral blood and anticoagulating and standing for 5 minutes and 2 hours. The statistical results are shown in **Table 2** and **Figure 2**.

**Table 2.** Comparison of the results of each test index at 5 minutes and 2 hours (mean  $\pm$  SD)

Observation index	5 minutes	2 hours	P-value
White blood cell count ( $10^9/L$ )	$9.07 \pm 5.87$	$9.01 \pm 5.70$	0.977
Red blood cell count ( $10^{12}/L$ )	$4.80 \pm 0.66$	$4.71 \pm 0.72$	0.729
Hemoglobin (g/L)	$127.00 \pm 17.93$	$123.33 \pm 16.20$	0.561
Hematocrit (%)	$38.83 \pm 4.33$	$37.91 \pm 3.90$	0.549
Mean corpuscular volume (fL)	$81.76 \pm 10.22$	$77.52 \pm 17.75$	0.529
Mean corpuscular hemoglobin (pg)	$26.74 \pm 3.98$	$26.53 \pm 4.03$	0.889
Mean corpuscular hemoglobin concentration (g/L)	$326.47 \pm 14.40$	$324.6 \pm 14.91$	0.730
Platelet count ( $10^9/L$ )	$239.13 \pm 66.35$	$220.00 \pm 71.25$	0.453
Mean platelet volume (fL)	$9.38 \pm 0.72$	$9.12 \pm 0.69$	0.30
Platelet distribution width (fL)	$15.887 \pm 0.29$	$14.72 \pm 2.75$	0.125
Plateletcrit (%)	$0.22 \pm 0.06$	$0.20 \pm 0.06$	0.275
Large platelet ratio (%)	$23.69 \pm 5.50$	$21.74 \pm 5.42$	0.337
Absolute neutrophil count ( $10^9/L$ )	$6.05 \pm 4.16$	$6.02 \pm 4.19$	0.985
Neutrophil percentage (%)	$67.57 \pm 10.49$	$67.34 \pm 11.75$	0.955
Absolute lymphocyte count ( $10^9/L$ )	$2.08 \pm 1.32$	$2.07 \pm 1.26$	0.976
Lymphocyte percentage (%)	$22.95 \pm 9.43$	$23.13 \pm 9.52$	0.959
Absolute monocyte count ( $10^9/L$ )	$0.77 \pm 0.94$	$0.76 \pm 0.82$	0.966
Monocyte percentage (%)	$7.58 \pm 2.64$	$7.67 \pm 3.17$	0.936
Absolute eosinophil count ( $10^9/L$ )	$0.14 \pm 0.16$	$0.15 \pm 0.16$	0.936
Eosinophil percentage (%)	$1.66 \pm 1.80$	$1.73 \pm 1.95$	0.916
Absolute basophil count ( $10^9/L$ )	$0.02 \pm 0.02$	$0.01 \pm 0.01$	0.104
Basophil percentage (%)	$0.24 \pm 0.20$	$0.17 \pm 0.16$	0.270
Red blood cell distribution width-CV	$0.15 \pm 0.02$	$0.15 \pm 0.02$	0.864
Red blood cell distribution width-SD (fL)	$42.6 \pm 5.09$	$41.89 \pm 4.78$	0.695



**Figure 2.** Comparison of the results of each test index after anticoagulation and standing for 5 minutes and 2 hours

## 4. Discussion

This study investigated the impact of the standing time on the accuracy of routine blood tests. By comparing the test results of blood samples from two groups of patients at different time points, it was found that prolonging the standing time had no significant impact on the results.

Although peripheral blood has the advantages of less blood collection volume, simple operation, and less pain, its stability is insufficient and it is easily affected by many factors<sup>[9,10]</sup>. Especially when a routine blood test is performed immediately, platelet morphological changes may occur, leading to abnormal white blood cell and platelet counts<sup>[11,12]</sup>. However, with the action of the anticoagulant EDTA-K2, platelet aggregation is inhibited, the platelet morphology returns to normal, and the count becomes stable.

This study increases the flexibility of clinical use of peripheral blood. Especially in cases of a large number of samples or long transportation times, prolonging the standing time has no negative impact on the test results, ensuring the reliability of diagnosis and treatment. At the same time, it emphasizes the importance of quality control in clinical laboratories. Optimizing the collection and processing processes can improve the reliability of test results<sup>[13,14]</sup>.

Although this study provides important insights, due to the limited sample size and the lack of in-depth investigation of factors such as temperature and transportation, it is recommended that future research expand the sample size and explore these factors to optimize the testing process<sup>[15]</sup>.

This study shows that anticoagulating peripheral blood and allowing it to stand for 5 minutes to 2 hours has no significant impact on routine blood tests. It helps to eliminate false platelet aggregation, does not affect the accuracy of the results and clinical decision-making, provides a practical guide for clinical practice, and improves the testing efficiency.



## 5. Conclusion

This study indicates that there is no significant difference in the results of complete blood count tests between peripheral blood anticoagulated and left to stand for 5 minutes compared to those left to stand for 1 hour and 2 hours. This suggests that in practical work, the pre-test turnaround time can be appropriately extended without affecting the accuracy of the test results and clinical decision-making.

## Funding

Project of Guangdong Provincial Medical Science and Technology Research Fund (A2022011); Major Science and Technology Project of Shenzhen Nanshan District Health System (NSZD2023067); Sub-project of Education (Health) Science and Technology Project of Nanshan District Technology Research and Development and Creative Design Project in Shenzhen (NS2022002)

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Jin Y, Lu J, Jin H, et al., 2018, Reference Intervals for Biochemical, Hemostatic and Hematological Parameters in Healthy Chinese Women During Early and Late Pregnancy. *Clin Chem Lab Med*, 56(6): 973–979.
- [2] Serafin A, Malinowski M, Prazmowska-Wilanowska A, 2020, Blood Volume and Pain Perception During Finger Prick Capillary Blood Sampling: Are All Safety Lancets Equal. *Postgrad Med*, 132(3): 288–295.
- [3] Han Z, He J, Xie X, et al., 2021, Investigation and Analysis on the Application of Peripheral Blood Specimens for Routine Blood Testing by Laboratory Physicians. *Ann Palliat Med*, 10(9): 9516–9522.
- [4] Cui Z, Cao W, 2023, Influence of Blood Sample Collection Site and Post-Collection Testing Time on the Results of Routine Blood Tests. *Guide of China Medicine*, 21(08): 122–124.
- [5] Grevsen AK, Hviid C, Hansen AK, et al., 2021, Platelet Count and Function in Umbilical Cord Blood Versus Peripheral Blood in Term Neonates. *Platelets*, 32(5): 626–632.
- [6] Kim N, Kim TY, Han JY, et al., 2023, Five Years' Experience with Gene Panel Sequencing in Hereditary Hemolytic Anemia Screened by Routine Peripheral Blood Smear Examination. *Diagnostics (Basel)*, 13(4): 770.
- [7] Huang L, Fang J, Wu J, et al., 2018, Prognostic Value of Combining Preoperative Serum Tumor Markers and Peripheral Blood Routine Indexes in Patients with Colorectal Cancer. *Chinese Journal of Intestinal Surgery*, 21(12): 1421–1426.
- [8] Keesler DA, St Martin A, Bonfim C, et al., 2018, Bone Marrow versus Peripheral Blood from Unrelated Donors for Children and Adolescents with Acute Leukemia. *Biol Blood Marrow Transplant*, 24(12): 2487–2492.
- [9] Chen J, Wang Y, Hong M, et al., 2024, Application of Peripheral Blood Routine Parameters in the Diagnosis of Influenza and *Mycoplasma pneumoniae*. *Virol J*, 21(1): 162.
- [10] Stichova J, Nechvatalova J, Litzman J, et al., 2021, Possibilities for the Analysis of Peripheral Blood B Cell Subpopulations in a Routine Immunological Laboratory. *Epidemiol Mikrobiol Imunol*, 70(4): 264–280.
- [11] Zhao X, Qin H, Chen W, et al., 2023, Analysis and Clinical Significance of Peripheral Blood Routine Changes of Platelet Donors with Ultra-High Frequency Donation. *Transfus Apher Sci*, 62(2): 103604.
- [12] Asma A, Anissa S, Touhami K, 2020, Aggregation Kinetic and Temperature Optimum of an EDTA-Dependent

Pseudothrombocytopenia. *Clin Chem Lab Med*, 59(1): e31–e33.

- [13] Chen WJ, Du H, Hu HF, et al., 2024, Levels of Peripheral Blood Routine, Biochemical and Coagulation Parameters in Patients with Hemorrhagic Fever with Renal Syndrome and Their Relationship with Prognosis: An Observational Cohort Study. *BMC Infect Dis*, 24(1): 75.
- [14] Gao F, Yang P, Lin Q, et al., 2018, Analysis of the Pre-Test Turnaround Time in Clinical Departments. *Modern Medicine & Health*, 34(24): 3763–3765.
- [15] Li X, Zhang J, Chen X, et al., 2017, Investigation and Analysis of the Total Turnaround Time of Adult Routine Blood Test Specimens in Our Hospital. *China Modern Medicine*, 24(15): 129–131 + 135.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Application of Modified Endoscopic Mucosal Resection and Endoscopic Submucosal Dissection in Treating Rectal Neuroendocrine Tumors and Prognostic Analysis

Yan Chen, Ying Chang\*

Department of Gastroenterology, Affiliated Hospital of Hebei University, 212 Yuhua East Road, Baoding 071000, Hebei, China

\*Corresponding author: Ying Chang, chy4815@126.com

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To analyze the application value of modified endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) in rectal neuroendocrine tumors, with a view to providing new clinical options for the early diagnosis and treatment of patients with such tumors, and thus improving their prognosis. *Methods:* Seventy-two patients with rectal neuroendocrine tumors who underwent surgical treatment in a hospital between October 2023 and September 2024 were selected and divided into a control group and an observation group using the mean score method, each with 36 cases. In the control group, traditional foreign body forceps combined with laparoscopic resection were performed, and in the observation group, modified EMR and ESD were performed as needed. The mass resection rate, histologically intact resection rate, postoperative serum vascular endothelial growth factors (VEGFA, VEGFB, VEGFC levels) in the postoperative period of 7d, and indicators of the rate of related complications of the two groups of patients were compared. *Results:* The mass resection rate of 91.67% and histological complete resection rate of 94.44% in the observation group were significantly higher than those of 72.22% and 66.67% in the control group; the VEGFA, VEGFB, and VEGFC levels of the observation group were  $82.08 \pm 7.94$  ng/ml,  $168.89 \pm 16.53$  ng/ml, and  $121.07 \pm 10.75$  ng/ml, respectively, in the postoperative period of 7 d after surgery; the levels were significantly higher than those of the control group:  $68.39 \pm 6.82$  ng/ml,  $141.06 \pm 14.12$  ng/ml, and  $98.45 \pm 9.87$  ng/ml, respectively, and the difference was statistically significant ( $P < 0.05$ ); the patients in the observation group had a lower rate of surgical complications than those in the control group (2.78% vs 8.33%), the difference was not statistically significant ( $P > 0.05$ ). *Conclusion:* Modified EMR and ESD in rectal neuroendocrine tumors are effective, not only can it effectively improve the rate of mass resection and histological integrity of the resection rate, but it can also further improve the level of serum vascular endothelial growth factor (VEGFA, VEGFB, VEGFC); thus, it is recommended to be promoted for use in clinical practice.

**Keywords:** Modified endoscopic mucosal resection; Endoscopic submucosal dissection; Rectal neuroendocrine tumor

**Online publication:** April 28, 2025

# 1. Introduction

Rectal neuroendocrine tumors (R-NETs) are rare tumors originating from the endocrine cells of the intestinal mucosa, accounting for 1–2% of all rectal tumors <sup>[1]</sup>. With the popularization of endoscopic techniques and the improvement of pathological diagnosis in recent years, the detection rate of R-NETs has been on the rise year by year. According to the World Health Organization (WHO) classification, the prognosis of R-NETs is closely related to tumor size, infiltration depth, histological grading (G1/G2/G3), and lymph node metastasis <sup>[2]</sup>. Among them, G1/G2 grade tumors with a diameter of  $\leq 1$  cm and confined to the mucosa or submucosa usually have a good prognosis, and the 5-year survival rate after complete resection can reach more than 95%; while those with tumors  $> 2$  cm or with myxoid infiltration and lymph node metastasis have a significantly increased risk of recurrence. Therefore, accurate early diagnosis and minimally invasive treatment are crucial for improving patient prognosis <sup>[3]</sup>. Clinically, endoscopic resection is recommended for R-NETs  $\leq 1$  cm in diameter, while  $> 2$  cm or high-grade tumors require radical surgery (e.g., total rectal mesentery resection). However, the treatment strategy for tumors between 1 and 2 cm remains controversial. Endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) are increasingly used as minimally invasive techniques in the treatment of R-NETs <sup>[4]</sup>. EMR is easy to perform and has a short operation time, but there are problems such as insufficient resection depth and a high rate of positive margins. ESD can achieve whole resection and improve the R0 resection rate, but it is technically difficult and has a higher risk of perforation. Currently, studies on the selection of indications, differences in efficacy, and long-term prognosis of the two procedures in R-NETs are still limited, especially the optimal management of 1–2 cm tumors for which no consensus has been reached <sup>[5]</sup>. The aim of this study was to systematically analyze the efficacy of modified EMR versus ESD in the treatment of R-NETs, with a view to providing an evidence-based basis for clinical decision-making.

## 2. Information and methodology

### 2.1. General information

Seventy-two patients with rectal neuroendocrine tumors who underwent surgical treatment in a hospital during the period from October 2023 to September 2024 were selected and divided into a control group and an observation group, each with 36 cases, using the mean score method. The general data of patients in the two groups are shown in **Table 1**.

Inclusion criteria: (1) Histopathologically confirmed diagnosis of rectal neuroendocrine tumor (grade G1/G2), in accordance with the WHO 2019 classification criteria; (2) Tumor confined to the mucosa or submucosa (stage T1) without lymph node or distant metastasis, as assessed by imaging; (3) Treated with modified EMR or ESD, and with complete clinical data (including preoperative evaluation, surgical records, and postoperative follow-up data); (4) Postoperative follow-up  $\geq 12$  months, with regular endoscopic and imaging review records; (5) All patients signed an informed consent form.

Exclusion criteria: (1) Pathological grade of G3 (neuroendocrine carcinoma) or tumor infiltrating the muscularis propria and above (T2–T4) with lymph node/distant metastasis (M1); (2) Previous rectal surgery, radiotherapy or systemic anti-tumor therapy (e.g. chemotherapy, targeted therapy); (3) Intraoperative finding of tumor unable to be completely resected, or intermediate open surgery; (4) Presence of severe cardiac, pulmonary, hepatic, renal functional Insufficiency, unable to tolerate endoscopic surgery; (5) Loss of postoperative visits or incomplete key clinical data (e.g. pathological results, imaging reports).

**Table 1.** Comparison of the general information of patients in the two groups

Groups	Gender		Age (mean $\pm$ SD, years)	Carcinoid diameter [n (%)]		Distance from anal dentate line (mean $\pm$ SD, cm)
	Male	Female		< 7 mm	$\geq$ 7 mm	
Control group ( <i>n</i> = 36)	21	15	50.02 $\pm$ 4.34	24 (66.67)	12 (33.33)	6.34 $\pm$ 1.48
Observation group ( <i>n</i> = 36)	23	13	49.77 $\pm$ 5.28	26 (72.22)	10 (27.78)	6.31 $\pm$ 1.52
$\chi^2/t$	0.2338		0.2195	0.2618		0.0848
<i>P</i>	0.6287		0.8269	0.6089		0.9326

SD: Standard deviation

## 2.2. Methodology

The control group implemented a traditional foreign body clamp combined with loopers resection. Preoperative conventional colonoscopy was performed to clarify the location and scope of the lesion, and then the lesion was fully elevated by submucosal injection of saline (containing epinephrine and indigo carmine), and the proximal mucosa of the lesion was clamped with a foreign body forceps and lifted upward to fully expose the base of the lesion. Subsequently, a high-frequency electrical coiler was placed, and the coiler was tightened at the base of the lesion, and electroresection was performed using the ENDOCUT mode (effect 3, power 40 W). After excision, the wound was inspected, and active bleeding points were stopped using hot biopsy forceps or metal clips. The excision specimen was fixed using filter paper and sent for pathological examination to assess the horizontal and vertical cutting edges. Postoperatively, patients were required to fast for 24 hours and were closely monitored for complications such as delayed hemorrhage or perforation.

The observation group underwent modified EMR and ESD as needed. (1) Endoscopic clear cap-assisted submucosal resection (EMR-C): Endoscopic multi-point injection of a melphalan-saline mixture around the lesion using a mucosal injection needle was performed until the lesion was fully elevated. Subsequently, a transparent cap was installed at the anterior endoscopic end, and the pre-set loopers were embedded in the inner groove of the transparent cap, and the elevated lesion was completely sucked into the transparent cap by negative pressure suction, and the loopers were slowly tightened to ensure complete ligation. A high-frequency electric knife (ENDOCUT mode) was used for resection, and the resection area included the tumor and the surrounding 0.5 cm of normal mucosal tissue. The wound was hemostitized by electrocoagulation and closed with additional titanium clips if necessary. The completely resected specimen was immediately fixed in 10% formalin solution and sent for pathological examination to assess the completeness of the resection. (2) Endoscopic submucosal dissection: Electrocoagulation marking was performed at 0.5 cm from the edge of the lesion using a Dual knife, followed by multi-point injections of a melphalan-saline mixture at the base of the lesion to fully elevate the submucosa. The Dual knife was used to circumferentially incise the mucosal layer along the marking point to reach the submucosal layer, and then the submucosal layer was delicately peeled off, with adequate hemostasis maintained to ensure a clear field of vision, and supplemental submucosal injections were given to maintain the lifting effect when necessary. Care was taken to maintain the integrity of the lesion during dissection until the lesion was completely detached from the muscularis propria. Thorough electrocoagulation was performed to stop hemorrhage, and hemostatic clips were used where appropriate to expose larger vessels. The specimen of complete stripping was fixed in 10% formalin solution immediately after endoscopic removal and sent for pathological examination to assess the horizontal and vertical cutting edges.



## 2.3. Observation indicators

(1) Surgical indicators: Statistical analysis of the rate of whole mass resection, histological complete resection rate, and the rate of related complications in the two groups of patients; (2) Vascular endothelial growth factor (VEGF) levels: 7d after surgery, patients' venous blood was collected and centrifuged to separate the serum, and then the serum was extracted using the enzyme-linked immunosorbent assay (ELISA) to measure VEGFA, VEGFB, and VEGFC levels.

## 2.4. Statistical methods

SPSS 21.0 statistical software was used to process the data, and the measurement information was expressed as mean  $\pm$  SD with *t*-test, and the count information was expressed as percentage (%) with  $\chi^2$  test, and the difference was considered statistically significant with  $P < 0.05$ .

## 3. Results

The whole mass resection rate and histologically complete resection rate of patients in the observation group were higher than those in the control group, and the VEGFA, VEGFB, and VEGFC levels were significantly higher than those in the control group at 7d postoperatively, and the difference was statistically significant ( $P < 0.05$ ); there was no statistical significance in the comparison of the related complication rates between the two groups ( $P > 0.05$ ), as shown in **Table 2**.

**Table 2.** Comparison of clinical outcomes between the two groups of patients

Groups	Whole mass removed [n (%)]	Histologically complete resection [n (%)]	Serum vascular endothelial growth factor (VEGF) levels at 7d postoperatively (mean $\pm$ SD, ng/ml)			Complication rate [n (%)]
			VEGFA	VEGFB	VEGFC	
Control group (n = 36)	26 (72.22)	24 (66.67)	68.39 $\pm$ 6.82	141.06 $\pm$ 14.12	98.45 $\pm$ 9.87	3 (8.33)
Observation group (n = 36)	33 (91.67)	34 (94.44)	82.08 $\pm$ 7.94	168.89 $\pm$ 16.53	121.07 $\pm$ 10.75	1 (2.78)
$\chi^2/t$	4.5997	8.8670	7.8476	7.6809	9.2998	0.2647
<i>P</i>	0.0320	0.0029	< 0.001	< 0.001	< 0.001	0.6069

## 4. Discussion

Rectal neuroendocrine tumors (R-NETs) are a group of low-grade malignant tumors originating from the endocrine cells of the intestinal mucosa, and their biological behaviors are closely related to tumor size, depth of infiltration, and histological grading. Surgical resection is the treatment of choice for G1/G2 grade tumors  $\leq$  2 cm in diameter that are confined to the mucosa or submucosa, with the core goals of achieving R0 resection (negative margins) and reducing the risk of local recurrence, while preserving anal function as much as possible [6]. Conventional foreign body forceps combined with loopers resection is a commonly used endoscopic treatment technique, whereby the lesion is lifted using a foreign body forceps after submucosal injection, and then resected electrically with a loopers [7]. However, there are significant limitations of this procedure: (1) a high rate of segmental resection, which can easily lead to positive margins and increase the risk of residual tumor; (2)



insufficient depth of resection, which makes it difficult to ensure complete resection of the submucosal layer, especially for slightly larger (1–2 cm) or slightly deeper infiltrating tumors<sup>[8]</sup>; (3) restricted intraoperative field of view and less precise operation, which may increase the risk of hemorrhage or perforation; and (4) postoperative pathology assessment is difficult, affecting subsequent treatment decisions<sup>[9,10]</sup>. Therefore, for R-NETs requiring high-precision resection, the efficacy and safety of this procedure are inadequate. Modified endoscopic mucosal resection (EMR-C) can improve the whole resection rate and ensure sufficient resection extent (0.5 cm of normal mucosa outside the tumor) through transparent cap-assisted negative pressure suction, while ESD achieves the whole resection of the lesion through layer-by-layer submucosal dissection, which is especially suitable for larger or complexly located tumors. Both can provide more complete pathological specimens, which is conducive to accurately assessing the status of the margins, and are less invasive with faster recovery, which is an important advancement in the minimally invasive treatment of R-NETs.

The results of this study showed that the whole mass resection rate of 91.67% and the histological complete resection rate of 94.44% in patients of the observation group were significantly higher than those of the control group, which were 72.22% and 66.67% respectively; and the serum VEGFA level in patients of the observation group in the 7d postoperative period was  $82.08 \pm 7.94$  ng/ml, VEGFB level was  $168.89 \pm 16.53$  ng/ml, and VEGFC level was  $121.07 \pm 10.75$  ng/ml, which were significantly higher than those of  $68.39 \pm 6.82$  ng/ml,  $141.06 \pm 14.12$  ng/ml, and  $98.45 \pm 9.87$  ng/ml in the control group, and the difference was statistically significant ( $P < 0.05$ ), suggesting that endoscopic clear-cap assisted mucosal resection (EMR-C) and ESD can obtain more complete tumor clearance, significantly improve the quality of treatment for R-NETs, and reduce the risk of recurrence.

## 5. Conclusion

In conclusion, modified EMR with ESD is a highly effective minimally invasive procedure for the treatment of rectal neuroendocrine tumors, which can significantly improve the whole resection rate and pathological integrity with good safety. Appropriate surgical modalities should be selected according to tumor characteristics in clinical practice to achieve the best prognosis.

## Funding

Clinical Study on Endoscopic Resection of Colorectal Submucosal Tumors Using Underwater Combined with Metal Clip-Assisted Snare, China (Grant No. 2441ZF271)

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Luo P, Liu A, Yi C, et al., 2025, Analysis of the Effect of Ultrasonic Endoscopy Combined with Modified Endoscopic Mucosal Resection in the Treatment of Rectal Neuroendocrine Tumors. *Chongqing Medical Journal*, OnlineFirst, 1–10.
- [2] Wang O, Fu YC, Zhang JC, et al., 2024, Meta-Analysis of the Efficacy of Endoscopic Mucosal Resection with Ligation

Device Versus Endoscopic Submucosal Dissection for the Treatment of Rectal Neuroendocrine Tumors ( $\leq 10$  mm). *Chinese Journal of Endoscopy*, 30(12): 43–54.

- [3] Gui G, Wang H, Yi J, et al., 2024, Clinical Study of Endoscopic Submucosal Dissection Guided by Endoscopic Ultrasonography for the Treatment of Patients with Rectal Neuroendocrine Tumors. *Cancer Progress*, 22(08): 877–880.
- [4] Zhang L, Liu M, Li Q, et al., 2024, Modified Endoscopic Mucosal Resection in Rectal Neuroendocrine Tumors. *Journal of Gastroenterology and Hepatology*, 33(02): 218–222.
- [5] Gao X, 2023, Randomized Controlled Clinical Study of Modified Transparent Cap-Assisted Endoscopic Submucosal Resection Versus Endoscopic Submucosal Dissection for the Treatment of Rectal Neuroendocrine Tumors  $\leq 10$  mm, dissertation, Southern Medical University.
- [6] Cao Y, Zhuang D, Xing Y, et al., 2022, Analysis of the Efficacy of Different Endoscopic Approaches for the Treatment of Rectal Neuroendocrine Tumors. *Chinese Journal of Endoscopy*, 28(11): 48–56.
- [7] Jin Y, Zhou J, Zhao J, et al., 2022, Analysis of Factors Affecting Incomplete Resection and Positive Vertical Margins of Specimens after ESD in Patients with Rectal Neuroendocrine Tumors. *Journal of Bengbu Medical College*, 47(10): 1397–1400 + 1406.
- [8] Luo L, 2022, Analysis of Risk Factors for Non-Curative Resection of Rectal Neuroendocrine Tumors Treated by Transendoscopic Submucosal Dissection, dissertation, Shihezi University.
- [9] Cui J, 2022, Clinical Effect of Endoscopic Submucosal Dissection in the Treatment of Rectal Neuroendocrine Tumors. *Jilin Medicine*, 43(03): 676–678.
- [10] Yang DJ, 2021, Endoscopic Submucosal Dissection of Rectal Neuroendocrine Tumors. *Journal of Digestive Oncology (Electronic Edition)*, 13(01): 83–84.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Research on the Application Value of the Extended Nursing Intervention Model in Senile Dementia Patients

Fang Yu\*, Xiaoxiao Wang

Guangdong Vocational College of Hotel Management, Shenzhen 518000, Guangdong, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the application value of the extended nursing intervention mode in senile dementia patients. *Methods:* A total of 60 cases of Alzheimer's disease patients were selected as the research subjects and divided using the random number table method into the control group and the observation group, each with 30 cases. The control group adopted conventional nursing, while the observation group adopted the extended nursing model of this study. The self-care ability, quality of life, cognitive function, and the frequency of unsafe behaviors were compared between the two groups. *Results:* After 6 months of intervention, the results showed that the scores of all dimensions in the relevant data tables such as the activity of daily living (ADL) scale, simple intelligence scale, and health survey scale in the observation group were higher than those in the control group, and the differences were statistically significant ( $P < 0.05$ ). The incidence of unsafe behaviors in the observation group was lower than that in the control group, and the difference was statistically significant ( $\chi^2 = 5.963$ ,  $P < 0.05$ ). *Conclusion:* Extended nursing plays a positive role in the nursing of Alzheimer's patients, including improving their cognitive function and restoring their self-care ability, so as to significantly improve their quality of life and reduce the occurrence of unsafe behaviors. It can be seen that the extended nursing intervention mode can be vigorously promoted in clinical practice.

**Keywords:** Senile dementia; Extended nursing intervention model; Coping style

**Online publication:** April 30, 2025

## 1. Introduction

The main manifestations of Alzheimer's disease are usually reflected in several aspects. The patients will first experience very significant memory impairment, especially for the decline of recent memory, and as the disease progresses, long-term memory will gradually be impaired. At the same time, the cognitive function of the patients will also show a significant decline, the ability to learn new knowledge will be weakened, and there will be disorientation, a decline in social ability, and other behaviors. Finally, at the mental level, patients may show

personality disorders such as emotional instability, irritability, paranoia, selfishness, and even mental symptoms such as delusions and hallucinations. Head trauma, thyroid disease, familial inheritance, and high or low maternal childbearing age can all contribute to the disease. As the disease worsens, the patient's ability to carry out daily living activities will gradually deteriorate, requiring care to a large extent; and their intelligence level will decline and eventually, they may lose the basic ability to take care of themselves. The purpose of this study was to observe the effect of an extended nursing intervention mode in senile dementia patients.

## **2. General information**

### **2.1. General information selection**

A total of 60 cases of Alzheimer's disease patients were selected as the research subjects and divided using the random number table method into the control group and the observation group, each with 30 cases. The control group had 18 women and 12 men, with an age of about 60 to 80 years old ( $\pm$  two years), the disease duration was about 2 to 10 years. In the observation group, there were 16 women and 14 men, whose ages were between 62 and 83 years old ( $\pm$  two years), and whose disease duration was between 2 and 10 years. The general data of the two groups were comparable.

### **2.2. Inclusion criteria**

In order to ensure the comparability and scientificity of the study, relatively strict inclusion criteria have been formulated. It is reflected in the following points: (1) All patients' clinical performance records and medical records must be complete, which is convenient for later comparative analysis and accurate report data; (2) Informed consent must be signed by the patient or the patient's family face to face, agreeing to participate in this study and accept the relevant examination and treatment; (3) The patient's condition is relatively stable, and all patients need to have a high compliance; (4) Patients with hepatic and renal insufficiency, coagulation dysfunction, combined immune system disorders, and systemic infection were excluded to ensure the smooth progress of the study.

Through the above strict research subject screening and inclusion criteria design, we could further ensure that the research subjects meet our research standards and ensure the scientificity and reliability of the research results. These will also lay a good foundation for us to carry out this study, and bring a favorable auxiliary diagnostic basis for clinical medical research.

### **2.3. Methods**

In this study, the control group adopted conventional nursing. During the hospitalization of patients, nursing staff should accompany them throughout the whole process, and explain the causes and symptoms of the disease to patients and their families in time to ensure that they have sufficient knowledge reserve to deal with follow-up nursing problems. At the same time, after discharge, the nursing staff will inform the patients of the follow-up visit time by telephone and other means, and provide guidance on the relevant drug use.

The observation group was treated with extended nursing intervention, the specific process was as follows: During hospitalization: (1) According to the situation of patients, an extended nursing group composed of family caregivers, community doctors, and psychological counselors was established. (2) A patient-centered attitude was maintained to understand and address patients' problems. Simultaneously, the patients' families were guided to

view situations from the patients' perspectives, to increase empathy and understanding, respect their circumstances, and avoid harming their self-esteem. (3) Modern equipment was utilized to establish communication channels. For instance, WeChat groups were created by hospitals to send information related to Alzheimer's disease to families and patients. Regular updates on staged treatment measures and precautions were shared to guide families and patients to read together, thereby enhancing their confidence in managing the disease. (4) An electronic registration form was used to record the personal and contact information of discharged patients to facilitate follow-up communication. Post-discharge care: (1) Psychological interventions were provided for patients and their families. Psychological counselors maintained communication with both groups, scheduled weekly video calls, responded to patients' questions, and offered sufficient care and respect. The depth of communication was continuously enhanced, and recent life difficulties were addressed as much as possible. Concurrently, communication with family members was maintained, and timely encouragement was provided to help them maintain a positive outlook. (2) Interventions in patients' daily lives were carried out. Patients were guided in performing simple tasks such as making their beds, dressing, and washing dishes, in order to gradually develop and improve their independent living and self-care abilities. During this process, activities such as going for walks and sunbathing were incorporated to increase opportunities for outdoor contact and to support patients in completing activities more smoothly. (3) Guidance and interventions concerning medication management were provided to both patients and their families. The use of Alzheimer's drugs was generally guided by clear indicators. Medical staff ensured that detailed information regarding dosages and the use of related medications was sent to the mobile phones of patients and their family members, thereby enhancing the accuracy and timeliness of medication administration. In this way, family members were also enabled to play a supervisory role. Additionally, relevant knowledge about Alzheimer's disease was regularly sent to patients and their families to help them carry out follow-up care with a more stable state of mind. (4) Safe nursing guidance was also emphasized. Caregivers were informed that identification cards containing family contact information could be worn on the wrist or attached in other secure locations to prevent loss of contact if the patient went missing. At home, hazardous substances and items that could pose a danger to patients were properly stored in locations out of their reach, in order to prevent accidental injury or harm to others. The indoor home environment was arranged with particular attention to soft and simple furnishings to minimize the risk of injury from falls or collisions. (5) Regular follow-up visits for the disease were scheduled. Communication between nursing staff and family members was conducted to arrange home visits every two weeks. The patient's recent condition was recorded in detail, and the follow-up frequency was adjusted based on the progression of the disease. At the end of each month, educational sessions on Alzheimer's disease were held, with both patients and family members invited to participate. These sessions emphasized the importance of home-based care and aimed to standardize caregiving practices to improve follow-up outcomes. Both groups were required to undergo interventions over a six-month period

## 2.4. Observation indicators

The cognitive function, self-care ability, quality of life, and incidence of unsafe behaviors were mainly compared between the two groups:

- (1) Cognitive function: Starting from seven aspects such as orientation, attention, computation, memory, recall, and language, the simple intelligence scale was used to evaluate the cognitive function of the patients before and after the intervention for 6 months. The total score was 30, where > 27 points indicates that the cognitive function of the patients was normal.



- (2) Self-care ability: The self-care ability of patients before and 6 months after intervention was assessed by the Activity of Daily Living (ADL) scale. The scale targets 10 basic items such as dressing and eating, with a full score of 100. A higher score indicates a stronger self-care ability.
- (3) Quality of life. A health survey scale was used to assess the condition of the patients before the intervention and after the completion of the 6-month intervention. The scale contains 36 items and is divided into eight dimensions in total. At the same time, a 6-level scoring method is adopted in the evaluation, which is converted into a percentage system for evaluation. The full score of each dimension is 100 points; the higher the score, the higher the quality of life of patients.
- (4) Unsafe behavior: It refers to the occurrence of unsafe behavior such as falling and attacking others during the nursing period of patients. Specifically, all patients in the two groups were evaluated. The measurement data were expressed as the number of cases and percentage (%), and  $\chi^2$  test was used for comparison between groups.  $P < 0.05$  was considered statistically significant.

