

Table 1. Basic characteristics of included literatures

Author and study type	n	Surgery type	Intervention time and method	FAS Tool Type	Functional activity	Outcome indicator
Li et al. 2019 ^[17] (RCT)	50	Traditional thoracotomy or thoracoscopic surgery	48h after operation (B)	3	Deep breathing, coughing, expectoration	1,2,3
Li et al. 2019 ^[18] (RCT)	60	Laparoscopic or open surgery	Postoperative 24h (A)	4	Effective cough, bed roll	1,2
Zhu et al. 2020 ^[21] (RCT)	49	Resection of huge liver cancer	1–3 days after surgery (A)	3	Effective cough	1,2,3,4
Li et al. 2020 ^[9] (RCT)	40	Underwent initial unilateral total hip arthroplasty	One week after operation (A)	4	Slip knee flexion, hip abduction	1,2,4
Xu et al. 2021 ^[10] (RCT)	62	Fracture surgery	Postoperative to discharge (A)	3	Fracture surgery joint function exercises	1,4
Zhang 2023 ^[24] (RCT)	42	Receive hip arthroplasty	7 days after operation (A)	4	Sitting up in bed, standing by bed, getting out of bed	1,2
Wang et al. 2023 ^[23] (RCT)	84	Unilateral lobectomy	Postoperative to discharge (A)	4	Effective coughing, deep breathing, movement of the affected limb	1
Tong et al. 2016 ^[6] (Methodology study)	84	Thoracotomy or laparotomy	Postoperative 24h	4	Effective cough	5
Cheng et al. 2015 ^[5] (Quasi-experimental study)	70	Thoracotomy or laparotomy	Postoperative 24h (A)	3	Effective cough	1,2,4
Cheng 2016 ^[8] (Quasi-experimental study)	73	Thoracotomy or laparotomy	Postoperative 24h (A)	4	Effective cough	1,2,4,5
Huang et al. 2017 ^[12] (Quasi-experimental study)	36	Gastrointestinal tumor resection	1–3 days after surgery (A)	3	Effective coughing, sitting up in bed, standing up, walking	1,2
Tang et al. 2018 ^[13] (Quasi-experimental study)	37	Resection of huge liver cancer (diameter ≥ 10 cm)	1–3 days after surgery (A)	3	Effective cough	1,2,3
Ying 2018 ^[14] (Quasi-experimental study)	40	Elective thoracotomy or epigastric surgery	Postoperative 24h (A)	3	Deep breathing, coughing	1,2,4
Wang 2019 ^[15] (Quasi-experimental study)	74	TKR or HA	48h after operation (A)	3	Ankle motion, knee flexion motion	1,2,3,4,5
He et al. 2019 ^[16] (Quasi-experimental study)	40	Patients undergoing laparoscopic radical gastrectomy for gastric cancer	1 day before surgery to 72 hours after surgery (A)	3	Effective cough, roll over in bed, get out of bed and walk	1,2
Sun 2020 ^[19] (Quasi-experimental study)	75	Lung cancer patients undergoing thoracoscopic lobectomy under general anesthesia	1–3 days after surgery (A)	4	Effective cough	1,2,4
Man et al. 2020 ^[20] (Quasi-experimental study)	95	Open thoracolumbar surgery	3 days after operation (A)	4	Axis turning	1,2,4
Lei et al. 2022 ^[22] (Quasi-experimental study)	53	Closed thoracic drainage	During postoperative chest tube indwelling (C)	4	Turn over, get out of bed	1,2,3,4

Note: A: Active pain assessment using FAS combined with NRS; B: Self-controlled multifunctional chest strap fixation; C: Modified chest tube fixation.

- (1) Pain control indicators include: pain intensity assessment (resting/active NRS/FAS score, 24-hour ambulatory pain intensity, highest/lowest pain score, FAS score), pain control effect (Houston Pain Questionnaire, Postoperative Pain Self-Management Behavior Questionnaire, Moderate to Severe Pain Incidence Rate, Analgesic Pump Pressing Ratio Before Activity, Analgesic Regimen Adjustment Rate, PCA Usage Pattern, etc.), Pain Impact Dimension (Interference with Respiration/Cough), Chronic Pain Index (Chronic Pain Incidence Rate after Discharge), etc.;
- (2) Functional recovery indexes included: first time out of bed, first anal exhaust time, postoperative hospital stay, functional activity quantification (walking distance), joint function score, rehabilitation compliance (rehabilitation activity completion rate), etc.;
- (3) Complication-related indicators included: nausea and vomiting, dizziness and lethargy, skin itching and other adverse reactions during analgesia, deep vein thrombosis, hypoxemia, atelectasis, pneumonia and other common complications, catheter prolapse and other adverse events;
- (4) Patient experience indicators include: pain control satisfaction, sleep quality, pain on the emotional impact of patients.
- (5) Instrument evaluation indexes include reliability and validity, nurse approval, etc.

3.3. Characteristics of FAS application in postoperative active pain management

The characteristics of FAS applications are as follows:

- (1) Distribution of surgical types: The 18 included studies covered multiple surgical specialties. In terms of the distribution of surgical types, thoracic surgery and general surgery were the main application fields of FAS. Traditional thoracotomy or thoracoscopic surgery accounted for 5 articles, general surgery accounted for 5 articles, including gastrointestinal tumor resection and liver cancer resection, and another 3 articles were mixed studies with surgical site of chest or abdomen; orthopedic surgery accounted for 5 articles, involving hip replacement, knee replacement, fracture surgery and thoracolumbar surgery;
- (2) FAS instrument types: 4-grade FAS and 3-grade FAS, 9 articles each, each accounting for 50%;
- (3) Characteristics of functional activity types: The functional activities included in the study can be divided into two categories: respiratory related activities were most widely used in 13 studies (#%), mainly including effective cough, deep breathing, expectoration, etc.; limb motor activities were found in 10 articles (#%), including turning over, sitting up, joint flexion and extension, getting out of bed and walking, etc.

3.4. FAS based assessment mode and effect evaluation index of postoperative active pain

Evaluation mode: FAS was combined with NRS was used in all studies. Most studies (n=#%) included this assessment model as part of the intervention approach.

Early postoperative period (within 72h after surgery) was the concentrated period of FAS application, and 13 studies (#%) selected this time for evaluation. In addition, 4 studies were evaluated 7 days after surgery, and 1 study was evaluated during catheterization.

The outcome indicators and effects are as follows:

- (1) Pain control indicators: the most core evaluation indicators, 17 studies (#%) all included such indicators, covering pain intensity evaluation, pain control effect, pain impact degree and other aspects, and all of them were positive outcomes;

- (2) Functional recovery indicators: 15 studies (#%) were used, mainly to evaluate the first time out of bed, hospital stay, functional exercise compliance, etc., and all of them were positive outcomes;
- (3) Complications and adverse event indicators: 6 studies were used, of which 2 studies had negative outcomes;
- (4) Patient experience indicators: 12 studies received attention, including pain control satisfaction, sleep quality, etc., of which 3 had negative outcomes. 6 studies mentioned measures related to complications, of which two had negative outcomes. 3 studies used instrumental assessment measures and all had positive outcomes.

4. Discussion

4.1. Analysis of FAS application in postoperative active pain management

The results of this review showed that FAS application in active pain management after surgery in China presented the following characteristics: thoracic surgery and general surgery were the main fields of FAS application in the distribution of operation types, which may be related to the need for respiratory function exercises such as deep breathing and cough after such operations.

After thoracoabdominal surgery, patients are often afraid to breathe deeply and cough due to incision pain, which is essential to prevent pulmonary complications, so accurate active pain assessment is needed to guide pain management. Although orthopedic surgery accounts for a relatively small proportion, its application value is equally important, especially after joint replacement, the patient's joint function exercise directly affects the surgical effect and rehabilitation process. In addition, it should be noted that effective cough was also used as the evaluation basis of FAS after some abdominal surgery. The patient did not have respiratory tract disease, which may be related to anesthesia. That is to say, the selection of functional activities needs to consider both anesthetic factors and surgical factors.

The three-grade FAS and four-grade FAS accounted for half of the application, indicating that there are different choices for FAS classification criteria in clinical practice. The four-level FAS can distinguish the influence of pain on functional activities more carefully, but the three-level FAS is relatively simple in operation and convenient for clinical application. The choice of FAS level should be based on the patient's condition, the training level of the healthcare staff, and the management needs of the department.

4.2. FAS evaluation model and its advantages

This study found that all included studies used FAS combined with NRS, which had the following advantages:

- (1) Comprehensive evaluation: NRS mainly reflected the subjective pain perception of patients, while FAS objectively evaluated the impact of pain on functional activities. The combination of NRS and FAS could comprehensively evaluate the pain status of patients from two dimensions of subjective perception and functional impact, providing more comprehensive information for formulating individualized analgesia programs. This joint assessment model is consistent with the multidimensional concept of pain management and helps to improve the accuracy and effectiveness of pain assessment;
- (2) Targeted guidance for analgesia: Traditional resting pain assessments often do not accurately reflect the patient's true pain experience while performing functional activities. The introduction of FAS enables medical staff to adjust analgesic strategies according to patients' functional activity needs, achieving "on-

demand analgesia”, which not only ensures that patients can complete necessary functional exercises, but also avoids adverse reactions caused by excessive analgesia;

- (3) Promote early rehabilitation: Early functional exercise after surgery is one of the core concepts of accelerated rehabilitation surgery. FAS-based activity pain assessment can help patients overcome activity avoidance behavior caused by pain fear, promote patients to actively participate in rehabilitation exercises, thus shortening hospital stay and improving rehabilitation results.

4.3. Timing and clinical significance of FAS application

The significance of FAS application are as outlined:

- (1) Scientificity of timing of evaluation: This review showed that FAS application was concentrated within 72 hours after operation. Early postoperative pain is the most severe period, but also the high risk period of complications, timely and accurate assessment of active pain is helpful to early detection of problems and timely intervention. At the same time, this period is also the critical period for patients to start functional exercise, FAS application can provide security for the safe development of functional exercise;
- (2) Importance of continuous evaluation: Although most studies focused on the early postoperative period, some studies extended the evaluation time to 7 days after operation, until discharge, and even to 2 months after discharge, which reflected the continuity and dynamics of FAS application. Pain is a dynamic process, and the patient’s functional status is constantly recovering, so continuous evaluation and dynamic adjustment of analgesia regimen are required.

4.4. Multidimensional evaluation of FAS application effect

This review showed that all studies achieved positive outcomes in pain control measures, indicating that FAS-based active pain management has a significant advantage in controlling pain intensity and improving pain control. This may be related to FAS’s ability to more accurately identify patients’ analgesic needs and thus achieve individualized analgesia.

15 studies showed positive outcomes in functional recovery indicators, including earlier time out of bed for the first time, shorter hospitalization days, and improved compliance with functional exercise. This shows that FAS can not only effectively control pain, but more importantly, it can promote the functional recovery of patients, which is of great significance for the overall rehabilitation of surgical patients.

Although there were 3 studies with negative outcomes in terms of patient experience indicators. Overall, the use of FAS still improved patient satisfaction with pain control and quality of sleep. From the characteristics of 3 studies with negative outcomes in patient experience, it may be related to the short observation time (all 3 studies had observation time within 24h after surgery). The improvement brought by FAS may be gradual, especially in terms of changing patient behavior and treatment adjustment. If the study observation time is short, its cumulative effect may not be fully demonstrated.

4.5. Challenges and future developments of FAS applications

FAS application still faces many challenges and limitations in the process of popularization, and needs future improvement and optimization of clinical practice:

- (1) Insufficient standardization in historical period: The included studies in this review showed that before the publication of the group standards of the Chinese Nursing Association, different studies had differences

in FAS grade selection, functional activity types, and evaluation timing. It should be noted that in 2024, the Chinese Nursing Association has implemented the group standard of “Adult Postoperative Pain Assessment and Nursing,” which clearly defines the application specification of FAS and provides a unified standard for clinical practice;

- (2) Medical staff training needs to be strengthened: accurate application of FAS depends on professional knowledge and skills, but there are few relevant training studies at present, and the understanding and application level of medical staff are inconsistent, which affects the application effect. It is urgent to formulate systematic training programs;
- (3) The quality of research evidence needs to be improved: the proportion of randomized controlled trials in existing studies is low (only 7 out of 18 included), the sample size is generally small, and the lack of multi-center, large-sample high-quality studies limits the popularization value of evidence.

Higher quality studies need to be carried out in the future to provide strong support.

In order to overcome the challenges and promote the development of FAS, continuous efforts should be made in the following directions:

- (1) Promoting standardized application guidelines: Since the Chinese Nursing Association has issued a group standard containing FAS standardization specifications in 2024, the future focus should be shifted to the clinical application and implementation effect evaluation of this standard to ensure that medical institutions at all levels can accurately understand and implement unified standards. It can further improve the selection basis of FAS and functional activities at different levels, and promote the development of systematic evaluation and meta-analysis in the future;
- (2) Develop digital assessment tools: With the help of medical informatization development, develop digital tools based on mobile devices or electronic medical records, realize standardization, convenience and digitalization of assessment, and improve efficiency and accuracy;
- (3) Expand the application field: on the basis of FAS mainly used in thoracic surgery, general surgery and orthopedics, explore its potential in neurosurgery, urology, gynecology and other surgical specialties, and expand the application scope and value;
- (4) Deepen the mechanism research: In-depth research on the mechanism of FAS to improve pain management effect, including its influence on patients' pain perception, rehabilitation behavior, psychological state, etc., to provide theoretical support for scientific application.

5. Conclusion

This scope review systematically combs the application status of FAS in the management of postoperative active pain in China. The results showed that FAS showed good clinical results in pain control and functional recovery. However, during the period 2015–2023 covered by this review, FAS use was not highly standardized and the quality of research evidence was limited. It is gratifying that the Chinese Nursing Association has issued relevant group standards in 2024, providing authoritative guidance for the standardized application of FAS. In the future, we should focus on the clinical promotion and implementation of this standard, the development of high-quality research and the development of digital tools, so as to promote the standardized application of FAS in postoperative pain management and provide more accurate and effective pain management services for patients.

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Disclosure statement

The authors declare no conflict of interest.

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Co-infection of *Tropheryma Whipplei* and *Mycobacterium tuberculosis* in 39 Cases: A Case Series Study

Long Jin, Xiaolei Zhang, Huailong Jiang, Qijian Li, Weinan Liu, Jiayao Wang, Zeyu Cao, Yuqin Liu*

Infectious Disease Hospital of Heilongjiang Province, Harbin 150500, Heilongjiang, China.

*Author to whom correspondence should be addressed.

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Abstract: *Background:* Whipple's Disease (WD) is a chronic and recurrent multisystem disease caused by *Tropheryma whipplei* (TW). Typically, MTB infection compromises the immune system. However, clinical reports of MTB and TW co-infection are rare. *Methods:* This study retrospectively analyzed the admission symptoms and biochemical test results of 39 patients co-infected with MTB and TW between January 1, 2023, and August 31, 2024, at the Infectious Disease Hospital of Heilongjiang Province, China. This study further compared the admission indicators between individuals with co-infections involving more than two pathogens (multi-infected) and those infected with only MTB and TW (Co-Infected). *Results:* The hospitalized patients had a median age of 50 (39–58) years. Most of the patients were male (69.23%, 27/39). Most patients presented with cough (87.18%, 34/39), sputum production (76.92%, 30/39), shortness of breath (64.10%, 25/39), and reduced appetite or even anorexia (53.85%, 21/39). However, fever (41.03%, 14/39) and fatigue (41.03%, 16/39) were less common. Among the patients who underwent these four biochemical tests, the majority (86.36%, 19/22) had an A/G ratio below the normal range at the time of admission, primarily due to an increase in serum globulin levels. Multi-Infected group had higher levels of alanine aminotransferase than the Co-Infected group (17 vs. 10, $p = 0.035$), and aspartate aminotransferase is also higher in the multi-infected group compared to the Co-Infected group (20 vs. 14, $p = 0.034$). *Conclusion:* This is the first study to report the coinfection of *Tropheryma whipplei* (TW) and *Mycobacterium tuberculosis* (MTB) in Heilongjiang Province, China. However, this study did not find significant differences from descriptions in existing literature. Therefore, this study has provided a descriptive analysis to serve as a reference for further understanding TW infections.

Keywords: *Mycobacterium tuberculosis*; *Tropheryma whipplei*; Pulmonary infection; Metagenomic next-generation sequencing

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1. Introduction

Whipple's Disease (WD) is a chronic, and recurrent multisystem disease caused by *Tropheryma whippelii* (TW) ^[1,2]. WD was first reported in 1907 by American pathologist George Hoyt Whipple, but the successful culture of TW strains was achieved only in 2000 ^[3,4]. WD is rare, with no reliable estimate of its actual prevalence, and as of 2007, only about 1,000 cases had been reported globally ^[1]. A recent review indicated that the prevalence in Italy and the United States is 3/1,000,000 and 9.8/1,000,000, respectively ^[5].

The clinical symptoms of WD are diverse and lack specificity ^[2]. Acute TW infections often present as self-limiting gastroenteritis, fever, cough, and bacteremia ^[1,2]. Most acute cases resolve with an immune response, while some progress to asymptomatic carriage or chronic infection, manifesting as endocarditis, encephalitis, arthritis, and more. Approximately 30% to 40% of WD patients exhibit pulmonary symptoms, including pneumonia, chronic cough, chest pain, dyspnea, pleural adhesions, and reduced lung capacity ^[6].

The amplification of TW 16S rRNA via PCR and its cell culture greatly advanced the understanding and treatment of Whipple's Disease ^[7]. In 2003, Bentley and Raoult independently completed the whole-genome sequencing of TW and conducted an analysis of its sequences ^[8,9]. Previous studies have indicated that this bacterium is difficult to culture *in vitro*, and diagnosis typically requires quantitative polymerase chain reaction (qPCR) and/or metagenomic next-generation sequencing (mNGS) techniques ^[6]. However, since neither qPCR nor mNGS are routine testing methods, infections caused by TW are often easily overlooked in clinical practice.

Between January 1, 2023, and August 31, 2024, this research has diagnosed 39 cases of pulmonary co-infection caused by TW and MTB. This study underscores the critical role of mNGS in identifying these pathogens. Our findings provide a valuable reference for further research on the interplay between Whipple's disease and tuberculosis and contribute to the development of relevant clinical guidelines.

2. Materials and methods

2.1. Patients and specimen collection

This study has retrospectively analyzed 18 bronchoalveolar lavage fluid (BALF) samples and 21 sputum samples that underwent mNGS testing between January 1, 2023, and August 31, 2024, at the Infectious Disease Hospital of Heilongjiang Province, China. All samples were collected in accordance with strict sterility protocols. This study collected baseline data of positive *T.whippelii*, including demographic information and laboratory data.

2.2. Diagnostic workflow for TW and MTB infection

Patients were diagnosed with MTB infection according to the National Diagnostic Criteria for Pulmonary Tuberculosis and the Classification of Tuberculosis ^[10–12]. The collected samples were sent to Dian Diagnostics for testing, and clinicians made a diagnosis of TW infection based on the test reports and clinical symptoms. In the absence of clear guidelines for diagnosing TW, the study referred to previously published literature, where TW was considered positive if at least three reads were mapped to the species level ^[3].

2.3. Statistical analysis

Data statistics and analysis were carried out in R (version 4.3.2). Continuous data were described using median (25th and 75th percentile quantile). Categorical data were presented as frequency and percentage (N (%)). The Wilcoxon rank-sum test was used to compare continuous data between groups, while Fisher's exact test was applied for

comparisons of categorical data between groups. $p < 0.05$ was considered to indicate statistical significance.

3. Results

Based on baseline characteristics, the hospitalized patients had a median age of 50 (39–58) years, a height of 170 (162–175) cm, a weight of 60 (55–66) kg, and a BMI of 20.76 (18.73–22.48) kg/m². Most of the patients were male (69.23%, 27/39, **Table 1**). Among those with known blood types, blood type O was the most common (23.08%, 9/39, **Table 1**). Socially, most patients were married (71.79%, 28/39, **Table 1**) and unemployed (61.54%, 24/39, **Table 1**).

Table 1. Baseline characteristic

Feature	N (%)
Sex	
Female	12 (30.77)
Male	27 (69.23)
Blood type	
A	7 (17.95)
AB	4 (10.26)
B	6 (15.38)
O	9 (23.08)
Unknown	13 (33.33)
Marital status	
Divorced	4 (10.26)
Married	28 (71.79)
Single	6 (15.38)
Widowed	1 (2.56)
Occupation	
Employee	2 (5.13)
Farmer	8 (20.51)
Retired	2 (5.13)
Student	2 (5.13)
Unemployed	24 (61.54)
Worker	1 (2.56)

Regarding admission symptoms, most patients presented with cough (87.18%, 34/39, **Table 2**), sputum production (76.92%, 30/39, **Table 2**), shortness of breath (64.10%, 25/39, **Table 2**), and reduced appetite or even anorexia (53.85%, 21/39, **Table 2**). However, fever (41.03%, 14/39, **Table 2**) and fatigue (41.03%, 16/39, **Table 2**) were less common.

Table 2. Admission symptoms

Feature	N (%)
Fever	14 (35.90)
Cough	34 (87.18)
Sputum	30 (76.92)
Fatigue	16 (41.03)
Tachypnea	14 (35.90)
Appetite loss	21 (53.85)

This study has plotted the biochemical test results of patients upon admission (**Figure 1**), focusing on total protein, albumin, globulin, and the albumin-to-globulin (A/G) ratio. The results showed that among the patients who underwent these four biochemical tests, the majority (86.36%, 19/22, **Figure 2**) had an A/G ratio (normal range: 1.5–2.5) below the normal range at the time of admission, primarily due to an increase in serum globulin levels.

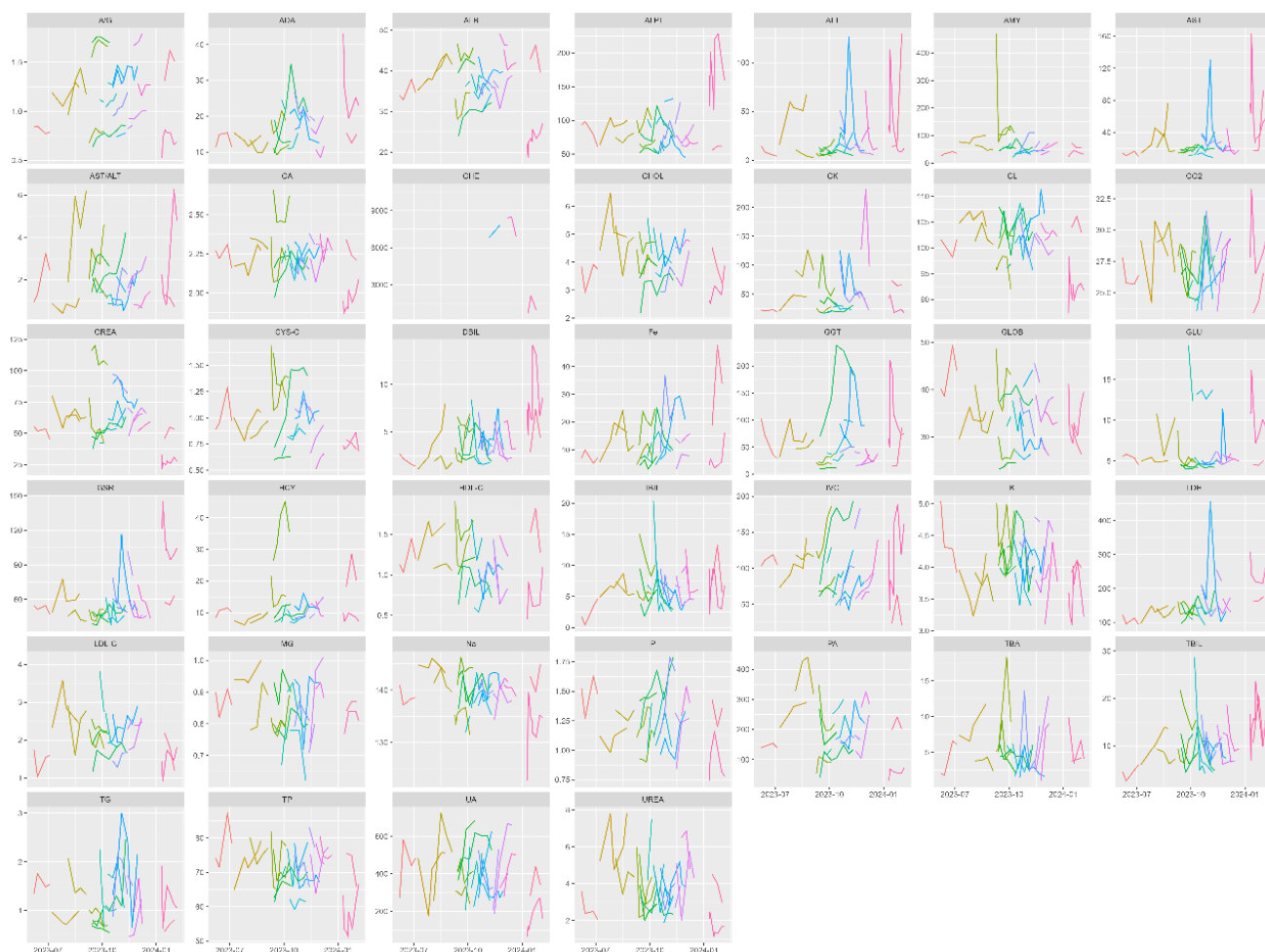


Figure 1. Biochemical test results of hospitalized patients.

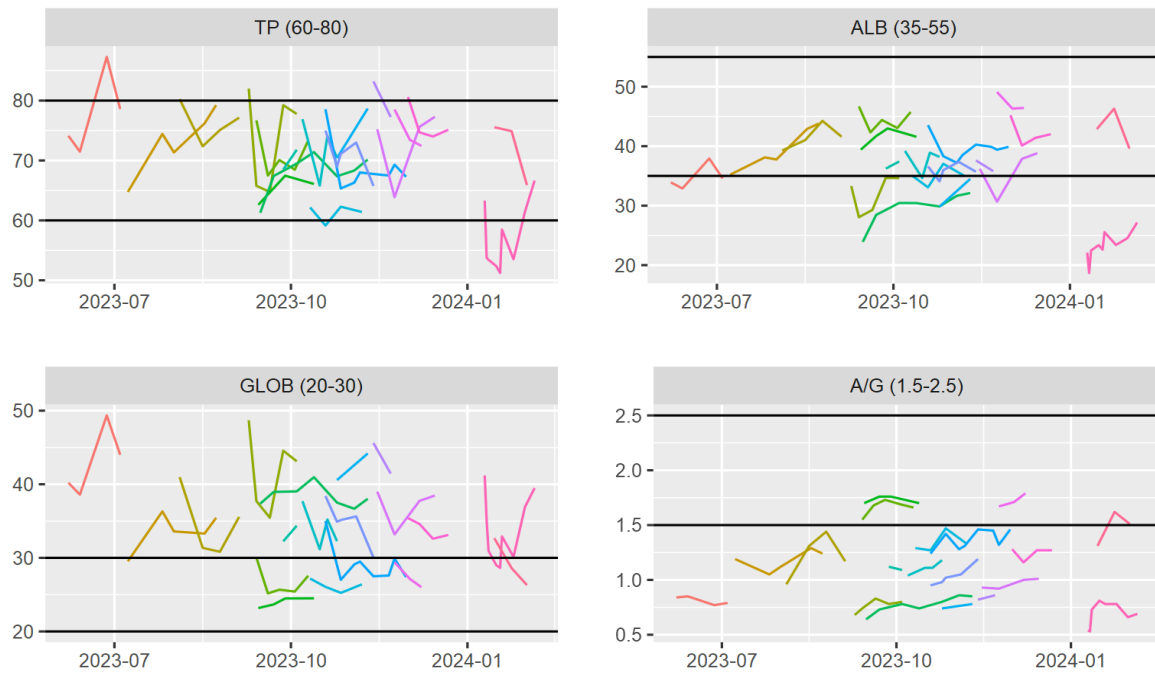


Figure 2. Biochemical test results of hospitalized patients (TP, ALB, GLOB, A/G).

Based on whole-genome sequencing results, we divided the population into two groups, those infected only with MTB and TW (labeled as 0, Co-Infected) and those infected with more than just MTB and TW (labeled as 1, multi-infected). After conducting a comparative analysis, the results indicate that the multi-infected group has higher levels of alanine aminotransferase than the Co-Infected group (17 vs. 10, $p = 0.035$, **Table 3**), and aspartate aminotransferase is also higher in the multi-infected group compared to the Co-Infected group (20 vs. 14, $p = 0.034$, **Table 3**).