### 3. Results

#### 3.1. Cognitive function and self-care of patients in the two groups before and after intervention

Before intervention, there was no statistical significance in the scores of the simple intelligence scale and ADL scale between the two groups ( $P > 0.05$ ). After 6 months of intervention, the simple intelligence scale data and the ADL scale data of the observation group were higher than those of the control group, with statistical significance ( $P < 0.05$ ), as shown in **Table 1**.

**Table 1.** Scores of cognitive function and self-care ability of patients in the two groups before and after intervention (points)

Group	MMSE		ADL	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Control group ( $n = 30$ )	12.34 $\pm$ 3.46	17.36 $\pm$ 3.78	22.36 $\pm$ 8.76	41.39 $\pm$ 10.28
Observation group ( $n = 30$ )	12.56 $\pm$ 3.28	25.56 $\pm$ 3.98	22.45 $\pm$ 8.64	58.73 $\pm$ 12.43
$t$	0.253	8.183	0.040	5.888
$P$	0.801	0	0.968	0

#### 3.2. Quality of life of patients in the two groups before and after intervention

In terms of quality of life, compared with SF-36 scores before intervention, there was no statistical significance between the two groups ( $P > 0.05$ ). However, after the intervention, the SF-36 scores of the observation group were higher than those of the control group in all dimensions, with statistical significance ( $P < 0.05$ ), as shown in **Table 2**.



**Table 2.** Quality of life of patients in the two groups before and after intervention (points)

Group	Physiology		Psychology		Physical pain		General health		Energy		Social		Emotional		Mental health	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Control group ( <i>n</i> = 30)	60.53 ± 2.41	71.36 ± 3.52	58.44 ± 2.30	69.43 ± 3.45	60.26 ± 2.51	72.57 ± 3.46	61.39 ± 2.68	73.35 ± 3.41	61.38 ± 2.44	72.59 ± 3.08	60.36 ± 2.31	74.55 ± 3.69	62.45 ± 2.39	71.57 ± 3.22	60.38 ± 2.31	74.56 ± 3.59
Observation group ( <i>n</i> = 30)	60.46 ± 2.32	80.59 ± 3.97	58.53 ± 2.41	78.39 ± 4.15	60.18 ± 2.45	80.43 ± 3.95	61.46 ± 2.71	81.46 ± 4.07	61.42 ± 2.51	79.47 ± 3.94	60.29 ± 2.23	81.36 ± 4.13	62.67 ± 2.46	81.69 ± 4.05	60.45 ± 2.39	81.37 ± 4.18
<i>t</i>	0.115	9.528	0.148	9.094	0.125	8.199	0.101	8.180	0.063	7.535	0.119	6.735	0.351	10.713	0.115	6.769
<i>P</i>	0.909	0	0.883	0	0.901	0	0.920	0	0.950	0	0.906	0	0.727	0	0.909	0

### 3.3. Occurrence of unsafe behaviors in the two groups

In terms of the occurrence of unsafe behaviors, the incidence of unsafe behaviors in the observation group was much lower than that in the control group, and the difference was statistically significant ( $P < 0.05$ ), as shown in Table 3.

**Table 3.** Occurrence of unsafe behaviors in the two groups [*n* (%)]

Group	Unsure of directions	Falling	Assault	Accidental ingestion	Total
Control group ( <i>n</i> = 30)	3 (10.00)	1 (3.33)	2 (6.67)	5 (16.67)	11 (36.67)
Observation group ( <i>n</i> = 30)	0 (0)	2 (6.67)	0 (0)	1 (3.33)	3 (10.00)
$\chi^2$					5.963
<i>P</i>					0.015

## 4. Discussion

Under the accelerating aging process, Alzheimer's disease has gradually become a popular disease, its induced reasons are usually nerve cell apoptosis, nutritional metabolism disorders, and gene mutations, generally manifested as memory decline, daily life ability decline, personality change, intellectual decline, and other forms. However, in the current medical development process, specific drugs for Alzheimer's patients have not been developed, therefore, long-term care for patients after discharge is indispensable. In the process of fighting against the disease, most patients affected by their own economic ability will not choose long-term hospitalization; there are some patients with relatively mild disease and the condition will not have much change<sup>[1]</sup>, who also do not need long-term hospitalization, these patients generally need rehabilitation training at home, so a sound and reasonable nursing process and life guidance for patients is of great significance.

The results of this study showed that the observation group had higher scores on the simple intelligence scale, ADL scale, and all dimensions of SF-36 than the control group, and the incidence of unsafe behaviors was also lower than the control group, suggesting that extended nursing mode had a significant promoting effect on improving patients' cognitive ability and improving patients' self-care ability<sup>[2]</sup>. Thus, extended nursing can effectively improve their quality of life.

The reasons are as follows: first of all, the extended nursing model can extend and develop the hospital nursing work in the direction of family care. It can help patients and their families improve the follow-up nursing

services after discharge, link the contents of the two directions, so as to continuously improve the quality of life of patients and reduce the probability of two or even multiple hospitalizations.

Secondly, extended nursing can conduct a comprehensive assessment of the patient's life ability and recovery, and can reflect the patient's disease progress in real time. It can carry out long-term and sustainable supervision on patients who have left the hospital. This supervision method is also the most effective, and to a certain extent, it can help patients develop a positive and healthy lifestyle. The traditional nursing work will become more detailed, specific, and scientific, to ensure that medical staff can solve the problems encountered in the process of patient discharge care, and ultimately continue to improve the nursing effect. In detail, psychological intervention can be conducted through in-depth communication with patients, give them sufficient respect and care, and discover the existing problems, to meet their psychological needs, to help establish a positive attitude and confidence in life, so as to stabilize the development trend of the patient's condition <sup>[3]</sup>. At the same time, due to the patient's illness, their cognitive ability and memory for things will be seriously decreased; the use of cognitive care can effectively alleviate the development of such diseases by going out and talking about the past to intervene to continuously enhance their awareness of the external environment.

In daily life, patients' rest time is also an important focus of extended nursing intervention. Helping them to reasonably arrange daily activities and rest time can continuously enhance patients' awareness of independent life, thus delaying the development of the disease. Medication guidance is to intervene in patients' medication mode, so that they can standardize medication and ensure the rationality of medication <sup>[4]</sup>. Safety nursing intervention is to reduce potential risks and prevent unsafe behaviors by wearing cards with contact information for patients and keeping dangerous goods away <sup>[5]</sup>.

Finally, it is necessary to regularly have follow-up visits to patients and their families and understand the development process of the disease of patients, develop more targeted care for them, as well as ensure operability, and constantly improve the quality of life of patients and their families.

## 5. Conclusion

Extended nursing has proven to be highly beneficial in the nursing and management of Alzheimer's patients, offering comprehensive support that enhances both physical and mental well-being. One of its most notable advantages is the improvement of cognitive function in patients. Through structured activities, cognitive stimulation therapies, and personalized care plans, extended nursing helps slow the progression of memory loss and mental decline, enabling patients to maintain better mental clarity for a longer period.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Liu C, He X, 2021, Effects of Targeted Nursing on Cognitive Function and Incidence of Adverse Events in Patients with Senile Dementia in Neurology Department. *Guizhou Medicine*, 45(4): 656–657.
- [2] Du H, Liu C, Liu X, et al., 2019, Effect of Montessori Education Theory on Cognitive Function and Quality of Life in Patients with Mild to Moderate Senile Dementia. *Journal of Nursing*, 26(5): 59–62.

- [3] Sun Y, Yu Y, Lu X, et al., 2019, Effect of Extended Care on Treatment Compliance and Quality of Life in Patients with Chronic Atrophic Gastritis. *Journal of Changchun University of Traditional Chinese Medicine*, 35(1): 156–159.
- [4] Wei J, Liu H, Lu H, et al., 2019, Application of Continuous Care based on Siebens Domain Management Model in Patients with Severe Cerebral Hemorrhage. *Chinese Journal of Modern Nursing*, 27(22): 3055–3059.
- [5] He L, Huang Y, Hou L, et al., 2019, Application Effect of Continuous Nursing based on 5E Rehabilitation Model in Hemodialysis Treatment of Patients with Mineral and Bone Abnormalities in Chronic Kidney Disease. *Guangxi Medical Journal*, 42(5): 651–655.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Evaluation of the Efficacy of Endoscopic Submucosal Dissection for the Treatment of $\geq 40$ mm Protruding Colorectal Tumors

Yan Chen, Ying Chang\*

Department of Gastroenterology, Affiliated Hospital of Hebei University, 212 Yuhua East Road, Baoding 071000, Hebei, China

\*Corresponding author: Ying Chang, [chy4815@126.com](mailto:chy4815@126.com)

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the effectiveness and safety of endoscopic submucosal dissection (ESD) in the treatment of  $\geq 40$  mm protruding colorectal tumors. *Methods:* Sixty-five patients with colorectal tumors who underwent surgical treatment in the Department of Anorectal Surgery of a hospital from July 2023 to June 2024 were selected and grouped according to the type of surgery, with 33 cases of **endoscopic mucosal resection (EMR) patients included in the control group, and 32 cases of ESD patients included in the observation group.** The surgical characteristics, adverse events, as well as the fasting time, postoperative hospital stay, and hospital costs of the two groups were compared. *Results:* The whole resection rate of the control group and the observation group was 100% and 69.70%, respectively, and the difference was statistically significant ( $P < 0.05$ ); there was no incidence of intraoperative hemorrhage, delayed hemorrhage, and perforation adverse events in the observation group, and the intraoperative hemorrhage rate of the control group was 9.09%, the delayed hemorrhage rate was 6.06%, and the perforation rate was 3.03%, and the difference was statistically significant ( $P < 0.05$ ); postoperative fasting time in the control group and observation group was  $1.13 \pm 0.32$  d vs  $1.22 \pm 0.33$  d, postoperative hospital stay was  $4.1 \pm 1.3$  d vs  $4.6 \pm 1.5$  d, and total hospitalization cost was  $9,639.8 \pm 1,303.5$  yuan vs  $9,978.6 \pm 1,506.8$  yuan, with statistically significant differences ( $P > 0.05$ ). *Conclusion:* The efficacy of endoscopic submucosal dissection for the treatment of  $\geq 40$  mm protruding colorectal tumors is precise, with a high rate of whole resection, which can significantly reduce the risk of intraoperative bleeding, delayed bleeding, perforation, and other adverse events.

**Keywords:** Endoscopic submucosal dissection; Protruding colorectal tumor; Resection rate; Adverse events

**Online publication:** April 28, 2024

## 1. Introduction

Colorectal tumors are one of the common malignant digestive tumors, and their incidence is increasing year by

year globally. With the rapid development of endoscopic technology, endoscopic submucosal dissection (ESD), as a minimally invasive treatment, has become an important therapeutic option for early colorectal tumors <sup>[1]</sup>. Compared with traditional endoscopic mucosal resection (EMR), ESD has a higher whole-mount resection rate and a lower incidence of adverse events, and is particularly suitable for the resection of larger lesions <sup>[2]</sup>. However, the therapeutic efficacy and safety of ESD for protruding colorectal tumors  $\geq 40$  mm in diameter still need to be further explored <sup>[3]</sup>. Protruding colorectal tumors usually present morphologically as polypoid or broad-based lesions, and their biological behavior may vary depending on size, location, and pathological type. Tumors  $\geq 40$  mm in diameter tend to have a higher risk of malignant potential and submucosal infiltration, thus requiring more stringent requirements for complete resection. Traditional surgical resection methods (e.g., EMR) are difficult to achieve complete resection of large lesions due to technical limitations, and often require piecemeal resection, which not only increases the difficulty of pathological assessment, but also leads to local recurrence due to incomplete resection <sup>[4]</sup>. In addition, segmental resection may also mask the infiltration depth of the lesion, affecting subsequent treatment decisions <sup>[5]</sup>. In contrast, ESD is able to achieve whole piece resection of large lesions through precise submucosal dissection techniques, providing a more complete specimen for pathological evaluation, and thus determining the depth of infiltration of the tumor and the status of the margins more accurately <sup>[6]</sup>. Currently, most domestic and international studies on ESD for large colorectal tumors focus on early gastric or esophageal cancers, and clinical data for protruding colorectal tumors with a diameter  $\geq 40$  mm are relatively limited. Although studies have shown that ESD has a high degree of safety and efficacy in the treatment of colorectal tumors, for large lesions, the technical difficulty and the risk of complications (e.g., perforation, bleeding, etc.) may be significantly increased <sup>[7]</sup>. Therefore, systematic evaluation of the efficacy and safety of ESD in such patients is important for optimizing clinical treatment strategies. The aim of this study was to investigate the whole resection rate, complete resection rate, and complication rate of ESD for  $\geq 40$  mm diameter protruding colorectal tumors by retrospective analysis and to compare it with conventional EMR treatment, so as to provide a more reliable evidence-based medical basis for minimally invasive treatment of colorectal tumors by clarifying the value of the clinical application of ESD in such patients.

## 2. Information and methodology

### 2.1. General information

Sixty-five patients with colorectal tumors who underwent surgical treatment in the Department of Anorectal Surgery of a hospital from July 2023 to June 2024 were selected and grouped according to the type of surgery, with 33 patients who underwent EMR included in the control group, and 32 patients who underwent ESD included in the observation group. In the control group, there were 20 males and 13 females, aged 55–69 years old, with an average of  $60.25 \pm 2.46$  years old; the lesion sites were: the right half of the colon in 21 cases, the left half of the colon and the rectum in 12 cases; the maximum diameter of the tumor was  $41.12 \pm 3.15$  mm. In the observation group, there were 22 males and 10 females, aged 56–70 years old, with an average of  $61.05 \pm 2.17$  years old; the lesion sites were: the right half of the colon in 19 cases, the left half of the colon and the rectum in 13 cases; and the maximum diameter of the tumor was  $40.72 \pm 3.00$  mm. The general data of the two groups of patients were compared, the difference was not statistically significant ( $P > 0.05$ ). The study protocol was approved by the Medical Ethics Committee of our hospital, and all patients voluntarily signed a written informed consent.

Inclusion criteria: (1) single protruding (polypoid or broad-based) colorectal tumor with a diameter of



≥ 40mm confirmed by endoscopy or imaging; (2) high-grade intraepithelial neoplasia (HGIN), intramucosal carcinoma (Tis/T1a), or superficial submucosal infiltration (SM1, with an infiltration depth of < 1000 μm); (3) no lymph node metastasis confirmed by ultrasonic endoscopy/EUS, CT/MRI (cN0) and distant metastasis (cM0); (4) patients signed informed consent and tolerated general anesthesia and ESD surgery (without severe cardiopulmonary dysfunction).

Exclusion criteria: (1) pathologically confirmed T1b (SM2/3, infiltration depth ≥ 1000 μm) or more advanced (≥ T2); (2) imaging or pathological confirmation of the presence of lymph node metastasis (pN+) or distant metastasis (M1); (3) lesions combined with ulceration, scarring, or deep infiltration signs (e.g., submucosal fibrosis, negative elevation sign); (4) combined with uncorrectable coagulation abnormalities (INR > 1.5, platelets < 50 × 10<sup>9</sup>/L) or inability to suspend anticoagulant drugs; (5) concomitant contraindications to pregnancy, active inflammatory bowel disease, and history of previous colorectal surgery resulting in anatomical abnormalities.

## **2.2. Methodology**

### **2.2.1. Control group**

Endoscopic mucosal resection (EMR) was performed in the control group. Preoperatively, the extent of the lesion was accurately assessed, and the lesion was augmented by submucosal injection of glycerol fructose-indigo carmine mixture (containing epinephrine). For pedunculated polyps, direct electrodes were used with a loop device, while broad-based lesions were resected in pieces by the “injection-loop” method; the trauma was treated with electrocoagulation to stop hemorrhage, and metal clips were used to close the defects if necessary, and close follow-up was required after the operation.

### **2.2.2. Observation group**

Endoscopic submucosal dissection (ESD) was performed in the observation group. The surgery was performed in strict accordance with the standard operating procedures: (1) mucosal marking: a high-frequency electric knife was used to mark the edge of the lesion at 0.5 cm with electrocoagulation; (2) submucosal injection: a mixture of indigo carmine-glycerol fructose-adrenaline was used for multiple injections, so as to make the submucosal layer rise sufficiently and form a stable “liquid cushion”; (3) marginal preincision: an IT knife or Dual knife was used to circumferentially incise the mucosa along the lateral side of the marked point; (4) submucosal dissection: the submucosal layer was gradually separated, keeping the field clear, and completely peeling off the lesion, and electrocoagulation was used during the operation to prevent bleeding; (5) wound treatment: metal clips were used to close the exposed muscular layer or electrocoagulation, and closely monitoring the complications such as delayed hemorrhage and perforation in the postoperative period.

## **2.3. Observation indicators**

Statistical analysis of surgical characteristics (whole or segmental resection), adverse events (intraoperative hemorrhage, postoperative hemorrhage, perforation), as well as indicators of duration of fasting, postoperative hospital stay, and hospital costs.

## **2.4. Statistical methods**

SPSS23.0 software was applied for statistical analysis, and the measurement information was expressed as mean ± standard deviation (SD), and *t*-test was used for comparison, and the count information was expressed as rate (%),



and  $\chi^2$  test was used for comparison, and  $P < 0.05$  was considered statistically significant difference.

### 3. Results

The whole block resection rate of the control group and observation group was 100% and 69.70%, and the R0 resection rate was 93.75% and 63.64%, respectively, with statistically significant differences ( $P < 0.05$ ); the incidence of intraoperative bleeding, delayed hemorrhage, and perforation adverse events in the observation group was 0, while the intraoperative bleeding rate of the control group was 9.09%, the rate of delayed hemorrhage was 6.06%, and the rate of perforation was 3.03%, the difference was statistically significant ( $P < 0.05$ ); the postoperative fasting time, postoperative hospitalization time, and total hospitalization cost of the two groups were compared, the difference was not statistically significant ( $P > 0.05$ ). See **Table 1**.

**Table 1.** Comparison of surgical data, adverse events, and postoperative conditions between the two groups

Groups	Block resection [n (%)]	Adverse events			Postoperative indicators		
		Intraoperative bleeding	Delayed hemorrhage	Perforation	Fasting time (d)	Length of postoperative stay (d)	Total cost of hospitalization (\$)
Control group (n = 33)	23 (69.70)	3 (9.09)	2 (6.06)	1 (3.03)	1.13 ± 0.32	4.1 ± 1.3	9639.8 ± 1303.5
Observation group (n = 32)	32 (100)	0	0	0	1.22 ± 0.33	4.6 ± 1.5	9978.6 ± 1506.8
$\chi^2/t$	9.2504		4.4235		1.5595	1.4375	0.9704
P	0.0024		0.0354		0.1239	0.1555	0.3355

### 4. Discussion

With the change of dietary structure and population aging, the incidence of colorectal tumors in China has shown a continuous upward trend. As an important clinical subtype, protruding colorectal tumors usually present as polypoid or broad-based lesions with a clear potential for malignant transformation. The incidence of high-grade intraepithelial neoplasia or early-stage carcinoma can be more than 30% for protruding colorectal tumors  $\geq 40$  mm in diameter<sup>[8]</sup>. Meanwhile, because the increase in tumor size is often accompanied by an elevated chance of submucosal infiltration, timely and complete resection is crucial to the prognosis. Although traditional surgery can ensure the extent of resection, it has the disadvantages of high trauma, slow recovery, and many complications. Endoscopic treatment, on the other hand, faces three major technical difficulties: first, the wide extent of the lesion makes complete resection difficult; second, the rich vascularity of the submucosal layer presents a high risk of intraoperative hemorrhage; and third, the thin wall of the colon, especially the right half of the colon, presents a significant increase in the risk of perforation<sup>[9]</sup>. In addition, the location of the lesion (e.g., distal rectum or hepatic-splenic flexure of the colon) significantly affects the difficulty of the operation, making endoscopic treatment of tumors  $\geq 40$  mm a major clinical challenge. ESD is an advanced endoscopic minimally invasive treatment technique, the core of which lies in the whole resection of the lesion through precise submucosal dissection, which mainly consists of three key links<sup>[10]</sup>: (1) formation of sufficient operating space through submucosal injections, and commonly used injections contain sodium hyaluronate, glycerol fructose, etc., which can maintain the

augmentation effect for a longer period of time; (2) circumferential preincision using a special electric knife (e.g., IT knife, Dual knife) to establish a clear resection boundary; (3) layer-by-layer peeling of the submucosal layer, and control of intraoperative bleeding through precise electrocoagulation hemostasis to achieve a true radical resection<sup>[11]</sup>.

In this study, by examining the whole resection rate, intraoperative bleeding rate, delayed bleeding rate, perforation rate, postoperative fasting time, postoperative hospitalization time, total hospitalization cost, and other indexes of the two groups of patients under different surgical protocols, it was found that the whole resection rate of the control group and the observation group was 100% and 69.70%, respectively, and the difference was statistically significant ( $P < 0.05$ ). The incidence of adverse events in the observation group was 0, while the intraoperative bleeding rate of the control group was 9.09%, the delayed bleeding rate was 6.06%, and the perforation rate was 3.03%, and the difference was statistically significant ( $P < 0.05$ ); the postoperative fasting time of the control group and the observation group was  $1.13 \pm 0.32$  d vs  $1.22 \pm 0.33$  d, the postoperative hospital stay was  $4.1 \pm 1.3$  d vs  $4.6 \pm 1.5$  d, and the total hospitalization cost was  $9639.8 \pm 1303.5$  yuan vs  $9978.6 \pm 1506.8$  yuan, the difference was not statistically significant ( $P > 0.05$ ). The reasons for this analysis were mainly attributed to the fact that ESD significantly reduced intraoperative bleeding through fine submucosal dissection techniques and effective hemostatic measures, and the risk of delayed bleeding could be controlled to less than 5% by using techniques such as prophylactic hemostatic clamping<sup>[12]</sup>; and the systematic submucosal dissection techniques maintained the perforation rate at an acceptable level (about 4–6%), making ESD the minimally invasive treatment of choice for large colorectal tumors.

## 5. Conclusion

In conclusion, endoscopic submucosal dissection for  $\geq 40$  mm protruding colorectal tumors is effective with a high rate of complete resection, and significantly reduces the risk of intraoperative hemorrhage, delayed hemorrhage, perforation, and other adverse events.

## Funding

Clinical Study on Endoscopic Resection of Colorectal Submucosal Tumors Using Underwater Combined with Metal Clip-Assisted Snare, China (Grant No. 2441ZF271)

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Zheng S, Yang L, 2025, Comparison of Clinical Efficacy of Endoscopic Submucosal Dissection and Laparoscopic Radical Surgery for Patients with Early Colorectal Cancer. Chinese Journal of Surgical Oncology, 17(01): 31–35.
- [2] Gao Y, Wang Y, Jia C, et al., 2025, Observation on the Clinical Effect of Endoscopic Submucosal Dissection in the Treatment of Bulging Colorectal Epithelial Tumor. Journal of Clinical Military Medicine, 53(02): 195–197.
- [3] Zhang Y, 2025, Application Value of Endoscopic Mucosal Resection and Endoscopic Mucosal Dissection in the

Treatment of Early-Stage Cancer and Precancerous Lesions in the Upper Gastrointestinal Tract. *China Modern Drug Application*, 19(03): 37–40.

- [4] Li Y, Zhang W, 2025, Clinical Effect of Endoscopic Submucosal Dissection in the Treatment of Precancerous Lesions and Early Stage of Cancer in the Digestive System. *China Medical Innovation*, 22(04): 48–51.
- [5] Xin J, Liu F, 2024, Analysis of Factors Affecting the Medium- and Long-Term Prognosis of Patients with Early Upper Gastrointestinal Tract Cancer Treated with Endoscopic Submucosal Dissection. *Guizhou Medicine*, 48(12): 1926–1928.
- [6] Liao Y, Feng S, Chen L, et al., 2024, Analysis of Risk Factors for Postoperative Delayed Bleeding After Endoscopic Submucosal Dissection in Patients with Gastrointestinal Tract Tumors and the Value of Nursing Guidance. *China Medical Guide*, 22(36): 13–16.
- [7] Zeng J, Chen J, Miao R, et al., 2024, Research Progress of Endoscopic Submucosal Dissection for Superficial Hypopharyngeal Carcinoma. *Modern Gastroenterology and Interventional Diagnosis and Treatment*, 29(12): 1488–1492.
- [8] Wang Z, Yang X, Gong J, et al., 2024, A Study on the Difference between Endoscopic Submucosal Dissection and Laparoscopic Surgery in the Treatment of Patients with Gastric Mesenchymal Tumor. *Modern Medicine and Health Research Electronic Journal*, 8(24): 86–89.
- [9] Zhao X, Guo J, Zhang X, et al., 2024, Comparison of the Efficacy and Complications of Early Esophageal Cancer Patients with Different Lesion Lengths Treated by Endoscopic Mucosal Dissection. *Journal of Practical Cancer*, 39(12): 2017–2020.
- [10] Du W, Shi X, 2024, Comparative Study on the Effects of Endoscopic Mucosal Resection and Endoscopic Submucosal Dissection in the Treatment of Patients with Early Gastric Cancer. *Modern Medicine and Health Research Electronic Journal*, 8(23): 76–78.
- [11] Lu Y, Ling T, 2024, Comparative Observation of Sleeve-Assisted Endoscopic Gastric Mucosal Resection and Endoscopic Gastric Mucosal Dissection for the Treatment of Gastric Submucosal Tumors with Tumor Diameter < 10 mm. *Shandong Medicine*, 64(33): 56–58.
- [12] Peng YM, 2024, Diagnostic Value of JNET Typing and Pitpattern Typing for  $\geq 30$  mm Diameter Bulging Colorectal Epithelial Tumors and its Influencing Factors, dissertation, Guizhou Medical University.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Exploring the Effectiveness of a Rapid Diagnostic Kit for Identifying Snake Venom Types in Blood Tests

Linfeng Zheng<sup>1</sup>, Ming Liu<sup>2</sup>, Ying Gao<sup>2</sup>, Biao Wu<sup>2\*</sup>

<sup>1</sup>Department of Emergency, The People's Hospital of Renshou County, Renshou 620500, Sichuan, China

<sup>2</sup>Department of Critical Medicine, The People's Hospital of Renshou County, Renshou 620500, Sichuan, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To develop a rapid diagnostic kit for identifying snake venom types, aimed at providing a basis for clinical diagnosis and laying a foundation for early treatment through quick blood testing of injured patients. *Methods:* Anti-snake venom immunoglobulin (IgG) was prepared, biotinylated specific IgG was screened, detection enzyme-labeled strips were produced, and rapid identification of snakebites was performed. Pre-experimental verification was conducted to establish standard curves and confirm specificity. The kit was tested on clinical samples and the results were analyzed. Repeatability and stability were evaluated through multiple repeated tests and experiments under different storage conditions. Finally, sensitivity and specificity were calculated, receiver operating characteristic curves (ROC curves) were drawn, and statistical analysis software was used for data analysis to ensure the reliability and effectiveness of the kit. *Results:* The test showed high sensitivity and specificity. *Conclusion:* The rapid diagnostic kit for identifying snake venom types in blood tests demonstrates high reliability and effectiveness in clinical diagnosis.

**Keywords:** Blood test; Snake venom types; Rapid diagnostic kit

**Online publication:** April 29, 2025

## 1. Introduction

Snakebites are a common and dangerous occurrence in daily life, with high mortality and disability rates. Globally, there are approximately 1.8 to 2.7 million cases of snakebites annually, resulting in 81,000 to 138,000 deaths<sup>[1]</sup>. Indirect information such as the condition of the wound and its surroundings, systemic clinical manifestations, and laboratory test results have traditionally been used to determine the type of snake venom. Based on these basic judgments, patients are provided with anti-snake venom serum for emergency treatment<sup>[2]</sup>. However, in clinical diagnosis, if the type of snake venom cannot be accurately and promptly determined, polyvalent anti-snake venom

serum is often used for detoxification. This approach has a lower potency and requires larger doses, leading to a higher incidence of side effects for patients. Therefore, clinical medical staff need to quickly identify the type of snake venom in patients within a short period and provide targeted treatment accordingly. This approach can improve the detoxification effect and enhance patient safety. To this end, this article explores the application effectiveness of a rapid diagnostic kit in the rapid blood testing of injured patients, providing a basis for the smooth progress of clinical diagnosis and improving the effectiveness and safety of snakebite treatment.

## 2. Materials and methods

### 2.1. General information

Ninety patients bitten by snakes (*Agkistrodon halys*, *Trimeresurus mucrosquamatus*, and *Trimeresurus stejnegeri*) in Renshou County from May to October 2025 were selected as research subjects. Serum samples were collected from the bite sites for repeatability and stability experiments. Among the patients, 45 were male and 45 were female, aged between 18 and 81 years old ( $54.27 \pm 2.50$ ). The study complied with medical ethical standards.

### 2.2. Methods

#### 2.2.1. Preparation of the rapid diagnostic kit for snake venom types

Three types of snake venoms were selected for identification, including *Agkistrodon halys*, *Trimeresurus mucrosquamatus*, and *Trimeresurus stejnegeri*. The venoms were dissolved in 20mM PBS and centrifuged to obtain the supernatant. The protein content was then measured. The venom was injected into rats via subcutaneous multi-point injection to prepare polyclonal anti-snake venom crude serum. The crude serum was precipitated using ammonium sulfate to remove non-protein components. The anti-snake venom IgG was purified using a Hitrap protein IgG column. The snake venoms were coupled to activated CNBr-activated Sepharose 4B affinity media, and an equal amount of wet affinity media coupled with any two venoms was mixed and loaded into a centrifugal concentration tube.

At room temperature, the anti-snake venom IgG was mixed with the remaining coupled affinity media. After centrifugation, the eluate was collected to produce species-specific IgG that differed from the other two venoms. It was mixed with biotin at a ratio of 1:5. The mixture was shaken and combined for 2 hours at room temperature, and the unbound biotin was removed to obtain biotinylated specific IgG. A 5-well enzyme standard strip and a “T”-shaped bracket were used to make a detection enzyme-labeled strip with three detection wells. One positive control well and one negative control well were set up, blocked with 2% bovine serum, rinsed, dried, and stored at -20°C. Wound fluid from snakebite patients was collected and dripped into each detection well, which was then combined with biotinylated specific IgG and avidinated HRP, followed by the addition of TMB for color development. The type of snake venom was identified based on the reaction in different detection wells.

#### 2.2.2. Evaluation of the diagnostic efficacy of the rapid diagnostic kit for snake venom types

After completing the kit, serum samples from patients bitten by *Agkistrodon halys*, *Trimeresurus mucrosquamatus*, and *Trimeresurus stejnegeri* in Renshou County were selected. A pre-experiment was conducted by diluting the venom serum samples to different concentrations and detecting them using the rapid diagnostic kit. The color intensity (OD value) corresponding to different concentrations was recorded. Standard curves of color intensity (OD value) corresponding to different concentrations were drawn for quantitative analysis in subsequent experiments.



The kit was used to test samples of *Agkistrodon halys*, *Trimeresurus mucrosquamatus*, and *Trimeresurus stejnegeri* venoms to determine the specificity of IgG for each venom. The detection results showed no cross-reaction with other non-target venom samples. Clinical sample testing was performed by obtaining blood samples from patients and centrifuging them to obtain the supernatant. The processed blood samples were placed in the reagent detection wells. According to the kit instructions, biotinylated specific antibodies, avidinated HRP, and TMB substrates were added to obtain color reaction time and intensity information.

Using the standard curve from the pre-experiment as a reference, the color intensity (OD value) in the clinical test results was converted into the corresponding venom concentration. The diagnostic consistency rate was calculated by comparing the test results with the clinical diagnosis. Repeatability experiments were conducted by randomly selecting some clinical samples and performing three experiments. The standard deviation and coefficient of variation (CV%) of the test results were calculated to evaluate the repeatability of the kit. Stability tests were performed by storing some detection enzyme strips at different temperatures (-20°C, 4°C, and room temperature) for 1, 3, and 6 months. The diagnostic stability of the kit under different storage conditions was evaluated through testing at different times. Based on the clinical sample test results, the sensitivity and specificity of the kit were calculated, and a receiver operating characteristic curve (ROC curve) was drawn. The area under the curve (AUC) was calculated to evaluate the overall diagnostic efficacy of the kit. Statistical analysis was performed using Stata 14.0 to calculate the 95% confidence interval and evaluate the reliability and effectiveness of the kit.

### 2.3. Observation

Indicators Sensitivity and specificity were calculated, and a receiver operating characteristic curve (ROC curve) was drawn. Statistical analysis software was used for data analysis.

### 2.4. Statistical analysis

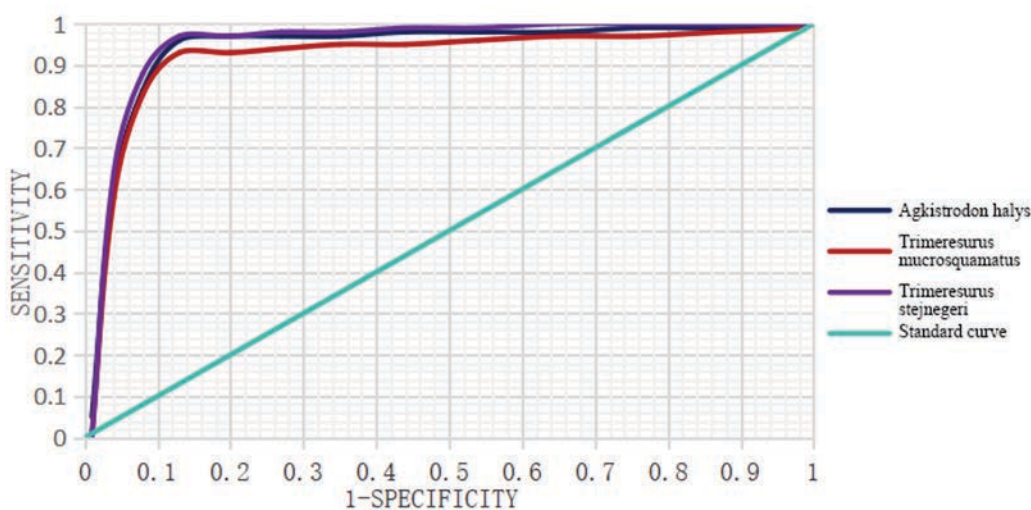
All data from the study were statistically analyzed using Stata 14.0. The 95% confidence interval was calculated to evaluate the reliability and effectiveness of the diagnostic kit.