Table 3. Comparison of admission characteristics between co-infected and multi-infected groups

Characteristic	Co-infected (N = 12)	Multi-infected (N = 27)	p
Sex			0.455
Female	5 (42%)	7 (26%)	
Male	7 (58%)	20 (74%)	
Blood type			0.553
A	2 (17%)	5 (19%)	
AB	0 (0%)	4 (15%)	
B	3 (25%)	3 (11%)	
O	2 (17%)	7 (26%)	
Unknown	5 (42%)	8 (30%)	
Marital status			0.615
Divorced	0 (0%)	4 (15%)	
Married	10 (83%)	18 (67%)	
Single	2 (17%)	4 (15%)	
Widowed	0 (0%)	1 (3.7%)	

Table 3 (Continued)

Characteristic	Co-infected (N = 12)	Multi-infected (N = 27)	p
Occupation			0.079
Employee	0 (0%)	2 (7.4%)	
Farmer	0 (0%)	8 (30%)	
Retired	1 (8.3%)	1 (3.7%)	
Student	0 (0%)	2 (7.4%)	
Unemployed	11 (92%)	13 (48%)	
Worker	0 (0%)	1 (3.7%)	
Age	57 (45, 62)	48 (36, 57)	0.152
Height	165 (160, 170)	174 (164, 178)	0.020
Weight	57 (51, 63)	60 (56, 67)	0.228
BMI	20.8 (18.2, 23.1)	20.6 (18.7, 22.3)	0.845
A/G	1.08 (0.90, 1.20)	1.10 (0.82, 1.31)	0.838
Unknown	4	13	
ADA	14 (11, 20)	18 (15, 20)	0.339
Unknown	4	13	
ALB	37 (35, 39)	37 (34, 44)	0.664
Unknown	4	13	
ALPI	87 (69, 102)	78 (63, 94)	0.365
Unknown	4	13	
ALT	10 (8, 14)	17 (13, 34)	0.035
Unknown	4	13	
AMY	53 (32, 63)	43 (36, 53)	0.764
Unknown	4	13	
AST	14 (13, 18)	20 (15, 37)	0.034
Unknown	4	13	
AST/ALT	1.64 (1.07, 2.10)	1.26 (0.88, 2.03)	0.413
Unknown	4	13	
CA	2.27 (2.19, 2.33)	2.27 (2.16, 2.36)	0.945
Unknown	4	13	
CHOL	4.96 (4.13, 5.45)	4.32 (3.43, 4.55)	0.142
Unknown	4	13	
CK	29 (22, 54)	46 (36, 73)	0.145
Unknown	4	13	
CL	103.0 (101.4, 104.7)	102.1 (100.8, 104.8)	0.714
Unknown	4	13	
CO2	28.41 (25.24, 29.15)	27.14 (23.60, 28.30)	0.275
Unknown	4	13	
CREA	59 (55, 66)	61 (47, 89)	0.92
Unknown	4	13	
CYS-C	0.95 (0.81, 1.09)	0.81 (0.71, 1.11)	0.616
Unknown	4	13	
DBIL	3.90 (2.30, 4.50)	3.70 (2.90, 6.10)	0.562

Table 3 (Continued)

Characteristic	Co-infected (N = 12)	Multi-infected (N = 27)	p
Unknown	4	13	
Fe	11.9 (7.4, 15.0)	6.7 (4.6, 11.7)	0.070
Unknown	4	13	
GGT	35 (27, 74)	30 (18, 48)	0.441
Unknown	4	13	
GLOB	35.0 (30.8, 40.4)	35.5 (30.0, 39.0)	0.973
Unknown	4	13	
GLU	5.34 (5.08, 8.18)	5.19 (4.57, 6.17)	0.473
Unknown	4	13	
GSR	53 (47, 58)	60 (49, 73)	0.33
Unknown	4	13	
HCY	9.6 (7.3, 11.7)	12.6 (8.2, 18.3)	0.133
Unknown	4	13	
HDL-C	1.16 (0.90, 1.57)	1.15 (0.79, 1.50)	0.918
Unknown	4	13	
IBIL	7.3 (5.9, 10.1)	8.6 (6.8, 9.5)	0.516
Unknown	4	13	
IVC	96 (76, 113)	65 (53, 115)	0.162
Unknown	4	13	
K	4.19 (3.98, 4.52)	4.01 (3.80, 4.40)	0.245
Unknown	4	13	
LDH	135 (120, 167)	162 (155, 210)	0.07
Unknown	4	13	
LDL-C	2.53 (1.97, 3.37)	2.24 (1.74, 2.56)	0.194
Unknown	4	13	
MG	0.90 (0.80, 0.92)	0.80 (0.77, 0.85)	0.259
Unknown	4	13	
Na	140.4 (137.5, 141.7)	138.8 (136.4, 140.9)	0.402
Unknown	4	13	
P	1.15 (1.06, 1.34)	1.09 (0.93, 1.29)	0.275
Unknown	4	13	
PA	182 (127, 228)	165 (128, 268)	0.868
Unknown	4	13	
TBA	6.10 (3.21, 7.22)	3.69 (1.68, 5.02)	0.11
Unknown	4	13	
TBIL	11.5 (7.7, 14.0)	12.7 (9.6, 16.6)	0.393
Unknown	4	13	
TG	1.22 (0.96, 1.89)	1.00 (0.71, 1.72)	0.365
Unknown	4	13	
TP	70.3 (68.9, 75.5)	75.4 (63.3, 78.6)	0.57
Unknown	4	13	
UA	300 (255, 430)	296 (225, 398)	0.815

Table 3 (Continued)

Characteristic	Co-infected (N = 12)	Multi-infected (N = 27)	p
Unknown	4	13	0.714
UREA	5.10 (3.89, 5.29)	4.45 (3.40, 5.62)	
Unknown	4	13	

4. Discussion

As from prior knowledge, this is the first study to report the coinfection of *Tropheryma whipplei* (TW) and *Mycobacterium tuberculosis* (MTB) in Heilongjiang Province, China. This study was attempted to identify distinct clinical characteristics in these cases compared to other diseases. However, this study did not find significant differences from descriptions in existing literature. Therefore, this study has provided a descriptive analysis to serve as a reference for further understanding TW infections.

China's first reported case of MTB and TW co-infection was documented in 2021 in Shanghai ^[14]. The patient exhibited fever, cough, and respiratory distress, but notably did not present with sputum production or fatigue. In our study of 39 patients, regarding admission symptoms, cough, sputum production, and shortness of breath were the predominant respiratory symptoms, underscoring the respiratory nature of the disease in our patient population. However, the relatively low incidence of fever and fatigue suggests that these symptoms may not serve as reliable indicators of disease severity or progression in this context. Biochemical analysis revealed that most patients had elevated serum globulin levels and a low serum albumin/globulin ratio, which may indicate an underlying infectious disease. Unfortunately, these symptoms and biochemical findings are nonspecific, and without considering NGS testing, TW infection might easily be overlooked. To underscore the importance of NGS in aiding the diagnosis of TW infection, this study conducted a search of CNKI and PubMed for reported cases of TW infection in China (see supplementary). From January 1, 2007, to September 3, 2024, a total of 109 cases of TW infection were reported, with 103 cases using NGS for auxiliary diagnosis.

Referencing the study by Lai et al., this study compared the admission biochemical results of the Co-Infected and Multi-Infected groups and found differences in alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels ^[15]. The finding was consistent with the results of Lai et al.'s study, although their results did not reach statistical significance. Along with the previously mentioned decrease in the albumin/globulin ratio, this emphasizes the necessity of closely monitoring and managing liver function in patients with multiple infections.

There are still some limitations in this study. In previous suggestions, Zong et al. proposed that NGS reports should include quality control measures, such as noting whether other samples in the same batch tested positive for the pathogen, to rule out false positives due to laboratory contamination ^[16]. All samples in our study underwent strict adherence to standard operating procedures for experimentation and quality control. Although it was suggested to add batch-specific results to further verify the reliability of the positive results, the research did not annotate each sample with the results of other samples in the batch. This is because the existing quality control measures have already ensured the reliability of the experimental results, and additional annotations could complicate the report unnecessarily. Furthermore, given the study design and sample size, implementing such a measure would present certain challenges in this study.

5. Conclusion

In conclusion, this study presents the first documented cases of TW and MTB co-infection in Heilongjiang Province, China. Although no significant clinical distinctions from mono-infections were identified, this descriptive analysis offers foundational data that may enhance clinical awareness and contribute to a deeper understanding of TW co-infection dynamics, underscoring the need for further investigation.

Disclosure statement

The authors declare no conflict of interest.

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Survey on High School Students' Mastery of First Aid Knowledge, Training Attitudes, and Needs

Shuai Liu, Yang Bai, Mingcan Xue, Lishuo Gao*

School of Nursing, Tianjin Medical University, Tianjin, 300070, China

*Corresponding author: Lishuo Gao, gaolishuo@tmu.edu.cn

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Abstract: *Objective:* To understand high school students' mastery of first aid knowledge and their needs for first aid training, analyze the influencing factors of their mastery of first aid knowledge, and provide a reference basis for targeted first aid training for high school students. *Methods:* A total of 930 high school students from three high schools in Nanchong City, Sichuan Province, were selected as the research subjects using the convenience sampling method. A self-made questionnaire was used for the survey. SPSS 25.0 software was employed for data description and analysis. *Results:* The average score for high school students' mastery of first aid knowledge was (12.23 ± 4.39) , with a pass rate of 29.5%. There were significant differences in the correct response rates for each question (4.62% to 92.80%). 92.9% of high school students expressed willingness to participate in first aid training. Multivariate logistic regression analysis revealed that participation in first aid training (not participating in training: $OR = 2.524$, $95\%CI = 1.858-3.428$) was an influencing factor for high school students' mastery of first aid knowledge. *Conclusion:* High school students have insufficient mastery of first aid knowledge, and the correct response rates need to be improved. It is essential to enhance the popularization of first aid knowledge among high school students and implement diversified training formats and courses.

Keywords: First aid knowledge; First aid training; High school students; Influencing factors

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1. Introduction

First aid ability is a fundamental survival skill that the public must possess. In emergency situations such as sudden illnesses and accidental injuries, timely and effective first aid measures can significantly reduce the disability and mortality rates. The "Healthy China 2030 Plan" explicitly proposes the strategic theme of "co-construction and sharing, health for all," with improving the health literacy of the entire population as a core objective ^[1].

First aid knowledge and skills, serving as the "critical line of defense" for safeguarding lives, constitute a vital component of health literacy, and the extent of their dissemination directly determines the effectiveness of interventions during the pre-hospital emergency waiting period ^[2]. Surveys indicate that the penetration rate of

first aid knowledge in China is less than 1%, significantly lower than that in developed countries. For instance, in Germany, the penetration rate of first aid knowledge among the public reaches as high as 80%, while in France, it stands at 40%^[3]. This discrepancy often leads to a lack of effective interventions during the critical rescue window in most emergency scenarios.

As the future backbone of society, the cultivation of first aid capabilities among adolescents holds profound significance for enhancing the overall first aid proficiency of society^[4]. Data reveals that approximately 1.2 million adolescents worldwide die annually from accidental events such as trauma and drowning, with 40% of these deaths being preventable through timely first aid. In the Netherlands, children as young as 10 are required to learn and master basic first aid skills and knowledge, and in Japan, the penetration rate of first aid knowledge among high school students reaches 92%^[3,5].

Currently, domestic research on the dissemination of first aid knowledge predominantly focuses on college students or adult populations, with relatively less attention given to high school students. Therefore, this study conducted an online survey from February to March 2025, aiming to understand the mastery of first aid knowledge, attitudes, and needs towards first aid training among high school students in Nanchong City, Sichuan Province, and to analyze the influencing factors affecting their grasp of first aid knowledge. The findings aim to provide a reference basis for formulating scientific first aid training strategies for high school students.

2. Subjects and methods

2.1. Subjects

From February to March 2025, a convenience sampling method was employed to select 930 high school students from three high schools in Nanchong City, Sichuan Province, as the research subjects. Among them, there were 484 males (52.04%) and 446 females (47.96%); 299 freshmen (32.15%), 273 sophomores (29.35%), and 358 juniors (38.50%); 132 students from rural areas (14.19%), 102 from towns (10.97%), and 696 from urban areas (74.84%); 131 students with family members engaged in the medical industry (14.09%) and 799 without (85.91%); 482 students who had participated in first aid training (51.83%) and 448 who had not (48.17%).

2.2. Methodology

2.2.1. Survey instruments

A self-developed questionnaire was employed, the main contents of which included:

- (1) General information: This section encompassed gender, grade level, residential location, whether any family members were engaged in the medical field, participation in first aid knowledge training, and the primary reasons for non-participation in such training;
- (2) Mastery of first aid knowledge: This section comprised 25 questions divided into four parts: basic first aid knowledge (4 multiple-choice questions), cardiopulmonary resuscitation (CPR) knowledge (6 multiple-choice questions), trauma first aid knowledge (10 multiple-choice questions), and first aid knowledge for common accidental injuries (5 multiple-choice questions). The overall Cronbach's α coefficient for this section of the questionnaire was 0.79, indicating good reliability. Each question was worth 1 point for a correct answer, with no points awarded for incorrect answers or "I don't know" responses. The minimum score was 0, and the maximum was 25. In this study, a passing score was defined as a total score of 15 or above;

- (3) Demand and attitudes toward first aid training: This section explored the necessity for high school students to acquire basic first aid knowledge and skills, their interest in first aid knowledge and skills training, willingness to participate in school-sponsored first aid training, reasons for willingness to participate in first aid training, confidence in mastering first aid content, attitudes toward learning through first aid training, and the types of out-of-hospital first aid knowledge and skills they wished to learn.

2.2.2. Survey methods and quality control

This study utilized a self-designed questionnaire, which was constructed and distributed via the Wenjuanxing platform, generating QR codes for distribution. Trained investigators distributed the QR codes of the questionnaire to class groups, and students completed and submitted the questionnaire by scanning the code. Control measures were implemented in the electronic questionnaire: all questions were set as mandatory, preventing submission if any were left unanswered; each WeChat account was limited to completing only one questionnaire, avoiding duplicate responses and missing items. After the survey, the researcher reviewed all data and excluded responses with excessively short completion times. A total of 934 questionnaires were collected, with 4 excluded due to excessively short completion times (less than 60 seconds). Ultimately, 930 valid questionnaires were collected, yielding a valid response rate of 99.57%.

2.2.3. Statistical analysis

Data were screened and exported using the Wenjuanxing software, and statistical analysis was performed using SPSS 25.0 software. Quantitative data conforming to a normal distribution were described statistically using the mean \pm standard deviation (SD), while qualitative data were described using frequency and percentage (%). Univariate analysis was conducted using independent sample t-tests and one-way analysis of variance. Factors influencing the mastery of first aid knowledge were analyzed using multivariate logistic regression. A *P*-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Mastery of first aid knowledge among high school students

The lowest score for first aid knowledge was 0 points, and the highest score was 24 points, with an average score of (12.23 ± 4.39) points (see **Table 1**).

Table 1. Scores for first aid knowledge among high school students

Domain	Number of items	Highest score	Lowest score	Mean \pm SD
First aid basics	4	4	0	2.89 ± 0.87
Cardiopulmonary resuscitation (CPR) knowledge	6	6	0	2.42 ± 1.60
Trauma first aid knowledge	10	10	0	5.23 ± 2.34
Emergency management of accidental injuries	5	5	0	1.68 ± 0.99
Total score	25	24	0	12.23 ± 4.39

Only 274 high school students scored 15 points or above, resulting in a pass rate of 29.5%. The accuracy rates for each question are shown in **Table 2**.

Table 2. Accuracy rates for first aid knowledge among high school students

Questions		Correct responses	Accuracy (%)
First aid basics	What is the universal emergency number in China?	817	87.85%
	When calling emergency services for a patient, which information is NOT essential to provide?	863	92.80%
	What is the first step when encountering a patient requiring emergency assistance outside hospital?	368	39.57%
	How to check if a patient is conscious?	641	68.92%
CPR knowledge	Where is the correct hand position for chest compressions in adults?	692	74.41%
	What is the compression-to-ventilation ratio during CPR?	229	24.62%
	What is the recommended chest compression rate?	251	26.99%
	What is the appropriate chest compression depth for adults?	244	26.24%
	Which statement about AED usage is correct?	281	30.22%
	What are the correct first aid measures for adult choking victims?	553	59.46%
Trauma first aid	What is the most direct, rapid, effective and safe method to stop most external bleeding?	276	29.68%
	Which item should NOT be used as a tourniquet when professional tourniquets are unavailable?	843	90.65%
	What is the maximum continuous duration for applying a tourniquet?	99	10.65%
	Which statement about wound dressing principles is incorrect?	349	37.53%
	Which is NOT a symptom of limb fracture?	693	74.52%
	Which action is inappropriate when providing first aid to fracture victims?	432	46.45%
	Which action is incorrect when splinting fracture victims?	552	59.35%
	What is the correct transport method for suspected spinal injury victims?	491	52.80%
	What is the appropriate on-site treatment method for specific injuries?	515	55.38%
	What is the correct approach for ankle sprain?	618	66.45%
Accidental injury management	What are the correct emergency measures for burn victims?	394	42.37%
	What are the correct emergency measures for heat stroke victims?	760	81.72%
	What are the correct first aid measures for drowning victims?	43	4.62%
	Which first aid measure is incorrect after a dog bite?	115	12.37%
	Which on-site measure is inappropriate after a traffic accident?	255	27.42%

3.2. Univariate analysis of mastery of first aid knowledge among high school students

Univariate analysis revealed statistically significant differences in the mastery of first aid knowledge among high school students based on gender, grade level, family residence, and participation in first aid training ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of mastery of first aid knowledge among high school students with different characteristics in Nanchong City (mean \pm SD, points)

Basic information	n	Percentage (%)	Score	t/F	P-value
Gender				-3.063	0.002*
Male	484	52.04	11.81 \pm 4.56		
Female	446	47.96	12.69 \pm 4.17		
Grade				12.904	< 0.001**
Grade 10	299	32.15	11.48 \pm 4.37		
Grade 11	273	29.35	13.29 \pm 4.35		
Grade 12	358	38.49	12.05 \pm 4.30		
Residence				3.385	0.034*
Rural	132	14.19	11.39 \pm 4.33		
Town	102	10.97	11.95 \pm 4.86		
Urban	696	74.84	12.43 \pm 4.32		
				1.887	0.059
Yes	131	14.09	12.90 \pm 4.12		
No	799	85.91	12.12 \pm 4.43		
				9.096	< 0.001**
Yes	482	51.83	13.44 \pm 4.08		
No	448	48.17	10.92 \pm 4.35		

Note: * P < 0.05, ** P < 0.01.

3.3. Multivariate analysis of mastery of first aid knowledge among high school students

A multivariate logistic regression analysis was conducted using the pass/fail status of the first aid knowledge questionnaire score as the dependent variable and four factors: gender, grade level, family residence, and participation in first aid training, as independent variables. The variable settings and assignments are shown in Table 4.

Table 4. Logistic regression coding and assignment

Code	Variable	Value assignment
Y	Questionnaire score	Pass = 0; Fail = 1
X1	Gender	Male = 1; Female = 2
X2	Grade	Grade 10 = 1; Grade 11 = 2; Grade 12 = 3
X3	Family residence	Rural = 1; Town = 2; Urban = 3
X4	First aid training received	Yes = 1; No = 2

The results showed that, using students who had received first aid training as a control group, students who had not received training had a higher probability of failing in first aid knowledge, with an odds ratio (*OR*) of 2.524 (95% confidence interval [*CI*] = 1.858 to 3.428), as shown in Table 5.

Table 5. Multifactorial logistic regression analysis of high school students' mastery of first aid knowledge

Aspects	β	S.E.	Wald χ^2	P-value	OR	95% CI
Gender						
Male ^a	-	-	-	-	-	-
Female	-0.133	0.149	0.797	0.372	0.876	0.654–1.172
Grade						
Grade10 ^a	-	-	-	-	-	-
Grade11	-0.151	0.188	0.645	0.422	0.860	0.595–1.243
Grade12	-0.520	0.179	8.442	0.004**	0.594	0.418–0.844
Residence						
Rural ^a	-	-	-	-	-	-
Town	0.245	0.234	1.096	0.295	1.278	0.807–2.023
Urban	-0.228	0.231	0.979	0.323	0.796	0.506–1.251
Attitude						
Yes ^a	-	-	-	-	-	-
No	0.926	0.156	35.134	< 0.001**	2.524	1.858–3.428

Note: a served as the reference group. * $P < 0.05$, ** $P < 0.01$.

3.4. Attitudes and needs of high school students toward first aid training

Among the surveyed high school students, 97.4% believed it was necessary to acquire first aid knowledge and skills, 82.4% expressed interest in first aid training, and 92.9% were willing to participate in such training, as shown in **Table 6**.

Table 6. Attitudes of high school students toward first aid training

Survey item	Options	Frequency	Percentage (%)
Necessity of mastering first aid knowledge and skills	Necessary	906	97.4
	Neutral	20	2.2
	Unnecessary	4	0.4
Interest in first aid training	Interested	766	82.4
	Neutral	145	15.6
	Not interested	19	2.0
Willingness to participate in first aid training	Willing	864	92.9
	Neutral	61	6.6
	Unwilling	5	0.5

In the survey of first aid knowledge needs, cardiopulmonary resuscitation (CPR), emergency bleeding control for trauma, wound bandaging, and fracture immobilization were identified as areas of high demand, as shown in **Table 7**.

Table 7 Needs of high school students for first aid training

First Aid Training Need	Frequency	Percentage (%)
Cardiopulmonary resuscitation (CPR)	779	90.16
Emergency bleeding control	721	83.45
Wound dressing	691	79.98
Fracture immobilization	589	68.17
Patient transport	518	59.95
On-site drowning rescue	648	75.00
Heat stroke management	687	79.51
Burn and scald management	621	71.88
Airway obstruction by foreign bodies	650	75.23
Out-of-hospital care for common emergencies	570	65.97

4. Discussion

4.1. Low level of mastery of first aid knowledge among high school students

This survey revealed that only 29.5% of high school students in Nanchong City, Sichuan Province, achieved a passing score in first aid knowledge, indicating a less-than-ideal level of knowledge acquisition.

Among the questions, only four had a correct response rate exceeding 80%: “What is the universal emergency phone number in China?”, “When calling an emergency number for an injured person, which of the following does not need to be clarified?”, “In the absence of a professional tourniquet, what cannot be used for bleeding control on-site?”, and “What are the correct on-site emergency first aid measures for heatstroke?”. The high correct response rates for these questions may be attributed to their common occurrence in daily life.

However, when it came to questions involving specific procedures or anatomical locations, the correct response rates were lower, such as on-site rescue measures for drowning victims (4.62%), rescue measures after a dog bite (12.37%), the maximum duration for tourniquet application (10.65%), and the frequency (26.99%) and depth (26.24%) of CPR, suggesting a lack of systematic and standardized first aid training among high school students^[4]. Such results may be related to the insufficient emphasis placed on popularizing first aid knowledge by families, schools, and society.

In the future, on the one hand, the normalized popularization of first aid education and training should be strengthened. On the other hand, first aid education courses should be incorporated into schools to enhance students’ safety awareness and first aid capabilities, and cultivate their abilities to urgently avoid risks and provide self-rescue and mutual rescue in emergencies^[6,7].

4.2. Factors influencing high school students’ scores in first aid knowledge

In the analysis of factors influencing high school students’ scores in first aid knowledge, whether they have participated in first aid training ($P < 0.05$) is a factor affecting their pass rate in first aid knowledge^[7,8]. High school students who have participated in first aid training generally possess more solid theoretical knowledge and practical skills in first aid, demonstrating higher levels of first aid knowledge and skills^[9,10]. This is the most direct and significant influencing factor. Meanwhile, studies have shown that trained students are more willing

to perform first aid operations in emergencies ^[10], indicating the significance of conducting systematic first aid training for high school students.

Gender, grade, and family residence do not affect high school students' pass rate in first aid knowledge. This result is consistent with the survey findings of He, possibly because education at the high school stage is primarily academically focused, and first aid education is not offered as a required course ^[11]. The extent of first aid knowledge popularization is far from sufficient, leading to generally low scores in first aid knowledge among high school students with different characteristics.

4.3. High school students' attitudes and needs towards first aid training

In the survey on attitudes towards first aid training, 97.4% of college students believed that learning first aid knowledge is necessary, 82.4% of high school students were interested in first aid training, and 92.9% of high school students were willing to participate in pre-hospital first aid training. These survey results indicate that the vast majority of students have a high level of interest and demand for first aid knowledge and are highly willing to participate in first aid training ^[4,7,12,13]. They believe that learning first aid knowledge is very necessary, reflecting the enhanced first aid awareness among contemporary high school students.

Among them, high school students showed a higher preference for learning pre-hospital first aid knowledge such as cardiopulmonary resuscitation (90.16%), emergency hemostasis for trauma (83.45%), wound dressing (79.98%), and fracture immobilization (68.17%). These pieces of knowledge are related to some common emergencies encountered in daily life and are also essential first aid skills that the public should master ^[2].

5. Conclusion

In summary, the overall level of first aid knowledge among high school students in three secondary schools in Nanchong City, Sichuan Province, is relatively low, and whether they have received first aid training is an influencing factor on their mastery of first aid knowledge. It is recommended that first aid training be incorporated into the normalized campus education system in the future, enabling first aid knowledge to become an essential life skill for teenagers and ultimately achieving an upgrade in public health concepts from “emergency response” to “proactive prevention.” This study still has certain limitations in its implementation: the convenience sampling method was used, with the sample primarily derived from high school students in Nanchong City, Sichuan Province, failing to cover groups from different regions and socioeconomic levels. This resulted in limited sample representativeness. Additionally, data were mainly obtained through self-administered questionnaires, which may be subject to the subjective perceptions and recall biases of the respondents, potentially leading to inaccuracies in some data. Subsequent studies could adopt stratified cluster sampling methods and optimize data collection methods to further confirm the results.

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Analysis of The Relationship between Psychological Status of Caregivers of Parkinson's Patients and Gender

Yanyan Bai*, Jiangfang Miao

Department of Neurology, Jiangyin Hospital Affiliated to Nantong University, Jiangyin 214400, Jiangsu, China

**Author to whom correspondence should be addressed.*

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Abstract: *Objective:* Understand the level of anxiety and depression of PD caregivers, and pay attention to the relationship between mental health and different genders. *Methods:* 200 PD patients and their caregivers were recruited. The Hamilton Anxiety Scale (HAMA) and the 17-item Hamilton Depression Scale (HAMD) were used to assess the anxiety and depression of the patients; The Mental Component Summary scale (MCS) of the SF-36 was used to test the mental health status of PD caregivers. *Results:* The PD caregivers HAMA detection of anxiety was 59 cases (29.5%), including 44 female caregivers and 15 males anxious; the PD caregivers HAMD detection of depression was 96 cases (48.0%), including 66 female caregivers and 30 male caregivers; the MCS score of PD male caregivers was 47 (42.75–52.25), and the MCS score of PD female caregivers was 41 (39–48). There were statistically significant differences in anxiety, depression and mental health scores among caregivers of different genders ($p < 0.05$). *Conclusion:* The anxiety, depression and mental health of PD female caregivers were worse than male caregivers. Clinical and social work need to pay more attention to the caregivers with mental health.

Keywords: Parkinson; Caregivers; Gender; Mental health

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1. Introduction

Parkinson's disease (PD), a prevalent neurodegenerative disorder, predominantly affects middle-aged and elderly populations. Characterized by progressive motor impairments for example muscle rigidity and bradykinesia; non-motor symptoms including cognitive decline and psychiatric disturbances, this condition increasingly necessitates caregiving support as patients' mobility deteriorates ^[1]. Insomnia, restless legs syndrome, excessive daytime sleepiness, and rapid eye movement sleep behavior disorder are significant burdens for people with Parkinson's disease ^[2]. Motor and non-motor symptoms are significantly correlated with poor sleep quality in people with Parkinson's disease ^[3,4]. Normal sleep duration is crucial for maintaining brain homeostasis, and is

optimal for middle-aged and older adults at about 7 hours per day ^[5]. The caregiving burden remains globally prevalent and challenging, with particular attention required for caregivers' anxiety, depression, and mental health. The significance of a comprehensive forecast of future prevalence of Parkinson's disease is underscored by the substantial increasing trends in the disease burden of Parkinson's disease, as it plays a crucial role in gaining insights into future epidemic patterns, facilitating proactive management, enabling informed policy decisions, and guiding public health interventions. To date, only one study has projected the future global number of patients with Parkinson's disease to 2040 on the basis of Global Burden of Disease 2015 and a 2014 meta-analysis, without projections for the global prevalence of Parkinson's disease. The prediction of future prevalence should be based on comprehensive, accurate, and updated historical data. Global Burden of Disease 2021 systematically quantifies the health loss caused by Parkinson's disease in terms of age, sex, year, and geographical location from 1990 to 2021. This provides a more recent and appropriate foundation for forecasting the future prevalence of Parkinson's disease than previous forecasts. The prevalence of Parkinson's disease is influenced by various factors, which in turn shape its future trajectory. Large scale epidemiological studies and meta-analyses have consistently shown that ageing is the primary risk factor for Parkinson's disease.

In addition to motor symptoms, PD patients may also experience non-motor symptoms such as cognitive decline, anxiety and depression, and sleep disorders, affecting the quality of life of both patients and caregivers. The original lifestyle of the caregivers is disrupted due to the care of patients, and personal interests and social activities are affected, which inevitably affect the physical and mental health of the caregivers over time, leading to a decrease in their quality of life, and in severe cases, leading to the emergence of another patient. and foreign studies have shown that due to the burden of care, caregivers experience a decline in quality of life to varying degrees. The health status of PD patients, the intensity of care patients, the help and support received by caregivers from families and society, and other factors affect the burden of care and quality of life of caregivers. PD is a chronic disease, and daily life care needs to be highly concerned, especially in China where medical insurance and care institutions are not perfect and caregivers are mostly family members and relatives and friends. Paying attention to physical and mental health of caregivers helps to improve the quality of life of patients and caregivers and reduce the emergence of another patient. In our clinical practice, all Parkinson's patients visiting our hospital were identified as family caregivers, a pattern likely influenced by local cultural traditions. This study analyzed 200 Parkinson's patients and their unpaid caregivers including all family caregivers treated at our hospital between August 2022 and September 2024, conducting standardized assessments of depressive and anxiety symptoms to evaluate the mental health status of these caregivers.

2. Data and research methods

2.1. Study subjects

A total of 200 PD patients were included in the study, comprising 112 males and 88 females. All information obtained was acquired with signed consent from all participating PD patients and interviewed caregivers. All PD patients met the diagnostic criteria for primary PD outlined in the "Diagnostic Criteria for Parkinson's Disease in China (2016 Edition)". The caregiver group consisted of 200 individuals (120 females, 80 males), all being family caregivers living with the aforementioned PD patients. Exclusion criteria for caregivers included those suffering from malignant tumors, severe cardiovascular/cerebrovascular diseases, mental disorders, or other conditions.

2.2. Method

The caregivers of patients under investigation underwent mental health assessments. First, the Hamilton Anxiety Rating Scale (HAMA) was used to evaluate caregivers' anxiety levels: scores < 7 indicate no anxiety, 7–14 suggest possible anxiety disorder, and ≥ 14 indicate severe anxiety disorder with higher scores indicating more severe symptoms. The Hamilton Depression Rating Scale (HAMD-17 items) assessed depressive levels: scores < 7 indicate no depression; 7–17 suggest possible depression; 17–24 indicate confirmed depression; ≥ 24 indicates severe depression. The Health Survey Brief SF-36 evaluated caregivers' health status, including physical and mental health components. The Mental Component Summary (MCS) evaluates four aspects: vitality, social functioning, emotional functioning, and mental health. Higher MCS scores indicate better mental health. In this study, the Mental Component Summary was selected to assess caregivers' mental health and analyze gender differences in psychological well-being.

2.3. Statistical methods

The analysis was conducted using SPSS 25.0 software. Data underwent Shapiro-Wilk normality tests, with non-normal distributions represented by mean (P25, P75). Between-group comparisons employed rank sum tests, while categorical data were presented as percentages. Two-sample *t*-tests were used for qualitative data comparisons. Statistical significance was defined as $p < 0.05$.

3. Results

3.1. General information

There were 200 PD caregivers, 80 males (40%) and 120 females (60%), with an age of (51.24 ± 11.25) years old. Their relationship with patients was spouse (187), son (13) or daughter. Their educational background was junior high school or below (111), high school or technical secondary school (65), college or above (24).