## 3. Results

### 3.1. Clinical test results

Based on clinical testing, ROC curves were generated for the rapid diagnostic kit's performance in identifying *Agkistrodon halys*, *Trimeresurus mucrosquamatus*, and *Trimeresurus stejnegeri* venoms, as shown in **Figure 1**. For *Agkistrodon halys*, the test sensitivity was 96.67%, specificity was 98.33%, and AUC was 0.943. For *Trimeresurus mucrosquamatus*, the sensitivity was 93.33%, specificity was 98.33%, and AUC was 0.9164. For *Trimeresurus stejnegeri*, the sensitivity was 96.67%, specificity was 96.67%, and AUC was 0.9335.





**Figure 1.** ROC Curve

### 3.2. Stability and reproducibility

Experiment samples were re-examined under different temperatures and storage durations, and the results remained unchanged.

## 4. Discussion

Snake venom is a natural protein secreted by snake venom glands, whose main components are proteins, polypeptides, enzymes, and small molecules, possessing biological activity<sup>[3, 4]</sup>. When a human is bitten by a venomous snake, the venom enters the body and is mainly excreted by the kidneys, leading to the accumulation of toxins in the kidneys and resulting in kidney damage. Acute kidney injury can occur within 1 hour to several days after being bitten by a venomous snake. Additionally, when venom enters the bloodstream after a snake bite, it can also cause vasculitis, triggering glomerular mesangial lysis and glomerulonephritis by releasing endogenous cytokines and inflammatory mediators. Venomous snakebites can also cause local or systemic multi-organ damage, with a high incidence of heart damage, reaching 0.2%–3.8%. If the diagnosis is based on an increase in troponin 1 or ischemic changes on an electrocardiogram, the incidence can reach 15.2%, which is the main cause of death after a venomous snake bite<sup>[5]</sup>.

However, different types of venomous snakes bite patients, resulting in different types of venom. Snake venom is a complex mixture composed of various proteins. According to toxicological analysis, snake venom can be classified into neurotoxins, blood circulation toxins, anticoagulants and procoagulants, snake venom enzymes, etc. Patients poisoned by different snake venoms require different treatment methods, and the clinical value produced after treatment also varies. Currently, in clinical medical work, laboratory testing is often used to identify the type of snake venom. There are no corresponding snake venom detection products available on the market, and this technology has not been widely used in clinical diagnosis. This study aims to innovate snake venom detection and diagnosis methods and explore the application value of rapid snake venom species diagnosis kits.

Compared with laboratory testing, the rapid snake venom species diagnosis kit is inexpensive and low-cost. It can be used for the screening of multiple specific antibodies, the preparation of test strips and auxiliary

reagents, without the need for expensive consumables. The operation is relatively simple, and the entire detection process can be completed using only the kit, without the need for medical equipment assistance, and has minimal requirements for the operator's skills. During the detection process, it only takes 40–45 minutes to complete the test, from taking out the test strip from a low-temperature environment to the end of color development, which can be done during the transfer of venomous snake bite patients. The detection accuracy is relatively high. The kit detection method applies the principle of antigen-antibody specific binding to accurately detect the binding effect of specific antibodies in the snake venom sample. The detection applies the biotin-avidin binding principle, and the color development signal presented in the test results is four times that of the traditional double-antibody sandwich method.

During the preparation of the rapid snake venom species diagnosis kit, proteins are used to obtain anti-snake venom IgG, species-specific IgG, and biotinylated specific IgG for identifying different types of snake venom. In the clinical study presented in this article, serum samples from patients bitten by *Agkistrodon halys*, *Trimeresurus mucrosquamatus*, and *Trimeresurus stejnegeri* in Renshou County were selected for clinical research. The rapid snake venom species diagnosis kit was applied to detect the type of snake venom in the serum samples. By plotting the ROC curve, the sensitivity, specificity, and AUC value of the kit were determined. The results showed that the diagnostic efficiency of the kit was high for different types of snake venom. This confirms that the rapid snake venom species diagnosis kit provides accurate results when applied to snake venom diagnosis. This testing method has broad application prospects in clinical diagnosis as a convenient and fast diagnostic tool with high diagnostic accuracy.

With this diagnostic method, doctors can quickly determine the species of snake and type of venom that caused the injury, providing a basis for clinical diagnosis and treatment. The application of this kit can greatly improve the diagnosis and treatment capabilities of remote areas or medical institutions for venomous snakebites, especially in areas and seasons with a high incidence of venomous snakebites, allowing doctors to quickly provide treatment to patients. In addition, the promotion of this kit can also advance multiple research studies on venomous snake bites, providing data support for the development of scientific countermeasures to improve prevention and treatment work. It can be widely used as a new tool and method for academic research. From an economic perspective, the use of the rapid snake venom species diagnosis kit can effectively reduce medical cost waste caused by factors such as increased testing difficulty and decreased testing accuracy, preventing loss of medical productivity. Early and accurate diagnosis of snake venom type in patients bitten by venomous snakes by clinical medical personnel can shorten the hospital stay of severe patients, reduce the cost of treatment, and alleviate the physical and psychological burden caused by prolonged treatment time, as well as reduce the economic burden associated with long-term treatment and rehabilitation. Simultaneously, the promotion and application of the rapid snake venom species diagnosis kit by clinical medical staff can effectively drive the development of other related industries in the local area, including kit production, sales, and supporting medical equipment supply, forming a new growth point in the local medical device market. It is estimated that after promoting and applying the rapid snake venom species diagnosis kit nationwide, billions of yuan in medical expenses can be saved annually, driving related industry chains and generating billions of yuan in economic value, thereby expanding the market scale.

In terms of social benefits, the application of the rapid snake venom species diagnosis kit can shorten the time required for diagnosis and treatment of venomous snake bite patients, improve patient prognosis, and effectively reduce patient mortality and disability rates. The quality of life of patients after treatment is significantly improved. The clinical application of this diagnostic method can reduce the burden on the families of venomous snake-bitten patients and society. Especially in poor or remote areas, the application and promotion of the rapid snake venom

species diagnosis kit can also enhance public awareness of knowledge related to the prevention and treatment of venomous snake bites, improve patients' self-protection awareness and emergency response capabilities after being bitten by venomous snakes, reduce the incidence of venomous snake bites, and mitigate the health threats posed by such bites. From a long-term perspective, the promotion and application of the rapid snake venom species diagnosis kit will also help improve the prevention and treatment system for venomous snakebites in society, enhance public health emergency response capabilities, promote healthy social development, and enhance the overall health level of the population.

## 5. Conclusion

In summary, the rapid snake venom species diagnosis kit demonstrates high diagnostic efficacy, stability, and reliability when applied to the identification and diagnosis of snake venom species in patients bitten by venomous snakes. The promotion and application of this project have broad prospects, can fully unleash its economic and social value, and belongs to an innovative clinical diagnostic technology that contributes to enhancing the diagnosis and treatment value of venomous snake bites, making significant contributions to the development of public health in China.

## Funding

Rapid Identification and Analysis of Snake Venom Types in Snakebites in Renshou County, (Project No.: 2024KJZD072)

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Nong J F, Huang Z, Huang ZZ, et al., 2023, Research Progress on Snake Venom Detection Methods and Their Applications. *Journal of Snake*, 35(2): 172–176.
- [2] Ning Z, Tan XL, Yang X, 2022, Preparation Method of a Detection Kit for *Deinagkistrodon Acutus* Venom Based on Improved Double Antibody Sandwich ELISA Method, patent, CN202111519610.9.
- [3] Xian RQ, Wang CC, Gong LP, et al., 2022, Detection of Thrombin-Like Enzymes in Changbaishan *Agkistrodon Halys Ussuriensis* Venom by UPLC-MS/MS. *Food and Drug*, 24(4): 323–327.
- [4] Ni DF, Bin WK, Chen SM, et al., 2022, Research Progress on Acute Kidney Injury Caused by Snake Venom. *Journal of Snake*, 34(4): 462–465, 470.
- [5] Chen J, Yang C J, 2024, Research Progress on Cardiac Injury Caused by Snake Venom. *Chinese Journal of Emergency Medicine*, 33(3): 430–433.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Correlation between Disease Uncertainty and Psychological Distress in Hospitalized Patients with Primary Liver Cancer

Dezhen Cui, OuYang Shan, Peixiang Chen\*

The Third Affiliated Hospital of Sun Yat-sen University, Department of Infectious Disease, Guangzhou 510630, Guangdong Province, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the correlation between disease uncertainty and psychological distress in hospitalized patients with primary liver cancer, providing a basis for clinical nursing interventions. *Methods:* A convenient sampling method was used to select 82 patients with primary liver cancer from a tertiary first-class hospital in Guangzhou from September 2023 to March 2024 as the research subjects. General information questionnaires, the Mishel Uncertainty in Illness Scale-Adult Version (MUIS-A), and the Kessler Psychological Distress Scale (K10) were used for investigation. Pearson correlation analysis and linear regression analysis were performed to explore the relationship between the two. *Results:* The total score of disease uncertainty in hospitalized patients with primary liver cancer was  $(99.20 \pm 8.79)$ , and the total score of psychological distress was  $(22.87 \pm 9.46)$ , both at a medium level. There was a positive correlation between disease uncertainty and psychological distress ( $r = 0.360$ ,  $P < 0.01$ ), and the ambiguity dimension had the strongest correlation with psychological distress ( $r = 0.399$ ,  $P < 0.01$ ). Regression analysis showed that the ambiguity dimension had a significant predictive effect on psychological distress ( $\beta = 0.399$ ,  $P < 0.01$ ). *Conclusion:* There is a close correlation between disease uncertainty and psychological distress in patients with primary liver cancer. In clinical nursing, it is necessary to pay special attention to patients' ambiguity regarding disease symptoms and prognosis. Targeted health education should be carried out to reduce their uncertainty, thereby improving their psychological state.

**Keywords:** Primary liver cancer; Disease uncertainty; Psychological distress; Nursing intervention

**Online publication:** April 29, 2025

## 1. Introduction

Primary liver cancer is one of the common malignant tumors in China, ranking fourth in incidence. It has a poor prognosis and a high recurrence rate. Patients often face heavy physical and psychological burdens<sup>[1, 2]</sup>. Disease uncertainty refers to an anxious state in which individuals experience due to a lack of clear understanding of

disease symptoms, treatments, and prognoses <sup>[3]</sup>. Psychological distress, on the other hand, refers to negative emotions such as depression and anxiety triggered by the disease <sup>[4]</sup>. Research has shown that disease uncertainty in patients with malignant tumors can exacerbate psychological distress and affect treatment compliance and quality of life <sup>[5]</sup>. However, currently, there are few studies on the relationship between disease uncertainty and psychological distress in patients with primary liver cancer.

This study aimed to analyze the current status and correlation of disease uncertainty and psychological distress in patients with primary liver cancer in a tertiary-level hospital in Guangzhou, providing theoretical support for clinical nursing, helping patients improve their psychological state, and enhancing treatment effectiveness.

## **2. Subjects and methods**

### **2.1. Research subjects**

A convenient sampling method was used to select patients with primary liver cancer hospitalized in a tertiary-level hospital in Guangzhou from September 2023 to March 2024 as the research subjects.

Inclusion criteria: (1) Pathologically diagnosed with primary liver cancer; (2) Informed consent and voluntary participation; (3) Clear consciousness and no communication barriers.

Exclusion criteria: (1) Complicated with mental illness; (2) Critically ill or unstable condition.

A total of 87 questionnaires were distributed, and 82 valid questionnaires were recovered, with a valid recovery rate of 94.2%.

### **2.2. Research tools**

- (1) General Information Questionnaire: It includes gender, age, educational level, marital status, and medical expense payment methods.
- (2) Mishel Uncertainty in Illness Scale-Adult Version (MUIS-A): The Chinese version consists of 33 items, divided into 4 dimensions: complexity, ambiguity, lack of disease information, and unpredictability. It uses a Likert 5-level scoring system, with a total score ranging from 32 to 160. The Cronbach's  $\alpha$  coefficient is 0.625.
- (3) Kessler Psychological Distress Scale (K10): It has 10 items and assesses emotions such as anxiety and depression in the past 4 weeks. The total score ranges from 10 to 50, and the Cronbach's  $\alpha$  coefficient is 0.950.

### **2.3. Data collection and statistical methods**

Anonymous questionnaires were used for data collection, and the data were analyzed by SPSS 26.0. Measurement data were expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ). The t-test or analysis of variance was used for inter-group comparisons. Pearson's method was used for correlation analysis, and regression analysis was performed with psychological distress as the dependent variable. A  $P$  value  $< 0.05$  was considered statistically significant.

## **3. Results**

### **3.1. General information of the research subjects**

Among the 82 patients, 82.9% (68 cases) were male and 17.1% (14 cases) were female. The age was mainly



between 45–59 years old (50.0%). Most patients (85.4%) had a middle-school education or below, and 91.5% of the patients used medical insurance (**Table 1**).

**Table 1.** General Information of the Research Subjects (n = 82)

Variable	Group	Number of Cases (%)
Gender	Male	68 (82.9)
	Female	14 (17.1)
Age (years)	≤ 44	10 (12.2)
	45–59	41 (50.0)
	≥ 60	31 (37.8)
Educational Level	Primary School or Below	27 (32.9)
	Middle School	43 (52.4)
	Junior College and Above	12 (14.6)
Medical Expense Payment	Self - payment	7 (8.5)
	Medical Insurance	75 (91.5)

### 3.2. Scores of disease uncertainty and psychological distress

The total score of disease uncertainty was ( $99.20 \pm 8.79$ ). The scores of each dimension were as follows: ambiguity ( $38.37 \pm 7.49$ ) > complexity ( $26.74 \pm 3.77$ ) > lack of disease information ( $18.77 \pm 3.98$ ) > unpredictability ( $15.31 \pm 2.60$ ). The total score of psychological distress was ( $22.87 \pm 9.46$ ), and 50% of the patients had moderate to severe psychological distress (**Table 2**).

**Table 2.** Scores of disease uncertainty, its related dimensions, and psychological distress

Variable	Scoring Range	Average Score ()
Total score of the disease uncertainty scale	32–160	$99.20 \pm 8.79$
Complexity	7–35	$26.74 \pm 3.77$
Ambiguity	13–65	$38.37 \pm 7.49$
Lack of disease information	7–35	$18.77 \pm 3.98$
Unpredictability	5–25	$15.31 \pm 2.60$
Total score of the psychological distress scale	10–50	$22.87 \pm 9.46$

### 3.3. Correlation between disease uncertainty and psychological distress

Pearson analysis showed that the total score of disease uncertainty was positively correlated with psychological distress ( $r = 0.360$ ,  $P < 0.01$ ), and the ambiguity dimension had the strongest correlation ( $r = 0.399$ ,  $P < 0.01$ ). Regression analysis further confirmed that the ambiguity dimension could independently predict psychological distress ( $\beta = 0.399$ ,  $P < 0.01$ ) (**Table 3**).



**Table 3.** Regression analysis of psychological distress and the ambiguity dimension

Variable	B	SE	Beta	<i>t</i>	<i>P</i>	95%CI
(Constant)	3.5617	5.060	-	0.704	0.484	-6.509–13.630
Ambiguity	0.503	0.129	0.399	3.887	0.000	0.246–0.761

Note: The regression equation is  $R^2 = 0.159$  ; the adjusted  $R^2 = 0.148$ ;  $F=15.106$ ,  $P < 0.01$ ; D-W value = 1.644.

## 4. Discussion

### 4.1. Current status of disease uncertainty in patients with primary liver cancer

In this study, the total score of disease uncertainty in patients was ( $99.20 \pm 8.79$ ), which was higher than that in the study by Xu *et al.* ( $93.86 \pm 12.19$ ). The ambiguity dimension had the highest score ( $38.37 \pm 7.49$ ), indicating that patients had insufficient understanding of disease symptoms and prognosis<sup>[5]</sup>. In clinical practice, routine health education mainly focuses on the treatment process, and the explanation of symptoms is relatively brief, which is likely to cause confusion among patients. It is recommended that nurses, combined with individual needs, enhance patients' understanding of the disease through graphic materials, case sharing, and other methods.

### 4.2. Current status of psychological distress and influencing factors

Fifty percent of the patients had moderate to severe psychological distress, and the scores of depression-related items (such as fatigue and low mood) were relatively high, which was closely related to the physical symptoms caused by liver cancer and economic pressure<sup>[6]</sup>. Research shows that psychological distress can exacerbate the inflammatory response and affect treatment effectiveness<sup>[7]</sup>. During nursing care, it is necessary to pay attention to patients' emotional changes and cooperate with the psychology department to carry out cognitive-behavioral therapy or group support activities to help patients establish positive coping strategies.

### 4.3. Interaction between disease uncertainty and psychological distress

There was a significant positive correlation between disease uncertainty and psychological distress, especially in the ambiguity dimension. Patients' uncertainty about symptoms can trigger anxiety, and anxiety may inhibit information-seeking behavior, forming a vicious cycle<sup>[8]</sup>. It is recommended that medical staff take the initiative to provide disease knowledge, simplify professional terms using multimedia tools, and encourage patients to ask questions to reduce the information gap.

## 5. Conclusion

The levels of disease uncertainty and psychological distress in patients with primary liver cancer are relatively high, and there is a significant positive correlation between them. Nursing interventions should focus on reducing patients' ambiguity regarding disease symptoms and prognosis. Through systematic health education, psychological counseling, and social support, their psychological state can be improved, ultimately enhancing treatment effectiveness and quality of life.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Fan SS, Yang LP, Zhao RN, et al., 2022, Comparative Analysis of the 2022 Edition of the Chinese Guidelines for the Diagnosis and Treatment of Primary Liver Cancer and the 2019 Edition of the Diagnosis and Treatment Specifications. *Chinese Journal of Cancer Prevention and Treatment*, 29(22): 1575–1578.
- [2] Su LY, Xing YR, 2022, Research on the Relationship Between Psychological Resilience, Personality, and Self-Efficacy in Patients with Primary Liver Cancer. *Chinese General Practice Nursing*, 20(24): 3434–3437.
- [3] Mishel MH, 1988, Uncertainty in Illness. *Image: The Journal of Nursing Scholarship*, 20(4): 225–232.
- [4] Kessler RC, Barker PR, Colpe LJ, et al., 2003, Screening for Serious Mental Illness in the General Population. *Archives of General Psychiatry*, 60(2): 184–189.
- [5] Xu QX, Li HY, Zhou YH, 2021, Analysis of the Current Status of Disease Uncertainty and Its Influencing Factors in Patients with Primary Liver Cancer. *Cancer Progress*, 19(04): 426–429.
- [6] Han J, Liu JE, Meng J, et al., 2008, Analysis of the Degree of Psychological Distress and Related Causes in Cancer Patients. *Chinese Journal of Nursing*, 43(06): 516–518.
- [7] Zhao FJ, Wang Q, Ren YH, et al., 2019, Changes in Serum CRP and hs-CRP Levels in Liver Cancer Patients with Depression and Their Impact on Prognosis. *Journal of Practical Oncology*, 33(01): 27–33.
- [8] Wan LJ, Xie GJ, Feng YY, et al., 2023, Current Status and Influencing Factors of Experiential Avoidance in Liver Cancer Patients. *Nursing Practice and Research*, 20(22): 3328–3333.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Exploration of the Application of Remote Ischemic Conditioning in Nursing of Cardiac Arrest

Yi-maizi Xu<sup>1</sup>, Mingyue Yang<sup>1</sup>, Fangchi Liu<sup>1</sup>, Chao Zhang<sup>1</sup>, Yimeng Yan<sup>1</sup>, Zhixian Feng<sup>2\*</sup>

<sup>1</sup>Hangzhou Normal University School of Nursing, Hangzhou 311121, Zhejiang, China

<sup>2</sup>Affiliated Shulan (HangZhou) Hospital, Shulan International Medical College, Zhejiang Shuren University, Hangzhou 310022, Zhejiang, China

*\*Corresponding author: Zhixian Feng, 1833898759@qq.com*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** Cardiac arrest (CA) is a major global public health challenge, and its high morbidity and low survival rate pose severe tests for emergency and critical care. Although modern CPR techniques significantly improve the immediate resuscitation success rate in CA patients, poor outcomes such as neurological impairment still significantly increase the long-term care burden and reduce the quality of survival. In recent years, the application of remote ischemic conditioning (RIC) has attracted much attention in the field of cardiac arrest through its unique myocardial-nerve dual protection mechanism against the heart. This paper summarizes the conceptual connotation, physiological mechanism, operation method, and its application progress in CA and explores the potential of this technology in the field of CA care in order to provide reference for the research and application of RIC in the field of emergency care.

**Keywords:** Remote ischemic conditioning; Cardiac arrest; Nursing; Review

**Online publication:** April 29, 2025

## 1. Introduction

Cardiac arrest (CA) is one of the main causes of death and disability worldwide, and its morbidity and mortality remain high <sup>[1]</sup>. Although the continuous development of emergency techniques such as cardiopulmonary resuscitation (CPR) has improved the survival rate of patients with cardiac arrest, the long-term prognosis is still not ideal, and survivors are often accompanied by different degrees of neurological dysfunction <sup>[2]</sup>. Therefore, it is of great significance in clinical and nursing work to explore effective adjuvant therapy to improve the survival rate and neurological prognosis of patients with CA. In recent years, remote ischemic conditioning (RIC), as an innovative therapeutic strategy, has been extensively and deeply studied for its mechanism of reducing reperfusion injury <sup>[3]</sup>. This strategy shows good protective effect in many ischemic diseases and provides a new research direction for the treatment of cardiac arrest in the clinic. This review focuses on reviewing the concept,

physiological mechanism, operation methods, and application progress of RIC in CA. By analyzing the existing research, it explores the potential of this technology in the field of CA nursing in order to provide a reference for clinical practice and future research of nursing practice in CA.

## **2. Remote ischemic conditioning**

### **2.1. The concept of remote ischemic conditioning**

RIC refers to the application of transient non-fatal ischemia-reperfusion stimulation on distant organs or tissues of the body (usually selected limbs), thus activating the endogenous protective mechanism, and significantly improving the tolerance of important organs such as heart, brain, liver, kidney, and skin to the subsequent severe ischemic and hypoxic injury<sup>[4]</sup>. As early as 1986, Murry first confirmed that intermittent reperfusion could prevent myocardial ischemic injury in animal experiments. Subsequent studies have gradually confirmed that this method is suitable for many important organs, such as kidney, liver, lung, gastrointestinal tract and skin<sup>[3]</sup>. Depending on the timing of intervention (pre, during, and post-ischemia), RIC can be divided into three categories: remote ischemic preconditioning(RIPC), perconditioning, and remote ischemic postconditioning (RIPostC)<sup>[4]</sup>.

### **2.2. Physiological mechanisms of remote ischemic conditioning**

The exact mechanism of RIC is not completely clear, but it has obvious similarities with ischemic regulation<sup>[5]</sup>. Several studies have shown that remote ischemic conditioning (RIC) induces the release of biologically active substances such as adenosine, nitric oxide, bradykinin, and norepinephrine. These substances exert their protective effects through multiple mechanisms, including neural regulation, humoral regulation, modulation of inflammatory responses, and activation of intracellular signaling pathways. These interconnected pathways work synergistically to transmit protective signals to target organs, resulting in a systemic protective effect<sup>[6, 7]</sup>. Common molecular mechanism of RIC: (1) Release of vasoactive substances to enhance cell membrane stability<sup>[7]</sup>; (2) Activation of mitochondrial K<sup>+</sup> -ATP channels to regulate neurotransmitter release<sup>[8]</sup>; (3) Activate eNOS, produce nitric oxide and reduce free radical release<sup>[9]</sup>; (4) Regulate immune cell and cytokine levels and suppress inflammatory responses<sup>[10]</sup>; (5) Enhance antioxidant capacity and reduce oxidative stress and inflammatory responses<sup>[11]</sup>; (6) Inhibit the ER stress pathway and prevent excessive autophagy activation<sup>[12]</sup>. The protective effect of RIC has obvious time window characteristics: the first stage occurs immediately after RIC treatment for 2 to 3 h; the second stage occurs for 12 to 24 h after RIC treatment, lasting for 48 to 96 h or even longer<sup>[13]</sup>.

### **2.3. Implementation of remote ischemic conditioning**

At present, the specific treatment scheme of RIC has not yet reached a unified consensus. The commonly used clinical operation scheme is as follows: fixing the cuff on the upper arm (bilateral or unilateral), rapidly inflating and pressurizing with a pressure of 200mmHg, releasing the pressure after 3–5 minutes, and pressurizing again after 5 minutes. This is an ischemia-reperfusion cycle, and one treatment lasts for 4–5 cycles, about 30–45 minutes<sup>[14, 15]</sup>. In clinical practice, the intervention of upper limb forearm ischemia is the most commonly used, and the simultaneous intervention of both limbs is more commonly used than unilateral intervention, and the protective effect is stronger<sup>[16, 17]</sup>. In terms of treatment cycle, there are differences among different studies. Some clinical studies adopt a single treatment, and long-term treatment schemes include 1–2 times a day for 1–4 weeks, or even extended to 3–12 months<sup>[7, 14]</sup>. Although there are differences in the treatment cycle and parameter setting,

existing studies have confirmed that various schemes can achieve certain organ protection effects.

### **3. The current situation of cardiac arrest**

#### **3.1. Definition and classification**

CA refers to the sudden stop of cardiac mechanical activity, accompanied by the disappearance of pulse and circulatory signs, which can be divided into out-of-hospital cardiac arrest (OHCA) and in-hospital cardiac arrest (IHCA) according to the location of the event <sup>[18]</sup>. In the out-of-hospital environment, OHCA patients are much more difficult to get professional first aid in time than IHCA patients, and the overall CA patients' condition progresses rapidly, which can cause irreversible damage to multiple organs in a short time.

#### **3.2. Morbidity and mortality rates**

It is reported that the mortality rate of CA is extremely high, ranging from 78% to 85% <sup>[19]</sup>. Among them, the incidence of OHCA is about 53–62/100,000. Because of its difficulty in treatment, the mortality rate is close to 90%, and only about 10% of patients can survive and leave the hospital <sup>[20,21]</sup>. Statistics show that 1.5–1.7 cases of IHCA will occur in every 1000 hospitalized patients, and about a quarter (25.8%) of the patients can be discharged alive after rescue <sup>[18]</sup>. After the occurrence of CA, the reperfusion injury (RI) may be caused by the resumption of perfusion. RI can lead to endothelial dysfunction, impaired oxygen and glucose metabolism, intracellular calcium influx, coagulation and platelet dysfunction, microvascular obstruction, myocardial dysfunction and arrhythmia, which seriously affects the prognosis of patients <sup>[22]</sup>. Given the high lethality of CA, the clinical treatment must race against time. The core goal is to quickly restore effective circulation, optimize organ perfusion, and maximize the protection of neurological function while improving the survival rate. This puts high demands on emergency treatment, which also means that nurses shoulder an extremely critical and arduous mission.

#### **3.3. Cause of disease**

The etiology of CA is mainly divided into cardiogenic and non-cardiogenic <sup>[23]</sup>. The cardiac causes include ischemic heart disease, non-atherosclerotic coronary disease, fatal arrhythmia without ischemic heart disease, cardiomyopathy, valvular heart disease, etc. Non-cardiac causes include trauma, malignant tumor, non-traumatic bleeding, asphyxia, lack of oxygen, drug overdose, septic shock, and many other factors.

### **4. Progress in the application of remote ischemic conditioning in cardiac arrest**

#### **4.1. Intervention approach of RIC in CA**

RIC mainly adopts two intervention strategies in the treatment of CA: RIPC and RIPC (usually 3–4 cycles of 5-min ischemia/ 5-min reperfusion with sphygmomanometer cuff on both upper limbs at a pressure of 200mmHg), which play a protective role in the heart through different time windows and molecular mechanisms <sup>[24,25]</sup>. RIPC is suitable for foreseeable ischemic events <sup>[26]</sup>. From the time sequence characteristics of nursing implementation, RIPC is more suitable for preventive intervention of foreseeable ischemic events, such as elective heart surgery and other clinical scenarios. Its protective mechanism involves inducing myocardial cells to release endogenous substances such as acetylcholine and adenosine in advance and finally triggering mitochondrial ROS- protein kinase-transcription factor cascade reaction by activating the downstream signal pathway of membrane receptors <sup>[27]</sup>.

However, the application of this technique in sudden cardiac arrest has obvious limitations <sup>[28]</sup>. In contrast,



RIPostC shows a wider application prospect in emergency nursing practice. It is an intervention measure implemented immediately after cardiac arrest and cardiopulmonary resuscitation, which not only retains some protective mechanisms of RIPC (such as adenosine receptor activation), but also alleviates reperfusion injury through unique ways such as delaying pH recovery and inhibiting mPTP opening <sup>[29, 30]</sup>. The existing research confirmed that RPostC can not only effectively alleviate myocardial injury, but also significantly improve the prognosis of neurological function after cardiac arrest <sup>[31]</sup>. RIC is simple to operate, low-cost, safe and non-invasive. At the same time, it will not hinder the reperfusion treatment, and it shows good therapeutic effect in the protection of heart and brain, which provides a solid foundation for its popularization and application in the field of emergency medicine <sup>[32]</sup>.

From the point of view of nursing operation, RIC's operation process is simple, the intervention process is completely non-invasive, it will not cause additional harm to patients, the implementation cost is low, and it has high health economic value. The implementation of this technology does not affect the development of emergency nursing measures such as routine cardiopulmonary resuscitation and advanced life support, and this compatibility makes it have unique application value in emergency nursing.

## **4.2. RIC in animal CA**

At present, RIC has played a good therapeutic role in many animal experiments. In the pig model of cardiac arrest, the application of RIC after resuscitation can effectively reduce the degree of myocardial injury <sup>[33]</sup>. Another pig model experiment showed that RPostC intervention significantly improved the prognosis of post-cardiac arrest syndrome (PCAS) in pig model <sup>[34]</sup>. The rat model of cardiac arrest confirmed that RIC intervention can reduce nerve injury and neuronal cell death, exert neuroprotective effect and improve brain function after resuscitation <sup>[28, 35]</sup>. In addition, in another study on rat model, RIC can effectively protect the brain from ischemic injury after asphyxial cardiac arrest <sup>[36]</sup>. These animal experimental results provide important mechanism evidence for the potential application value of RIC in cardiac arrest nursing.

## **4.3. RIC in clinical CA**

Clinical evidence shows that, RIC is very likely to bring clinical benefits to patients with heart diseases <sup>[37]</sup>. Previous studies have confirmed that it is not only safe and feasible to apply RIC to the care of patients with CA resuscitation when OHCA patients are transported to the emergency room, but also can significantly improve the clinical prognosis of patients <sup>[3]</sup>. In patients with ST-segment elevation myocardial infarction (STEMI) complicated with cardiogenic shock or cardiac arrest, RIC intervention before percutaneous coronary intervention (PCI) can significantly reduce the risk of adverse cardiac events for 90 days <sup>[38]</sup>. In cardiovascular surgery, preoperative application of RIPC can effectively improve the mitochondrial function and contraction function of atrial myocardium in patients with ischemic cardiac arrest, and provide significant cardiac protection for surgical patients <sup>[39]</sup>. Although the study confirmed the protective effect of RIC on the myocardium and nerves of CA, the research data of RIC in the clinical field and nursing field of cardiac arrest are still limited. The answers to these key questions need to be carried out in large-scale, multi-center randomized controlled clinical trials in the future to provide more reliable evidence-based medical evidence. Future nursing research should also pay attention to the key issues such as the integration strategy of RIC and existing advanced life support processes.

## **4.4. Risk assessment of the RIC in the CA**



As a non-invasive and simple treatment method, it shows good patient tolerance in clinic, but its application in patients with cardiac arrest still needs to pay attention to related adverse reactions and contraindications. The existing clinical evidence shows that RIC may cause local reactions such as arm pain, skin redness, swelling, skin petechiae and local edema, as well as general symptoms such as dizziness and finger numbness <sup>[40, 41]</sup>. When the lower limb is used as the treatment site, it is necessary to pay special attention to the risks of deep venous thrombosis and venous reflux disorder <sup>[42]</sup>. In addition, the contraindications of RIC include: soft tissue or vascular injury, intracranial hemorrhage, hemorrhagic disease or bleeding tendency, history of atrial fibrillation or myocardial infarction, severe vascular disease, uncontrolled hypertension (systolic blood pressure  $\geq 180$ –200mmHg) and injury or infection at the operation site <sup>[43, 44]</sup>. Therefore, before implementing RIC, nurses should make a comprehensive evaluation, strictly grasp the indications and contraindications, and at the same time, make emergency plans, so as to identify and deal with possible complications in time and ensure the safety and effectiveness of treatment.

## **5. Enlightenment of the application of remote ischemic regulation in nursing care of cardiac arrest**

### **5.1. The potential of RIC to improve the prognosis of CA**

#### **(1) Reducing reperfusion injury**

Based on the mechanism of RIC, the endogenous protective mechanism induced by RIC is expected to significantly reduce the reperfusion injury of CA patients after reperfusion. It may promote the recovery of cardiac function by alleviating myocardial ischemia-reperfusion injury, improving myocardial microcirculation and reducing myocardial cell apoptosis <sup>[45]</sup>. For example, in some animal studies, it was confirmed that patients treated with RIC after resuscitation showed better left ventricular systolic function and more significant improvement of myocardial zymogram, which provided a strong experimental basis for RIC in reducing the nursing of heart reperfusion injury <sup>[33, 46]</sup>.

#### **(2) Neurological protection**

After cardiac arrest, patients are often accompanied by different degrees of neurological dysfunction. RIC may effectively improve the prognosis of neurological function by regulating the level of oxidative stress, inhibiting neuroinflammatory reaction and promoting synaptic remodeling <sup>[47]</sup>. In addition, the systemic endogenous protective mechanism triggered by RIC can also be applied to the cerebrovascular system, so it is expected to improve the ischemia and hypoxia of the brain and have a positive impact on the prognosis of patients' neurological function. The existing animal studies show that RIC may improve the neurological function score after cardiac arrest, improve the brain function after resuscitation and prolong the survival time <sup>[31]</sup>. Although there is no direct clinical evidence to support it at present, based on the results of animal experiments, the physiological characteristics of cerebral vessels, and the mechanism of RIC, this speculation has high rationality and potential application value.