3.2. Analysis of HAMA, HAMD, and MCS scores between genders

According to the Student's *t*-test ($p < 0.05$), the data did not meet the normality assumption. The Wilcoxon rank sum test was conducted, revealing statistically significant differences in HAMA ($z = -5.42$, $p < 0.001$), HAMD ($z = -4.392$, $p < 0.001$), and MCS ($z = -4.748$, $p < 0.001$) scores between groups. Female caregivers exhibited higher HAMA and HAMD scores than male caregivers, with higher scores indicating more pronounced anxiety and depressive symptoms. Conversely, female caregivers scored lower on the MCS scale compared to males, suggesting poorer mental health status among female caregivers. See **Table 1** for details.

Table 1. Comparison of HAMA, HAMD and MCS scores between different genders of carers

Nature leave	Example count	Caregiver HAMA score		Caregiver HAMD score		Caregiver MCS score	
		Median	(P25 P75)	Median	(P25 P75)	Median	(P25 P75)
Male group	80	5	(3.25 14.75)	7.5	(5.5 18.5)	47	(42.75 52.25)
Women group	120	8.75	(6 19)	9	(5 22.5)	41	(39 48)
<i>z</i>			-5.420		-4.392		-4.748
<i>p</i>			< 0.001		< 0.001		< 0.001

3.3. Comparison of anxiety and depression prevalence among caregivers

The HAMA scale (≥ 14 points) indicates anxiety, while the HMAD scale (≥ 17 points) reflects depression. Among Parkinson's disease (PD) caregivers: 59 (29.5%) were identified with anxiety through HAMA assessment (44 female vs. 15 male), and 96 (48.0%) showed depressive symptoms through HMAD evaluation (66 female vs. 30 male). Chi-square test results demonstrate higher prevalence rates of anxiety and depression in female caregivers compared to their male counterparts. See **Table 2**.

Table 2. Differences in psychological status of female carers compared with the control group (n%)

Nature leave	Caregiver anxiety disorder		Caregiver depression	
	Exist	Not have	Exist	Not have
Male Group	15 (18.75)	65 (81.25)	30 (37.5)	50 (62.5)
Women Group	44 (36.67)	76 (63.33)	66 (55.0)	54 (45.0)
χ^2		5.697		10.443
p		0.017		0.001

3.4. Summary

This study investigated the level of anxiety, depression and mental health among caregivers of patients with PD in Jiangyin City. Although our sample size was not, it was also meaningful in reflecting data on a potential correlation. The results showed that female caregivers had a higher incidence of anxiety and depression and a worse mental health status than male caregivers. See **Tables 1** and **2** for details.

There are still some shortcomings in this study. There may be some bias in the single-center study. In the future study, more factors will be included, and the medical team will be strengthened to cooperate with the community and Parkinson's disease patient alliance association to carry out effective medical measures and reasonable community cooperation mode.

4. Discussion

Rapid eye movements, sleep behavior disorder, insomnia, restless legs syndrome, obstructive sleep apnea and excessive daytime sleepiness are the most common non-motor symptoms of Parkinson's disease [6]. The association between sleep duration and quality of life in Parkinson's patients is complicated, so better care is very important for patients to provide appropriate and improve the quality life of Parkinson's patients. A caregiver for a patient with a chronic illness is defined as someone who lives with the patient and is directly involved in some aspect of care or is affected the patient's health problems. Caregivers for patients with chronic illness play a significant role in ensuring safety at home, adherence to treatment, and activities of daily living; the patient's response to medications and treatment also depends on the direct observation of the caregiver who can provide reliable information about the patient's condition and is essential in the treatment. Parkinson's disease is the second most common neurodegenerative disease in the world. The World Health Organization has estimated that neurodegenerative diseases including Parkinson's disease and Alzheimer's disease will become the second leading cause of death worldwide by 2040, surpassing cancer related deaths.

A longitudinal study by Lyons et al. noted that female caregivers exhibited a faster increase in depression prevalence; Murat Gultekin et al. proposed that depression and anxiety are the most significant factors affecting

the quality of life of Parkinson's disease (PD) caregivers, with female caregivers facing particularly greater risks of anxiety and depression ^[7,8]. A meta-analysis integrating results from 229 studies revealed that female caregivers experienced poorer burden, depression levels, subjective well-being, and physical health compared to their male counterparts ^[9]. These findings align with our assessment results. The reasons for this may include: during the caregiving process, individuals undergo behavioral changes and role identity shifts; in the case of family caregivers, the role transitions from an equal relationship within intimate family ties to a more nursing-oriented one, leading to increased responsibilities for those being cared for. Given that men have higher prevalence of Parkinson's disease than women, female caregivers tend to be more prevalent within family units. Caregivers experiencing role and task transitions are prone to isolation, anxiety, and tension ^[10]. Moreover, these caregivers often neglect self-care while assisting vulnerable individuals, resulting in adverse health consequences such as sleep deprivation, anxiety, and depression ^[11,12]. Women's emotional fluctuations correlate with hormonal changes, which are linked to neurotransmitter balance, potentially increasing risks of anxiety and depression. In traditional Chinese culture, women typically shoulder more household responsibilities and caregiving duties, demonstrating greater competence than men, which may exacerbate their mental stress.

In fact, the effect of treatment, the observation of the condition, and the quality of life of patients and caregivers cannot be separated from the psychological state of the caregiver. Therefore, PD caregivers should be supported by society and professional medical institutions. It is very important to provide psychological therapy, or even drug therapy, for with psychological problems, such as anxiety or depression. Caregivers can also gain relevant professional knowledge from doctors during the process of accompanying patients in the treatment of PD. Therefore, doctors also consider the influence of the psychological state of caregivers on the effect of PD treatment, and discover problems early to give help and support. In our country, there is a lack of investigation on the mental and psychological state of PD caregivers, and there is also a lack of attention to this issue.

5. Conclusion

This study aims to draw attention to the risk of depressive anxious symptoms in caregivers and to provide more comprehensive support for the treatment of PD through the judgment and analysis of relevant psychological problems in PD caregivers. Since there is currently no known cure for Parkinson's disease, caregivers continue to experience stress and negative emotions while caring for patients with worsening symptoms ^[13]. Clinicians must conduct regular screenings and collaborate with multidisciplinary teams to provide coping strategies and resources for those in need, with particular attention given to caregivers experiencing mental health issues.

Disclosure statement

The authors declare no conflict of interest.

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Exploration of a Comprehensive Service Pathway for AI-Assisted Rational Clinical Use of Western Medicines

Wenjing Bao

Tiemao Township Health Center, Tumote Left Banner, Hohhot 010100, Inner Mongolia Autonomous Region, China

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Abstract: *Objective:* To analyze the application value of artificial intelligence (AI) in the comprehensive service pathway for rational clinical use of western medicines. *Methods:* A sample of 73 patients undergoing western medicine treatment from December 2024 to March 2025 was selected and divided into groups by lottery. Group A received AI-assisted management for rational clinical use of western medicines, while Group B received conventional management. Thirty-six patients taking oral western medicines were included in Group B. *Results:* Group A outperformed Group B in terms of the irrationality rate of western medicine usage, drug management scores, adverse reaction rates, complaint rates, and satisfaction levels, with $p < 0.05$. *Conclusion:* AI-assisted rational clinical use of western medicines enhances drug management quality, reduces the irrationality rate of medication usage, and decreases complaint rates related to western medicine usage.

Keywords: AI-assisted western medicine management; Rational use of western medicines; Safety of western medicines

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1. Introduction

The goal of rational use of western medicines is to enhance therapeutic efficacy, inhibit disease progression, promote disease recovery, and optimize patients' quality of life. Against the backdrop of rapid medical advancements, most medical scholars have shown increased attention and emphasis on pharmaceutical drug management.

Currently, western medicines are widely used in clinical treatment, and with the continuous enrichment of western medicine varieties, the difficulty of drug management has increased. However, it should be noted that some drugs have toxic effects, and irrational medication use can damage patients' liver and kidney functions, even increasing their mortality rate^[1].

Therefore, during the treatment of diseases with western medicines, it is crucial to minimize the toxic and side effects of western medicines, avoid adverse reactions that may cause further damage to patients' bodies, and ensure the safety of western medicine treatment. With the continuous maturation of AI technology, its gradual

application in medical services has accelerated the process of a new era of intelligent healthcare.

Pharmacy services are extremely important in medical services, and the introduction of AI technology can enhance the efficiency and optimize the quality of pharmacy services. This article explores the application value of AI in rational clinical use of western medicines by using a sample of 73 patients who took oral western medicines from December 2024 to March 2025.

2. Materials and methods

2.1. Materials

From December 2024 to March 2025, 73 patients undergoing Western medicine treatment were selected as samples and randomly assigned into groups by drawing lots. The baseline data of patients in Group A receiving Western medicine treatment were compared with those in Group B, with $p > 0.05$, as shown in **Table 1**.

Table 1. Baseline data analysis table for patients receiving western medicine treatment

Group	n	Gender (%)		Age (years)		Disease course (days)	
		Male	Female	Range	Mean	Range	Mean
A	37	19 (51.35)	18 (48.65)	32–61	46.91 ± 2.42	1–4	2.36 ± 0.25
B	36	18 (50.00)	18 (50.00)	33–61	46.88 ± 2.39	1–5	2.39 ± 0.27
χ^2/t		0.0133		0.0533		0.4928	
p		0.9081		0.9577		0.6237	

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

- (1) Receiving Western medicine treatment
- (2) Providing informed consent
- (3) Having respiratory, digestive, urinary, circulatory, or nervous system disorders.

2.2.2. Exclusion criteria

- (1) Incomplete medical records
- (2) Critically ill patients
- (3) Patients at high risk of mortality.

2.3. Methods group

In the AI-assisted western pharmacy management model, several key functions are integrated to improve efficiency, accuracy, and patient safety.

First, AI-assisted prescription review utilizes a comprehensive drug database that integrates drug knowledge and usage instructions. By analyzing patients' allergy histories, comorbidities, and disease progression, the system enables automated prescription review, rapidly identifying potential drug interactions and dosage errors. This approach enhances the efficiency and accuracy of prescription verification, while licensed pharmacists, guided by AI alerts, prioritize high-risk patients for further inspection.

Second, AI-assisted dispensing streamlines the medication distribution process. After patients complete

their payment, billing information is transmitted to the pharmacy, where staff place medications into intelligent baskets. Patients verify their identity via an identification card on a display screen, after which the corresponding dispensing window flashes green, signaling accurate identity confirmation. Staff then dispense medications according to medical advice and advise patients to handle fragile or non-full-box items with care.

Third, AI-supported medication management employs a mobile supervision application that synchronizes prescription data, sends timely medication reminders for example before or after meals, and adjusts dosage recommendations based on patient factors such as age and weight through integration with electronic medical records.

In addition, western medicine consultation services are provided through a dedicated hotline and WeChat groups managed by professional pharmacists who address patient inquiries and offer personalized medication guidance. To further enhance service quality, process optimization ensures that problematic prescriptions identified during AI review are promptly returned to physicians for correction, thereby improving prescription rationality at the source.

Once verified, medications are dispensed efficiently to reduce patient waiting times, while pharmacists inform patients of precautions and provide consultation when necessary. Moreover, a quality supervision system is established to record and analyze patient, medication, and prescription data, allowing for continuous improvement of the database and regular assessment of pharmacy service quality.

Finally, pharmacy staff training is strengthened through regular online and offline sessions covering AI-assisted service principles, operational standards, and quality control requirements, ensuring all personnel possess the necessary professional knowledge and management skills. In contrast, Group B follows traditional procedures, dispensing medications based on prescriptions while verifying the types, quantities, and dosages of medications.

For special western medicines requiring additional precautions, pharmacists enhance communication with patients by verbally explaining relevant medication instructions.

2.4. Statistical research

Data processing was completed using SPSS 21.0, with percentages used to describe count data (χ^2 test) and mean \pm standard deviation ($\bar{x} \pm s$) used to describe measurement data for western medicine treatment recipients (t -test). Significant differences were considered when $p < 0.05$.

3. Results

3.1. Unreasonable medication usage rate

The unreasonable medication usage rate among western medicine treatment recipients in Group A was 2.70%, which was lower than the 16.67% observed in Group B ($p < 0.05$), as shown in **Table 2**.

Table 2. Comparison of irrational drug use rates among patients treated with Western medicine (n, %)

Group	Improper medication method/dosage	Repeated administration	Antibiotic abuse	Improper combination therapy	Irrational medication rate
A (n = 37)	1 (2.70)	0 (0.00)	0 (0.00)	0 (0.00)	1 (2.70)
B (n = 36)	2 (5.56)	1 (2.78)	1 (2.78)	2 (5.56)	6 (16.67)
χ^2	-	-	-	-	4.1040
p -value	-	-	-	-	0.0428

3.2. Drug management quality score

The drug management quality score of Group A was higher than that of Group B, with $p < 0.05$. The details of the comparison of drug management quality scores for Western medicine were shown in **Table 3**.

Table 3. Comparison of drug management quality scores for Western medicine (n, %)

Group	Drug classification	Drug labeling	Drug storage location	Timely drug restocking	Drug shelf life
A (n = 37)	96.26 ± 2.16	97.18 ± 2.41	96.19 ± 2.44	97.26 ± 2.33	96.44 ± 2.11
B (n = 36)	91.44 ± 1.38	90.38 ± 1.49	92.68 ± 2.06	91.58 ± 1.58	90.36 ± 1.62
χ^2	11.3263	14.4525	6.6322	12.1567	13.7820
p	0.0000	0.0000	0.0000	0.0000	0.0000

3.3. Adverse reaction rate and complaint rate

The adverse reaction rate (2.70%) and complaint rate (0.00%) among patients treated with Western medicine in Group A were lower than those in Group B (16.67% and 11.11%, respectively), with $p < 0.05$. As shown in **Table 4**.

Table 4. Comparison of adverse reaction rates and complaint rates among patients treated with Western medicine (n, %)

Group	Fatigue	Gastrointestinal symptoms	Drowsiness	Skin rash	Incidence rate	Complaint rate
A (n = 37)	0 (0.00)	0 (0.00)	0 (0.00)	1 (2.70)	1 (2.70)	0 (0.00)
B (n = 36)	1 (2.78)	2 (5.56)	1 (2.78)	2 (5.56)	6 (16.67)	4 (11.11)
χ^2	-	-	-	-	4.1040	4.3494
p	-	-	-	-	0.0428	0.0370

3.4. Satisfaction

The satisfaction rate in Group A (97.30%) was higher than that in Group B (80.56%), with $p < 0.05$. As shown in **Table 5**.

Table 5. Comparison of satisfaction rates among patients treated with Western medicine (n, %)

Group	Satisfied	Basically satisfied	Dissatisfied	Satisfaction rate
A (n = 37)	30 (81.08)	6 (16.22)	1 (2.70)	36 (97.30)
B (n = 36)	19 (52.78)	10 (27.78)	7 (19.44)	29 (80.56)
χ^2	-	-	-	5.2411
p	-	-	-	0.0221

4. Discussion

Western medicine is an important method for treating diseases in modern medicine. Under the influence of factors such as a rich variety of drugs and combined medication, the efficacy of Western medicine has been significantly improved. Rational use of Western medicine can achieve ideal therapeutic effects. Through targeted and gentle

treatment, it can promote disease recovery, optimize the body's health status, and thereby enhance the patient's quality of life. In recent years, China's medical model has continuously improved, and the level of medical technology has developed rapidly, coupled with an increased emphasis on the safety of Western medicine use among patients^[2]. The rational and scientific of Western medicine use directly affect drug efficacy and patients' physiological health. If irrational use of Western medicine occurs, it can lead to increased medication risks and higher drug complaint rates. For example, the abuse of Western medicine can impair the body's repair function, making it difficult for patients to resist bacterial and viral infections. Another example is the irrational use of antibiotics, which can increase the risk of bacterial resistance.