### **5.2. Potential of RIC with CA rehabilitation therapy**

For surviving patients with cardiac arrest, rehabilitation therapy is of great significance to their functional recovery. RIC can continue to play a role in the rehabilitation stage, organically combined with rehabilitation training, and can promote the further recovery of patients' cardiac and neurological functions. Previous studies have shown that

the application of RIC technology in the recovery period after stroke can help the rehabilitation of neurological function <sup>[48]</sup>. This gives an important enlightenment to the patients who are recovering from cardiac arrest. Nurses can combine the existing clinical evidence to further explore the intervention effect of RIC in the rehabilitation treatment of patients with cardiac arrest, so as to help better improve the rehabilitation effect of patients and improve their quality of life.

### **5.3. RIC may optimize emergency nursing practice**

RIC is feasible to be integrated into the emergency nursing process of patients with cardiac arrest. When the patient has cardiac arrest, the nursing staff can quickly prepare for RIC treatment of the patient's limbs while taking routine first aid measures such as cardiopulmonary resuscitation, to improve the treatment efficiency. This process integration makes full use of RIC's characteristics of simple operation and less trauma, and will not interfere with key emergency measures such as cardiopulmonary resuscitation, which provides a new idea for optimizing the emergency nursing process of cardiac arrest. During the implementation of RIC, nurses need to closely monitor patients' vital signs and limb peripheral circulation. Because RIC may cause patients with short-term limb pain, numbness and other discomfort symptoms, nurses should give psychological comfort and detailed explanation in time to relieve patients' tension. At the same time, the patient's reaction to RIC should be closely observed, such as whether there are abnormal situations such as blood pressure fluctuation and arrhythmia, to adjust the RIC scheme in time or take corresponding treatment measures. Through strict condition monitoring and evaluation, the safe and effective implementation of RIC in cardiac arrest nursing can be ensured.

## **6. Application challenges of RIC in CA**

Because the research data of RIC in CA clinical field and nursing field are still limited, the practical application effect and safety of the above enlightenment need to be tested by large-scale clinical trials. This limits the popularization and application of RIC in the field of cardiac arrest nursing to some extent. RIC is a relatively new intervention strategy in the treatment of CA, but the nurses in the emergency center have a serious lack of understanding of its mechanism, operation method and application value in CA nursing. In the future, clinical and nursing researchers can carry out more related clinical trials, more comprehensively and accurately verify the application effect and safety of RIC in CA nursing, as well as provide solid data support for its promotion in the field of first aid.

## **7. Conclusion**

As an innovative treatment strategy, RIC has shown remarkable clinical potential in the field of CA treatment. Although the research data of RIC in the field of CA nursing is limited at present, through the analysis of the research results of RIC in CA treatment, it can be inferred from the theoretical level that RIC has significant potential application value in improving the prognosis of patients with cardiac arrest and optimizing emergency nursing practice. These characteristics make RIC an important part of CA emergency care program and provide new treatment options for improving patients' survival rate and quality of life. However, in the actual application process, there are indeed many challenges, and it is necessary for researchers to continue in-depth research and gradually solve these problems in order to promote the application of RIC in CA emergency care.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Ait Hssain A, Chalkias A, Vahedian-Azimi A, et al., 2025, Survival Rates with Favorable Neurological Outcomes After In-Hospital and Out-of-Hospital Cardiac Arrest: A Prospective Cohort Study. *Intensive Crit Care Nurs*, 87: 103889.
- [2] Secher N, Adelborg K, Szentkúti P, et al., 2022, Evaluation of Neurologic and Psychiatric Outcomes After Hospital Discharge Among Adult Survivors of Cardiac Arrest. *JAMA Netw Open*, 5(5): e2213546.
- [3] Bartlett E, Morse SC, Morse D, et al., 2024, Randomized Feasibility Trial of Remote Ischemic Conditioning to Enhance Resuscitation (RICE). *Resuscitation*, 195.
- [4] Saccaro LF, Aimo A, Emdin M, et al., 2021, Remote Ischemic Conditioning in Ischemic Stroke and Myocardial Infarction: Similarities and Differences. *Front Neurol*, 12: 716316.
- [5] Incognito AV, Millar PJ, Pyle WG, 2021, Remote Ischemic Conditioning for Acute Respiratory Distress Syndrome in COVID-19. *Am J Physiol Lung Cell Mol Physiol*, 320(3): L331–L338.
- [6] Yan MY, Liu JM, Wu J, et al., 2024, Impact of Remote Ischemic Postconditioning on Acute Ischemic Stroke in China: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Syst Rev*, 13(1): 141.
- [7] Zhao W, Li S, Ren C, et al., 2019, Remote Ischemic Conditioning for Stroke: Clinical Data, Challenges, and Future Directions. *Ann Clin Transl Neurol*, 6(1): 186–196.
- [8] Hausenloy DJ, Barrabes JA, Botker HE, et al., 2016, Ischaemic Conditioning and Targeting Reperfusion Injury: A 30-Year Voyage of Discovery. *Basic Res Cardiol*, 111(6): 70.
- [9] Totzeck M, Hendgen-Cotta U, Rassaf T, 2015, Concepts of Hypoxic NO Signaling in Remote Ischemic Preconditioning. *World J Cardiol*, 7(10): 645–651.
- [10] Liu ZJ, Chen C, Li XR, et al., 2016, Remote Ischemic Preconditioning-Mediated Neuroprotection against Stroke is Associated with Significant Alterations in Peripheral Immune Responses. *CNS Neurosci Ther*, 22(1): 43–52.
- [11] Sun YY, Zhu HJ, Zhao RY, et al., 2023, Remote Ischemic Conditioning Attenuates Oxidative Stress and Inflammation via the Nrf2/HO-1 Pathway in MCAO Mice. *Redox Biol*, 66: 102852.
- [12] Yu Y, Zhou H, Xiong Y, et al., 2020, Exosomal miR-199a-5p Derived from Endothelial Cells Attenuates Apoptosis and Inflammation in Neural Cells by Inhibiting Endoplasmic Reticulum Stress. *Brain Res*, 1726: 146515.
- [13] Hausenloy DJ, Yellon DM, 2010, The Second Window of Preconditioning (SWOP) Where Are We Now? *Cardiovasc Drugs Ther*, 24(3): 235–254.
- [14] Li S, Xing X, Wang L, et al., 2024, Remote Ischemic Conditioning Reduces Adverse Events in Patients with Acute Ischemic Stroke Complicating Acute Myocardial Infarction: A Randomized Controlled Trial. *Crit Care*, 28(1): 5.
- [15] Zhao W, Hausenloy DJ, Hess DC, et al., 2023, Remote Ischemic Conditioning: Challenges and Opportunities. *Stroke*, 54(8): 2204–2207.
- [16] Randhawa PK, Bali A, Jaggi AS, 2015, RIPC for Multiorgan Salvage in Clinical Settings: Evolution of Concept, Evidence and Mechanisms. *Eur J Pharmacol*, 746: 317–332.
- [17] Zhu Y, Li X, Lei X, et al., 2025, The Potential Mechanism and Clinical Application Value of Remote Ischemic Conditioning in Stroke. *Neural Regen Res*, 20(6): 1613–1627.

- [18] Barros AJ, Enfield KB, 2023, In-Hospital Cardiac Arrest. *Emerg Med Clin North Am*, 41(3): 455–464.
- [19] Lazzarin T, Tonon CR, Martins D, et al., 2022, Post-Cardiac Arrest: Mechanisms, Management, and Future Perspectives. *J Clin Med*, 12(1).
- [20] Zumbrunn SK, Blatter R, Bissmann B, et al., 2025, The Prognosis After Cardiac Arrest: Evidence on the Short- and Long-Term Course. *Dtsch Arztebl Int*, (Forthcoming).
- [21] Kovoort JG, Jerrow R, Cork S, et al., 2025, Gaps in Public Access Defibrillation: Analysis of International Legislation. *JACC Adv*, 4(2): 101573.
- [22] Yellon DM, Hausenloy DJ, 2007, Myocardial Reperfusion Injury. *N Engl J Med*, 357(11): 1121–1135.
- [23] Myat A, Song KJ, Rea T, 2018, Out-of-Hospital Cardiac Arrest: Current Concepts. *The Lancet*, 391(10124): 970–979.
- [24] Cour M, Buisson M, Klouche K, et al., 2019, Remote Ischemic Conditioning in Septic Shock (RECO-Sepsis): Study Protocol for a Randomized Controlled Trial. *Trials*, 20(1): 281.
- [25] Hausenloy DJ, Yellon DM, 2016, Ischaemic Conditioning and Reperfusion Injury. *Nat Rev Cardiol*, 13(4): 193–209.
- [26] Cho YJ, Kim WH, 2019, Perioperative Cardioprotection by Remote Ischemic Conditioning. *Int J Mol Sci*, 20(19): 4839.
- [27] Zhang H, Hu H, Zhai C, et al., 2024, Cardioprotective Strategies After Ischemia-Reperfusion Injury. *Am J Cardiovasc Drugs*, 24(1): 5–18.
- [28] Huang Y, Gao X, Zhou X, et al., 2021, Remote Ischemic Postconditioning Inhibited Mitophagy to Achieve Neuroprotective Effects in the Rat Model of Cardiac Arrest. *Neurochem Res*, 46(3): 573–583.
- [29] Donato M, Evelson P, Gelpi RJ, 2017, Protecting the Heart from Ischemia/Reperfusion Injury: An Update on Remote Ischemic Preconditioning and Postconditioning. *Curr Opin Cardiol*, 32(6): 784–790.
- [30] Fujita M, Asanuma H, Hirata A, et al., 2007, Prolonged Transient Acidosis During Early Reperfusion Contributes to the Cardioprotective Effects of Postconditioning. *Am J Physiol Heart Circ Physiol*, 292(4): H2004–H2008.
- [31] Xu J, Sun S, Lu X, et al., 2015, Remote Ischemic Pre- and Postconditioning Improve Postresuscitation Myocardial and Cerebral Function in a Rat Model of Cardiac Arrest and Resuscitation. *Crit Care Med*, 43(1): e12–e18.
- [32] Ho AFW, Chong J, Ong MEH, et al., 2020, Remote Ischemic Conditioning in Emergency Medicine—Clinical Frontiers and Research Opportunities. *Shock*, 53(3): 269–276.
- [33] Albrecht M, Meybohm P, Broch O, et al., 2015, Evaluation of Remote Ischaemic Post-Conditioning in a Pig Model of Cardiac Arrest: A Pilot Study. *Resuscitation*, 93: 89–95.
- [34] Wang Z, Wu L, Xu J, et al., 2020, Limb Ischemic Postconditioning Alleviates Postcardiac Arrest Syndrome Through the Inhibition of Mitochondrial Permeability Transition Pore Opening in a Porcine Model. *Biomed Res Int*, 2020: 9136097.
- [35] Fan R, Yu T, Lin JL, et al., 2016, Remote Ischemic Preconditioning Improves Post-Resuscitation Cerebral Function via Overexpressing Neuroglobin After Cardiac Arrest in Rats. *Brain Res*, 1648(Pt A): 345–355.
- [36] Dave KR, Saul I, Prado R, et al., 2006, Remote Organ Ischemic Preconditioning Protects Brain from Ischemic Damage Following Asphyxial Cardiac Arrest. *Neurosci Lett*, 404(1-2): 170–175.
- [37] Hausenloy DJ, Ntsekhe M, Yellon DM, 2020, A Future for Remote Ischaemic Conditioning in High-Risk Patients. *Basic Res Cardiol*, 115(3): 35.
- [38] Cheskes S, Koh M, Turner L, et al., 2020, Field Implementation of Remote Ischemic Conditioning in ST-Segment-Elevation Myocardial Infarction: The FIRST Study. *Can J Cardiol*, 36(8): 1278–1288.
- [39] Kleinbongard P, Gedik N, Kirca M, et al., 2018, Mitochondrial and Contractile Function of Human Right Atrial Tissue in Response to Remote Ischemic Conditioning. *J Am Heart Assoc*, 7(15): e009540.
- [40] Pico F, Lapergue B, Ferrigno M, et al., 2020, Effect of In-Hospital Remote Ischemic Preconditioning on Brain Infarction Growth and Clinical Outcomes in Patients with Acute Ischemic Stroke: The RESCUE BRAIN Randomized Clinical

Trial. *JAMA Neurol*, 77(6): 725–734.

- [41] Asadi M, Hooshmandi E, Emaminia F, et al., 2022, Safety and Efficacy of Remote Ischemic Preconditioning in Patients with Severe Carotid Artery Stenosis Before Carotid Artery Stenting: A Proof-of-Concept, Randomized Controlled Trial. *Curr J Neurol*, 21(2): 119–124.
- [42] Zahariev T, Anastassov V, Girov K, et al., 2009, Prevalence of Primary Chronic Venous Disease: The Bulgarian Experience. *Int Angiol*, 28(4): 303–310.
- [43] Chen HS, Cui Y, Li XQ, et al., 2022, Effect of Remote Ischemic Conditioning vs Usual Care on Neurologic Function in Patients with Acute Moderate Ischemic Stroke: The RICAMIS Randomized Clinical Trial. *JAMA*, 328(7): 627–636.
- [44] An JQ, Cheng YW, Guo YC, et al., 2020, Safety and Efficacy of Remote Ischemic Postconditioning After Thrombolysis in Patients with Stroke. *Neurology*, 95(24): e3355–e3363.
- [45] Kleinbongard P, Skyschally A, Heusch G, 2017, Cardioprotection by Remote Ischemic Conditioning and Its Signal Transduction. *Pflugers Arch*, 469(2): 159–181.
- [46] Abe T, Morita K, Shinohara G, et al., 2017, Synergistic Effects of Remote Perconditioning with Terminal Blood Cardioplegia in an In Vivo Piglet Model. *Eur J Cardiothorac Surg*, 52(3): 479–484.
- [47] Xie B, Gao X, Huang Y, et al., 2021, Remote Ischemic Postconditioning Inhibits Hippocampal Neuronal Apoptosis and Mitophagy After Cardiopulmonary Resuscitation in Rats. *Shock*, 55(1): 74–82.
- [48] Geng X, Wang Q, Lee H, et al., 2025, Correction: Remote Ischemic Postconditioning vs. Physical Exercise After Stroke: An Alternative Rehabilitation Strategy? *Mol Neurobiol*, (Forthcoming).

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



# Predictive Modeling of Comorbid Anxiety in Young Hypertensive Patients Based on a Machine Learning Approach

Haiyan Xiao<sup>1,2</sup>, Aide Fan<sup>2</sup>, Zhiyong Liu<sup>2</sup>, Keping Yang<sup>1\*</sup>

<sup>1</sup>Jingzhou Hospital Affiliated to Yangtze University, Jingzhou 434020, Hubei, China

<sup>2</sup>Changde First Hospital of Traditional Chinese Medicine, Changde 415099, Hunan, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To analyze the risk factors of anxiety in young hypertensive patients and build a prediction model to provide a scientific basis for clinical diagnosis and treatment. *Methods:* According to the research content, young hypertensive patients admitted to the hospital from January 2022 to December 2024 were selected as the research object and at least 950 patients were included according to the sample size calculation. According to the existence of anxiety, 950 patients were divided into control group (n = 650) and observation group (n = 300), and the clinical data of all patients were collected for univariate analysis and multivariate Logistic regression analysis to get the risk factors of hypertension patients complicated with anxiety. All patients were randomly divided into a training set (n = 665) and a test set (n = 285) according to the ratio of 7:3, and the evaluation efficiency of different prediction models was obtained by using machine learning algorithm. To evaluate the clinical application effect of the prediction model. *Results:* (1) Univariate analysis showed that age, BMI, education background, marital status, smoking, drinking, sleep disorder, family history of hypertension, history of diabetes, history of hyperlipidemia, history of cerebral infarction, and TC were important risk factors for young hypertensive patients complicated with anxiety. (2) Multivariate Logistic regression analysis showed that hypertension history, drinking history, coronary heart disease history, diabetes history, BMI, TC, and TG are important independent risk factors for young hypertensive patients complicated with anxiety. (3) Extra Trees has the highest predictive power for young people with hypertension complicated with anxiety, while Decision-Tree has the lowest predictive power. *Conclusion:* Hypertension history, drinking history, coronary heart disease history, diabetes history, BMI, TC, and TG are important independent risk factors that affect the anxiety of young hypertensive patients. Extra Trees model has the best prediction efficiency among different groups of models.

**Keywords:** Machine learning method; Youth hypertension; Anxiety; Prediction model

**Online publication:** April 28, 2025



# 1. Introduction

Hypertension is a common chronic disease, which means that blood pressure is measured three times on different days without using antihypertensive drugs, with systolic blood pressure  $\geq 140\text{mmHg}$  and/or diastolic blood pressure  $\geq 90\text{mmHg}$  <sup>[1]</sup>. Studies have shown that in recent years, the incidence of hypertension is younger <sup>[2]</sup>. According to statistics, the incidence of hypertension among young people in the world is on the rise <sup>[3, 4]</sup>. In some developed countries, the incidence of hypertension among young people is about 5%–10%, while in developing countries, the proportion is gradually increasing. The occurrence of hypertension in young people is closely related to heredity and lifestyle. If there are hypertensive patients in the family, the probability of genetic related genes in young people is high, which may lead to abnormal vascular wall structure and function and lead to hypertension <sup>[5]</sup>. In addition, a long-term high-salt diet will increase sodium ions in the body, lead to water and sodium retention, increase blood volume, and then raise blood pressure <sup>[6]</sup>.

At the same time, long-term heavy drinking will damage vascular endothelial cells, affect the normal function of blood vessels, trigger blood pressure fluctuations, and lack of exercise will easily cause body fat accumulation, leading to obesity, which is an important risk factor for hypertension <sup>[7]</sup>. If not treated in time, long-term hypertension will increase the burden on the heart and cause left ventricular hypertrophy, which may further develop into heart failure <sup>[8]</sup>. At the same time, hypertension is also an important risk factor for cardiovascular and cerebrovascular diseases such as coronary heart disease and stroke, which increases the risk of myocardial infarction, cerebral hemorrhage, and cerebral infarction <sup>[9]</sup>. At present, the pathogenesis of hypertension in young people is not clear, but some scholars point out that anxiety is one of the important causes of hypertension. Therefore, early screening of influencing factors of anxiety in young hypertensive patients can provide scientific basis for clinical diagnosis and treatment.

In the era of rapid development of science and technology, machine learning algorithm, as the core technology in the field of artificial intelligence, is deeply affecting many industries, especially in the medical field, bringing a new perspective and method for disease prediction <sup>[10, 11]</sup>. Machine learning algorithm is a technology that allows computers to learn from data and make predictions or decisions. Traditional programming is based on predefined rules and instructions, while machine learning is different <sup>[12]</sup>. Based on a large number of data, it allows computer models to automatically find patterns, laws, and characteristics in the data. The learning process of algorithm is similar to that of human learning knowledge from experience, except that it is realized by mathematical model and complicated calculation, and it has a very wide and important application in predicting the occurrence of diseases <sup>[13, 14]</sup>.

Many studies have shown that in the prediction of cardiovascular diseases, multi-dimensional data such as patients' age, gender, blood pressure, blood lipid, and family history can be intergrated, using logistic regression, decision tree and other algorithms to build a prediction model <sup>[15, 16]</sup>. Logistic regression algorithm can analyze the linear relationship between these factors and the incidence of cardiovascular diseases and predict the individual incidence probability by calculating the weight of each factor <sup>[17]</sup>. The decision tree divides the data into tree structures, makes decisions according to different feature nodes, and intuitively shows the logical process of disease prediction. With the help of these models, doctors can intervene patients with high risk factors in advance to prevent the sudden onset of cardiovascular diseases <sup>[18]</sup>. Based on this, this study takes young hypertensive patients admitted to our hospital as the research object, analyzes the risk factors of anxiety in young hypertensive patients, and constructs a prediction model based on machine learning method.

## 2. Data and methods

### 2.1. Research object

According to the research content, young hypertensive patients admitted to our hospital from January 2022 to December 2024 were selected as the research object, and at least 950 patients were included according to the sample size calculation. According to the existence of anxiety, a total of 950 patients were divided into control group ( $n = 650$ ) and observation group ( $n = 300$ ), and randomly divided into training set ( $n = 665$ ) and test set ( $n = 285$ ) according to the ratio of 7:3. This study has been approved by the hospital's Ethics Committee.

### 2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Meet the diagnostic criteria in the Guidelines for Hypertension in China in 2018; (2) Hamilton Anxiety Scale score  $\geq 14$ ; (3) 18 years old  $\leq 40$  years old; (4) Perfect clinical data.

Exclusion criteria: (1) Malignant hypertension; (2) Being conscious and able to communicate normally; (3) Accompanied by blood system diseases; (4) Poor compliance.

### 2.3. Research methods

The clinical data (gender, age, BMI, education background, marital status, smoking, drinking, sleep disorder, family history of hypertension, history of diabetes, hyperlipidemia and history of cerebral infarction) and laboratory indicators (WBC, PLT, LDL, TG, TC, AST, ALT) were collected for univariate analysis and multivariate Logistic regression analysis, and the efficacy of different models in predicting anxiety in young hypertensive patients was analyzed.

### 2.4. Statistical methods

Data were analyzed using SPSS 26.0 software. For count data, they were expressed in the form of %, and the correlation between groups was explored with the help of the  $X^2$  test or Fisher's exact probability method; for the metrics that conformed to the normal distribution, the study presented them in the form ( $\bar{x} \pm s$ ) and the significance of the difference was assessed by the t-test. Multifactorial Logistic regression analysis was performed for indicators with differences in univariate analysis. In addition, seven models were constructed in the *R* language to evaluate the efficiency of different predictive models, and  $P < 0.05$  indicated that the differences were statistically significant.

## 3. Results

### 3.1. Anxiety status of 950 patients

Among 950 patients,  $n = 300$  patients have anxiety, accounting for 31.58%.

### 3.2. Comparison of clinical indicators between two groups of patients

Taking whether young hypertensive patients are complicated with anxiety as the dependent variable, and taking gender, age, BMI, education background, marital status, smoking, drinking, sleep disorder, family history of hypertension, diabetes, hyperlipidemia, cerebral infarction, WBC, PLT, LDL, TG, TC, AST and ALT as the independent variables, the results show that age, BMI, education background, marital status, as shown in **Table 1**.

**Table 1.** Univariate analysis of influencing factors of anxiety in young hypertensive patients

Index	Control group (n = 650)	Observation group (n = 300)	X <sup>2</sup> /t value	P value
Gender			3.382	0.004
Male	320	160		
Woman	330	140		
Age (years)	27.68 ± 2.38	34.15 ± 2.22	39.771	< 0.001
BMI(kg/m2)	25.76 ± 1.37	26.18 ± 1.25	4.513	< 0.001
Academic degree			4.220	0.047
Primary school and below	105	52		
Junior high school and senior high school	365	189		
College or above	180	59		
Marital status			5.921	0.015
be unmarried	315	120		
married	270	115		
Divorced or widowed	65	65		
Smoke	112	130	73.668	< 0.001
Drink Wine/alcohol	106	141	82.500	< 0.001
Sleep disorder			55.134	< 0.001
Have	65	87		
Without	585	213		
Family history of hypertension	85	92	41.891	< 0.001
History of diabetes	67	121	116.582	< 0.001
History of hyperlipidemia	80	91	45.186	< 0.001
History of cerebral infarction	73	84	41.842	< 0.001
WBC(109/L)	6.59 ± 1.67	6.78 ± 1.72	1.615	0.107
PLT (109/L)	189.23 ± 60.02	189.12 ± 56.70	0.027	0.979
LDL(mmol/L)	2.15(1.81, 2.55)	2.20(1.59, 2.43)	-0.459	0.382
TG(mmol/L)	1.12(0.78, 1.85)	1.26(0.75, 1.81)	0.657	0.360
TC(mmol/L)	4.89(4.23, 5.67)	4.59(5.23)	3.390	0.001
AST(U/L)	25.47 ± 12.15	27.28 ± 10.13	1.145	0.175
ALT(U/L)	26.78 ± 11.10	28.10 ± 10.95	1.711	0.087

### 3.3. Multivariate logistic regression analysis of young hypertensive patients complicated with anxiety

Multivariate logistic regression analysis found that hypertension history, drinking history, coronary heart disease history, diabetes history, BMI, TC, and TG are important independent risk factors affecting anxiety in young hypertensive patients, as shown in **Table 2**.

**Table 2.** Multivariate logistic regression analysis of anxiety in young hypertensive patients

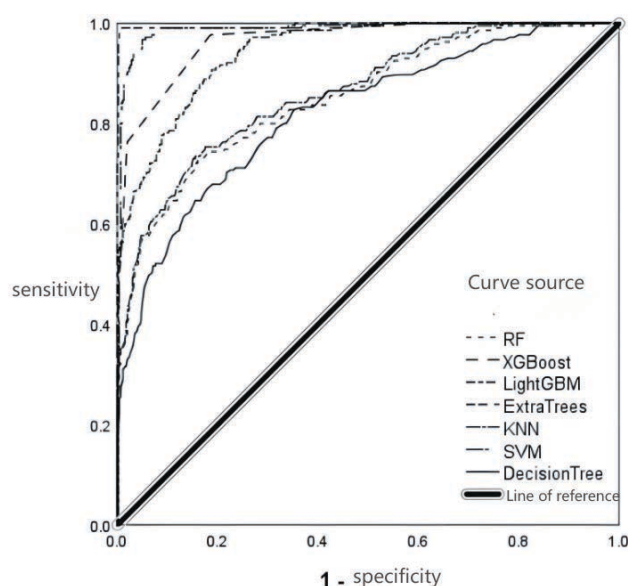
Variable	$\beta$ value	SE value	Wald	P	OR	95% CI
Constant term	-1.579	0.478	8.239	0.004	0.180	
History of hypertension	1.780	0.312	27.671	0.001	4.579	3.110–10.648
Drinking history	1.167	0.314	12.145	0.001	2.891	1.657–5.420
History of coronary heart disease	0.745	0.750	0.234	0.002	1.760	1.213–3.165
History of diabetes	1.142	0.278	13.453	0.005	3.110	1.770–5.781
BMI	1.316	0.512	7.112	0.015	3.905	2.235–7.112
TC	0.981	0.530	10.901	0.010	2.675	1.678–5.104
TG	1.139	0.441	6.718	0.002	6.453	2.896–6.178

### 3.4. Model prediction efficiency comparison

As can be seen from the table, Extra Trees has the highest prediction efficiency for young people with hypertension complicated with anxiety, while Decision-Tree has the lowest prediction efficiency. See **Table 3** and **Figure 1**.

**Table 3.** Comparison of forecasting efficiency of different models

Model	Sensitivity	Specificity	Youden's index	AUC value (95% CI value)
ExtraT rees	0.897	0.916	0.975	0.917(0.981–1.001)
SVM	0.935	0.935	0.920	0.978(0.890–0.976)
XGBoost	0.957	0.827	0.779	0.958(0.943–0.967)
LightGBM	0.872	0.818	0.724	0.934(0.918–0.949)
KNN	0.742	0.825	0.579	0.867(0.814–0.883)
RF	0.710	0.839	0.582	0.855(0.812–0.876)
Decision-Tree	0.659	0.851	0.483	0.820(0.785–0.859)

**Figure 1.** ROC curve of different models for predicting hypertension complicated with anxiety in young people.

## 4. Discussion

Multivariate logistic regression analysis showed that hypertension history, drinking history, coronary heart disease history, diabetes history, BMI, TC, and TG were important independent risk factors affecting anxiety in young hypertensive patients <sup>[19]</sup>. Logistic regression analysis shows that gender, drinking history, lack of exercise, other chronic diseases, and insomnia are the risk factors for anxiety and depression in middle-aged and elderly hypertensive patients <sup>[20]</sup>. Multivariate logistic regression analysis shows that poor economic situation, short medical history of hypertension, diabetes, and coronary heart disease are independent risk factors for anxiety in female hypertensive patients. The validity of this study is verified.

Moreover, the study also found that Extra Trees has the highest prediction efficiency for young people with hypertension complicated with anxiety, while Decision-Tree has the lowest prediction efficiency. To sum up, there are many factors that affect the anxiety of young hypertensive patients, and among different groups of models, Extra Trees model has the best prediction efficiency.

## 5. Conclusion

Hypertension, along with several other key risk factors, has been identified as significant independent predictors of anxiety in young hypertensive patients. Among these factors, a history of hypertension, alcohol consumption, coronary heart disease, and diabetes play crucial roles in influencing psychological distress. Additionally, body mass index (BMI), total cholesterol (TC), and triglyceride (TG) levels are closely associated with increased anxiety levels in this patient population.

To assess and predict anxiety risk in young hypertensive individuals, various predictive models have been developed and evaluated. Notably, the Extra Trees model (Extremely Randomized Trees) demonstrates superior predictive performance compared to other modeling approaches. Its high accuracy, robustness, and ability to handle complex interactions among risk factors make it the most effective tool for identifying anxiety susceptibility in this demographic. Further research and clinical application of the Extra Trees model could enhance early intervention strategies and improve mental health outcomes for young adults with hypertension.

## Disclosure statement

The authors declare no conflict of interest

## References

- [1] Zhang C, Wang S, Wang X, et al., 2024, Study on the Prevalence and Risk Factors of Hypertension Among the Elderly in Liangyuan District, Shangqiu. *China Health Statistics*, 41(4): 543–550.
- [2] Zhang Y, Wang L, Huang Y, et al., 2024, Prevalence of Hypertension, Depression and Anxiety Disorder and Related Factors. *Chinese Mental Health Journal*, 38(12): 1021–1027.
- [3] Shen J, Yang X, Niu W, et al., 2024, Construction of Nomogram Based on Risk Factors to Assess the Risk of Target Organ Damage in Patients With Hypertension and Unexplained Hypokalemia. *China Cardiovascular Research*, 22(11): 1052–1056.
- [4] Ye Q, Wang Y, Li L, et al., 2023, Study on the Prevalence and Influencing Factors of Mild Cognitive Impairment in Young and Middle-Aged Hypertensive Inpatients. *China General Medicine*, 26(2): 154–167.

- [5] Liu D, Wang M, 2023, Analysis of Risk Factors in Young Patients With Hypertensive Cerebral Hemorrhage. Chinese Sci-tech Journal Database (Abstract Edition) Medicine and Health, 2023(5): 42–44.
- [6] Liu X, 2023, Analysis of Clinical Characteristics and Risk Factors of Middle-Aged and Young People With Hypertension. Modern Diagnosis and Treatment, 34(23): 3590–3592.
- [7] Chen Y, Wang Y, Li B, et al., 2024, Study on the Relationship Between LMR and Anxiety in Elderly Patients With Essential Hypertension. Laboratory Medicine and Clinic, 21(1): 20–23.
- [8] Li J, Zheng M, 2023, Investigation on Health Behavior Status of Young and Middle-Aged Patients With Hypertension and Analysis of Influencing Factors. Clinical Medical Research and Practice, 8(15): 5–8.
- [9] Yang F, Han B, Xu X, et al., 2024, Study on Sleep Quality of Young and Middle-Aged Hypertensive Inpatients and Its Influencing Factors. Shanxi Medical Journal, 53(7): 519–522.
- [10] Zeng H, Tian B, Yuan H, et al., 2024, Prediction Model of Chronic Kidney Disease With Hypertension or Diabetes by Machine Learning Algorithm. Journal of Kunming Medical University, 45(3): 99–105..
- [11] Xiao H, Yang K, 2024, To Explore the Predictive Value of Machine Learning Model for Young People With Hypertension Complicated With Anxiety. Electronic Journal of Modern Medicine and Health Research, 8(10): 119–124.
- [12] Wei S, Zhang Z, Wang Y, et al., 2024, Systematic Evaluation of Constructing Hypertension Risk Prediction Model Based on Machine Learning. Journal of Mudanjiang Medical College, 45(5): 55–61.
- [13] Cui W, Lin P, Liu X, et al., 2022, Cardiovascular Risk Prognosis Model of Essential Hypertension Based on Machine Learning. China Journal of Gerontology, 42(15): 3625–3629.
- [14] Qin W, Gan F, Yin B, et al., 2023, Risk Prediction Model of Hypertension Complicated With Retinopathy Based on Machine Learning Algorithm. Journal of Nanchang University (Medical Edition), 63(5): 49–80.
- [15] Liu J, Zheng W, Fang F, et al., 2024, Building an Evaluation and Prediction Model of Anxiety and Depression of the Elderly in the Community Based on Machine Learning. Chinese Journal of Geriatrics, 43(2): 234–239.
- [16] Liu T, Zhu Q, Xu L, et al., 2022, Risk Prediction Model of Essential Hypertension Complicated With Cerebral Infarction Based on Machine Learning. Journal of Naval Medical University, 43(3): 258–265.
- [17] Zeng Q, Jiang W, 2023, Research Progress of Hypertension Risk Prediction Model Based on Machine Learning. Chinese Sci-tech Journal Database (Abstract Edition), 2023(3): 122–125.
- [18] Guan Y, Zhu B, Ma J, et al., 2024, Predictive Value of Different Machine Learning Algorithms on the Risk of Senile Essential Hypertension. Chinese Medicine Guides, 21(18): 49–52.
- [19] Ji J, Du T, Wang X, et al., 2024, Influencing Factors of Anxiety and Depression in Middle-Aged and Elderly Hypertensive Patients in Rural Areas of Northern Henan. Journal of Cardiovascular and Cerebrovascular Diseases of Integrated Traditional Chinese and Western Medicine, 22(16): 3050–3055.
- [20] Wang C, Bian L, Li X, 2023, Investigation on Depression and Risk Factors of Elderly Patients With Hypertension in Yuetan Community of Beijing. Basic Medicine and Clinic, 43(5): 798–803.