Additionally, irrational combined medication can weaken or enhance the efficacy of drug components due to interactions between different drugs, and may even induce adverse drug reactions. Furthermore, the large-scale use of hormonal drugs can suppress organ function, increase the risk of endocrine disorders, and even lead to dependency on hormonal drugs. In addition, a high rate of irrational use or adverse drug reactions of Western medicine can also increase the risk of a negative social image for hospitals and even affect their revenue. As the variety of Western medicines continues to expand, they almost cover conservative treatment for all diseases^[3]. However, frequent and continuous use of Western medicines, influenced by the complexity of drug names, types, and dosage forms, often leads to incidents of irrational drug use, such as antibiotic abuse, improper routes of administration, and duplication of active ingredients. These issues compromise the efficacy of Western medicines and can lead to a series of complications, resulting in abnormal physiological health.

Irrational use of Western medicines can trigger medical accidents. Therefore, it is crucial to prioritize the management of Western medicines to ensure patient safety. Conventional Western medicine management is carried out in accordance with departmental procedures, emphasizing the rational use of Western medicines to reduce issues related to irrational drug administration. During modern drug management, the introduction of AI technology offers a new approach to Western pharmacy services. AI technology assists in the rational clinical use of Western medicines, eliminating the need for pharmacists to review prescriptions individually. This reduces the time required for pharmacist review and enhances the efficiency of Western medicine prescription audits. Consequently, pharmacists can dedicate more energy to pharmaceutical guidance, optimizing the overall pharmaceutical service quality in Western pharmacies^[4]. Furthermore, In the field of Western medicine, AI technology assists in ensuring clinical medication appropriateness. It integrates detailed patient medication information, including dosage, indications, and administration timing. By allowing pharmacists to input keywords and retrieve drug information rapidly, it streamlines the dispensing process and eliminates cumbersome manual data checks. During practical medication management, the system provides online responses to patient inquiries. For chronic patients in particular, AI facilitates remote services, encouraging medication adherence and improving the utilization of healthcare resources. Offering precise medication advice to patients helps avoid unnecessary drug regimen adjustments, thereby shortening the treatment cycle and enhancing overall clinical efficiency. Based on the data analysis in this article, AI-assisted services for the rational clinical use of Western medicines can reduce incidents of irrational drug use. By analyzing the causes, AI technology integrates drug information and clinical practice outcomes was observed, further enabling the rapid identification of irrational prescriptions or high-risk drug combinations that may lead to complications. For instance, patients taking anticoagulants and antibiotics simultaneously are at a higher risk of adverse events such as bleeding. With the introduction of AI-assisted services, drug interactions can be swiftly detected and identified, and irrational prescriptions can be flagged for licensed pharmacists. This enhances the efficiency of prescription review and helps prevent

complications in patients ^[5]. During the actual implementation of AI-assisted clinical rational drug use services for Western medicine, AI integrates patient case information and medication data, assessing liver and kidney function, etiology, and symptoms. It can accurately predict the metabolism and efficacy of Western drugs and, by analyzing relevant test results, calculate the optimal dosage. This effectively prevents adverse events such as thrombosis and bleeding. After physicians complete the prescription of Western drugs, the AI system immediately reviews the prescription, evaluating whether the route of administration, dosage, and frequency are abnormal, thereby reducing the prescription error rate. Additionally, by opening medication consultation hotlines and WeChat groups for medication management services, pharmacists can promptly address patients' medication concerns and guide them in proper drug use, ensuring patient medication safety ^[6]. Furthermore, some chemotherapy drugs require strict dosage control to avoid serious adverse reactions caused by incorrect dosages. The introduction of AI technology can enhance the management efficiency of high-risk and special drugs. Another set of data indicates that after implementing AI-assisted clinical rational drug use services for Western medicine, Group A achieved higher scores in drug management. Analyzing the causes, AI-assisted clinical rational drug was determined to integrate with clinical case data and hospital database information, further providing physicians with personalized drug administration services. For example, by searching keywords in the database, physicians can access information on similar past cases and receive recommended treatment plans, thereby improving diagnostic and therapeutic outcomes. During AI-assisted drug management, real-time and dynamic monitoring of patient condition fluctuations allows for the evaluation of treatment efficacy. Adjustments to medication regimens can be made based on patient feedback, further enhancing drug management scores. For instance, AI can adjust insulin dosage based on patients' blood glucose fluctuations to maintain stable blood glucose levels. Additionally, by opening medication consultation hotlines, setting up online consultation modules, and guiding patients to download apps, hospitals can provide intelligent medication supervision services, ensuring patients take the appropriate dosage of medication at the right time and preventing missed or incorrect doses ^[7].

Another set of data indicates that after the implementation of AI-assisted clinical rational drug use services for Western medicine, Group A experienced a reduction in adverse reaction events and complaint incidents. Analyzing the reasons, during the period of AI-driven intelligent services, it was possible to avoid factors that could lead to an increase in complications. Additionally, efficient medication adherence as per medical advice reduced the recurrence of primary diseases and alleviated the medical burden on patients, resulting in fewer complaint incidents during their intake of Western medicine. The final set of data shows that after the implementation of AI-assisted clinical rational drug use services for Western medicine, patients in Group A reported high satisfaction levels. Analyzing the reasons, AI determines drug dosages based on patients' actual physiological conditions, thereby avoiding the risks associated with high-dose medication that could increase drug reactions. This approach also reduces the waste of medical resources and subsequently lowers medical costs, leading to higher patient satisfaction. Furthermore, the introduction of AI technology has facilitated timely medication reminders, provided medication consultation services, and ensured medication adherence, thereby reducing instances of missed doses. As a result, patients are more satisfied with Western medicine services.

5. Conclusion

In summary, AI-assisted clinical rational drug use services for Western medicine can reduce incidents of irrational Western medicine use, improve drug management scores, minimize drug side effects, and result in fewer

complaints related to Western medicine treatment. Therefore, it is worthy of promotion.

Disclosure statement

The author declares no conflict of interest.

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Regulation of Hemodynamic Stability in Urological Stone Patients During General Anesthesia Recovery Period Through Thermal Insulation Nursing Based on Temperature Intervention

Ying Chen

Nanjing Integrated Traditional Chinese and Western Medicine Hospital Affiliated to Nanjing University of Chinese Medicine, Nanjing 210014, Jiangsu, China

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Abstract: *Objective:* This study primarily analyzes the effectiveness of thermal insulation nursing (empowered by temperature intervention) in urological stone patients during the general anesthesia recovery period. *Methods:* A total of 76 urological stone patients who underwent surgical treatment as the preferred option were selected as the research subjects. The earliest consultation time was May 2024, and the latest was May 2025. The patients were randomly divided into two groups using the random number table method, namely the observation group and the control group, with 38 patients in each group. The intervention indicators of the patients were compared. *Results:* The overall satisfaction rate in the observation group was higher than that in the control group, and the incidence of adverse reactions was lower, with $p < 0.05$. At 0.5 hours, 1 hour after surgery, and at the end of surgery, the body temperature in the observation group was significantly different from that in the control group, with $p < 0.05$. Postoperatively, various hemodynamic indicators in the observation group were significantly different from those in the control group, with $p < 0.05$. The time to clench the first upon verbal command, the time to open the eyes upon verbal command, the extubating time, and the recovery retention time in the observation group were all shorter than those in the control group, with $p < 0.05$. Postoperative stress indicators and agitation scores at different time points in the observation group were significantly different from those in the control group, with $p < 0.05$. *Conclusion:* For urological stone patients during the general anesthesia recovery period, actively implementing thermal insulation nursing combined with temperature intervention not only enhances hemodynamic stability but also effectively reduces the risk of adverse reactions such as hypothermia and shivering. It optimizes the recovery condition, significantly improves the stress state, and increases nursing satisfaction.

Keywords: Thermal insulation nursing; Temperature intervention; Urological stones; General anesthesia recovery period; Hemodynamics; Stability

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1. Introduction

In recent years, due to the accelerated development of modern medical technologies, the methods of anesthesia for surgical treatment have become more diverse, and the application of general anesthesia protocols has yielded relatively promising results. General anesthesia enables the body to absorb drugs intravenously, effectively suppressing the human nervous system. Additionally, after surgery, patients' respiratory and skeletal muscles are more relaxed, which facilitates the smooth conduct of operations. However, for patients undergoing surgical treatment, hypothermia refers to a body temperature below 36°C throughout the perioperative period. Particularly during the recovery phase from general anesthesia, the causes of hypothermia in patients are attributed to surgical and anesthetic factors and are also considered a common complication during the peri-anesthesia period ^[1]. The presence of hypothermia can induce numerous complications, making it difficult to ensure adequate oxygen supply to tissues, while also suppressing coagulation and immune functions, which is highly detrimental to optimizing prognostic outcomes. Therefore, after patients are transferred to the anesthesia recovery room post-surgery, it is essential to closely monitor their vital signs and actively implement thermal insulation nursing measures to accelerate the recovery of their vital signs, reduce the occurrence of postoperative adverse reactions, and thereby achieve the goal of optimizing prognosis ^[2].

The following study selects patients with urinary stones during the general anesthesia recovery period as the research subjects to systematically explore the effects of temperature intervention-enabled thermal insulation nursing.

2. Materials and methods

2.1. Baseline data

The study included 76 patients with urinary stones who underwent general anesthesia surgery at the hospital as the primary subjects. The diagnosis and treatment periods spanned from May 2024 to May 2025. The patients were randomly divided into two groups using a random number table method, namely the observation group (38 cases) and the control group (38 cases). Comparing the data between the two groups indicated a p -value > 0.05 , suggesting significant comparability.

2.1.1. Control group

22 males and 16 females, with the oldest patient aged 76 and the youngest aged 57, averaging (64.86 ± 4.54) years.

2.1.2. Observation group

The male-to-female ratio was 23:15, with ages ranging from 55 to 79 years and a median age of (64.82 ± 4.60) years.

2.2. Methodology

In the control group, patients received routine care, while in the observation group, patients underwent thermal insulation nursing based on temperature intervention, as follows:

2.2.1. Preoperative phase

Prior to surgery, nursing staff should closely observe the patient's condition and physical status. If the patient

exhibits signs of restlessness or anxiety, targeted psychological counseling should be provided, and the patient's concerns should be addressed through gentle communication. Additionally, patients should be thoroughly informed about the surgical procedure, the characteristics and safety of general anesthesia, and the treatment plan to alleviate their anxiety and fear regarding the surgery. Patients should be instructed to fast for 12 hours and abstain from water for 8 hours before surgery to prevent aspiration or vomiting during the procedure.

2.2.2. Intraoperative phase

During the surgical procedure, it is essential to establish intravenous access, with nursing staff assisting the surgeon in performing relevant anesthesia procedures and helping the patient maintain a proper position. This not only ensures patient comfort during the surgery but also provides the surgeon with a clear surgical field. Furthermore, surgical supplies should be prepared in advance to ensure coordination with the surgeon and minimize the patient's exposure to cold environments. Infusion bags required for the surgery should be processed using a liquid warming device to maintain a temperature of approximately 38°C, closely matching the normal body temperature.

2.2.3. Postoperative phase

After surgery, patients should be transferred to the post-anesthesia care unit, where nursing staff should cover the patient's body with a constant-temperature blanket set at approximately 37°C to provide continuous warmth and maintain body temperature stability. The infusion fluids required for postoperative patients should be warmed, and the temperature should be maintained at around 38°C to prevent the effects of low temperature on the body. Close monitoring of the patient's vital signs is essential, and targeted interventions should be promptly implemented if any abnormal temperature changes occur.

2.3. Evaluation indicators

- (1) Compare patient satisfaction with nursing care and the incidence of adverse reactions.
- (2) Assess intergroup differences in body temperature changes at various time points, hemodynamic indicators, postoperative recovery time, stress indicators before and after surgery, and agitation scores at different time points using a systematic evaluation approach.

2.4. Statistical analysis

2.4.1. Data processing

SPSS 21.0 statistical software was used in this study to perform statistical analysis

2.4.2. Data description

Count data were presented as (n%), and measurement data as ($\bar{x} \pm s$)

2.4.3. Difference testing

Count data were tested using χ^2 , and measurement data using t , and the criteria for determining statistical significance was set as $p < 0.05$.

3. Results

3.1. Research on nursing satisfaction in the observation group and the control group

The overall satisfaction rate in the observation group was higher than that in the control group, with $p < 0.05$, details in **Table 1**.

Table 1. Comparison of nursing satisfaction between the two groups (n/%)

Group	n	Highly satisfied	Satisfied	Dissatisfied	Total satisfaction
Observation	38	23	14	1	37 (97.37)
Control	38	20	10	8	30 (78.95)
χ^2					6.1758
p					0.0129

3.2. Comparison of body temperature changes at different time points between the two groups

There was no significant difference in body temperature between the groups before surgery. For instance, $p > 0.05$. At 0.5 hours, 1 hour after the start of surgery, and at the end of surgery, the body temperature in the observation group was higher than that in the control group, with $p < 0.05$, details show in **Table 2**.

Table 2. Analysis of body temperature changes at different time points in the observation group and the control group ($\bar{x} \pm s$)

Group	n	Preoperative (°C)	0.5 h after surgery start (°C)	1 h after surgery start (°C)	End of surgery (°C)
Observation	38	36.23 \pm 0.46	36.75 \pm 0.32	36.79 \pm 0.42	36.57 \pm 0.26
Control	38	36.21 \pm 0.44	35.24 \pm 0.23	35.66 \pm 0.35	35.98 \pm 0.62
t -value		0.1937	23.6202	12.7411	5.4097
p -value		0.8470	0.0000	0.0000	0.0000

3.3. Comparison of hemodynamic indicators at different time points between the observation group and the control group

After surgery, the SBP, DBP, and HR between the groups were compared, with $p < 0.05$, details show in **Table 3**.

Table 3. Study on hemodynamic indicators at different time points between the two groups ($\bar{x} \pm s$)

Group	n	SBP (mmHg)		DBP (mmHg)		HR (mmHg)	
		Pre-operative	Post-operative	Pre-operative	Post-operative	Pre-operative	Post-operative
Observation	38	133.95 \pm 10.52	132.09 \pm 8.13	80.52 \pm 9.04	85.57 \pm 8.13	70.55 \pm 8.17	75.09 \pm 5.13
Control	38	133.99 \pm 10.47	152.36 \pm 8.44	80.57 \pm 9.08	96.64 \pm 8.25	70.51 \pm 8.13	80.42 \pm 6.58
t -value		0.0166	10.6626	0.0241	5.8915	0.0214	3.9380
p -value		0.9868	0.0000	0.9809	0.0000	0.9830	0.0002

3.4. Analysis of postoperative recovery time in the two groups

Compared with the control group, all indicators in the observation group showed $p < 0.05$, details show in **Table 4**.

Table 4. Comparison of postoperative recovery time between the observation group and the control group ($\bar{x} \pm s$)

Group	n	Fist response to call (min)	Eye opening response to call (min)	Extubation time (min)	Recovery room stay time (min)
Observation	38	10.95 \pm 3.21	15.84 \pm 1.45	23.21 \pm 2.14	55.28 \pm 4.35
Control	38	15.02 \pm 4.41	20.51 \pm 2.26	34.12 \pm 2.68	69.62 \pm 5.22
<i>t</i> -value		4.5997	10.7211	19.6099	13.0094
<i>p</i> -value		0.0000	0.0000	0.0000	0.0000

3.5. Research on stress indicators before and after nursing in the observation group and the control group

Before surgery, there were no differences in indicators between the groups, with $p > 0.05$; After surgery, the stress indicators in the observation group were compared with those in the control group, with $p < 0.05$, details show in **Table 5**.

Table 5. Comparison of changes in stress indicators between the two groups ($\bar{x} \pm s$)

Group	n	AD (pmol/mL)		NE (pmol/mL)		CRP (ng/L)	
		Pre-operative	Post-operative	Pre-operative	Post-operative	Pre-operative	Post-operative
Observation	38	51.88 \pm 4.55	110.77 \pm 7.99	142.75 \pm 7.04	151.22 \pm 9.84	7.06 \pm 1.12	46.58 \pm 4.22
Control	38	51.84 \pm 4.51	156.65 \pm 8.08	142.79 \pm 6.84	175.35 \pm 7.77	7.09 \pm 1.14	59.14 \pm 5.17
<i>t</i> -value		0.0385	24.8890	0.0251	11.8638	0.1157	11.6016
<i>p</i> -value		0.9694	0.0000	0.9800	0.0000	0.9082	0.0000

3.6. Comparison of agitation scores between the two groups at different time points

The agitation scores of the observation group at 3 minutes, 5 minutes, 10 minutes, and 15 minutes postoperatively were all lower than those of the control group, with $p < 0.05$, refer **Table 6**.

Table 6. Analysis of agitation scores in the observation and control groups at different time points ($\bar{x} \pm s$)

Group	n	3-min Score (points)	5-min Score (points)	10-min Score (points)	15-min Score (points)
Observation	38	2.33 \pm 0.31	6.68 \pm 1.14	5.06 \pm 0.43	3.14 \pm 0.24
Control	38	4.26 \pm 0.21	13.05 \pm 1.15	9.95 \pm 0.21	6.92 \pm 0.33
<i>t</i> -value		31.7742	24.2497	62.9916	57.1053
<i>p</i> -value		0.0000	0.0000	0.0000	0.0000

3.7. Comparison of adverse reactions between the two groups

When comparing the adverse reactions between the two groups, $p < 0.05$, refer **Table 7**.

Table 7. Study on adverse reactions in the observation and control groups (n/%)

Group	n	AD (pmol/mL)			
		Hypothermia	Mild	Moderate	Severe
Observation	38	1 (2.63)	1 (2.63)	1 (2.63)	0 (0.00)
Control	38	7 (18.42)	4 (10.53)	4 (10.53)	3 (7.89)
χ^2		5.0294		7.5165	
p		0.0249		0.0061	

4. Discussion

It is widely acknowledged that urinary stones, as a common type of urinary system disease, carry a high risk of incidence and can significantly impact the quality of life of affected individuals ^[3]. In the clinical treatment of patients with urinary stones, surgical intervention is the preferred method. With the rapid advancement of medical technology, the importance of drug anesthesia in diagnostic and therapeutic procedures has gradually become prominent, particularly general anesthesia, which temporarily suppresses the central nervous system, leading to loss of consciousness and pain sensation, and is widely recognized in clinical practice. However, the recovery period from general anesthesia is relatively complex and critical, during which patients experience certain physiological changes. Therefore, it is crucial to ensure that their hemodynamic indicators remain stable during this stage. The reason is that excessive fluctuations in human hemodynamics can slow down the postoperative recovery of patients, prolong their hospital stay, and even expose them to a higher risk of complications such as hypertension, hypotension, arrhythmia and more, directly threatening their life and health.

During the recovery period from general anesthesia, hypothermia is a common issue that can significantly affect patients' physiological functions and cause substantial fluctuations in their hemodynamic indicators ^[4]. Under such circumstances, patients' blood vessels constrict, and peripheral vascular resistance significantly increases, leading to elevated blood pressure levels. Meanwhile, patients' cardiac electrophysiological activities are also affected, exposing them to a higher risk of arrhythmia ^[5]. Therefore, it is essential to implement necessary thermal insulation nursing measures for patients with urinary stones during the recovery period from general anesthesia.

In clinical practice, integrating temperature intervention measures into thermal insulation nursing can effectively inhibit heat loss and facilitate the body's own heat production in patients, enabling them to maintain a normal body temperature throughout the perioperative period. During surgical treatment, the human body gradually loses heat due to factors such as radiation, conduction, evaporation, and convection. Based on thermal insulation nursing, the use of heated blankets and insulating blankets can reduce heat loss caused by radiation and convection ^[6]. During the implementation of thermal insulation nursing, the risk of pathological physiological reactions caused by low body temperature in patients is significantly reduced, preventing excessive vasoconstriction ^[7].

According to the comparison results of data indicators, after temperature intervention was applied to enhance thermal insulation nursing, various clinical indicators of patients were superior to those of the control group, with $p < 0.05$. This indicates that the rational use of thermal insulation nursing can improve the hemodynamic stability of patients with urinary stones during the general anesthesia recovery period, enabling them to awaken within a short period and facilitating the improvement of their stress state, thereby reducing the risk of hypothermia events. The reason for this is that this nursing model is innovative and can compensate for the deficiencies of traditional

nursing. It employs highly targeted nursing measures based on various factors contributing to hypothermia. Through the heating treatment of infused liquids and the use of thermal insulation blankets, it maintains the stability of vital signs in patients during the general anesthesia recovery period, which is more conducive to accelerating their recovery.

5. Conclusion

Overall, applying temperature intervention to enhance thermal insulation nursing for patients with urinary stones during the general anesthesia recovery period can further improve their stress state during the recovery period, ensure the stability of their hemodynamic indicators, effectively prevent adverse reactions such as hypothermia, and facilitate their early postoperative awakening.

Disclosure statement

The author declares no conflict of interest.

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Observation on the Effect of Dexmedetomidine in Suppressing Cough Reflex During Tracheal Extubation in Pediatric Patients Undergoing General Anesthesia

Jian Wu*, Lijuan Chen, Jinwen Zeng

Department of Anesthesiology, Huangjiang Hospital, Dongguan 523000, Guangdong, China

**Author to whom correspondence should be addressed.*

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Abstract: *Objective:* To investigate the suppressive effect of dexmedetomidine on the cough reflex during tracheal extubation in pediatric patients undergoing general anesthesia and its impact on vital signs. *Methods:* A total of 60 pediatric patients undergoing elective surgery admitted to our hospital from January to August 2025 were selected and randomly divided into an observation group and a control group, with 30 cases in each group, using a random number table method. The control group received an intravenous infusion of 0.9% sodium chloride injection 30 minutes before the end of surgery, while the observation group received an intravenous pump infusion of dexmedetomidine (1 µg/kg, diluted to 4 µg/ml with normal saline). The severity of cough (graded from 0 to 3) and vital signs, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse oxygen saturation (SpO₂), were recorded 5 minutes before extubation, at the time of extubation, and 5 minutes after extubation in both groups. *Results:* The severity of cough in the observation group was significantly milder than that in the control group ($P < 0.05$), with a significantly higher proportion of grade 0 cough in the observation group (23.33% vs 3.33%). At extubation and five minutes post-extubation, the observation group exhibited significantly lower HR, SBP, and DBP than the control group ($P < 0.05$). In contrast, SpO₂ levels remained comparable between the groups ($P > 0.05$). *Conclusion:* Dexmedetomidine can effectively suppress the cough reflex during tracheal extubation in pediatric patients undergoing general anesthesia, reduce the severity of cough, stabilize hemodynamic parameters, and has no significant impact on respiratory function, demonstrating good clinical safety.

Keywords: Cough reflex; Dexmedetomidine; Tracheal extubation period; General anesthesia; Pediatric patients

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1. Introduction

Cough reflex during tracheal extubation in pediatric patients undergoing general anesthesia is one of the common

adverse reactions in clinical anesthesia, primarily caused by the stimulation of tracheal intubation on the airway mucosa, leading to airway smooth muscle contraction, increased secretions, and subsequently causing symptoms such as coughing and breath-holding ^[1]. Severe cough reflexes not only increase the suffering of pediatric patients but may also lead to complications such as increased intracranial pressure, blood pressure fluctuations, tracheal injury, laryngeal spasm, and even endanger the life safety of pediatric patients ^[2]. Therefore, finding a safe and effective method to suppress the cough reflex during tracheal extubation in pediatric patients under general anesthesia holds significant clinical importance.

Dexmedetomidine, a commonly used α_2 -adrenergic receptor agonist in clinical practice, not only exhibits significant sedative, analgesic, and anxiolytic effects but also has minimal inhibitory effects on the respiratory system. Recent literature has reported that dexmedetomidine can effectively reduce the incidence of cough reflex during airway extubation in adult patients ^[3]. However, there is limited research on its application in pediatric patients. This study examines whether dexmedetomidine can suppress the cough reflex during tracheal extubation in anesthetized children, to establish an evidence base for clinical anesthesia care.

2. Materials and methods

2.1. General information

60 pediatric patients who underwent elective otolaryngological and general surgical procedures at our hospital from January to August 2025 were selected as the study subjects. They were randomly assigned to either an observation group or a control group, with 30 participants in each, for clinical comparative analysis using a double-blind randomized number method.

Inclusion criteria are as follows:

- (1) ASA classification of I-II;
- (2) Age < 3–15 years;
- (3) Surgical procedures including adenoidectomy and laparoscopic pediatric hernia repair;
- (4) Informed consent obtained from the patients and their families who voluntarily participated in the trial.

Exclusion criteria are as follows:

- (1) Presence of difficult ventilation;
- (2) History of allergy or contraindication to the drugs used;
- (3) Concurrent cardiac conditions;
- (4) Mental state abnormalities;
- (5) Severe liver and kidney dysfunction.

A comparison of the general information between the two groups of pediatric patients ($P > 0.05$) indicated comparability (**Table 1**). This study was approved by the hospital's ethics committee.

Table 1. Comparison of general information between the two groups of pediatric patients (mean \pm SD/n (%))

Parameter	Control group (n=30)	Observation group (n=30)	t/ χ^2 value	P-value
Gender (M/F, n)	25/5	19/11	3.068	0.080
Age (years)	8.62 \pm 2.31	8.25 \pm 2.18	0.638	0.526
Weight (kg)	32.56 \pm 8.74	31.89 \pm 9.02	0.292	0.771

2.2. Methods

2.2.1. Preoperative preparation

Pediatric patients followed routine preoperative fasting and water deprivation protocols. Three minutes before anesthesia, administer midazolam at a dose of 0.05 mg/kg, and routinely monitor electrocardiogram (ECG), heart rate (HR), pulse oxygen saturation (SpO₂), non-invasive blood pressure (NIBP), and end-tidal carbon dioxide (ET-CO₂).

2.2.2. Anesthesia induction and maintenance

Sufentanil was administered at a dose of 0.4-0.5 µg/kg, propofol at 2–3 mg/kg, and cisatracurium besylate at 0.2 mg/kg. After 3 minutes, tracheal intubation was performed using a disposable endotracheal tube equipped with a high-volume, low-pressure cuff. Mechanical ventilation should be set with a tidal volume of 6–8 mL/kg, and the respiratory rate was adjusted to maintain intraoperative ET-CO₂ between 35–45 mmHg. Anesthesia was maintained with continuous infusions of propofol and remifentanyl, titrated to keep intraoperative blood pressure and heart rate within 20% of the baseline values in response to surgical stimulation.

2.2.3. Pharmacological intervention

For the observation group, 30 minutes before the end of surgery, dexmedetomidine was administered at a dose of 1 µg/kg, diluted with normal saline to a concentration of 4 µg/mL, and it was continuously infused through a peripheral vein at a rate of (kg body weight) mL/h.

For the control group, 30 minutes before the end of surgery, 0.9% sodium chloride injection was continuously infused through a peripheral vein at a dose of (1/4 kg body weight) mL and a rate of (kg body weight) mL/h.

2.3. Observation indicators

2.3.1. Grading of cough severity

The grading criteria for evaluation of cough severity were as follows: 0 points = no cough; 1 point = a single cough; 2 points = non-continuous coughing more than once; 3 points = continuous, repetitive coughing with head elevation ^[4].

2.3.2. Vital sign indicators

Vital sign indicators such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse oxygen saturation (SpO₂) were recorded for both groups of children at 5 minutes before extubation, during extubation, and 5 minutes after extubation ^[5].

2.4. Statistical methods

All statistical analyses were performed using SPSS software (version 26.0). Categorical data were presented as mean ± standard deviation (SD) and compared using the χ^2 test. Continuous data were presented as mean ± SD and were compared using the Student's t-test. A *P*-value of less than 0.05 was defined as statistically significant.

3. Results

3.2. Comparison of severity grades of cough between two groups of children

The severity of cough in the observation group was significantly milder than that in the control group, with a

significantly higher proportion of Grade 0 cough compared to the control group ($P < 0.05$). See **Table 2** for details.

Table 2. Comparison of severity grades of cough between two groups of children (cases, %)

Observation indicator	Control group (n=30)	Observation group (n=30)	χ^2 value	P-value
Grade 0	1 (3.33)	7 (23.33)	5.192	0.023
Grade 1	14 (46.67)	18 (60.00)	1.071	0.301
Grade 2	12 (40.00)	5 (16.67)	4.022	0.045*
Grade 3	3 (10.00)	0 (0.00)	3.158	0.076

3.3. Comparison of vital signs at different time points between two groups of children

Five minutes before extubation, there was no significant difference in HR, SBP, DBP, or SpO₂ between the two groups ($P > 0.05$). During extubation and 5 minutes after extubation, the HR, SBP, and DBP in the observation group were lower than those in the control group ($P < 0.05$); there was no significant difference in SpO₂ between the two groups ($P > 0.05$). See **Table 3** for details.

Table 3. Comparison of vital signs at different time points (mean \pm SD)

Parameter	Time point	Control group (n=30)	Observation group (n=30)	t-value	P-value
HR (bpm)	5 mins before extubation	98.62 \pm 10.31	97.25 \pm 9.89	0.525	0.601
	At extubation	125.36 \pm 12.45	108.74 \pm 11.23	5.429	0.000
	5 mins after extubation	112.58 \pm 10.67	99.87 \pm 9.54	4.864	0.000
SBP (mmHg)	5 mins before extubation	95.62 \pm 8.31	94.25 \pm 7.89	0.655	0.515
	At extubation	128.36 \pm 10.45	110.74 \pm 9.23	6.922	0.000
	5 mins after extubation	115.58 \pm 9.67	102.87 \pm 8.54	5.396	0.000
DBP (mmHg)	5 mins before extubation	62.62 \pm 6.31	61.25 \pm 5.89	0.869	0.388
	At extubation	85.36 \pm 7.45	72.74 \pm 6.23	7.118	0.000
	5 mins after extubation	75.58 \pm 6.67	66.87 \pm 5.54	5.020	0.000
SpO ₂ (%)	5 mins before extubation	98.62 \pm 0.31	98.68 \pm 0.30	0.762	0.449
	At extubation	97.36 \pm 0.45	97.74 \pm 0.33	3.730	0.000
	5 mins after extubation	98.58 \pm 0.27	98.87 \pm 0.24	4.397	0.610

4. Discussion

Dexmedetomidine is a novel, highly selective α_2 -adrenergic receptor agonist. Its mechanism of action primarily involves binding to α_2 -adrenergic receptors in the central nervous system and peripheral tissues, inhibiting the release of norepinephrine, and thereby exerting sedative, analgesic, and anxiolytic effects^[6]. The α_2 -adrenergic receptors are divided into three subtypes: α_2A , α_2B , and α_2C . Among them, the α_2A receptor is mainly distributed in the locus coeruleus and dorsal horn of the spinal cord in the central nervous system and is closely related to sedative and analgesic effects; The α_2B receptor is primarily distributed in vascular smooth muscle and is associated with vasoconstriction, while the α_2C receptor is mainly found in areas such as the cerebral cortex and

hippocampus and is related to cognitive function^[7,8]. Dexmedetomidine exhibits significantly higher affinity for the α_2A receptor compared to the α_2B and α_2C receptors. As a result, it has strong sedative and analgesic effects, with relatively minor impacts on the cardiovascular system.