#### **Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



# The Effect of the Medical and Nursing Integration Model in the Care of Patients Undergoing Inguinal Hernia Surgery

Qian Sun<sup>1</sup>, Weihua Liu<sup>1\*</sup>, Yinghui Hou<sup>1</sup>, Jingyan Wang<sup>2</sup>

<sup>1</sup>Department of General Surgery, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

<sup>2</sup>Surgical Ward, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

\*Corresponding author: Weihua Liu, 1593194800@163.com

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the application effect of the care of patients with inguinal hernia surgery, medical and nursing integration model with a view to providing help for the optimization of clinical surgical care program. *Methods:* Seventy-eight inguinal hernia patients who underwent surgical treatment in a hospital during the period of December 2023 to November 2024 were selected and divided into a control group and a study group, each with 39 cases, using the mean score method. The control group was given the usual clinical surgical care model, and the observation group was given the medical and nursing integration model, and the nursing effects of the two groups were compared. *Results:* The postoperative pain level score of patients in the observation group ( $2.23 \pm 0.52$ ) was lower than that of the control group ( $3.86 \pm 1.02$ ); the gastrointestinal recovery time of patients in the observation group ( $23.12 \pm 4.06$ h), and the time to get out of bed ( $15.42 \pm 4.19$ d) were shorter than that of the control group ( $29.53 \pm 3.47$  h) and ( $20.85 \pm 3.08$  d), and the differences were statistically significant ( $P < 0.05$ ); postoperative sleep efficiency score (the observation group  $5.12 \pm 1.14$ ), sleep disorder score ( $6.42 \pm 1.29$ ), time to sleep score ( $7.56 \pm 1.57$ ), and daytime function score ( $6.25 \pm 1.19$ ) in were significantly lower than those in the control group [ $(7.46 \pm 1.29)$ , ( $8.63 \pm 1.41$ ), ( $10.37 \pm 1.38$ ), and ( $8.49 \pm 1.24$ ), respectively], with the differences being statistically significant ( $P < 0.05$ ); the incidence of complications such as urinary retention, local hematoma, and incision infection during the treatment period of the patients in the observation group (2.56%) was significantly lower than that of the control group (20.51%), and the difference was statistically significant ( $P < 0.05$ ); in the observation group, the patient care satisfaction (97.44%) was significantly higher than that of the control group (76.92%), and the difference was statistically significant ( $P < 0.05$ ). *Conclusion:* The integrated model of medical care has significant advantages in the care of patients undergoing inguinal hernia surgery, which can effectively alleviate postoperative pain, shorten the gastrointestinal recovery time and the time to get out of bed, and at the same time significantly improve the quality of patient's sleep, and reduce the risk of complications such as urinary retention, local hematomas, and incisional infections, to obtain a higher degree of satisfaction from patients, and it is recommended that it should be popularized and applied in other medical departments.

**Keywords:** Inguinal hernia surgery; Integrated health care; Surgical indicators; Complications; Satisfaction

**Online publication:** April 28, 2025

# 1. Introduction

Inguinal hernia is a common and frequent disease in general surgery, which is prone to incarceration and has a greater risk of incomplete intestinal obstruction and intestinal necrosis <sup>[1]</sup>. Clinical treatment of inguinal hernia often uses tension-free repair or laparoscopic hernia repair, but the prognosis of the patient's effect in addition to rely on the level of surgical operation of the physician, but also depends largely on the quality of care safety <sup>[2]</sup>. With the development of medical technology and the improvement of patients' demand for medical services, the traditional nursing model has been difficult to meet the all-round needs of inguinal hernia surgery patients. The healthcare integration model, as a new medical service model, emphasizes the joint participation of doctors and nurses in the diagnosis, treatment and care process of patients, providing patients with more high-quality, efficient, and continuous medical services through close cooperation, information sharing, and responsibility sharing <sup>[3]</sup>. In recent years, the healthcare integration model has been widely used both at home and abroad and has achieved remarkable results in the treatment and care of a variety of diseases, but its application in the care of patients undergoing inguinal hernia surgery has been less well researched, and there is a lack of practical basis for its value, especially in terms of improving the patients' postoperative pain, reducing the rate of complications, and shortening the length of hospitalization <sup>[4]</sup>. Because of this, this study was conducted through a small-sample clinical trial to investigate the specific application effect of the healthcare integration model in the care of patients with inguinal hernia surgery, with a view to providing a scientific basis for the further optimization of nursing care programs for patients with inguinal hernia surgery.

## 2. Information and methodology

### 2.1. General information

A total of 78 inguinal hernia patients who underwent surgical treatment at a hospital between December 2023 and November 2024 were divided into two groups using the mean score method: a control group and a study group, each consisting of 39 patients. In the control group, there were 24 males and 15 females, with ages ranging from 19 to 63 years, and an average age of  $43.89 \pm 6.15$  years. The disease duration for this group ranged from 1 to 6 months, with a mean duration of  $2.12 \pm 0.35$  months. In the study group, there were 23 males and 16 females, with ages ranging from 22 to 64 years, and an average age of  $42.73 \pm 6.39$  years. The disease duration in this group varied from 1 to 8 years, with a mean of  $2.40 \pm 0.41$  months. Statistical comparisons of general information, such as age, gender, and disease duration, between the two groups revealed no significant differences ( $P > 0.05$ ), indicating that the groups were comparable. The study was approved by the hospital's Ethics Committee for implementation.

The inclusion criteria of the study included: (1) patients who were clearly diagnosed with inguinal hernia by clinical examination (e.g. ultrasound, CT, etc.) and underwent surgical treatment; (2) aged between 19 and 64 years old and able to cooperate in completing the nursing care and follow-up; (3) patients who were aware of the purpose of the study, the process and the potential risks, and voluntarily signed the informed consent for the study; and (4) patients who were free of severe cardiac, pulmonary, hepatic, and renal dysfunction underlying disease, and were able to tolerate the surgery and postoperative care.

The exclusion criteria consisted of: (1) those with serious diseases such as combined malignant tumours, serious infections, coagulation disorders, etc.; (2) previous history of inguinal area surgery; (3) pregnant or breastfeeding females; (4) unable to cooperate with nursing care or follow up visits; and (5) those who are

currently participating in other clinical trial studies.

## 2.2. Methodology

The control group adopts the conventional clinical surgical nursing model. After admission, patients receive routine inguinal hernia surgery nursing, including preoperative perfecting of various examinations, preoperative assessment, implementation of health education and psychological counselling. During the operation, the nursing staff actively cooperated with the surgeon to ensure that the operation was carried out smoothly. Postoperatively, the patient's vital signs were closely monitored, the incision was observed to prevent complications such as incision infection and urinary retention, and postoperative rehabilitation guidance was provided.

The observation group adopts the medical and nursing integration model of care, and the specific implementation steps are as follows:

(1) Formation of an integrated medical and nursing care team

One deputy chief physician, one attending physician, one anesthetist, two charge nurses, and three nurses were deployed to form a multidisciplinary integrated medical and nursing care team, and the team members worked together to formulate a personalized care plan.

(2) Preoperative nursing

Doctors and nurses work together to conduct a comprehensive assessment of the patient, including medical history, physical condition, psychological state, and surgical risk, as well as explain the surgical process, precautions, and postoperative rehabilitation to the patient and his family to reduce the patient's anxiety. Nurses also assist in completing required preoperative examinations, such as blood tests and electrocardiograms, as per the doctor's instructions. Furthermore, they guide the patient on essential preoperative preparations, including fasting and drinking guidelines, to ensure the patient is ready for surgery.

(3) Intraoperative nursing

During the operation, the nurse works closely with the surgeon and anesthetist, monitors the patient's vital signs in real time, and deals with abnormalities promptly. They also record the intraoperative situation in detail and hand it over to the ward nurses after the operation to ensure that the information is transmitted accurately and correctly.

(4) Postoperative care

Doctors and nurses check in together daily to assess the patient's recovery and make timely adjustments to the treatment plan and nursing measures. At the same time, according to the patient's pain score, the medical and nursing team work together to formulate an analgesic program to ensure patient comfort. The condition of the incision is closely monitored, and patients are encouraged to get out of bed early to prevent complications such as incision infection and urinary retention. A personalized rehabilitation plan was formulated with the patient's actual situation, including dietary guidance, activity suggestions, and follow-up arrangements, to promote the patient's rapid recovery.

(5) Discharge and follow-up

After discharge, the integrated health care team works together to provide patients with detailed discharge instructions, including medication, diet, activities and follow-up time, etc., and regularly follows up with patients by phone or outpatient clinic to learn about their recovery, answer questions promptly, and ensure the effectiveness of rehabilitation.

## 2.3. Observation indicators

- (1) Surgery-related indexes: Observe and record the postoperative gastrointestinal recovery time and the time of getting out of bed activities of the two groups of patients; apply visual analogue scoring (VAS) to quantify the pain level of the two groups of patients. Scoring range 0–4 points, no pain: 0 points; mild pain: 1–2 points; moderate pain: 3–4 points; severe pain: 5 points.
- (2) Sleep quality score: Pittsburgh Sleep Quality Index Scale (PSOI) was used for sleep quality assessment, the evaluation contained sleep efficiency, sleep disorders, time to fall asleep, daytime functioning, etc., and the scoring range of each dimension was 0–12 points, and the higher the score suggested that the patient's sleep quality was poorer.
- (3) Assessment of complication rate: Observe and record the occurrence of urinary retention, local hematoma and incision infection complications during the treatment period of the two groups of patients, and the total incidence rate = the number of cases occurring/total number of cases  $\times 100\%$ .
- (4) Nursing satisfaction: The hospital's own questionnaire was used to investigate the patients' satisfaction with nursing techniques, medical and nursing attitudes, timeliness in meeting patients' needs, and ward environment. Patients ticked satisfied, more satisfied, or dissatisfied according to their real feelings. Total satisfaction = (satisfied + more satisfied) number of cases / total number of cases  $\times 100\%$ .

## 2.4. Statistical analysis

SPSS24.0 software was applied for statistical processing. Measurement data such as postoperative pain level, gastrointestinal recovery time, time to get out of bed, sleep efficiency, sleep disorders, time to fall asleep, and daytime function were expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ). Comparisons were made using the t-test. Count data, including related complications and nursing satisfaction, were expressed as rates [n(%)] and compared using  $\chi^2$  test, where  $P < 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Comparison of surgery-related indicators between the two groups

The postoperative pain level scores of patients in the observation group were lower than those of the control group, and the gastrointestinal recovery time and time to get out of bed were shorter than those of the control group, with statistically significant differences ( $P < 0.05$ ), as shown in **Table 1**.

**Table 1.** Comparison of surgery-related indicators between the two groups of patients ( $\bar{x} \pm s$ )

Groups	Postoperative pain level (points)	Gastrointestinal recovery time (h)	Time out of bed (d)
Control group ( $n = 39$ )	$3.86 \pm 1.02$	$29.53 \pm 3.47$	$20.85 \pm 3.08$
Observation group ( $n = 39$ )	$2.23 \pm 0.52$	$23.12 \pm 4.06$	$15.42 \pm 4.19$
$t$	8.891	7.495	6.521
$P$	$< 0.001$	$< 0.001$	$< 0.001$

### 3.2. Comparison of postoperative sleep quality PSQI scores between the two groups of patients

The postoperative sleep efficiency, sleep disorder, time to sleep, and daytime function scores of the patients in the observation group were significantly lower than those of the control group, and the differences were statistically significant ( $P < 0.05$ ), as shown in **Table 2**.

**Table 2.** Comparison of PSQI scores for postoperative sleep quality between the two groups ( $\bar{x} \pm s$ , points)

Groups	Sleep efficiency	Sleep disorder	Bedtime	Daytime function
Control group (n = 39)	7.46 ± 1.29	8.63 ± 1.41	10.37 ± 1.38	8.49 ± 1.24
Observation group (n = 39)	5.12 ± 1.14	6.42 ± 1.29	7.56 ± 1.57	6.25 ± 1.19
<i>t</i>	8.489	7.221	8.395	8.140
<i>P</i>	< 0.001	< 0.001	< 0.001	< 0.001

### 3.3. Comparison of the incidence of relevant complications between the two groups of patients

The incidence of complications such as urinary retention, local hematoma and incision infection during the treatment period of patients in the observation group was significantly lower than that of the control group, and the difference was statistically significant ( $P < 0.05$ ), as shown in **Table 3**.

**Table 3.** Comparison of the incidence of relevant complications between the two groups of patients, [n (%)]

Groups	Urine retention	Local hematoma	Cutaneous infection	Total incidence
Control group (n=39)	2 (5.13)	5 (12.82)	1 (2.56)	8 (20.51)
Observation group (n=39)	0	1 (2.56)	0	1 (2.56)
$\chi^2$				4.522
<i>P</i>				0.034

### 3.4. Comparison of patient care satisfaction between the two groups

The patient care satisfaction of the observation group was significantly higher than that of the control group, and the difference was statistically significant ( $P < 0.05$ ), shown in **Table 4**.

**Table 4.** Comparison of patient care satisfaction between the two groups [n (%)]

Groups	Dissatisfied	More satisfied	Unsatisfactory	Total satisfaction
Control group (n = 39)	20 (51.28)	10 (25.64)	9 (23.08)	30 (76.92)
Observation group (n = 39)	27 (69.23)	11 (28.21)	1 (2.56)	38 (97.44)
$\chi^2$				7.341
<i>P</i>				0.007



## 4. Discussion

As inguinal hernia surgery involves structural repair of the abdominal wall, postoperative patients often face risks such as pain, gastrointestinal dysfunction, and incisional infection, which may prolong the recovery time and affect the quality of life <sup>[5]</sup>. In addition, the occurrence of complications such as decreased sleep quality and urinary retention in the postoperative period can further increase the difficulty of nursing care. Therefore, methods to optimize patients' postoperative recovery process through effective nursing interventions have become a key difficulty in inguinal hernia surgery nursing <sup>[6]</sup>. In the nursing practice of inguinal hernia surgery patients, the conventional clinical surgical nursing model is mainly carried out through preoperative examination, health education, intraoperative co-operation, and postoperative monitoring. However, its limitations are very significant. Firstly, the conventional nursing model lacks in-depth collaboration between doctors and nurses, resulting in a lack of close articulation between nursing measures and treatment protocols, which can affect the recovery effect of patients <sup>[7]</sup>. Secondly, the conventional nursing model has limited effects in postoperative pain management, gastrointestinal function recovery and sleep quality improvement, which cannot meet the all-round needs of patients and makes it difficult to effectively respond to the complex recovery process after surgery.

The integrated healthcare model is a new type of healthcare service model, the core of which lies in the close collaboration and information sharing between doctors and nurses, emphasizing the joint participation of a multidisciplinary team, and realizing the whole-process management from pre-operative assessment, intra-operative cooperation to post-operative recovery through the development of personalized care plans <sup>[8]</sup>. The core advantage of the healthcare integration model is that it can integrate medical resources, optimize the nursing process, improve the relevance and continuity of care, and improve the quality of care by identifying and solving problems in patients' postoperative recovery in a more timely manner through joint room visits between doctors and nurses, and the joint development of treatment plans and nursing measures <sup>[9, 10]</sup>.

In this study, by comparing the clinical outcomes of the two groups of patients under different care models, it was found that the postoperative pain score of patients in the observation group ( $2.23 \pm 0.52$ ) was significantly lower than that of the control group ( $3.86 \pm 1.02$ ), indicating that the healthcare integration model was more effective in relieving postoperative pain. Additionally, the gastrointestinal recovery time ( $23.12 \pm 4.06$  hours) and the time to get out of bed were both shorter in the observation group compared to the control group ( $15.42 \pm 4.19$  days), suggesting that this model helped accelerate postoperative recovery. The sleep quality scores of patients in the observation group were also significantly better than those in the control group, indicating that the healthcare integration model improved postoperative sleep quality. Furthermore, the complication rate in the observation group (2.56%) was significantly lower than in the control group (20.51%), and patient satisfaction with nursing care (97.44%) was notably higher than in the control group (76.92%), further demonstrating the effectiveness of this model in reducing complications and improving patient satisfaction.

## 5. Conclusion

In summary, the healthcare integration model in the care of patients undergoing inguinal hernia surgery effectively relieves postoperative pain, accelerates gastrointestinal recovery, shortens the time to get out of bed, improves sleep quality, and significantly reduces the incidence of complications. Through close collaboration between doctors, nurses, and other care providers, this model enhances patient satisfaction with care. It also offers a scientific basis for optimizing care plans for patients undergoing inguinal hernia surgery. Therefore, it is recommended that this



model be further promoted and applied in clinical practice to improve the quality of surgical care.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Xie L, 2025, Analysis of the Application Value of Humanised Care in the Care of Elderly Patients with Perioperative Hernia. *Primary Medical Forum*, 29(03): 72–75.
- [2] Li H, Xue XB, 2025, Application Effect of Xiao's Double C Nursing Model Under Joint Assessment Strategy in Hernia Repair for Adult Inguinal Hernia Patients. *Chinese Health Care*, 43(02): 149–152.
- [3] Han Y, Yue Y, Fu Z, et al., 2024, Application Analysis of Two-Session Collaborative Nursing Model in Inguinal Hernia Surgery Patients. *Heilongjiang Medicine*, 48(24): 3057–3059.
- [4] Zhao L, Zhang C, He S, et al., 2024, Effects of Collaborative Care Based on the FTS Concept on Recovery and Social Support of Inguinal Hernia Surgery Patients. *Hebei Medicine*, 46(23): 3674–3676+3680.
- [5] Ye Y, 2024, Application Effect of Perioperative Nursing Under the Guidance of Accelerated Rehabilitation Surgery Concept in Patients Undergoing Inguinal Hernia Surgery. *Chinese Community Physician*, 40(27): 142–144.
- [6] Xu X, 2024, The Effect of Integrated Medical and Nursing Work Model on Children's Compliance Behaviour and Complications During the Perioperative Period of Inguinal Hernia Laparoscopy. *Journal of Qiannan National Medical College*, 37(02): 227–230.
- [7] Peng Y, Peng J, He L, 2021, Analysis of the Effect of Healthcare Integration Model on the Nursing Care of Patients with Inguinal Hernia Treated by Tension-Free Repair. *Chinese Community Physician*, 37(32): 122–123.
- [8] He H, Shen W, Zhang W, et al., 2021, Effect of Rapid Rehabilitation Surgical Care on Postoperative Recovery of Adult Inguinal Hernia Patients Treated with Hernia Repair. *Chinese Journal of Hernia and Abdominal Wall Surgery (Electronic Edition)*, 15(6): 679–682.
- [9] Slonetskyi BI, Verbitskiy IV, Kotsiubenko VO, 2024, Specific Features of Diagnostic and Treatment Tactics in Patients with Crushed Abdominal Hernias Without Resection of a Hollow Organ. *Pril (Makedon Akad Nauk Umet Odd Med Nauki)*, 45(2): 59–66.
- [10] Zhu M, Zhang P, Sun L, et al., 2022, Application Effect of Clinical Surgical Nursing Cooperation in Patients with Laparoscopic Hernia Repair. *China Contemporary Medicine*, 29(26): 190–192.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Research on the Role of Ezrin in Glucose and Lipid Metabolism

Ruyuan Zhang<sup>1</sup>, Zhixiong Liu<sup>2</sup>, Huimin Su<sup>3\*</sup>

<sup>1</sup>Kunming Medical University, Qijing 655099, Yunnan, China

<sup>2</sup>Kunming Medical University Haiyuan College, Kunming 650106, Yunnan, China

<sup>3</sup>Department of Internal Medicine II, The Third Affiliated Hospital of Kunming Medical University, Kunming 650000, Yunnan, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** Ezrin, as a key connecting protein between the cytoskeleton and cell membrane, plays an important role in various cellular physiological processes. In recent years, people have gradually attached importance to its research in the field of glucose and lipid metabolism. Based on relevant research materials, this article elaborates the structure and function of Ezrin, and focuses on its role and potential mechanism in the diseases related to abnormal glucose and lipid metabolism, such as diabetes and its complications, to provide new ideas and theoretical basis for in-depth understanding of the regulation of glucose and lipid metabolism and the prevention and treatment of related diseases.

**Keywords:** Ezrin; Glucose and lipid metabolism; Insulin signaling pathway

**Online publication:** April 29, 2025

## 1. Introduction

Glucose and lipid metabolism is an important process to maintain the normal physiological function of the body, and its imbalance is closely related to the occurrence and development of many diseases, such as diabetes, cardiovascular disease, etc. Ezrin, a protein with important functions in cellular biology, has been found to be associated with glucose and lipid metabolism in recent years<sup>[1, 2]</sup>. In-depth research on the role of Ezrin in glucose and lipid metabolism is of great significance for revealing the pathogenesis of glucose and lipid metabolism disorders and searching for new therapeutic targets.

## 2. Structure and function of ezrin

### 2.1. Structural features

Ezrin is encoded by the VIL2 gene located on human chromosome 6q25.2-q26, which is approximately 24 kb

long and contains 13 exons. This protein is composed of 586 amino acids and has a molecular weight of 81 kDa. Its structure mainly consists of three parts: a highly conserved spherical amino acid terminal (N-terminus) that can be connected to the membrane and bind to cell adhesion molecules (such as ICAM-1, ICAM-2), cell surface transmembrane glycoprotein (CD44), highly glycosylated type I transmembrane glycoprotein (CD43), and other cell adhesion molecules. The middle is an elongated alpha helical structure. The positively charged C-terminal actin binding region contains a threonine residue (Thr567), which is the most important activation site for Ezrin phosphorylation<sup>[3, 4]</sup>.

## **2.2. Function overview**

Ezrin is a connecting protein between the cytoskeleton and cell membrane, which plays a structural and functional regulatory role in the integration and stability of cell membrane regions. It is involved in the formation of microvilli, maintenance of cell morphology, cell movement and adhesion, remodeling of the cytoskeleton, and cellular signal transduction processes. Ezrin acts as a membrane organism and connector in the connection between the cytoskeleton and cell membrane, ensuring effective connection between the cell membrane and cytoskeleton. Meanwhile, studies have shown that Ezrin is closely related to the occurrence, development, and metastasis of tumors, and has always been regarded as a key factor in tumor metastasis<sup>[5, 6]</sup>. In addition, Ezrin plays an important role in establishing cell polarity and localizing organelles.

## **3. Ezrin and sugar metabolism**

### **3.1. Study of Ezrin in diabetes**

When researchers treated podocytes with high concentrations of glucose, a series of complex molecular events occurred within the cells. The high glucose environment first activates the Smad3 signaling pathway, which acts as the start of a domino effect, leading to a significant increase in Ezrin phosphorylation levels at the Thr567 site. Researchers have accurately detected changes in Ezrin phosphorylation levels through techniques such as protein immunoblotting. Subsequently, the intracellular PKA activity was inhibited, which triggered upregulation of NADPH oxidase 4 expression, leading to a large production of reactive oxygen species (ROS). A large amount of ROS disrupts the redox balance within cells, ultimately leading to podocyte apoptosis. Researchers observed a significant increase in podocyte apoptosis rate using a cell apoptosis detection kit.

In contrast, the situation is completely different in podocytes expressing shRNA-ezrin. Due to the specific interference of shRNA-ezrin on the expression of Ezrin gene, the content of Ezrin in cells is significantly reduced. After high glucose treatment, the apoptosis of these podocytes was significantly reduced. Through TUNEL staining and other methods, it was clearly observed that the number of apoptotic podocytes expressing shRNA-ezrin was significantly lower than that of normal podocytes. At present, the reasons for the difference between these two results are not fully understood. The expression and activation of Ezrin in normal physiological state and high glucose stress state show dynamic changes. How this change accurately regulates downstream signal pathways and the specific role and regulatory mechanism in the complex pathological process of diabetes still need further research.

Under high concentration glucose induction, significant changes were also observed in the mitochondria of renal tubular cells. Researchers used immunofluorescence and protein quantification analysis techniques to find that the expression level of phosphorylated Ezrin (phosphor-ezrin, p-ezrin) in renal tubular cell mitochondria

showed a significant upward trend. At the same time, through ATP detection kits and other methods, it was detected that the intracellular ATP level also increased accordingly. This phenomenon suggests a correlation between phosphorylated Ezrin and mitochondrial dysfunction in renal tubular cells caused by hyperglycemia. As the energy factory of cells, mitochondria dysfunction plays an important role in the occurrence and development of diabetes complications such as diabetes nephropathy. In a hyperglycemic environment, mitochondrial respiratory chain function is impaired, oxidative phosphorylation efficiency is reduced, leading to decreased or abnormal ATP synthesis <sup>[7, 8]</sup>. The increase of phosphorylated Ezrin may be involved in this pathological process, which changes the location and function of mitochondrial-related proteins by affecting the stability of mitochondrial membrane, thus affecting the energy metabolism and ROS production of mitochondria, and ultimately promoting the development of complications such as diabetes and nephropathy.

### **3.2. Potential effects of Ezrin on insulin signaling pathway**

The insulin signaling pathway is like a precise regulatory network, ensuring the stability of blood sugar. Insulin binds to insulin receptors on the cell membrane and initiates a series of phosphorylation cascades, including phosphorylation of insulin receptor substrates (IRS), which in turn activate downstream signaling molecules such as phosphatidylinositol 3-kinase (PI3K), promoting glucose uptake and metabolism. Although there is currently limited research on the direct effects of Ezrin on the insulin signaling pathway, given its crucial role in cellular signaling transduction, it is speculated that Ezrin may be involved in the regulation of insulin signaling. Ezrin, as a connecting protein between the cytoskeleton and the cell membrane, interacts closely with some receptors and signaling molecules on the cell membrane <sup>[9, 10]</sup>. It interacts with receptors such as integrins, which may alter the microenvironment of the cell membrane and the spatial conformation of receptors, indirectly affecting the binding affinity between insulin and its receptors. Meanwhile, Ezrin may also interact with some adaptor proteins involved in insulin signal transduction, interfering with the normal assembly and signal transmission sequence between signaling molecules, thereby affecting the insulin signal transduction process. However, these are only speculations based on existing research. In the future, advanced technologies such as gene knockout and protein-protein interactomics need to be used to further explore the specific sites and molecular mechanisms of Ezrin in the insulin signaling pathway, in order to clarify its precise role in maintaining blood glucose homeostasis <sup>[11]</sup>.

## **4. Ezrin and lipid metabolism**

### **4.1. Functional study of Ezrin in adipocytes**

During the process of adipocyte differentiation, the expression level and phosphorylation status of Ezrin show dynamic changes. Researchers tracked changes in Ezrin during the differentiation of adipocytes from mesenchymal stem cells to mature adipocytes using real-time quantitative PCR and protein immunoblotting techniques. In the early stages of differentiation, the expression level of Ezrin gradually increases and reaches its peak in the middle stage of differentiation, and then remains relatively stable in the mature stage. Meanwhile, through phosphorylation-specific antibody detection, it was found that the phosphorylation status of Ezrin at Thr567 site also changed with the differentiation process, and the phosphorylation level significantly increased during the critical differentiation period.

Ezrin may profoundly affect the morphological changes of adipocytes and the distribution of lipid droplets through its interaction with the cytoskeleton. During the differentiation of adipocytes, the cytoskeleton

undergoes rearrangement, and Ezrin acts as a connecting protein that interacts with cytoskeletal components such as actin microfilaments. Research has found that inhibiting the expression or activity of Ezrin can lead to abnormal morphology of adipocytes and disrupted distribution of lipid droplets. Researchers observed through immunofluorescence staining that under normal circumstances, lipid droplets are evenly distributed within cells, but when Ezrin function is restricted, lipid droplets tend to aggregate or disperse unevenly.

In addition, Ezrin may also be involved in regulating the expression of genes related to lipid synthesis and breakdown in adipocytes, thereby affecting the lipid metabolism function of adipocytes. Research has shown that Ezrin can interact with some transcription factors to regulate the expression of key genes such as fatty acid synthase (FAS) and hormone sensitive lipase (HSL). For example, in adipocytes overexpressing Ezrin, FAS gene expression is upregulated, promoting fatty acid synthesis, while HSL gene expression is downregulated, inhibiting fat breakdown and ultimately leading to increased fat storage.

## **4.2. Ezrin and blood lipid abnormalities and related diseases**

Dyslipidemia is an important risk factor for various diseases, such as cardiovascular disease. Some studies have found that Ezrin expression and function are abnormal in animal models or patients with dyslipidemia. In atherosclerotic plaque, the expression level of Ezrin was significantly increased by immunohistochemical staining and quantitative analysis. Further research found that Ezrin may be closely related to the infiltration of inflammatory cells and the formation of foam cells. The infiltration of inflammatory cells, such as monocytes and macrophages, into the vascular wall is one of the initial steps of atherosclerosis. Ezrin may affect the adhesion process between inflammatory cells and vascular endothelial cells by regulating the expression and function of cell adhesion molecules. Research has shown that Ezrin can interact with cell adhesion molecules such as ICAM-1, enhancing its stability and activity on the cell membrane. When the expression of Ezrin is abnormally elevated, inflammatory cells are more likely to adhere and migrate to the lower endothelium of the vascular wall, absorb oxidized low-density lipoprotein (ox-LDL), and gradually transform into foam cells. The formation of a large number of foam cells is a characteristic manifestation of atherosclerosis, and its accumulation further promotes the formation and development of plaque. In addition, Ezrin may also participate in regulating the proliferation and migration of smooth muscle cells and play a role in the remodeling of atherosclerotic plaque, but the specific mechanism remains to be further studied.

## **5. Conclusion**

In summary, Ezrin, as a key protein connecting the cytoskeleton and cell membrane, plays an important role in various cellular processes related to glucose and lipid metabolism. In diabetes and its complications, the expression and phosphorylation of Ezrin are closely related to apoptosis and mitochondrial dysfunction. In terms of lipid metabolism, Ezrin participates in the differentiation and functional regulation of adipocytes, and is associated with the occurrence and development of dyslipidemia and related diseases such as atherosclerosis. Furthermore, Ezrin may play a bridging role in the interrelationships of glucose and lipid metabolism. However, there are still many shortcomings in the current research on the role of Ezrin in glucose and lipid metabolism. For example, the specific molecular mechanisms by which Ezrin participates in glucose and lipid metabolism in different cell types are not yet fully understood. The interaction between Ezrin and other signaling pathways related to glucose and lipid metabolism needs further investigation. The development of drugs or therapeutic strategies targeting Ezrin to



regulate glucose and lipid metabolism is still in the exploratory stage. Future research requires the comprehensive use of various techniques such as cell biology, molecular biology, genetics, etc., to deeply study the mechanism of Ezrin in glucose and lipid metabolism and provide new targets and strategies for the prevention and treatment of diseases related to glucose and lipid metabolism disorders.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Yang Z, 2020, Expression of Ezrin in Circulating Tumor Cells in Nasopharyngeal Carcinoma and Its Clinical Significance, thesis, Jinan University.
- [2] Fan B, Liao DB, Fan S, et al., 2019, Effects of Fuzheng Jiedu Decoction and Intensity Modulated Radiotherapy on KISS-1 and Ezrin Protein Expression in Patients with Cervical Cancer. *Western Traditional Chinese Medicine*, 32(10): 53–55.
- [3] Xu Y, 2015, Study on the Relationship Between Ezrin Protein, E-Cadherin and CD44V6 Protein Expression in NSCLC. *Journal of Shandong Medical College*, 37(4): 281–284+236.
- [4] Zhao Y, Sun G, You Q, 2015, Research Progress of Ezrin-Rhizoprotein-Meningin and Respiratory Diseases. *Chinese Journal of Pulmonary Diseases (Electronic Version)*, 8(4): 475–477.
- [5] Xie Y, Fan G, Huang Z, et al., 2014, Expression of Ezrin and CD44 in Renal Cell Carcinoma and Its Clinical Significance. *Chinese Journal of Cancer Biotherapy*, 21(6): 665–668.
- [6] Zhao Q, Pang H, Ma N, et al., 2014, Study on the Relationship Between the Expression of Ezrin and the Metastasis of Non-Small Cell Lung Cancer. *Progress in Modern Biomedicine*, 14(27): 5235–5237+5241.
- [7] Wang L, Zhu Y, Yuan Y, et al., 2012, Expression of Ezrin and Aquaporin 3 in Skin Squamous Cell Carcinoma. *Journal of Zhengzhou University (Medical Edition)*, 47(01): 23–26.
- [8] Xi C, Cai X, 2007, Study on Ezrin and Tumor Metastasis. *Medical Review*, (22): 1714–1716.
- [9] Gu Y, Xu T, Chang C, et al., 2025, Research Progress on the Role of Ezrin in Glycolipid Metabolism. *China Journal of Pathophysiology*, 41(01): 202–208.
- [10] Jia G, Yan X, Jiang J, et al., 2017, The Role of Ezrin in Mesenchymal Transition of Bronchial Epithelial Cells Induced by Transforming Growth Factor- $\beta$ . *Chinese Journal of Respiratory and Critical Care Medicine*, 16(03): 280–286.
- [11] Wang L, Zhu Y, Yuan Y, et al., 2012, Expression of Ezrin and Aquaporin 3 in Skin Squamous Cell Carcinoma. *Journal of Zhengzhou University (Medical Edition)*, 47(01): 23–26.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



# Application Value of Bundle Management in Safe Nursing Care for Patients with Autoimmune Encephalitis

Ying Cui\*

School of Clinical Medicine, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the application effect of bundle management in the safe nursing of patients with autoimmune encephalitis. *Methods:* Seventy-five patients with autoimmune encephalitis who met the inclusion criteria in our hospital from January 2024 to June 2024 were randomly divided into two groups: an observation group of 39 patients and a control group of 36 patients. The control group received routine nursing care, while the observation group implemented a bundle management strategy based on routine nursing care. Safety nursing outcomes, clinical symptom improvement time, hospital stay, and neurologic function recovery were observed in both groups. *Results:* The incidence of adverse events in the observation group was 12.82%, significantly lower than the 33.33% in the control group, with a statistically significant difference ( $P < 0.05$ ). There was no statistically significant difference in restraint usage and ICU transfer rates between the two groups ( $P > 0.05$ ). The clinical symptom improvement time, hospital stay, and neurologic function recovery in the observation group were significantly better than those in the control group, with a statistically significant difference ( $P < 0.05$ ). *Conclusion:* Through the bundle management model, effective connections can be ensured in various aspects of treatment and rehabilitation for patients with autoimmune encephalitis, providing patients with comprehensive and multi-level nursing services and improving their overall satisfaction and treatment effectiveness.

**Keywords:** Bundle management; Autoimmune Encephalitis; Safe nursing; Clinical effect

**Online publication:** April 29, 2025

## 1. Introduction

Autoimmune encephalitis is an inflammatory disease of the central nervous system, with main symptoms including consciousness disturbance, epileptic seizures, and intellectual decline. The etiology of autoimmune encephalitis is complex, and its specific cause is currently unclear. However, most scholars believe it is related to genetics, infection, and autoimmunity. In recent years, with the deepening of research on autoimmune encephalitis, the treatment effect has been continuously improved, prognosis has been enhanced, and it has gradually become a

common clinical disease in neurology. The 2018 Chinese Guidelines for the Diagnosis and Treatment of Epileptic Diseases included autoimmune encephalitis in the types of epileptic seizures and proposed strengthening nursing management for patients with autoimmune encephalitis to reduce adverse events and improve patients' quality of life. Therefore, to improve healthcare providers' understanding of this disease and ensure that patients receive safe and effective treatment, this study adopted the nursing model of bundle management to provide patients with comprehensive and full-cycle nursing intervention, aiming to promote their physical and mental health development and improve their quality of life.

## **2. Materials and methods**

### **2.1. General information**

From January 2024 to June 2024, a total of 75 patients with autoimmune encephalitis who met the inclusion criteria were admitted to our hospital. Among them, 39 were in the observation group, including 24 males and 15 females, with an average age of  $(43.38 \pm 10.62)$  years, average weight of  $(62.40 \pm 8.15)$  kg, and disease duration ranging from 20 to 95 days. There were 36 patients in the control group, with a male-to-female ratio of 1:1, an average age of  $(43.8 \pm 10.6)$  years, average weight of  $(63.4 \pm 8.13)$  kg, and disease duration ranging from 20 to 95 days. There were no statistically significant differences in gender, age, and disease duration between the two groups ( $P > 0.05$ ), making them comparable.

Inclusion criteria were based on the Chinese Expert Consensus on the Diagnosis and Treatment of Autoimmune Encephalitis (2022 Edition), age  $\geq 18$  years, and signed informed consent by family members or patients <sup>[1]</sup>. Exclusion criteria included severe cardiac, liver, or renal insufficiency, malignant tumors or immunodeficiency diseases, history of mental illness or cognitive impairment that prevents cooperation with nursing, and withdrawal or death during the study <sup>[2]</sup>.

### **2.2. Methods**

The control group received routine nursing care, including monitoring of vital signs, medication management, basic nursing, immunotherapy (such as glucocorticoids, gamma globulin, etc.) according to doctor's orders, and routine health education.

The observation group implemented a bundle management strategy based on routine nursing care, with specific measures as follows: Establishing a multidisciplinary team including neurology, ICU, rehabilitation, and psychology departments to develop individualized nursing plans; keeping emergency medications (such as diazepam) bedside and monitoring electroencephalograms (EEG); using the fall risk assessment scale (Morse scale), bedrail protection, and 24-hour dedicated care; assessing swallowing function (VFSS or FEES) and providing nasal feeding if necessary; applying intermittent pneumatic compression devices (IPC) combined with early rehabilitation training; adopting non-pharmacological restraints (such as environmental adjustments, psychological counseling), and using sedatives if necessary; implementing the NRS scoring system and a stepwise analgesic plan; initiating rehabilitation training (such as cognitive training and physical function exercises) once the condition stabilizes; and regularly conducting family training to improve home care abilities.

### **2.3. Observation indicators**

The safety nursing outcomes of the two groups were observed, including the incidence of adverse events (such as epileptic seizures, falls, aspiration, DVT, etc.), the utilization rate of restraints (such as physical/pharmacological

restraints), and the ICU transfer rate (the proportion of cases transferred to the ICU due to worsened condition). Additionally, the improvement time of clinical symptoms (days), length of hospital stay (days), and modified Rankin Scale (mRS) scores (to evaluate neurologic function recovery, with a score range of 0–6, where lower scores indicate better prognosis) were also observed.

## 2.4. Statistical methods

Statistical analysis was performed using SPSS 27.0 software. Measurement data were expressed as mean  $\pm$  standard deviation ( $\pm$ s), and comparisons between groups were made using the t-test. Count data were expressed as rates (%), and comparisons between groups were made using the chi-square test. A  $P$ -value  $< 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Comparison of safety nursing outcomes between the two groups

The incidence of adverse events in the observation group was 12.82%, which was significantly lower than the 33.33% in the control group, with a statistically significant difference ( $P < 0.05$ ). There was no statistically significant difference in the utilization rate of restraints and the ICU transfer rate between the two groups ( $P > 0.05$ ), as shown in **Table 1**.

**Table 1.** Comparison of safety nursing outcomes between two groups of patients[n(%)]

Group	Adverse event rate	Restraint utilization rate	ICU transfer rate
Control group ( $n=36$ )	12(33.33)	15(41.67)	8(22.22)
Observation group ( $n=39$ )	5(12.82)	9(23.08)	3(7.69)
$\chi^2$	4.494	2.973	3.158
$P$	0.034	$> 0.05$	$> 0.05$

### 3.2. Comparison of clinical symptom improvement time, hospital stay, and neurologic function recovery between the two groups

The clinical symptom improvement time, hospital stay, and neurologic function recovery in the observation group were significantly better than those in the control group, with a statistically significant difference ( $P < 0.05$ ); see **Table 2** for details.

**Table 2.** Comparison of clinical symptom improvement time, hospital stay, and neurologic function recovery between the two groups ( $\bar{x} \pm s$ )

Group	Clinical symptom improvement time (d)	Length of hospital stay (d)	Recovery of neurological function (score)
Control group ( $n=36$ )	$7.52 \pm 2.36$	$14.85 \pm 3.72$	$3.45 \pm 1.28$
Observation group ( $n=39$ )	$5.23 \pm 1.87$	$11.62 \pm 2.95$	$2.16 \pm 0.94$
$t$	4.876	5.213	3.942
$P$	0.000	0.000	0.00

## 4. Discussion

According to statistics, the global incidence of autoimmune encephalitis is between 1/200,000 and 3/200,000. Among these cases, patients aged 65 and above account for 70%, with males predominating over females. Additionally, studies have indicated that epilepsy, diabetes, chronic obstructive pulmonary disease, and other conditions are risk factors for autoimmune encephalitis <sup>[3]</sup>. Clinically, patients with autoimmune encephalitis may exhibit varying degrees of consciousness and intellectual impairments, accompanied by symptoms such as headache, vomiting, and epileptic seizures. It is generally believed that the initial onset may primarily manifest as consciousness disturbances, and as the disease progresses, the proportion of symptoms related to nervous system dysfunction gradually increases.

Specifically, some patients may present with focal encephalopathy (e.g., cerebral infarction) or psychomotor disorders (e.g., hemiplegia); a few patients manifest diffuse brain injury (e.g., status epilepticus); and another subset of patients experience peripheral neuropathy (e.g., Raynaud's syndrome, sensory disturbances, numbness, tingling sensations, skin rashes, etc.) <sup>[4]</sup>. It's worth noting that early-stage autoimmune encephalitis patients are highly susceptible to being misdiagnosed with diseases other than autoimmune encephalitis, leading to delayed treatment. Therefore, careful observation of the clinical manifestations of autoimmune encephalitis patients is crucial for early detection of their unique characteristics <sup>[5]</sup>. Diagnosing autoimmune encephalitis is challenging due to its early-stage similarity with other neurological diseases.

Currently, diagnosis relies primarily on medical history collection, physical examination, imaging, and laboratory tests. MRI is the most commonly used imaging technique, often revealing bilateral symmetric cerebral atrophy in the cerebral hemispheres. Some patients may also exhibit vascular malformations, intracranial hemorrhages, and calcifications. Laboratory tests include detecting anti-NMDA receptor antibodies, measuring beta-amyloid protein ( $A\beta$ ) levels, and performing transferrin PET scans to aid in diagnosis. Currently, the primary treatment methods for autoimmune encephalitis include symptomatic treatment, immunosuppression, and neuroprotection.

Clinical research has found that nursing interventions for autoimmune encephalitis patients can significantly improve their quality of life <sup>[5]</sup>. Firstly, establishing a reasonable health education system allows patients' families to grasp disease knowledge and related nursing skills, reducing patients' mental stress and anxiety levels. Secondly, strengthening communication with patients' families enhances their cooperation. Furthermore, regularly conducting health education lectures encourages patients to actively participate in activities, improves physical fitness, and helps them develop healthy lifestyle habits through tailored dietary plans and guidance <sup>[6, 7]</sup>. As patients with autoimmune encephalitis often experience severe symptoms such as consciousness disturbances, cognitive decline, and epileptic seizures after onset, they face a high risk of mortality upon admission. To reduce mortality rates, healthcare professionals must be adequately prepared to provide timely and effective treatment. For this specific population, medical professionals should also utilize modern medical technologies such as intracranial pressure monitoring, EEG, blood oxygen saturation measurements, and chest CT scans to assess the patient's condition and adjust nursing plans accordingly, ensuring patient safety.

Bundle management, as a novel management philosophy and model, centers on the patient, establishes a multidisciplinary team, and implements a comprehensive nursing model characterized by integration, systematization, and continuity. Its core lies in integrating resources, breaking down departmental barriers, and facilitating information sharing to enhance nursing quality <sup>[8]</sup>. In recent years, this management model has been widely applied in clinical settings, yielding positive results and gaining recognition and promotion from the

international nursing community. In China, bundle management represents a patient-centered, systematic nursing management approach aimed at establishing scientific and efficient nursing workflows. This enables nursing staff to complete various nursing tasks more accurately and timely, thereby improving nursing quality and efficiency<sup>[9]</sup>. Currently, the bundle management model has been widely adopted in clinical nursing practice, achieving remarkable success.

The results of this study indicate that the adoption of a bundle management model in the care of patients with autoimmune encephalitis integrates the entire process from admission to discharge, including patient condition assessment, treatment, rehabilitation training, psychological support, and other aspects. Specifically, first, a comprehensive assessment of the patient is conducted, including neurological symptoms, mental state, vital signs, etc. Simultaneously, the patient's family members are trained to understand the basic knowledge of the disease and preventive measures so as to provide more care and attention to the patient in daily life. Secondly, personalized nursing plans are developed based on the patient's actual condition, including medication, nutritional support, exercise guidance, psychological counseling, and other aspects<sup>[10]</sup>. Additionally, communication and collaboration between doctors and nurses are strengthened to discuss the best treatment plan and adjust nursing measures promptly. Finally, patients are regularly organized to participate in rehabilitation activities such as Tai Chi and yoga to promote their physical and mental recovery.

Autoimmune encephalitis is a severe and progressive disease characterized by high disability rates, high fatality rates, and high recurrence rates. Therefore, early diagnosis and timely treatment are particularly important, and it is also very necessary to provide full-course nursing and long-term management to patients. In this context, bundle management is applied to the long-term care of patients, enabling them to receive effective and safe nursing. Although the application of bundle management in the long-term care of patients with autoimmune encephalitis has been reported in the literature, a unified nursing model has not yet been established. Based on existing research and years of clinical experience, this study proposes a bundle management model suitable for patients with autoimmune encephalitis in China, including: (1) Strengthening education and raising awareness of the disease among patients and their families; (2) Establishing a three-level linkage mechanism between medical staff, nursing staff, and patients to optimize nursing resource allocation; (3) Emphasizing psychological nursing and paying attention to patients' emotional needs; (4) establishing a multidisciplinary team to standardize treatment plans.

## 5. Conclusion

In summary, the bundle management model can achieve continuous nursing services for patients from admission to discharge, which is more conducive to improving the overall condition of patients and enhancing their quality of life. Although bundle management has achieved good results in patients with autoimmune encephalitis in our hospital, there are still some issues that need further exploration and improvement, such as how to combine this model with traditional nursing models and make appropriate adjustments based on the different conditions of patients; and how to determine the standards and quantitative indicators of bundle management. In addition, various unpredictable problems may be encountered during implementation, such as insufficient professional knowledge and skills of medical staff, inadequate medical equipment, etc., which can affect the effectiveness of bundle management. Therefore, it is necessary to continuously improve the bundle management system, strengthen nursing staff training, and enhance medical standards to better ensure patient safety.



## Disclosure statement

The author declares no conflict of interest.

## References

- [1] Zhao H, 2022, The Application Effect of Cluster Management in Young Female Patients with Autoimmune Encephalitis. *Women's and Children's Health Guide*, 1(6): 144–147.
- [2] Song X, Cao M, Xiang L, et al., 2024, Nursing Care of a Patient with Anti-NMDA Receptor Encephalitis Complicated with Autoimmune Polyendocrine Syndrome. *General Nursing*, 22(17): 3353–3356.
- [3] Xi L, Liu Z, Zhang K, et al., 2021, The Effect of Whole-Process Nursing Method in the Treatment of Autoimmune Encephalitis with Rituximab. *China Medical Herald*, 11(14): 107–110, 150.
- [4] Wang Q, Bo L, Sun Y, et al., 2021, Retrospective Analysis of Clinical and Nursing Characteristics of Patients with Autoimmune Encephalitis. *Nursing Research*, 35(14): 2609–2612.
- [5] Du H, Cai Z, Shi G, 2017, Nursing Care of Two Patients with Autoimmune Encephalitis Complicated with Severe Tongue Bite. *Chinese Journal of Practical Nursing*, 33(28): 2179–2180.
- [6] Shi X, Feng W, 2021, The Application Value of Comprehensive Nursing in the Clinical Nursing of Patients with Autoimmune Encephalitis. *China Contemporary Medicine*, 28(3): 235–237.
- [7] Qin P, Shi L, Li T, et al., 2018, Analysis of the Application Effect of Cluster Protection Strategy in the Diagnosis and Treatment of Severe Hand, Foot, and Mouth Disease. *Internal Medicine*, 13(3): 386–388.
- [8] Yang Y, Jiang X, 2024, Application of Cluster Management in Improving Bed Utilization Rate. *Modern Hospital Management*, 22(1): 64–66.
- [9] Liu A, Tian J, Li F, et al., 2021, Practice and Effect Analysis of Emergency Cluster Management. *Chinese Journal of Hospital Administration*, 37(8): 686–689.
- [10] Liu H, Xu J, Zhang H, et al., 2021, Implementing Cluster Management to Shorten the Average Length of Stay. *Modern Hospital Management*, 19(4): 53–55.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



# Real-world Clinical Study of Recombinant Human Growth Hormone in the Treatment of Idiopathic Short Stature

Jianhua Liu, Jin Shi\*

Department of Child Health Care, Huangshi Maternity and Children's Health Hospital, Affiliated Materinty and Children's Health Hospital of Hubei Polytechnic University, Huangshi 435000, Hubei, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To investigate the clinical efficacy and safety evaluation of Polyethylene Glycol Recombinant Human Growth Hormone Injection (PEG-rhGH) in the treatment of idiopathic short stature. *Methods:* A total of 1402 patients were enrolled from March 21, 2024 to January 13, 2025, including 778 males and 624 females, with ages mainly ranging from 5 to 13 years old. Follow-up visits were completed by 488 patients for the first time, 174 patients for the second time, and 81 patients for the third time. All patients were treated with PEG-rhGH (Jin Sai Zeng) as the main therapy after admission. The changes in height information, IGF-1, and thyroid examination results of each patient at the initial diagnosis, 6, 9, and 12 months after treatment were observed and analyzed. *Results:* There was no statistical difference between the baseline and the initial diagnosis, as well as the second follow-up visit ( $P < 0.05$ ), while there was a statistical difference between the baseline and the first and third follow-up visits ( $P > 0.05$ ). There was a statistically significant difference in IGF-1 between the initial diagnosis and the first follow-up visit ( $P < 0.05$ ), but no statistical difference between the first, second, and third follow-up visits ( $P > 0.05$ ). Additionally, IGF-1 levels increased with time. There was no statistical difference in TSH between the initial diagnosis and the first, second, and third follow-up visits ( $P > 0.05$ ). There was a statistical difference in free T3 between the initial diagnosis and the first and second follow-up visits ( $P < 0.05$ ), but no statistical difference between the second and third follow-up visits ( $P > 0.05$ ). There was no statistical difference in free T4 between the initial diagnosis and the first and second follow-up visits ( $P > 0.05$ ), but there was a statistical difference between the second and third follow-up visits ( $P < 0.05$ ). *Conclusion:* PEG-rhGH (Jin Sai Zeng) is significantly effective in improving height and IGF-1 levels in patients with idiopathic short stature.

**Keywords:** Recombinant human growth hormone; Idiopathic short stature; Clinical efficacy

**Online publication:** April 29, 2025

## 1. Introduction

Idiopathic short stature (ISS) refers to an abnormal growth and development condition characterized by

unexplained growth retardation or stagnation at a relatively low level. It is currently believed to be associated with genetic and environmental factors, with an incidence rate of 1% to 3%. The clinical manifestations include short stature, often accompanied by symptoms such as delayed bone age and undeveloped secondary sexual characteristics. Approximately 60% to 80% of children with short stature have ISS, which affects their physical development and self-confidence. If not corrected promptly, it can have severe adverse effects on their lives. A study of 136 children with short stature in Changde, Hunan Province, found that there were more boys than girls, with an average age of 11.2 years, and 38 children (27.94%) had ISS <sup>[1]</sup>. Another study of 5613 children in Shantou, Guangdong Province, found that 127 children had short stature, with a prevalence rate of 2.26%, mainly in the age range of 3 to 16 years old, and 38 children (29.92%) had ISS <sup>[2]</sup>. Recombinant human growth hormone is a peptide hormone that mainly acts on the growth plate of bones, promoting cell division and proliferation in bone tissue, and stimulating continuous proliferation of epiphyseal chondrocytes to increase the patient's height <sup>[3]</sup>. Additionally, from a pharmacoeconomic perspective, the cost of treatment is lower than that of pharmacological therapy but still higher than what ordinary families can afford <sup>[4]</sup>. This study aims to retrospectively investigate the clinical data of patients with idiopathic short stature treated in our hospital from July 1 to September 30, 2024, and to explore the impact of factors such as disease severity and bone age delay on the effectiveness of recombinant human growth hormone treatment for IA. The goal is to provide a reference for the rational use of growth hormone in clinical practice and theoretical support for the development of relevant intervention measures. (Note: There are some inconsistencies in the time periods mentioned in the abstract, which may need to be revised for clarity and accuracy.)

## 2. Materials and methods

### 2.1. General information

From March 21, 2024, to January 13, 2025, a total of 1402 individuals were enrolled, including 778 males and 624 females. The patients' ages were mainly between 5 and 13 years old. Subsequently, 488 people completed the first follow-up, 174 completed the second follow-up, and 81 completed the third follow-up. The enrolled patients were mainly from departments such as Child Health Care, Pediatric Endocrinology, Pediatric Respiratory, and Endocrinology.

Inclusion Criteria: (1) Pre-pubescent children (aged 3 to 14 years), gender unrestricted; (2) Symmetrical short stature, with height falling behind the 3rd percentile (P3, -1.88SD) or 2 standard deviations (SD) of the growth curve for normal children of the same age and gender; (3) Any drug provocation test result indicating a GH peak value >10ug/l; (4) Slow growth, with a growth rate of < 5cm/year; (5) Normal intelligence, mental state, and consciousness; (6) Normal birth length, weight, and body proportions, with no evidence of systemic, endocrine, nutritional, chromosomal abnormalities, or genetic variations; (7) After full communication, the patients' families are informed and agree to treatment with polyethylene glycol recombinant human growth hormone injection (Jinsai Zeng) and have signed an informed consent form.

Exclusion Criteria: (1) Exclusion of other primary (e.g., genetic syndromes) and secondary growth disorders that affect growth, including various diseases related to the environment, hormones, nutrition, and/or systemic organic diseases, such as Cushing's syndrome, hypothyroidism, pseudohypoparathyroidism, growth hormone deficiency, bone/cartilage disease, small for gestational age, chromosomal diseases, Turner syndrome, Noonan syndrome, etc.; (2) Allergy to polyethylene glycol recombinant human growth hormone injection (Jinsai Zeng) and its excipients; (3) Presence of diseases and tumors unsuitable for growth hormone therapy, such as cardiac, liver, kidney, and other

important organ dysfunctions and other chronic diseases, or pituitary dysfunction, cerebrovascular disease, etc.; (4) Other situations where the researcher believes it is not appropriate to adopt growth hormone therapy.

## 2.2. Methods

All patients were treated primarily with polyethylene glycol recombinant human growth hormone injection (Jinsai Zeng) after admission. For some children with a shorter duration of illness and a lesser degree of disease, oral medication and physical therapy were used in addition to rhGH. For children with complex conditions and multiple comorbidities, rhGH was used alone.

## 2.3. Observation indicators

The changes in height information, IGF-1, and thyroid test results of each patient were observed at the initial diagnosis and after 6, 9, and 12 months of treatment.

## 2.4. Statistical methods

SPSS 27.0 statistical software was used for statistical analysis of the data. Measurement data were expressed as mean  $\pm$  standard deviation, and the t-test was used for comparison between groups. Count data were expressed as a percentage (%), and the  $\chi^2$  test was used for comparison between groups.

## 3. Results

### 3.1. Changes in height information

There was no statistical difference between the baseline and the initial diagnosis, as well as the second follow-up ( $P < 0.05$ ). However, there was a statistical difference between the baseline and the first and third follow-ups ( $P > 0.05$ ). See Table 1 for details.

**Table 1.** Height information (, cm)

Group	Number of Cases	Height Information
Baseline	1402	123.50 $\pm$ 17.78
Initial diagnosis	1402	125.58 $\pm$ 49.43
The first follow-up	488	128.05 $\pm$ 52.15
The second follow-up	174	125.41 $\pm$ 15.49
The third follow-up	81	128.12 $\pm$ 14.44
<i>t</i>		1.483 <sup>a</sup> 2.830 <sup>b</sup> 1.355 <sup>c</sup> 2.295 <sup>d</sup>
<i>P</i>		> 0.05 <sup>a</sup> 0.005 <sup>b</sup> > 0.05 <sup>c</sup> 0.022 <sup>d</sup>

Note: a, b, c, and d represents the comparison between baseline and initial diagnosis, first follow-up, second follow-up, and third follow-up, respectively.

### 3.2. Patient IGF-1

There was a statistically significant difference in IGF-1 levels between the initial diagnosis and the first follow-up ( $P < 0.05$ ). However, there were no statistically significant differences between the first, second, and third follow-ups when compared pairwise ( $P > 0.05$ ). Additionally, IGF-1 levels increased with time, as shown in **Table 2**.

**Table 2.** Patient IGF-1 (U/mL)

Group	Number of Cases	IGF-1
Baseline	1402	186.22 ± 120.95
Initial diagnosis	488	268.51 ± 128.24
The first follow-up	174	275.24 ± 116.70
The second follow-up	81	304.02 ± 114.43
The third follow-up		12.742 <sup>a</sup> 0.608 <sup>b</sup> 1.845 <sup>c</sup>
<i>P</i>		0.000 <sup>a</sup> > 0.05 <sup>b</sup> > 0.05 <sup>c</sup>

Note: a, b, and c represent the comparison between the first follow-up and initial diagnosis, the first follow-up and second follow-up, and the second follow-up and third follow-up, respectively. The actual table with data would follow this text in a formatted document.

### 3.3. Thyroid test results

There were no statistically significant differences in TSH levels between the initial diagnosis and any of the follow-ups (first, second, and third) when compared pairwise ( $P > 0.05$ ). For free T3, there were statistically significant differences between the initial diagnosis and both the first and second follow-ups ( $P < 0.05$ ), but no difference between the second and third follow-ups ( $P > 0.05$ ). For free T4, there were no statistically significant differences between the initial diagnosis and the first or second follow-ups ( $P > 0.05$ ), but there was a difference between the second and third follow-ups ( $P < 0.05$ ). See **Table 3** for details.

**Table 3.** Thyroid test results (μIU/mL)

Group	Number of Cases	TSH	Free T3	Free T4
Baseline	1402	2.95 ± 8.25	5.43 ± 1.53	13.36 ± 13.67
Initial diagnosis	488	2.48 ± 1.37a	5.46 ± 1.48a	47.89 ± 771.67a
The first follow-up	174	2.45 ± 1.10b	5.98 ± 1.32b	15.47 ± 5.22b
The second follow-up	81	2.18 ± 0.87c	5.95 ± 1.19c	17.63 ± 2.90c
The third follow-up		1.252 <sup>a</sup> 0.260 <sup>b</sup> 1.944 <sup>c</sup>	12.916 <sup>a</sup> 4.090 <sup>b</sup> 0.174 <sup>c</sup>	1.676 <sup>a</sup> 0.554 <sup>b</sup> 3.480 <sup>c</sup>
<i>P</i>		> 0.05 <sup>a</sup> > 0.05 <sup>b</sup> > 0.05 <sup>c</sup>	0.000 <sup>a</sup> 0.000 <sup>b</sup> > 0.05 <sup>c</sup>	> 0.05 <sup>a</sup> > 0.05 <sup>b</sup> 0.001 <sup>c</sup>

Note: a, b, and c represents the comparison between the first follow-up and initial diagnosis, the first follow-up and second follow-up, and the second follow-up and third follow-up, respectively.

## 4. Discussion

Idiopathic short stature (ISS) refers to a group of heterogeneous short stature diseases with unknown etiology. It refers to children whose height is below 2 standard deviations (SD) of the mean height for their age, gender, and ethnicity, or below the 3rd percentile (P3, -1.88 SD), and whose birth length, weight, and body proportions are normal without evidence of systemic, endocrine, nutritional, chromosomal abnormalities, or genetic variations [5]. The etiology of ISS is complex, and its occurrence is closely related to growth hormone secretion disorders or deficiencies, growth hormone resistance, and insufficient activity [6-8]. Therefore, recombinant human growth hormone (rhGH) therapy is one of the main treatments for children with ISS. In 2021, the China National Medical Products Administration approved rhGH for the treatment of ISS and suggested adjusting treatment based on growth response, i.e., the rate of height increase. Ling *et al.* interpreted the guidelines and proposed that due to the high heterogeneity of ISS patients, their physical and psychological factors, dosage, treatment risks, and benefits should be more carefully evaluated during growth hormone therapy [9,10].

Jinseiseng is the first long-acting growth hormone independently developed in China and the world's first polyethylene glycolated growth hormone injection to be listed. The successful launch of the long-acting growth hormone brand has reduced the injection frequency from once a day to once a week, ending the history of needing daily growth hormone injections for treatment. Compared to short-acting growth hormone, the long-acting formulation has a longer duration of action. The main reason is that the long-acting growth hormone utilizes a natural peptide bond to connect inert PEG and naturally structured growth hormone, much like putting a huge armor on the growth hormone. This significantly reduces the speed of its filtration by the kidneys, decreases protease degradation, and enhances the stability of the growth hormone drug in the human body [11, 12]. Therefore, the elimination rate of the drug is greatly slowed down, and the duration of the drug effect is significantly increased.

The results of this study showed that analyzing the height SDS data of patients who completed three follow-ups indicated a relatively positive treatment effect during the treatment phase. Most patients showed significant initial treatment effects and had relatively stable efficacy. There was no statistically significant difference between the baseline and the first and second follow-ups ( $P < 0.05$ ), but there was a statistically significant difference between the baseline and the first and third follow-ups ( $P > 0.05$ ). These results suggest that there are statistically significant differences in height SDS values at different follow-up time points, and these values improve with time.

Statistical analysis of patients' IGF-1 showed an increasing trend in insulin-like growth factor-1. The t-test revealed a statistically significant difference between groups, with IGF-1 levels increasing over time.

Statistical analysis was conducted on patients' TSH (Thyroid Stimulating Hormone), free T3 (free triiodothyronine), and free T4 (free thyroxine levels). The t-test results showed no statistically significant differences, indicating that the treatment had no significant effect on patients' thyroid function. These results suggest that there are statistically significant differences in height SDS values at different follow-up time points, and these values improve with time. Statistical analysis of patients' IGF-1 showed an increasing trend, and the t-test revealed a statistically significant difference between groups. Both the first and second follow-ups showed statistically significant differences compared to the baseline. Moreover, the treatment had no significant effect on the patients' thyroid function.

## 5. Conclusion

In summary, recombinant human growth hormone (Jinsaizeng) treatment for idiopathic short stature has significant efficacy in improving patients' height and IGF-1 levels. This study provides strong clinical evidence



for the application of rhGH in the treatment of idiopathic short stature. Future studies can further validate the long-term effects and economic value of rhGH treatment by extending follow-up time, expanding sample size, and optimizing stratified analysis, providing more comprehensive guidance for clinical practice.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Ge L, Zhao C, Xu F, et al., 2023, Research Progress on Polyethylene Glycol Recombinant Human Growth Hormone in the Treatment of Idiopathic Short Stature in Children. *Modern Clinical Medicine*, 49(2): 128–130.
- [2] Wang X, Deng Q, Li M, et al., 2024, Clinical Study on the Effect of PEG-rhGH in the Treatment of Children with Idiopathic Short Stature on Growth Rate. *Chinese Journal of Clinical Pharmacology*, 40(18): 2685–2689.
- [3] Feng X, Wang C, 2023, Research Progress on Multi-Omics Biomarkers of Idiopathic Short Stature. *International Journal of Pediatrics*, 50(11): 746–749.
- [4] Song M, Liu H, Wang J, et al., 2024, Diagnostic Value of Combined Detection of Serum Nesfatin-1, IGFBP-3, and FGF-21 in Idiopathic Short Stature. *Labeled Immunoassays and Clinical Medicine*, 31(4): 658–665.
- [5] Zhang D, Cheng W, Zhang L, et al., 2024, Clinical Study on Long-Acting and Short-Acting Recombinant Human Growth Hormone in the Treatment of Children with Idiopathic Short Stature. *Chinese Journal of Clinical Pharmacology*, 40(15): 2178–2181.
- [6] Sun Z, Ma Y, Tian C, 2024, Efficacy and Safety of Recombinant Human Growth Hormone in the Treatment of Idiopathic Short Stature. *Chinese Journal of Practical Medicine*, 51(21): 101–103.
- [7] Zou H, Hu Y, Xiong T, et al., 2023, Clinical Study on Recombinant Human Growth Hormone in the Treatment of Children with Idiopathic Short Stature. *Chinese Journal of Clinical Pharmacology*, 39(19): 2761–2765.
- [8] Gu J, Sun S, Gao X, et al., 2024, Effects of Growth Hormone Combined with Nutritional Therapy on Physical Function Indicators of Children with Idiopathic Short Stature. *Chinese Journal of Maternal and Child Health Research*, 35(2): 59–63.
- [9] Ling R, Wang H, Ding H, 2018, Continuous Nursing Practice for Children with Idiopathic Short Stature. *Journal of Clinical Medicine in Practice*, 22(16): 93–97.
- [10] Zhou Y, Zhang H, Zhu S, 2023, Study on the Correlation Between Serum PCSK9 and FGF-23 Expression and the Occurrence of Idiopathic Short Stature. *Youjiang Medical Journal*, 51(12): 1096–1101.
- [11] Guo Y, Xu S, 2023, Efficacy of Calcium Gluconate Combined with rhGH in the Treatment of Idiopathic Short Stature in Children. *Shenzhen Journal of Integrated Traditional Chinese and Western Medicine*, 33(3): 11–14.
- [12] Zhu M, Qian W, Lu Y, et al., 2024, Diagnostic Value of Short-Chain Fatty Acids in Children with Idiopathic Short Stature. *Laboratory Medicine and Clinic*, 21(13): 1860–1863, 1869.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Nursing Effects of Routine Care and Specialized Nursing Intervention on Patients with Dysphagia during Acute Stroke

Dandan Shi\*

School of Clinical Medicine, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To compare the nursing effects of routine care and specialized nursing intervention on patients with dysphagia during acute stroke. *Methods:* A total of 188 patients with acute stroke and dysphagia who received treatment at our hospital from May 2022 to December 2024 were selected as study subjects. The patients were randomly divided into a control group and an observation group, with 94 patients in each group. The control group received routine nursing intervention, while the observation group received specialized nursing intervention. The general information, swallowing function, quality of life, and nursing satisfaction were compared between the two groups. *Results:* There was no statistically significant difference in general information between the two groups ( $P > 0.05$ ). The SAS score of the observation group after nursing was significantly lower than that of the control group ( $t=19.463$ ,  $P = 0.000 < 0.001$ ). After intervention, the number of patients with lung infection in the observation group was significantly lower than that in the control group ( $\chi^2=7.309$ ,  $P = 0.007 < 0.01$ ). The overall quality of life score of the observation group was significantly better than that of the control group after intervention ( $P < 0.001$ ). The nursing satisfaction of the observation group was significantly higher than that of the control group ( $\chi^2 = 15.865$ ,  $P = 0.000 < 0.001$ ). *Conclusion:* Compared with routine care, specialized nursing intervention can effectively improve the swallowing function of patients with dysphagia during acute stroke, enhance their quality of life, and increase nursing satisfaction.

**Keywords:** Stroke; Routine care; Specialized nursing intervention; Dysphagia

**Online publication:** April 29, 2025

## 1. Introduction

Stroke is a highly prevalent and disabling neurological disease. According to WHO data, a large number of new stroke patients are reported every year, and these patients often suffer from various severe complications, especially swallowing dysfunction. Due to impaired swallowing function, patients' daily diet is greatly disturbed, further limiting their nutritional intake and affecting the recovery of bodily functions<sup>[1]</sup>. Additionally, decreased swallowing ability can lead to food and saliva entering the airways, which can easily cause complications such as lung infections.

Once lung infection occurs, it can worsen the patient's condition and potentially endanger their life <sup>[2]</sup>.

In clinical nursing practice, improving the nursing effects for patients with dysphagia during acute stroke has been a key focus and challenging issue for healthcare professionals. Routine care provides basic nursing services to patients to some extent, but its limitations become apparent when facing the complex and highly individualized problem of dysphagia. In recent years, specialized nursing intervention, as an emerging nursing model, has gradually gained attention. It emphasizes multidisciplinary collaboration, precise assessment, and personalized intervention, which theoretically promises to bring better nursing effects to patients with dysphagia during acute stroke. However, current comparative studies on the nursing effects of routine care and specialized nursing intervention for these patients are still inadequate. Therefore, conducting this study to deeply analyze and compare the effects of the two nursing models has important practical significance and clinical value for optimizing clinical nursing plans and improving patient care quality.

## **2. Materials and methods**

### **2.1. General information**

In this study, a total of 188 patients with acute stroke and dysphagia who received treatment at our hospital from May 2022 to December 2024 were selected as the research subjects. The patients were randomly divided into a control group and an observation group, with 94 patients in each group, using a random number table method.

Inclusion criteria: (1) Meet the diagnostic criteria for stroke revised by the Fourth National Cerebrovascular Disease Academic Conference, and confirmed by cranial CT or MRI; (2) The onset time is within 72 hours; (3) Presence of dysphagia; (4) The patient or family members signed an informed consent form and were willing to cooperate with the study.

Exclusion criteria: (1) Severe heart, liver, kidney, and other important organ failure; (2) Presence of consciousness or cognitive impairment that prevents cooperation with evaluation and care; (3) Previous history of head and neck radiotherapy or throat surgery affecting swallowing function; (4) Presence of mental illness or language communication disorders that prevent accurate expression of personal feelings.

### **2.2. Methods**

The control group received routine nursing intervention, including close monitoring of patients' vital signs, observation of disease progression, basic disease care according to medical advice (such as controlling blood pressure, blood sugar, oral care, assisting patients to maintain a comfortable position), verbal education on nursing knowledge, and guidance on simple swallowing training.

The observation group received specialized nursing intervention.

- (1) Establishment of a specialized nursing team: The team consists of neurologists, rehabilitation therapists, nutritionists, and responsible nurses. The neurologist is responsible for accurately diagnosing the patient's condition and developing a scientific treatment plan. The rehabilitation therapist uses professional assessment tools to comprehensively evaluate the patient's swallowing function <sup>[1]</sup>. The nutritionist tailors personalized dietary plans based on the patient's swallowing status and nutritional needs <sup>[2]</sup>. The responsible nurse is in charge of implementing specific nursing measures, closely observing changes in the patient's condition, and providing timely feedback.
- (2) Cause analysis: The team comprehensively reviews the patient's medical records, communicates deeply with the patient and their family members, and analyzes the causes of swallowing disorders from multiple dimensions based on various examination results. In terms of the nervous system, the team

assesses the degree and location of damage to the swallowing nerves caused by brain lesions. Regarding muscle function, they evaluate the strength and coordination of the muscles in the mouth and throat. Psychologically, they focus on whether patients experience anxiety, depression, or other negative emotions that affect swallowing function due to illness. Additionally, they consider the potential impact of factors such as the patient's past medical history and age on swallowing.

- (3) Design of nursing plan: A comprehensive training plan for patients with swallowing difficulties may incorporate several targeted interventions. Oral sensory training involves stimulating the oral mucosa with an ice-cold cotton swab to enhance sensory perception and responsiveness <sup>[3]</sup>. To improve muscle function, swallowing muscle strength training focuses on exercises that target the tongue and chewing muscles, helping to build strength and control. Additionally, swallowing coordination training is employed to enhance the timing and rhythm of the swallowing process, typically by alternating between dry (empty) swallows and swallowing with food <sup>[4]</sup>. It is essential to strengthen the patient's dietary care by adjusting food texture based on swallowing function, following the principle of small and frequent meals to ensure balanced nutrition. The nurse in charge should actively communicate with the patient, provide good psychological support, alleviate negative emotions, and increase the patient's confidence in recovery. Additionally, it is necessary to enhance health education for the patient and their family members, educating them on disease-related knowledge and nursing essentials to improve their self-care abilities.

### 2.3. Observation indicators

The general conditions of the two groups were recorded. The Standard Swallowing Assessment (SSA) scale was used to evaluate patients' swallowing function. The World Health Organization Quality of Life Questionnaire-26 (WHOQOL-26) was used to assess the quality of life before and after nursing in both groups. A self-made satisfaction survey questionnaire was used to investigate nursing satisfaction in both groups.

### 2.4. Statistical methods

Data analysis was performed using SPSS 24.0 statistical software. Measurement data were expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ), and comparisons between groups were made using t-tests and  $\chi^2$  tests. A  $P$ -value  $< 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Comparison of general information between the two groups

There was no statistically significant difference in the general information between the two groups ( $P > 0.05$ ).

**Table 1.** Comparison of general information between the two groups

Group	Number of cases ( <i>n</i> )	Gender ( <i>n</i> )		Age ( $\pm s$ , years old)
		Male	Female	
Control group	94	49	45	68.17 $\pm$ 1.32
Observation group	94	48	46	68.21 $\pm$ 1.28
$\chi^2/t$ value		0.021		0.211
$P$ value		0.884		0.833

### 3.2. Comparison of swallowing function scores before and after nursing between the two groups

The SAS score of the observation group after nursing was significantly lower than that of the control group ( $t=19.463$ ,  $P = 0.000 < 0.001$ ) (see **Table 2**).

**Table 2.** Comparison of swallowing function scores before and after nursing between the two groups

Group	SAS Score	
	Before Nursing	After Nursing
Control group( $n=94$ )	$35.89 \pm 3.61$	$32.25 \pm 3.26$
Observation group( $n=94$ )	$35.79 \pm 3.65$	$23.15 \pm 3.15$
$t$	0.189	19.463
$P$	0.850	0.000

### 3.3. Comparison of the incidence of pulmonary infection between the two groups

After intervention, the number of patients with pulmonary infection in the observation group was significantly lower than that in the control group ( $\chi^2=7.309$ ,  $P = 0.007 < 0.01$ ) (see **Table 3**).

**Table 3.** Comparison of pulmonary infection between the two groups of patients

Group	Number of cases of lung infection ( $n/\%$ )
Control group ( $n=94$ )	20(21.28%)
Observation group ( $n=94$ )	7(7.45%)
$\chi^2$	7.309
$P$	0.007

### 3.4. Comparison of quality of life before and after nursing between the two groups

After intervention, the overall quality of life scores of the observation group were significantly better than those of the control group ( $P < 0.001$ ) (see **Table 4**).

**Table 4.** Comparison of quality of life before and after nursing between the two groups

Group		WHOQOL-26 Score				
		Physical Health	Psychological Health	Social Relationships	Environmental Factors	Total Score
Control group ( $n=94$ )	Before Intervention	$19.62 \pm 2.88$	$15.58 \pm 3.48$	$9.62 \pm 2.11$	$19.75 \pm 3.29$	$64.46 \pm 3.66$
	After Intervention	$20.05 \pm 3.02$	$16.58 \pm 3.61$	$9.96 \pm 2.17$	$20.69 \pm 3.25$	$64.86 \pm 3.65$
	$T$	0.999	1.934	1.089	1.971	0.750
	$P$	0.319	0.055	0.278	0.050	0.454
Observation group ( $n=94$ )	Before Intervention	$18.25 \pm 2.82$	$15.24 \pm 3.55$	$9.56 \pm 2.13$	$19.25 \pm 3.46$	$61.39 \pm 3.59$
	After Intervention	$26.51 \pm 3.68$	$20.55 \pm 3.59$	$14.35 \pm 2.46$	$25.88 \pm 3.47$	$85.14 \pm 3.64$
	$t$	17.273	10.197	14.272	13.118	45.040
	$P$	0.000	0.000	0.000	0.000	0.000



### 3.5. Comparison of nursing satisfaction between the two groups

The nursing satisfaction of the observation group was significantly higher than that of the control group ( $\chi^2=15.865$ ,  $P=0.000 < 0.001$ ), as shown in **Table 5**.

**Table 5.** Comparison of nursing satisfaction between the two groups

Group	Nursing Satisfaction			
	Very Satisfied	Generally Satisfied	Dissatisfied	Overall Satisfaction Rate
Control group ( $n=94$ )	30(31.91%)	39(41.49%)	25(26.6%)	69(73.4%)
Observation group ( $n=94$ )	74(78.72%)	15(15.96%)	5(5.32%)	89(94.68%)
$\chi^2$				15.865
$P$				0.000

## 4. Discussion

The results of this study indicate that nursing case intervention has significant advantages in improving swallowing function, quality of life, and nursing satisfaction for patients with swallowing disorders in acute stroke.

In terms of improving swallowing ability, targeted rehabilitation training is provided by rehabilitation therapists in the nursing case team. Oral sensory training stimulates the receptors of the oral mucosa, improving oral sensitivity and enhancing swallowing reflexes. Swallowing muscle training for the tongue and chewing muscles strengthens related muscles and improves swallowing coordination. Swallowing coordination training helps patients gradually learn the correct swallowing method through swallowing and dry swallowing, thereby reducing the risk of aspiration<sup>[5,6,7]</sup>. Traditional therapies, due to their lack of systematization and individualization, often struggle to meet patients' rehabilitation needs.

Patients with swallowing disorders in acute stroke face a high risk of lung infections due to aspiration, negatively impacting their prognosis<sup>[8]</sup>. Nursing case intervention assesses patients' aspiration risks and eating methods, allowing for timely adjustments such as improved eating posture and appropriate utensils to reduce bacterial growth in the mouth and minimize aspiration. Traditional routine nursing methods for aspiration prevention are often general and lack specificity. The results of this study show that the incidence of lung infections in patients receiving nursing case intervention is significantly lower than those receiving routine care. This is because nursing case intervention constructs a rigorous complication prevention and control system from multiple dimensions, forming a closed-loop management from risk identification to intervention implementation, effectively reducing the occurrence of aspiration and related complications, ensuring patient respiratory safety, and enhancing nursing safety.

Quality of life is key to evaluating nursing efficacy. Patients with swallowing disorders in acute stroke often experience psychological issues like anxiety and depression due to their physical limitations and concerns about their prognosis, significantly reducing their quality of life. Nursing case intervention provides comprehensive nursing support. Individualized dietary plans from nutritionists adjust food texture and nutritional combinations based on patients' swallowing ability and nutritional status, ensuring adequate nutrition and promoting rapid recovery<sup>[9]</sup>. Psychological nursing focuses on patients' psychological state, providing effective communication and support to alleviate negative emotions caused by illness and swallowing disorders, boosting patients' confidence and enthusiasm for recovery, and enhancing their psychological quality of life<sup>[10]</sup>. Health education for patients

and their families improves self-care abilities, enabling better care and support in home and social environments and enhancing quality of life in social and environmental domains. Routine nursing interventions are relatively weak in these areas, making nursing case intervention more effective in improving patients' quality of life.

In terms of nursing satisfaction, nursing case intervention provides comprehensive and personalized nursing services, fully considering patients' needs at every step and enhancing their perception of quality nursing care, thereby increasing nursing satisfaction. While routine nursing can meet basic patient needs, its lack of personalization and refinement leads to relatively low nursing satisfaction.

## 5. Conclusion

In summary, compared to routine nursing, nursing case intervention effectively improves swallowing function, quality of life, and nursing satisfaction for patients with swallowing disorders in acute stroke. Future efforts should deepen multidisciplinary collaboration, such as regular case discussions among rehabilitation medicine, nutrition, and psychology experts to jointly develop rehabilitation plans. Exploring advanced rehabilitation training techniques and equipment, like using virtual reality technology to create an immersive training environment, can enhance training fun and effectiveness. Conducting more clinical research to optimize nursing case intervention processes and content will provide stronger evidence support for clinical nursing, better meet patient care needs, and bring hope for their recovery.

## Disclosure statement

The author declares no conflict of interest.

## References

- [1] Ma H, 2022, Observation on the Effect of Early Rehabilitation Nursing on Patients with Swallowing Disorders After Acute Stroke. *Guide of China Medicine*, 20(33): 175–177.
- [2] Zhang J, Zhang X, 2024, Rehabilitation Nursing for Patients with Swallowing Disorders After Acute Stroke. *Journal of Shandong Medical College*, 46(6): 59–60.
- [3] Li C, Wan Q, Zhang X, et al., 2024, Observation on the Effect of Bing'an Tongluo Method on Swallowing Disorders in Patients with Acute Ischemic Stroke. *Inner Mongolia Journal of Traditional Chinese Medicine*, 43(11): 111–115.
- [4] Chen Y, Du J, Huang X, et al., 2022, Observation on the Rehabilitation Effect of Integrated Traditional Chinese and Western Medicine Treatment for Swallowing Disorders After Acute Stroke. *China Continuing Medical Education*, 14(19): 191–195.
- [5] Ma L, Gao W, Wang Y, 2023, Application of Rehabilitation Nursing in Patients with Swallowing Disorders Caused by Acute Stroke. *Chinese Health Care & Nutrition*, 41(12): 128–131.
- [6] Liu Y, Sun J, Shao L, 2021, Study on the Effect of Early Rehabilitation Nursing on Swallowing Dysfunction and Limb Function Recovery in Patients with Acute Stroke. *China Practical Medicine*, 16(36): 208–210.
- [7] Zhang W, 2021, Application of Early Rehabilitation Nursing in Patients with Swallowing Disorders After Acute Stroke. *Guide of China Medicine*, 19(18): 199–200.
- [8] Zhang S, 2024, Application Effect of Nursing Case in Screening Swallowing Disorders in Patients with Acute Stroke. *Smart Healthcare*, 10(28): 133–136.

- [9] Zhou Y, Liu H, 2023, Application Effect of Checklist-Based Stroke Swallowing Disorder Evaluation Training Combined with Stepped Segmented Dietary Guidance in Patients with Acute Stroke. *Chinese Community Doctors*, 40(34): 103–105.
- [10] Chen X, Wu S, Shen L, 2022, Observation on the Effect of Early Rehabilitation Nursing for Patients with Swallowing Disorders After Acute Stroke. *China Health Standard Management*, 13(4): 172–176.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# A Study on Balancing the Demands of Patients' Families and the Responsibilities of Medical Staff in Medical Emergencies: Starting from the Xiao Zhijun Case and the Yulin Pregnant Woman Case

Yuji Lin\*, Yurou Zhang

Southwest Minzu University, Chengdu 610093, Sichuan, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** Through analyzing the cases of Xiao Zhijun and the Yulin maternal jumping incident, the authors found significant disputes between the requests for non-indicated cesarean section and medical risk prevention, as well as between the psychology of avoiding childbirth pain and surgical responsibility. Currently, based on people's current awareness and the responsibility orientation of expert opinions in disputes, medical institutions tend to satisfy family members' surgical requirements after fulfilling their obligation to fully inform about risks, to reduce the risk of losing disputes. This phenomenon actually reflects the contradiction between the demands of patients' families and the responsibilities of medical staff in medical decision-making. To balance the responsibilities of medical staff and the demands of patients' families, the authors believe that multiple governance paths need to be constructed: first, optimizing the level of medical staff's communication; second, strengthening medical risk science popularization relying on modern information technology to improve patients' risk cognition ability; and third, raising society's correct understanding of cesarean section through multiple channels. These measures can help to enhance patients' trust in hospital diagnosis and treatment results and promote harmonious development of doctor-patient relationships.

**Keywords:** Non-indicated cesarean section request; Medical staff responsibility; Doctor-patient relationship

**Online publication:** April 29, 2025

## 1. Introduction

The cases of Xiao Zhijun (2007) and the Yulin maternal jumping incident (2017) have exposed the structural contradiction between the demands of patients' families and the diagnostic and treatment responsibilities of medical staff in medical practice. By examining the legislative evolution from the Tort Liability Law to the Civil Code, the authors found that despite legislators' efforts to balance the rights and obligations of

both doctors and patients, there are still ambiguous areas of interpretation and application of legal norms in emergency medical decision-making scenarios. Specifically, when faced with surgical requests from family members, medical staff struggle to balance the surgery and the increased risk of childbirth danger it poses to the mother. More precisely, they face difficulties accurately defining the boundaries of “informed consent” and “emergency risk avoidance” obligations stipulated in Article 1219 of the Civil Code. This leads to a dilemma in clinical practice where medical staff either excessively avoid medical risks or blindly comply with family wishes. Additionally, medical institutions continuously face potential medical disputes and legal liability risks due to patients and their families’ misperceptions of risk. This contradiction is essentially a concentrated manifestation of insufficient legal system supply in areas such as medical decision-making power allocation and risk responsibility determination, which urgently needs to be resolved through detailed legal interpretation and improved risk-sharing mechanisms.

## **2. Legislative evolution of balancing patient family demands and medical staff responsibilities**

According to the provisions of Article 33 of the “Regulations on the Administration of Medical Institutions” issued in 1994, medical staff must obtain the consent and signature of the patient’s family members or related persons before performing surgery on the patient. However, after the incident of Xiao Zhijun in 2007, the contradiction between the patient’s informed consent rights and the hospital’s implementation of surgical treatment sparked social concern. Subsequently, modifications were made to the “Tort Liability Law” in 2009. Article 56 of the “Tort Liability Law” provides a legal loophole for medical staff to rescue patients by stating that in emergency situations such as rescuing critically ill patients, if the opinions of the patient or their close relatives cannot be obtained, medical measures can be immediately implemented upon approval by the person in charge of the medical institution or an authorized person.

Article 1220 of the “Civil Code of the People’s Republic of China” (hereinafter referred to as the “Civil Code”), which came into effect in 2021, and Article 32 of the revised “Regulations on the Administration of Medical Institutions” in 2022, also contain similar provisions. These articles grant medical institutions emergency decision-making power under the condition of “rescuing critically ill patients in emergency situations.” Furthermore, Article 21, Paragraph 3, of the “Law of the People’s Republic of China on the Protection of Women’s Rights and Interests (2022 Revision),” which came into effect in 2023, states that when medical institutions perform reproductive surgery, special examinations, or special treatments, they should obtain the consent of the woman herself; in cases where the woman and her family members or related persons have differing opinions, the wishes of the woman herself should be respected. This demonstrates that legislators have ultimately granted women the right to choose their own reproductive and other special treatments.

## **3. Ways the current Civil Code balances the demands of patients’ families and the responsibilities of medical professionals**

Firstly, it emphasizes the responsibilities of hospitals, including their obligation to provide compliant and effective medical care, as well as their liability for any damages caused to patients during medical treatment. According to Articles 1218, 1219(2), 1221, 1222, 1224, and 1226 of the Civil Code, medical institutions are responsible for compensating patients for any harm caused by the negligence of their medical professionals



or violations of medical regulations. This legal framework establishes a system of liability that is primarily based on fault liability, with fault presumption as a secondary principle. Specifically, Articles 1219 and 1221 define the obligation to inform patients and the standard of reasonable medical care, respectively, both of which are grounded in fault liability. Article 1222 shifts the burden of proof to medical institutions in certain circumstances, reflecting the rule of presumption of fault in special situations. Additionally, Article 1226 prohibits excessive medical treatment, further clarifying the legal obligations of medical institutions to protect patients' rights and avoid wasting medical resources. These provisions not only emphasize the responsibility of medical institutions and their professionals for the consequences of their negligence but also promote a balance between the standardization and efficiency of medical services by reasonably limiting the scope of liability. This approach effectively reduces unnecessary economic burdens and medical risks for patients.

Furthermore, the Civil Code underscores the importance of communication between doctors and patients, as well as the protection of patients' and their families' right to informed consent. According to Articles 1219(1), 1225(2), and 1226, legislators encourage open communication between medical professionals and patients. These provisions not only emphasize the duty of hospitals to explain medical conditions and treatment options to patients but also strive to ensure that patients receive effective medical care while explicitly prohibiting excessive medical treatment driven by profit. Furthermore, the law focuses on protecting patients' right to informed consent, aiming to enhance trust in medical treatment.

In addition, the Civil Code highlights the protection of the rights and interests of both patients and medical institutions. In terms of patient protection, Article 1226 explicitly prohibits hospitals from performing unnecessary medical procedures driven by profit, ensuring that patients receive compliant and effective medical services. Article 1123 establishes the principle of no-fault liability for damage caused by defective medical products, breaking through traditional limitations of fault liability and providing patients with more adequate remedies for harm caused by such products. Articles 1225 and 1226, which concern patients' rights to access and copy medical records and the protection of their personal information, respectively, constitute institutional guarantees for patients' rights to informed consent and privacy. The synergistic effect of these provisions reflects the Civil Code's emphasis on core patient rights such as the right to effective treatment, the right to remedies for damage, the right to informed consent, and the right to privacy.

On the other hand, the Civil Code also safeguards the rights and interests of medical institutions. Article 1224 enumerates exemption clauses for medical institutions, and Article 1228 prohibits actions that interfere with medical order, forming a dual protective mechanism. The former reasonably defines the boundaries of medical risk by limiting the conditions under which medical institutions can be exempted from liability in emergencies or when limited by medical capabilities. The latter creates a safe and orderly environment for medical activities, legally protecting the legitimate rights and interests of medical institutions and their practitioners. This institutional design not only highlights the preferential protection of patients' rights but also ensures the healthy development of the medical industry through liability exemptions and behavioral norms, reflecting a balance and unity of legislative values.

#### **4. Reflections on the Xiao Zhijun case and the Yulin Maternal jumping case**

Despite relevant provisions in the Civil Code on balancing the responsibilities of medical professionals and the demands of patients' families, medical staff still face difficult decisions during surgical procedures.

First, the dilemma between non-indicated cesarean section requests and hospital responsibilities. In 2015, the World Health Organization stated in its “Statement on Cesarean Section Rates” that cesarean sections can lead to serious, sometimes permanent complications, disabilities, or death, especially in facilities with inadequate resources or technical capabilities. It emphasized that cesarean sections should only be performed when there are medical indications. “Compared to natural childbirth, the risk of complications from cesarean section is 2–5 times higher, the rate of major hemorrhage is 3–4 times higher, the proportion of patients requiring intensive care due to major hemorrhage is more than 10 times higher, and the rate of postoperative infection is 6–8 times higher.”<sup>[1]</sup>.

As of March 30, 2025, a precise search on the theme of “Comparison of the Effects of Cesarean Section and Natural Childbirth on Mothers” was conducted in the China National Knowledge Infrastructure (CNKI) database, resulting in a total of 14 valid documents. Through systematic literature review, it was found that existing studies mainly focus on dimensions such as maternal childbirth trauma, postpartum pain management, and perinatal emotional regulation. The research results indicate that, under the premise of meeting the medical indications for natural childbirth, natural childbirth has significant advantages in reducing the risk of perineal tearing, shortening the postoperative recovery period, reducing the incidence of chronic pain, and improving postpartum psychological status. Therefore, existing studies generally advocate for the preferential selection of natural childbirth to ensure the physical and mental health of mothers while reducing the consumption of medical resources.

Through a questionnaire survey, the author collected 172 survey results. Among women with childbirth experience, around 40.74% believed that cesarean section is beneficial to the health of the mother, while 41.12% of women without childbirth experience believed the same. Among men, around 81.58% believed that natural childbirth is beneficial to the mother’s health. Among women without childbirth experience, a percentage of 84.11% believed that most women cannot tolerate the pain of childbirth, while 77.78% of women with childbirth experience believed that the pain of childbirth is tolerable. Among men, 42.11% would choose to listen to their wives’ requests for cesarean section surgery when their wives propose it due to unbearable pain, even if medical staff recommend natural childbirth. Among men who choose to persuade their wives to have a natural childbirth, 46.67% would request a cesarean section from the doctor when their wives request it again with strong emotions.

Based on this, it can be inferred that, firstly, if knowledge about cesarean sections is not popularized, a certain proportion of people may believe that cesarean sections are beneficial to the mother’s health and choose the higher-risk option of cesarean section. Secondly, a large number of mothers who fear childbirth pain may request doctors to switch from natural childbirth to cesarean section due to psychological reasons, such as fear of pain, which increases the surgical risks encountered during childbirth.

Specifically, firstly, 92.59% of women with childbirth experience believe that mothers have the right to request cesarean section surgery due to unbearable childbirth pain, and 12.79% of people still believe that the hospital should bear responsibility for the injury or death of the mother and fetus even if the medical staff have fulfilled the hospital’s existing diagnosis and treatment obligations. However, 68.02% of people believe that they should be responsible for the risks if they request a cesarean section themselves. This suggests that if medical staff agree to requests for cesarean section surgery, it may reduce certain medical disputes.

Secondly, in the empirical analysis of verdicts conducted by relevant scholars: (1) In terms of the proportion of losing cases, the proportion of hospital responsibility, and the average amount of compensation,

the hospital's refusal to perform surgery is higher than agreeing to perform surgery; (2) In related disputes, the expert opinion has lower requirements for agreeing to surgery than refusing surgery on behalf of the hospital. This suggests that court verdicts and expert opinions guide medical staff to agree to requests for cesarean section surgery.

Therefore, based on people's current awareness and the responsibility orientation of expert opinions in disputes, hospitals should agree to surgery requests after clearly informing the relevant individuals of the risks of cesarean section surgery, to reduce the risk of disputes and the risk of losing lawsuits.

## **5. Surgical risk assumption and hospital responsibility**

Through analyzing the Xiao Zhijun case and the Yulin maternal jumping case, the author believes that these two cases expose two major legal issues in medical practice: first, the imbalance of rights and obligations between doctors and patients caused by ambiguous distribution rules; second, the institutional defects of doctor-patient communication mechanisms. These two types of issues not only concern the results of individual case verdicts but also reflect the inadequacies of China's medical responsibility legal system in emergency treatment scenarios.

In the Xiao Zhijun case, Xiao refused to sign because he was concerned that he would be responsible for Li Liyun's surgery after signing. In the context of modern medical technology innovation, advancements in medical means have significantly improved the success rate of natural births, enhanced the possibility of curing diseases, and delayed the occurrence of death to some extent. However, this has also triggered a noteworthy social phenomenon, where some members of the public have gradually downplayed the objective attributes of the natural law of "birth, aging, illness, and death" and instead tend to demand that specific responsible entities bear legal responsibility for unexpected events in medical scenarios. This shift not only reflects changes in public risk perception and responsibility expectations but also highlights new challenges faced by medical ethics and legal responsibility identification in modern society.

In the author's survey, around 12.79% of people believe that during the childbirth process, hospitals should bear the responsibility for accidents that occur, regardless of whether medical staff have made every effort to implement appropriate levels of diagnosis and treatment. Only 14.53% believe that "accidents" during medical care are truly accidental and no one should bear responsibility. Through interviews, the author found that there are deviations in the public's perception of medical risk responsibility. In surveys regarding the attribution of responsibility for medical surgery accidents, most people believe that if an accident occurs during their surgery, they will first look to see if the medical staff is responsible. If the medical staff is not responsible, then the husband who signed the consent form should bear some responsibility. This misconception of responsibility reflects a lack of full understanding among the public about the objectivity and uncontrollability of medical accidents and an excessive tendency to seek attribution of responsibility. From a legal perspective, such cognitive deviations may lead to further broadening of responsibility identification in medical disputes, thereby exacerbating the trust crisis between doctors and patients. Therefore, improving people's correct understanding of "accidents", strengthening risk awareness instead of obsessively seeking responsibility attribution, is a critical path for improving medical dispute prevention mechanisms and promoting positive doctor-patient relationships.

In the Yulin maternal jumping case, the tragic outcome may have been caused by, on the one hand, the

patient's distrust of the treatment advice given by the hospital, and on the other hand, the lack of communication from the hospital in doctor-patient interactions.

### **5.1. Patients' distrust of the treatment advice given by the hospital**

The lack of security felt by patients seeking medical treatment under conditions of information asymmetry; misdiagnosis by some medical staff leading to skepticism among patients and their relatives toward the hospital's diagnostic opinions, as well as the attitude of medical staff affecting patients' trust in doctors' recommendations, all impact patients' trust in the hospital's diagnosis and treatment <sup>[2]</sup>. Distrust in the hospital's treatment advice can lead to refusal to accept the hospital's treatment.

## **5.2. The lack of communication from the hospital in doctor-patient interactions**

### **5.2.1. Lack of prenatal communication with expectant mothers**

#### **(1) Insufficient attention to healthy eating and reasonable weight gain**

With the rapid economic development of our country, the living standards of the people have significantly improved. For expectant mothers, compared to previous issues of malnutrition during pregnancy due to material constraints, the current risk of metabolic diseases during pregnancy caused by unbalanced dietary structure and excessive nutritional supplementation (such as gestational diabetes, gestational hypertension, etc.) is becoming a new focus of obstetric clinical attention. According to relevant research, the weight gain of pregnant women during pregnancy is related to the weight of newborns <sup>[3]</sup>. Overnutrition intake during pregnancy may increase the incidence of macrosomia, cesarean section, and hypertension in pregnant women <sup>[4]</sup>.

However, dietary management during pregnancy and perinatal systematic healthcare management can help reduce the occurrence of adverse pregnancy outcomes <sup>[5, 6]</sup>. The current problem is that expectant mothers and their families, holding the belief of "for the health of the child", uncontrollably supplement nutrition during pregnancy, resulting in a serious excess of nutritional intake during pregnancy. At the same time, the implementation of the concept of reasonable weight gain during pregnancy by medical staff is not optimistic. In most cases, reminders are only given when there are signs of overweight in pregnant women, and some medical staff even fail to fulfill their reminder responsibilities. Therefore, prenatal communication between medical staff and expectant mothers and their families still needs to focus on reasonable weight gain, maintaining healthy nutritional intake during pregnancy, and promoting the improvement of pregnancy outcomes.

#### **(2) Lack of mental health support**

Women who fear childbirth pain and have no experience of childbirth are prone to develop adverse prenatal psychology during their first pregnancy, and may even suffer from adverse psychological diseases such as prenatal depression or postpartum depression, which have a negative impact on pregnancy outcomes. Except for a few top-tier hospitals or specialized hospitals that provide prenatal mental health support for expectant mothers, most secondary hospitals that receive expectant mothers still cannot provide mental health support. Therefore, there is a lack of duty performance by medical staff in terms of mental health support for expectant mothers. The psychological communication between medical staff and pregnant women during pregnancy, as well as the promotion of mental health support for expectant mothers, urgently need attention.



### **5.2.2. Lack of communication during childbirth**

With the popularization of compulsory education and the advocacy of scientific awareness, more and more people are willing to trust professional advice given by doctors in their professional fields. However, during the delivery process, some medical staff may try to persuade expectant mothers who fear childbirth pain to choose natural childbirth through their families, who have a closer relationship with the expectant mothers. However, some families may focus on the newborn, ignoring the safety of the expectant mother herself. With the continuous development of society, more and more women pay more attention to their own conditions during the delivery process. In this context, using “naturally delivered babies are smarter/healthier” as a persuasion direction may produce negative effects that are contrary to expectations. Therefore, as authoritative professionals, medical staff should actively communicate with expectant mothers, reduce the selection of wrong persuasion directions by family members, strengthen family members’ awareness of cesarean section, and enhance knowledge promotion and communication skills with family members.

### **5.3. Suggestions for promoting harmonious doctor-patient relationships and balancing patient demands and medical responsibilities**

After discussing the issues related to the Xiao Zhijun case and the Yulin expectant mother jumping case, it can be seen that: (1) balancing the responsibilities of medical staff and the demands of patients’ families not only requires optimizing the level of medical staff’s notification and strengthening the popularization of medical knowledge and risk common sense; (2) according to the current state of people’s awareness and the responsibility orientation of disputes in appraisal opinions, hospitals should agree to surgical requirements after clearly informing relevant personnel of the risks of cesarean section surgery, to reduce the risk of disputes and the risk of losing lawsuits they face <sup>[7]</sup>.

#### **5.3.1 Suggestions for balancing the responsibilities of medical staff and the demands of patients’ families**

- (1) Strengthen risk awareness and build reasonable expectations for patients and their families seeking medical treatment  
Strengthen patients’ and their families’ awareness of surgical risks, build reasonable expectations for patients seeking medical treatment, and reduce irrational behaviors of patients, thereby reducing doctor-patient disputes and promoting coordinated doctor-patient relationships.
- (2) Standardize hospital diagnosis and treatment behavior, and rebuild doctor-patient trust  
A database of medical staff who violate regulations can be established, and those who violate regulations can be subject to limited practice restrictions and punishments to combat illegal medical behaviors and urge hospital medical staff to implement compliant medical behaviors.

#### **5.3.2. Suggestions to raise awareness of cesarean section in society**

- (1) Using “Internet +” for health education is conducive to reducing the insufficient understanding of scientific childbirth among expectant mothers and their families, promoting expectant mothers to master correct knowledge about pregnancy, forming a scientific cognition of natural childbirth and cesarean section, and urging expectant mothers and their families to make scientific decisions <sup>[8]</sup>. The use of “Internet +” for health education is not only conducive to reducing the communication pressure



between medical staff and expectant mothers and their families, but also conducive to promoting trust between expectant mothers and their families in the medical advice given by medical staff, and promoting a harmonious and stable doctor-patient relationship.

- (2) Strengthen the communication responsibility of medical staff and enhance psychological counseling during pregnancy preparation. Improve the psychological state of pregnant women during pregnancy, strengthen the level of awareness of cesarean section during pregnancy, promote the shortening of the birth process and increase the rate of natural childbirth, and reduce the risks borne by expectant mothers during natural childbirth <sup>[9]</sup>.
- (3) Optimize the level of hospital notification and achieve information exchange between doctors and patients. Medical staff should first participate in dietary recommendations for expectant mothers before childbirth, manage the diet of expectant mothers during pregnancy, reduce the incidence of macrosomia and cesarean section, improve pregnancy outcomes, reduce doctor-patient disputes, and promote harmonious doctor-patient relationships. Secondly, medical staff should fulfill their obligation to inform expectant mothers and their families of the risks of cesarean section surgery before childbirth, optimize the level of notification, and promote scientific selection of cesarean section surgery by expectant mothers and their families.

## 6. Conclusion

Both the Xiao Zhijun case and the Yulin expectant mother jumping case reveal the complex contradiction between the demands of patients' families and the responsibilities of medical staff in medical emergencies. This contradiction runs through multiple levels, such as legislative evolution, judicial practice, and clinical diagnosis and treatment. How to balance the demands of patients' families and the responsibilities of medical staff is a long-term and arduous task that still requires the efforts and collaboration of multiple parties. Only through continuous improvement and perfection can we achieve the maximum balance of the interests of both doctors and patients, and provide patients with safer, more effective, and more humane medical services.

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Yin K, 2018, How Should Doctors Respond to Pregnant Women's Requests for Non-Indicated Cesarean Section?—An Empirical Analysis Based on Verdict Documents. *Medicine and Philosophy (B)*, 39(7): 1–5
- [2] Wang X, 2019, "Family Members of the Patient, Please Come." Shanghai Translation Publishing House.
- [3] Shi X, He X, Meng R, et al., 2023, Correlation Between Weight Gain During Pregnancy and Neonatal Birth Weight. *Nursing Research*, 37(23): 4327–4331.
- [4] Wang J, Min M, 2024, The Influence of Weight Management During Pregnancy on Pregnancy Complications and Outcomes. *Guizhou Medicine*, 48(1): 159–160.
- [5] Guo P, Xiao L, Chen S, et al., 2020, The Effect of Dietary Management During Pregnancy on the Weight of Pregnant Women and Pregnancy Outcomes. *Food and Nutrition in China*, 26(7): 65–67.

- [6] Jin H, Chen Y, 2017, The Influence of Perinatal Systematic Health Management on the Cesarean Section Rate of Pregnant Women and the Birth Weight of Newborns. *Chinese and Foreign Medical Research*, 15(28): 177–179
- [7] Li X, 2024, Research on Patients' Informed Consent Rights in China, thesis, Shandong University of Political Science and Law.
- [8] Ma X, Wang X, Meng W, et al., 2024, Meta-Analysis of the Impact of “Internet +” Based Health Education on the Cesarean Section Rate and Postpartum Complications of Pregnant Women. *Chinese Maternal and Child Health Care*, 39(2): 380–385.
- [9] Li A, Zheng C, 2023, The Influence of Prenatal Psychological Resilience Support and Nursing on the Psychological State and Birth Outcomes of Pregnant Women. *Chinese Medicine Guide*, 21(31): 158–161.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Progress in Interventional and Surgical Treatment of Obstructive Hypertrophic Cardiomyopathy

Youjin Qiao\*

Department of Cardiac Surgery, Heart Center, Qingdao Municipal Hospital, Qingdao 266000, Shandong, China

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** To improve the treatment effect of obstructive hypertrophic cardiomyopathy, this article focuses on the treatment of obstructive hypertrophic cardiomyopathy and conducts a comprehensive analysis of the disease. It highlights the limitations of traditional treatment methods and elaborates on interventional and surgical treatments. Additionally, this article compares the indications, risks, treatment effects, and costs of the two different treatment methods, providing a reference for doctors and patients in selecting clinical treatment plans.

**Keywords:** Obstructive hypertrophic cardiomyopathy; Interventional therapy; Surgical treatment

**Online publication:** April 29, 2025

## 1. Introduction

Obstructive hypertrophic cardiomyopathy is a disease that severely affects patients' physical health and may even threaten their lives. With the continuous development of medical technology, the limitations of traditional drug therapy and dual-chamber pacemaker treatment for this disease have gradually emerged. Simultaneously, interventional and surgical treatment methods have been continuously innovated and optimized, offering new hope for patients seeking effective treatment. Both interventional and surgical treatments have their advantages and disadvantages, and the most appropriate treatment method should be selected based on the patient's actual condition.

## 2. Overview of obstructive hypertrophic cardiomyopathy

Wen *et al.* proposed that hypertrophic cardiomyopathy is a genetic disease<sup>[1]</sup>. One of the main characteristics of this disease is myocardial hypertrophy, and common clinical symptoms include thromboembolism, heart failure,

and arrhythmia. The left ventricular outflow tract pressure gradient in obstructive hypertrophic cardiomyopathy is not less than 30 mmHg. According to the location of the obstruction, it can be divided into mid-ventricular septal obstruction, left ventricular outflow tract obstruction, and right ventricular obstruction.

In a healthy heart, the ventricular septum separates the left and right ventricles, with a thickness of approximately 0.9 cm. However, in patients with obstructive hypertrophic cardiomyopathy, the thickness of the ventricular septum increases significantly. When the heart is in a contractile state, the increased myocardial thickness narrows the passage between the left ventricle and the aorta, severely affecting the smoothness of blood flow to the aorta. This can lead to a series of symptomatic manifestations such as dyspnea, precordial pain, dizziness, and arrhythmia. In severe cases, patients may even experience sudden death.

### **3. Limitations of traditional treatments for obstructive hypertrophic cardiomyopathy**

Although traditional treatments for obstructive hypertrophic cardiomyopathy play a significant role in managing the disease, their limitations have gradually become apparent with the continuous advancement of medical technology.

Pharmacotherapy serves as a fundamental approach in traditional treatments, commonly utilizing calcium channel blockers and beta-blockers. According to research, calcium channel blockers not only weaken myocardial contraction but also aid in myocardial relaxation. Beta-blockers, on the other hand, can reduce heart rate, attenuate myocardial contractility, improve left ventricular obstruction, and enhance ventricular dilation, thereby alleviating symptoms. However, pharmacotherapy can only provide symptomatic relief, but it cannot effectively inhibit the progression of myocardial hypertrophy or completely resolve left ventricular obstruction. For patients with severe disease, it is challenging to achieve improved quality of life and disease control solely through pharmacotherapy.

In the late 20th century, dual-chamber pacemaker therapy was widely used in the clinical treatment of obstructive hypertrophic cardiomyopathy. The basic principle of this therapy involves placing a right ventricular electrode at the apex of the patient's right ventricle to alter ventricular depolarization and advance the contraction and depolarization of the interventricular septum. Early studies showed that some patients with severe disease symptoms and those who did not respond significantly to pharmacotherapy experienced significant symptom relief, such as dyspnea and angina, and a reduction in left ventricular outflow tract pressure gradient after dual-chamber pacemaker therapy. However, subsequent controlled trials found that although dual-chamber pacemaker therapy can reduce the left ventricular outflow tract pressure gradient, many patients did not experience a significant decrease. The improvement in symptoms may have been solely due to the placebo effect of pacemaker implantation, leading to questions about the application of this treatment in obstructive hypertrophic cardiomyopathy.

## **4. Interventional therapy for obstructive hypertrophic cardiomyopathy**

### **4.1. Percutaneous septal myocardial chemical ablation**

Liu *et al.* proposed that percutaneous septal myocardial chemical ablation is a procedure guided by transthoracic echocardiography<sup>[2]</sup>. Through the skin, intercostal space, and apex of the heart, while the heart is beating, a radiofrequency needle is directly and precisely delivered to the location of myocardial hypertrophy

in the interventricular septum. With the help of the radiofrequency needle, the temperature of the hypertrophic myocardial tissue is locally increased, causing the myocardial cells to dehydrate and ultimately undergo coagulative necrosis.

The significant advantage of this interventional therapy is that it causes minimal trauma to the patient, does not require thoracotomy, and does not depend on the patient's good condition. Patients can recover quickly after the procedure and do not need absolute bed rest; they can immediately get out of bed and move around <sup>[3-5]</sup>. Clinical practice studies have shown that most patients with obstructive hypertrophic cardiomyopathy experience a significant decrease in left ventricular outflow tract pressure gradient and good symptom relief, such as dyspnea and chest pain, after undergoing percutaneous septal myocardial chemical ablation. Their activity level also improves significantly, leading to a better quality of life <sup>[6]</sup>. Long-term follow-up of patients has revealed that some patients continue to experience relief of left ventricular outflow tract obstruction years later. However, this interventional therapy also carries certain risks and may cause complications such as ventricular septal perforation, expansion of myocardial infarction range, coronary artery dissection, and complete heart block. Nevertheless, with the continuous advancement of medical technology, this interventional therapy has become more mature, and doctors have accumulated richer treatment experience, resulting in a lower incidence of complications <sup>[7]</sup>.

## **4.2. Radiofrequency catheter ablation**

Chen *et al.* proposed that radiofrequency catheter ablation is an interventional therapy that precisely ablates the location of septal obstruction through a catheter <sup>[8]</sup>. This interventional approach offers precise positioning without the need for vascular dissection, resulting in minimal trauma to the patient and faster postoperative recovery. The basic principle of this interventional therapy involves utilizing the thermal effect of radiofrequency current to induce necrosis of the diseased myocardial tissue in the heart, thereby blocking abnormal electrical conduction pathways and restoring normal heart rhythm.

During radiofrequency catheter ablation treatment, doctors can accurately determine the location of abnormal electrical activity in the heart with the support of three-dimensional mapping technology. They then precisely deliver the radiofrequency catheter to that location and perform ablation on the diseased tissue, minimizing damage to normal myocardial tissue. This interventional therapy has a high success rate and can achieve good treatment results for many patients who are intolerant to drug therapy or for whom drug therapy is ineffective or suboptimal. However, this interventional approach also carries certain risks and may cause complications such as phrenic nerve injury, peripheral arterial embolism, stroke, pulmonary vein stenosis, and pericardial tamponade, requiring doctors to have a high level of professional skill and rich experience.

## **5. Surgical treatment of obstructive hypertrophic cardiomyopathy**

### **5.1. Classic surgical treatment**

Surgical treatment for obstructive hypertrophic cardiomyopathy has a long history, and one of the classic surgical methods is the resection of interventricular septum myocardium. This surgical approach was proposed by Professor Morrow from the United States in the 1960s, so it is also known as the Morrow procedure. This surgical treatment requires the patient's heart to be stopped, and extracorporeal circulation needs to be implemented. Doctors need to perform thoracotomy to expose the heart and then directly resect the hypertrophic



interventricular septum myocardial tissue to completely relieve the left ventricular outflow tract obstruction. For many patients who do not respond to drug therapy or for whom the effect is suboptimal, the Morrow procedure brings new hope. Through the Morrow procedure, the left ventricular outflow tract pressure gradient can be significantly reduced, promoting the recovery of heart function. With the continuous development of medical technology, the Morrow procedure has also undergone continuous improvement.

The emergence of modified and extended Morrow procedure not only allows for the removal of hypertrophic septal myocardium, but also enables treatment of the patient's septal fusion area and mitral valve papillary muscles, severing the abnormal connection between the two. Through the application of the modified and extended Morrow procedure, left ventricular outflow tract stenosis and mitral regurgitation can be improved, resulting in more significant relief of patient symptoms. According to clinical practice research, patients treated with the modified and extended Morrow procedure showed a significant decrease in left ventricular outflow tract pressure gradient, better recovery of cardiac function, and significantly extended survival time. However, both the original Morrow procedure and the modified and extended Morrow procedure have limitations. Both require open-chest surgery, which can cause significant trauma, require a long recovery time, and have high requirements for the patient's own conditions.

## **5.2. Minimally invasive surgical treatment**

To address the shortcomings of traditional surgical procedures, minimally invasive surgical treatments have emerged, particularly the "myocardial shaving system," which has brought new hope to patients with obstructive hypertrophic cardiomyopathy. This surgical approach involves making a small incision on the patient's left anterior chest wall and using the myocardial shaving system to resect hypertrophic myocardial tissue while the heart continues to beat, guided by B-mode ultrasound.

Compared to traditional open-chest surgical methods, the advantages of minimally invasive surgery are more significant. Firstly, minimally invasive surgery causes less trauma to patients. Traditional surgery requires thoracotomy with larger incisions and can damage the patient's chest bones and muscular tissue. Minimally invasive surgery, with smaller incisions, avoids significant bodily harm and reduces postoperative pain. Secondly, recovery is faster due to the reduced trauma. Patients can ambulate soon after surgery and quickly return to normal work and life. Thirdly, minimally invasive surgery offers higher safety as it neither requires cardiac arrest nor extracorporeal circulation, reducing the risks of infection, bleeding, and other complications. Finally, this surgical approach boasts a high success rate, with lower chances of postoperative complications and significant improvement in patients' quality of life. The advent of minimally invasive surgical techniques provides a more effective and safer treatment option for obstructive hypertrophic cardiomyopathy, deserving widespread clinical promotion.

## **6. Comparison of interventional therapy and surgical treatment for obstructive hypertrophic cardiomyopathy**

In the treatment of obstructive hypertrophic cardiomyopathy, both interventional therapy and surgical treatment have their respective advantages. Doctors and patients need to comprehensively consider various factors before making treatment decisions to select the most appropriate treatment plan.

From the perspective of indications, surgical treatment has a broader range of applications. Surgical

treatment is suitable for patients who have not responded significantly to drug therapy, those with a heart function classification of III or IV, and those with a left ventricular outflow tract pressure gradient of no less than 50 mmHg. In particular, it is suitable for patients with severe ventricular septal hypertrophy or lesions affecting the apex of the heart, abnormal mitral valve structure, those who are not suitable for chemical ablation, and those with concurrent structural heart disease or other coronary heart diseases <sup>[9]</sup>. Surgical treatment can directly address the diseased tissue, remove hypertrophic myocardial tissue, and repair abnormal mitral valves. Radiofrequency catheter ablation in interventional therapy is suitable for patients with arrhythmia, while percutaneous septal myocardial chemical ablation is suitable for patients who are not tolerant of surgical treatment or have suitable anatomy for septal branch vessels.

From the perspective of risk, interventional therapy has a relatively small trauma and thus a lower risk, but it may also cause some complications. However, with the continuous development of medical technology, the probability of complications has been decreasing and doctors have accumulated rich treatment experience to effectively respond to complications in a timely manner. Surgical procedures require open-chest access, which can cause greater trauma to patients and carry a higher risk compared to interventional therapy. However, the current risk of surgical death has been significantly reduced, and some medical institutions have achieved almost zero mortality rates.

From the perspective of treatment effectiveness, surgical treatment can completely remove the hypertrophic myocardial tissue, significantly improve left ventricular outflow tract obstruction and mitral regurgitation, and achieve long-lasting treatment effects. It can also restore the patient's left ventricular pressure to near-normal levels and restore heart capacity. Some patients who have undergone surgical treatment for many years still maintain good heart function and have significantly improved quality of life. Although interventional therapy can also effectively improve patients' symptoms, the durability of the treatment effect may not be as good as surgical treatment for some patients.

When selecting a treatment plan, doctors and patients can also make appropriate choices based on the patient's economic conditions. Typically, the cost of surgical treatment is relatively high, which can be a challenge for patients' financial situation, while the cost of interventional therapy is relatively low <sup>[10]</sup>.

In addition, when providing advice on treatment options, doctors need to comprehensively consider the patient's condition, physical status, and age. If the patient is young, physically fit, and the condition is suitable for surgical treatment, doctors may recommend prioritizing surgical treatment to achieve complete resolution of the disease. If the patient is older, has poor physical conditions, and is not tolerant of surgery, doctors may suggest interventional therapy. When advising patients on treatment options, doctors will provide detailed information about the advantages and risks of interventional therapy and surgical treatment, and select the most appropriate treatment plan through adequate communication and collaboration.

## 7. Conclusion

In summary, with the continuous development of medical technology, significant progress has been made in the treatment of obstructive hypertrophic cardiomyopathy. Traditional treatment methods have gradually been replaced by interventional therapy and surgical treatment. Both interventional therapy and surgical treatment have their respective advantages. Doctors need to recommend the most appropriate treatment method based on the patient's actual situation, as well as a comprehensive consideration of various treatment indications, risks,

effects, and costs. They should also explain the advantages of the selected treatment method to the patient and strive to gain their approval. With the continuous development and optimization of medical technology, the risk of interventional therapy and surgical treatment is expected to further decrease, and the treatment effect will be more durable. This can better improve patients' symptoms and enhance their quality of life.

## Disclosure statement

The author declares no conflict of interest.

## References

- [1] Wen Y, Yang M, Hu H, 2022, Progress in the Treatment of Obstructive Hypertrophic Cardiomyopathy to Relieve Obstruction. *Advances in Cardiovascular Diseases*, 43(9): 799–802, 811.
- [2] Liu S, Ma Z, Shao H, et al., 2024, Changes in Electrocardiogram After Percutaneous Intramyocardial Septal Radiofrequency Ablation for Obstructive Hypertrophic Cardiomyopathy. *Chinese Journal of Cardiac Pacing and Electrophysiology*, 38(2): 100–104.
- [3] Yao S, Luo S, Huang B, 2024, Research Status of Myocardial Myosin Inhibitors in the Treatment of Obstructive Hypertrophic Cardiomyopathy. *Advances in Cardiovascular Diseases*, 45(5): 397–401.
- [4] Wei P, Feng S, Fang F, et al., 2024, Transcatheter Mitral Valve Edge-to-Edge Repair for Non-Obstructive Hypertrophic Cardiomyopathy With Severe Mitral Regurgitation: A Case Report. *Chinese Journal of Cardiology*, 52(5): 534–537.
- [5] Sun J, Li P, Yu X, et al., 2023, Comparative Study on the Prognosis of Septal Ablation in the Treatment of Patients With Mild and Severe Obstructive Hypertrophic Cardiomyopathy. *Chinese Journal of Cardiology*, 51(5): 513–520.
- [6] Liu F, Ji Q, Wang Y, et al., 2023, Surgical Treatment of Obstructive Hypertrophic Cardiomyopathy: A 5-Year Experience of 421 Cases in a Single Center. *Chinese Journal of Surgery*, 61(3): 201–208.
- [7] Liang S, Pu Z, 2023, Technical Essentials and Research Progress in the Treatment of Obstructive Hypertrophic Cardiomyopathy. *Journal of Electrocardiology and Circulation*, 42(4): 315–319.
- [8] Chen Y, Liu H, Chen H, et al., 2022, Systematic Evaluation and Meta-Analysis of the Efficacy and Safety of Radiofrequency Ablation in the Treatment of Obstructive Hypertrophic Cardiomyopathy. *Chinese Journal of Interventional Cardiology*, 30(12): 940–949.
- [9] Lei C, Wang J, Liu L, 2024, New Progress in the Treatment of Obstructive Hypertrophic Cardiomyopathy With Liwen Procedure. *Advances in Cardiovascular Diseases*, 45(11): 964–967.
- [10] Guo H, Wei P, 2023, Challenges and Future of Surgical Treatment for Obstructive Hypertrophic Cardiomyopathy. *Chinese Journal of Surgery*, 61(3): 181–186.

### Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# The Clinical Application Value of Bundled Nursing Care in Postoperative Recovery of Lung Cancer Patients

Cuifang Liu<sup>†</sup>, Yaqian Li<sup>†</sup>, Kun Wang\*, Pei Liu, Hongyu Liang, Xiaoxue Huang

Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

<sup>†</sup>These authors contributed equally to this work and share the first authorship

*\*Author to whom correspondence should be addressed.*

**Copyright:** © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To investigate the clinical application value of bundled nursing care in postoperative recovery of lung cancer patients. *Methods:* Eighty lung cancer patients who underwent surgical treatment from October 2022 to May 2024 were selected as the study subjects. Their clinical data were retrospectively analyzed and grouped by nursing methods. The bundled nursing care group (n = 40) received bundled nursing care, while the conventional nursing care group (n = 40) received routine nursing care. Lung function, immune function, complication rate, pain level, exercise tolerance, and quality of life were compared between the two groups. *Results:* Before nursing, there were no statistically significant differences in lung function, immune function, pain level, exercise tolerance, and quality of life between the bundled nursing care group and the conventional nursing care group ( $P > 0.05$ ). After nursing, both groups showed improvement in lung function, immune function, pain level, exercise tolerance, and quality of life, but the bundled nursing care group had better results and a lower complication rate, with statistical significance ( $P < 0.05$ ). *Conclusion:* The bundled nursing care has a higher clinical application value in postoperative recovery of lung cancer patients and is worthy of widespread clinical use.

**Keywords:** Bundled nursing care; Lung cancer; Lung function; Immune function; Pain level; Exercise tolerance

**Online publication:** April 29, 2025

## 1. Introduction

Lung cancer is a malignant tumor that severely impairs patients' lung function and has a very high fatality rate <sup>[1]</sup>. Currently, surgery is the main treatment method for this disease. However, due to patients' inadequate knowledge of the disease and fear of surgery, their compliance with medical advice is poor, affecting the surgical outcome <sup>[2]</sup>. Therefore, comprehensive intervention is needed to improve patients' compliance and enhance the treatment effect. Relevant reports have clearly pointed out that the bundled nursing care has a high clinical application value in postoperative recovery of lung cancer patients <sup>[3]</sup>. It can provide patients with systematic nursing services, fully

meet their nursing needs, further control complications, enhance immune and lung functions, and improve patients' quality of life. To verify the application value of bundled nursing care, this study selected 80 lung cancer patients who underwent surgical treatment from October 2022 to May 2024 as the study subjects and analyzed their lung function, immune function, complication rate, pain level, exercise tolerance, and quality of life.

## 2. Materials and methods

### 2.1. Materials

Eighty lung cancer patients who underwent surgical treatment between October 2022 and May 2024 were selected as the study subjects. Their clinical data were retrospectively analyzed, and they were grouped based on nursing methods. The bundled nursing care group received bundled nursing care ( $n = 40$ ), while the conventional nursing care group received routine nursing care ( $n = 40$ ). The conventional nursing care group consisted of 22 males and 18 females, aged between 47 and 72 years, with a mean age of  $(56.66 \pm 5.17)$  years. The bundled nursing care group consisted of 23 males and 17 females, aged between 48 and 74 years, with a mean age of  $(56.88 \pm 5.63)$  years. The basic characteristics of the study subjects were comparable ( $P > 0.05$ ).

- (1) Inclusion criteria: The experimental content was approved by the ethics committee; The study subjects met the clinical diagnosis guidelines for lung cancer<sup>[4]</sup>, were confirmed by pathological examination, actively cooperated with the experiment, were over 18 years old, and were aware of the experimental procedures and signed a consent form.
- (2) Exclusion criteria: Patients with immune diseases, poor communication<sup>[5]</sup>, confusion, mental abnormalities, organ dysfunction<sup>[6]</sup>, and those who withdrew from the study midway.

### 2.2. Methods

The conventional nursing care group received routine nursing care. Before surgery, patients were introduced to the attending doctor and hospital environment in detail to reduce their strangeness, and were guided to complete various inspection items and make preparations. At the same time, patients were provided with psychological intervention and health knowledge education to eliminate negative emotions, improve knowledge awareness, and strengthen patients' compliance with medical advice. During surgery, actively cooperate with doctors in various operations and dynamically monitor patients' vital signs. After surgery, patients' surgical incisions were closely observed, and adverse reactions such as pressure ulcers and venous thrombosis were actively prevented, and abnormalities were promptly handled.

The bundled nursing care group received bundled nursing care. Preoperative intervention included providing patients with extensive health knowledge education, including disease pathogenesis, pathogenic factors, surgical procedures, precautions, and possible complications. Animations and short videos were used to mobilize patients' enthusiasm for learning and strengthen their mastery of disease knowledge. At the same time, during the preoperative visit stage, active communication with patients was initiated to accurately evaluate their psychological state. By sharing successful cases and introducing mature medical technology, patients' anxiety and unease were reduced, thereby improving their confidence in treatment.

Intraoperative intervention involved establishing intravenous access for patients, guiding them to maintain a correct and comfortable surgical position, connecting vital sign monitors, instructing patients to wear respiratory masks, performing oxygen inhalation operations, and placing hot water bags on the skin of the surgical area, with the water temperature controlled at about 50°C. Abnormalities such as shortness of breath and coughing were



promptly reported and intervened as indicated. Postoperative intervention involved continuously monitoring patients' vital signs, providing low-flow oxygen inhalation, ensuring warmth, observing incision conditions such as redness, swelling, and bleeding, and paying attention to patients' skin color and urine output. At the same time, pain management was provided to patients. As patients often experience stronger pain 1–2 days after surgery, methods such as watching videos and listening to music were used to distract their attention and reduce pain. If the pain was unbearable, pain medication was administered as prescribed. In addition, patients were guided on proper postoperative eating habits, with a focus on liquid foods within 6 hours after surgery, avoidance of spicy and cold foods, adherence to the principle of eating small, frequent meals, drinking warm water to accelerate metabolism, and engagement in rehabilitation interventions.

Postoperative activity guidance was provided based on the patient's condition. On the day of removing the chest closed drainage tube, patients were instructed to avoid holding their breath, straining to defecate, violent coughing, and strenuous exercise. On the first postoperative day, patients were encouraged to perform bedside activities for 3–5 minutes. On the 2nd and 3rd postoperative days, patients walked for 5–10 minutes three times a day. From the 4th postoperative day until discharge, patients walked for 10–20 minutes once a day and climbed 10 flights of stairs twice a day without resting. Within two weeks of discharge, patients exercised for 10–20 minutes twice a day, and from two weeks to one month, they exercised for 20–30 minutes twice a day. Exercise options included walking, climbing stairs, and hiking. After discharge, to ensure that patients maintained a safe and effective exercise frequency and intensity, they were taught how to monitor their exercise pulse. Follow-up visits were conducted to urge patients to continue their exercise training.

### **2.3. Observation indicators**

- (1) Lung function was tested using a spirometer, analyzing forced expiratory volume in one second and forced vital capacity (FEV1, FVC) levels <sup>[7]</sup>.
- (2) Immunoglobulin G and immunoglobulin A (IgG, IgA) were determined by immunofluorescence assay, while CD4 and CD8 were measured using enzyme-linked immunosorbent assay <sup>[8]</sup>
- (3) Daily logs were used to analyze the occurrence of complications such as lung infection, atelectasis, high fever, and bleeding
- (4) The VAS scoring scale was utilized to evaluate the degree of pain, with higher scores indicating greater pain <sup>[9]</sup>; the 6-minute walk test was employed to assess exercise tolerance, with longer distances indicating better endurance <sup>[10]</sup>.
- (5) The SF-36 scoring scale was used to evaluate social functioning, vitality, physiological functioning, and mental health, with higher scores indicating better quality of life <sup>[11]</sup>.

### **2.4. Statistical methods**

SPSS 26.0 system was applied. Count data were represented by (n, %) and tested using chi-square test; measurement data were expressed as ( $\pm$ s) and tested using t-test. Statistical significance was indicated by  $P < 0.05$ .

## **3. Results**

### **3.1. Comparison of lung function indicators between the bundled care group and the conventional care group**

Before nursing, there was no statistical difference in lung function indicators between the bundled care group and the

conventional care group ( $P > 0.05$ ). After nursing, the lung function indicators of the bundled care group were higher than those of the conventional care group, showing statistical significance ( $P < 0.05$ ), as seen in **Table 1** below:

**Table 1.** Comparison of lung function indicators between the bundled care group and the conventional care group  
( $\bar{x} \pm s$ )

Group/Number of Cases	FVC(L)		FEV1(L)	
	Before Nursing	After Nursing	Before Nursing	After Nursing
Bundled care group (n = 40)	1.43 $\pm$ 0.27	2.46 $\pm$ 0.53	0.77 $\pm$ 0.14	1.52 $\pm$ 0.51
Conventional care group (n = 40)	1.42 $\pm$ 0.28	1.63 $\pm$ 0.41	0.73 $\pm$ 0.15	1.25 $\pm$ 0.25
<i>t</i>	0.466	5.214	0.536	6.845
<i>P</i>	0.427	0.000	0.364	0.000

### 3.2. Comparison of immune function indicators between the conventional care group and the bundled care group

Before nursing, there was no statistical difference in immune function indicators between the bundled care group and the conventional care group ( $P > 0.05$ ). After nursing, the immune function indicators of the bundled care group were more ideal than those of the conventional care group, showing statistical significance ( $P < 0.05$ ), as seen in the table below:

**Table 2.** Comparison of immune function indicators between the conventional care group and the bundled care group  
( $\bar{x} \pm s$ )

Group/ Number of Cases	IgA(g/L)		IgM(g/L)		CD <sup>4</sup>		CD <sup>8</sup>	
	Before Nursing	After Nursing	Before Nursing	After Nursing	Before Nursing	After Nursing	Before Nursing	After Nursing
Bundled care group (n = 40)	2.24 $\pm$ 0.32	2.52 $\pm$ 0.34	1.33 $\pm$ 0.36	1.75 $\pm$ 0.33	35.25 $\pm$ 10.39	42.27 $\pm$ 9.23	31.36 $\pm$ 3.38	25.47 $\pm$ 3.43
Conventional care group (n = 40)	2.22 $\pm$ 0.44	2.31 $\pm$ 0.25	1.31 $\pm$ 0.33	1.53 $\pm$ 0.25	34.37 $\pm$ 10.44	38.56 $\pm$ 8.35	32.17 $\pm$ 3.39	28.62 $\pm$ 3.16
<i>t</i>	0.327	2.563	0.247	3.154	0.135	2.144	0.352	2.454
<i>P</i>	0.842	0.000	0.741	0.000	0.924	0.000	0.805	0.000

### 3.3. Comparison of complication rates between the conventional care group and the bundled care group

The complication rate in the bundled care group was lower than that in the conventional care group, showing statistical significance ( $P < 0.05$ ), as seen in **Table 3**.

**Table 3.** Comparison of complication rates between the conventional care group and the bundled care group [cases (%)]

Group/ Number of cases	Pulmonary infection(n)	Atelectasis(n)	High fever(n)	Bleeding(n)	Total incidence [n(%)]
Bundled care group ( <i>n</i> = 40)	1	0	1	0	2(5.50)
Conventional care group ( <i>n</i> = 40)	4	2	2	1	9(22.50)
$\chi^2$					4.984
<i>P</i>					< 0.05

### 3.4. Comparison of pain level and exercise tolerance between the conventional care group and the bundled care group

Before nursing, there was no statistical difference in pain level and exercise tolerance between the conventional care group and the bundled care group ( $P > 0.05$ ). After nursing, the pain level in the bundled care group was lower than that in the conventional care group, and the exercise tolerance was stronger than that in the conventional care group, showing statistical significance ( $P < 0.05$ ), as shown in **Table 4**.

**Table 4.** Comparison of VAS scores between the conventional care group and the bundled care group ( $\bar{x} \pm s$ , points)

Group/ Number of cases	VAS Score		Exercise tolerance	
	before nursing	After nursing	Before nursing	After nursing
Bundled care group ( <i>n</i> = 40)	8.59 ± 1.73	3.47 ± 0.37	237.49 ± 29.37	420.78 ± 50.95
Conventional Care Group( <i>n</i> =40)	8.92 ± 1.85	5.81 ± 1.66	238.06 ± 28.14	330.28 ± 36.82
<i>t</i>	0.217	6.944	0.428	9.149
<i>P</i>	< 0.05	< 0.05	> 0.05	< 0.05

### 3.5. Comparison of quality of life scores between the conventional care group and the bundled care group

Before nursing, there was no statistical difference in quality of life scores between the conventional care group and the bundled care group ( $P > 0.05$ ). After nursing, the quality of life scores in the bundled care group were higher than those in the conventional care group, showing statistical significance ( $P < 0.05$ ), as seen in **Table 5**.

**Table 5.** Comparison of quality of life scores between the conventional care group and the bundled care group ( $\bar{x} \pm s$ , points)

Group/ Number of cases	Social functioning		Vitality		Physiological function		Mental health	
	Before Nursing	After Nursing	Before Nursing	After Nursing	Before Nursing	After Nursing	Before Nursing	After Nursing
Bundled care group ( <i>n</i> = 40)	71.66 ± 2.94	91.07 ± 3.39	70.47 ± 1.84	93.47 ± 3.56	70.16 ± 2.45	92.75 ± 2.39	68.27 ± 8.03	93.85 ± 2.27
Conventional care group ( <i>n</i> = 40)	71.47 ± 2.66	81.11 ± 5.26	69.48 ± 2.11	81.46 ± 4.16	69.33 ± 3.32	83.22 ± 1.14	67.27 ± 8.33	82.44 ± 3.55
<i>t</i>	0.342	3.407	0.363	3.667	0.235	3.514	0.537	4.106
<i>P</i>	> 0.05	< 0.05	> 0.05	< 0.05	> 0.05	< 0.05	> 0.05	< 0.05

## 4. Discussion

Lung cancer often presents with no obvious symptoms in its early stages, and as it progresses, symptoms such as chest pain and cough become apparent. As a clinically common malignant tumor, it has a very high mortality rate, necessitating timely and effective treatment to prolong lifespan. Among diversified treatment options, surgical treatment stands out due to its effectiveness. However, it has a certain degree of invasiveness, and coupled with the poor physical condition of patients, it can easily lead to various postoperative complications. Effective intervention is required to improve patients' physical functions and enhance their quality of life<sup>[12]</sup>.

The results of this study indicate that before nursing, there was no statistical difference in lung function indicators between the bundled care group and the conventional care group ( $P > 0.05$ ). After nursing, the lung function indicators of the bundled care group were higher than those of the conventional care group, showing statistical significance ( $P < 0.05$ ). Similarly, before nursing, there was no statistical difference in immune function indicators between the two groups ( $P > 0.05$ ). After nursing, the immune function indicators of the bundled care group were more ideal than those of the conventional care group, demonstrating statistical significance ( $P < 0.05$ ). The bundled care group also had a lower complication rate compared to the conventional care group, with statistical significance ( $P < 0.05$ ).

Furthermore, before nursing, there was no significant difference in pain level and exercise tolerance between the two groups ( $P > 0.05$ ). However, after nursing, the bundled care group had a lower pain level and stronger exercise tolerance than the conventional care group, exhibiting statistical significance ( $P < 0.05$ ). Additionally, before nursing, there was no statistical difference in quality of life scores between the two groups ( $P > 0.05$ ). After nursing, the bundled care group had higher quality of life scores than the conventional care group, indicating statistical significance ( $P < 0.05$ ).

The reasons for these findings can be attributed to the preoperative psychological nursing and health education, which not only alleviate patients' negative emotions but also improve their knowledge level, strengthening their compliance with medical advice. This ensures the smooth implementation of surgery, avoids stress reactions, and consequently reduces postoperative complications and pain levels. Simultaneously, intraoperative nursing prevents patients from experiencing hypothermia and adverse reactions, enhancing their comfort and facilitating the successful completion of surgery. Furthermore, postoperative pain management, dietary nursing, and rehabilitation care effectively reduce patients' pain, improve bodily nutrition, boost immunity, and promote early recovery. These results fully demonstrate the clinical application value of the bundled nursing care program for postoperative recovery of lung cancer patients, and also validate the value of conducting this experiment.

## 5. Conclusion

In summary, the bundled nursing care program has a more significant clinical application value for postoperative recovery of lung cancer patients. It is beneficial for strengthening patients' lung function and immune function, reducing postoperative complications, and further improving their exercise tolerance and quality of life. Therefore, it should be widely applied in clinical practice.

## Funding

Science and Technology Support Program of Baoding City, Hebei Province (Project No.: 2241ZF326)