The causes of coughing during tracheal tube removal after general anesthesia in children include: direct mechanical stimulation of the airway mucosa by the endotracheal tube; increased airway secretions during tube removal; reduced vital capacity and bronchoconstriction; increased airway resistance and impaired ventilation during extubation, which can induce severe coughing in children^[9]. In severe cases, adverse consequences such as tachycardia, hypertension, intracranial hypertension, glottic edema, and even asphyxiation may occur, posing certain difficulties for the surgical treatment of children.

The results of this study demonstrate a superior improvement in cough severity in the observation group compared to the control group ($P < 0.05$). This outcome is closely related to the mechanism of action of dexmedetomidine. Dexmedetomidine suppresses the cough reflex center in the central nervous system, weakening or blocking the efferent pathway of the cough reflex, thereby inhibiting the coughing response. Additionally, it offers some protective functions for the respiratory tract, whereby it can inhibit the activity of tracheal glands and bronchial smooth muscle, reducing airway secretions; it also enhances the synthesis and release of pulmonary surfactant, as well as increases ciliary motility and clearance capacity, further alleviating the coughing response^[10].

In terms of vital signs, during and 5 minutes after extubation, the heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) in the observation group were all lower than those in the control group ($P < 0.05$), while no significant difference was observed in oxygen saturation (SpO₂) between the two groups ($P > 0.05$). This is because dexmedetomidine can slow down the heart rate and decrease blood pressure by inhibiting sympathetic nerve activity and reducing peripheral vascular resistance. Meanwhile, dexmedetomidine has a relatively weak inhibitory effect on the respiratory center, thus not significantly affecting the respiratory function of children, which explains why there was no significant difference in SpO₂ between the two groups.

This study confirmed that dexmedetomidine can significantly reduce the incidence of coughing during tracheal intubation after pediatric general anesthesia induction, with good safety. The study also found that administering dexmedetomidine before pediatric general anesthesia induction can shorten the awakening time and surgical stress index, and effectively improve postoperative agitation.

However, the limitations of this study include the following:

- (1) The small number of pediatric patients in this study prevents the drawing of more convincing research conclusions;
- (2) Only one basic anesthesia method was selected, so it is unclear whether similar results can be obtained with other basic anesthesia methods and whether there are differences among different age groups.

Subsequent work should focus on and address these issues.

5. Conclusion

In summary, dexmedetomidine has a good inhibitory effect on the cough reflex during extubation after pediatric general anesthesia, maintaining stable vital signs in pediatric patients with minimal decrease in heart rate. It also demonstrates good tolerability and safety characteristics, making it suitable for clinical promotion. During clinical application, attention should be paid to individual differences, and the dosage and infusion time of the drug should be reasonably adjusted based on the patient's condition, with close monitoring of vital sign changes to ensure

medication safety.

Disclosure statement

The author declares no conflict of interest.

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The Impact of Progressive Effect Nutritional Care on Treatment Adherence, Quality of Life, and Nutritional Status in Uremia Patients Undergoing Dialysis

Limin Xu, Liuping Fu, Yueting Chen, Weiwei Dai, Jianmin Yao*

Shanghai Integrated Traditional Chinese and Western Medicine Hospital, Shanghai 200080, China

**Author to whom correspondence should be addressed.*

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Abstract: *Objective:* To investigate the impact of progressive effect nutritional care on uremia patients undergoing dialysis. *Methods:* A total of 101 uremia patients undergoing dialysis admitted from January 2024 to March 2025 were selected as the study subjects and divided into two groups by lottery method. The control group (55 cases) received routine care, while the observation group (56 cases) received a combination of routine care and progressive effect nutritional care. *Results:* After 4 weeks of care, the observation group demonstrated higher treatment adherence ($P < 0.05$), better quality of life ($P < 0.05$), and improved nutritional status ($P < 0.05$) compared to the control group. *Conclusion:* Progressive effect nutritional care can significantly enhance treatment adherence, quality of life, and nutritional status in uremia patients undergoing dialysis.

Keywords: Nutritional status; Progressive effect nutritional care; Quality of life; Routine care; Treatment adherence; Uremia

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1. Introduction

Uremia is a clinical syndrome of advanced kidney disease, characterized by pathological phenomena such as electrolyte imbalances and metabolic acidosis due to the progression of chronic renal failure to its end stage ^[1]. Patients often experience symptoms such as fatigue, edema, and poor appetite, which severely impact their quality of life ^[2]. Dialysis can help eliminate excess water and medium-to-large molecular substances, but the treatment process is lengthy and imposes significant economic burdens ^[3]. Furthermore, during dialysis, patients may lose certain amounts of proteins, trace elements, vitamins, amino acids, and other nutrients, leading to malnutrition and adversely affecting their health status and dialysis outcomes ^[4].

Therefore, it is crucial to provide effective dialysis care for patients, regulate their nutritional status, and enhance dialysis outcomes. Progressive effect nutritional care involves tailoring nutritional interventions based

on individual nutritional status to improve the specificity of nutritional support and enhance patients' health and quality of life. This study aimed to analyze the effectiveness of progressive effect nutritional care in uremia patients undergoing dialysis.

2. Materials and methods

2.1. General information

The sample size for the study was calculated using the formula:

$$n1 = n2 = 2[(u\alpha + u\beta)/(\delta/\sigma)]^2 + 0.25u\alpha^2$$

where $n1$ and $n2$ are the sample sizes for the observation group and the control group, respectively

The initial estimated sample size was 80 cases, with $n1 = n2 = 40$ cases.

However, various issues such as sample attrition and sample exclusion arose during the study, prompting an increase in the total sample size to 101 cases within the permissible range, with $n1$ being 56 cases and $n2$ being 55 cases.

A total of 101 uremic patients undergoing dialysis from January 2024 to March 2025 were selected as the study subjects and divided into two groups using the lottery method. The control group consisted of 55 patients, including 32 males and 23 females, aged between 41 and 73 years (57.34 ± 4.38 years), with a dialysis duration of 6 to 32 months (19.25 ± 3.23 months). The observation group included 56 patients, comprising 36 males and 20 females, aged between 44 and 71 years (57.87 ± 4.52 years), with a dialysis duration of 8 to 31 months (19.92 ± 3.47 months). There were no significant differences in the data between the groups ($P > 0.05$), indicating comparability. This study was approved by the Medical Ethics Committee, and informed consent was obtained from the patients or their families.

Inclusion criteria:

- (1) Patients meeting the diagnostic criteria for uremia outlined in the “Clinical Management Guidelines for Slowing the Progression of Chronic Kidney Disease (2025 Edition)”^[5];
- (2) Patients with indications for hemodialysis who comply with clinical dialysis treatment;
- (3) Patients with normal language expression and communication abilities.

Exclusion criteria:

- (1) Patients with other major diseases;
- (2) Patients with mental illnesses;
- (3) Patients with communication barriers.

2.2. Methods

The control group received routine care, including the distribution of manuals and oral education on uremia and hemodialysis knowledge. Patients were guided to self-monitor their condition, identify and address abnormalities early, actively soothe their emotions, and examples of successful hemodialysis cases were cited to enhance treatment compliance.

The observation group received a progressive nutritional nursing approach combined with other measures as outlined:

- (1) Nutritional assessment: Upon admission, nutritional risk was evaluated using the Subjective Global Assessment (SGA) method, which took into account gastrointestinal symptoms, appetite status, and changes in body weight. The total score was 7 points, with nutritional status classified according to the score: 6–7 points indicated Grade A (good nutrition); 3–5 points indicated Grade B (suspected

malnutrition); and 1–2 points indicated Grade C (severe malnutrition). Nutritional nursing plans were adjusted based on these classifications to determine nutritional doses and implement nursing interventions:

- (i) Grade C nursing: To prevent and improve common complications such as gastrointestinal dysfunction and malnutrition, full-nutrient enteral support with a nutrient-configured solution was administered as early as possible. The heat-to-nitrogen ratio was 145:1, with a total intake of 25–30 kcal/kg/day. The composition included 20% protein, 30% fat, and 50% carbohydrates. The enteral pumping rate was 20–30 mL/hour, with each infusion consisting of 300–500 mL. There should be a 3–4 hour interval between two enteral nutrition infusions;
- (ii) Grade B nursing: Patients in this group had a certain tolerance capacity and stronger enteral nutrition tolerance compared to Grade C. The infusion solution was the same as that used in Grade C, with a total intake of 40–45 kcal/kg/day. The composition included 20%–25% protein, 30%–35% fat, and 35%–40% carbohydrates. The enteral pumping rate was 30–50 mL/hour, with a 4-hour interval between two enteral nutrition infusions. After each infusion, 20–30 mL of warm water was injected to flush the catheter;
- (iii) Grade A nursing: If patients did not require enteral feeding, a dietary management plan was formulated based on their dietary preferences and habits. The daily intake included 30–35 g of meat, 55–60 g of high-quality protein, 350–400 g of legume products, 100 g of regular staple foods, and 300–350 g of fruits. Dietary management adhered strictly to a three-meals-and-two-snacks schedule, following a low-oil, low-salt, and light diet principle. Calcium and sodium intake were controlled to reduce cardiac load. Urine output was recorded, and water intake was adjusted accordingly, with an additional 500 mL of drinking water added to the urine volume.

Both groups received nursing care for 4 weeks.

2.3. Observation indicators

Treatment adherence was evaluated based on patients' dialysis performance. Complete adherence meant that patients fully complied with medical advice without reminders, including timely admission for dialysis, proper preparation for dialysis, and cooperation during dialysis procedures; partial adherence indicated that patients occasionally needed reminders, with fewer than 2 reminders per week, to fully comply with medical advice for dialysis; non-adherence referred to patients who frequently required reminders, needing 2 or more reminders to cooperate with dialysis or still unable to follow medical advice after reminders. Treatment adherence was calculated as 1 minus non-adherence.

Quality of life was assessed using the Kidney Disease Quality of Life Scale Questionnaire ^[6]. The questionnaire consisted of 36 questions, with 12 general questions covering physical and mental health, each with a total score of 100. Additionally, there were 24 specific questions addressing symptoms and discomfort, the impact of kidney disease, and kidney burden, each also with a total score of 100. Higher scores indicated better quality of life.

Nutritional status was evaluated by collecting 5 mL of fasting venous blood samples, which were then centrifuged under standard conditions (3000 r/min, radius of 10 cm, duration of 15 minutes). Hemoglobin, transferrin, and albumin levels were measured using an automated blood cell analyzer.

2.4. Statistical methods

Data were analyzed using SPSS 27.0 software. Categorical data were presented as percentages (%) and compared

using the χ^2 test. Continuous data conforming to a normal distribution were expressed as mean \pm standard deviation (SD), and comparisons within and between groups were performed using the t-test (or F-test). A *P*-value less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of treatment adherence between the two groups

As shown in **Table 1**, the treatment adherence in the observation group was higher than that in the control group (*P* < 0.05).

Table 1. Treatment adherence in the two groups (n/%)

Group	n	Full compliance	Partial compliance	Non-compliance	Treatment compliance rate
Observation group	56	34 (60.71)	20 (35.71)	2 (3.57)	54 (96.43)
Control group	55	20 (36.36)	25 (45.45)	10 (18.18)	45 (81.82)
χ^2 value					6.143
<i>P</i> -value					0.013

3.2. Comparison of quality of life between the two groups

As shown in **Table 2**, after 4 weeks of nursing, the quality of life in the observation group was higher than that in the control group (*P* < 0.05).

Table 2. Quality of life in the two groups (mean \pm SD, points)

Aspects	Observation group (n=56)	Control group (n=55)	t-value	<i>P</i> -value
Physical health				
Before care	46.23 \pm 4.15	47.08 \pm 4.38	1.050	0.296
After care	56.98 \pm 4.87 ^a	52.07 \pm 4.65 ^a	5.431	< 0.001
Mental health				
Before care	48.72 \pm 4.35	49.65 \pm 4.49	1.108	0.270
After care	59.01 \pm 4.87 ^a	54.06 \pm 4.65 ^a	5.475	< 0.001
Symptoms/discomfort				
Before care	45.17 \pm 4.12	45.98 \pm 4.36	1.006	0.317
After care	55.67 \pm 4.56 ^a	51.21 \pm 4.43 ^a	5.225	< 0.001
Effects of kidney disease				
Before care	47.27 \pm 4.31	48.24 \pm 4.49	1.161	0.248
After care	58.73 \pm 4.69 ^a	54.01 \pm 4.48 ^a	5.420	< 0.001
Burden of kidney disease				
Before care	44.62 \pm 4.32	45.58 \pm 4.59	1.135	0.259
After care	55.96 \pm 4.85 ^a	52.32 \pm 4.69 ^a	4.019	< 0.001

Note: Compared with the same group before nursing, ^a*P* < 0.05.

3.3. Comparison of nutritional status between the two groups

As shown in **Table 3**, after 4 weeks of nursing, the nutritional status of the observation group was higher than that of the control group ($P < 0.05$).

Table 3. Nutritional status of the two groups (mean \pm SD, g/L)

Aspects	Observation group (n=56)	Control group (n=55)	t-value	P-value
Hemoglobin (g/L)				
Before care	74.12 \pm 9.13	75.76 \pm 9.45	0.930	0.355
After care	118.75 \pm 9.85 ^a	102.12 \pm 9.67 ^a	8.974	< 0.001
Transferrin (g/L)				
Before care	0.82 \pm 0.24	0.85 \pm 0.26	0.632	0.529
After care	3.08 \pm 0.37 ^a	2.38 \pm 0.34 ^a	10.374	< 0.001
Albumin (g/L)				
Before care	23.51 \pm 3.52	24.34 \pm 3.67	1.216	0.227
After care	39.86 \pm 3.99 ^a	34.64 \pm 3.85 ^a	7.012	< 0.001

Note: Compared with the same group before nursing, ^a $P < 0.05$.

4. Discussion

Studies have indicated that nutritional status is a major factor affecting the safety of dialysis treatment for uremia patients, with higher complication rates and mortality in malnourished patients [7]. Patients undergoing dialysis for uremia require a long-term low-protein diet to slow the progression of the disease. If adequate nutrients are not supplemented in a timely manner, malnutrition may result [8]. Uremia patients completely lose or lose most of their renal function, making it impossible for them to undergo normal metabolism and eliminate toxins from the body. Accumulated toxins can induce gastrointestinal reactions such as poor appetite, nausea, and vomiting, reducing food intake and increasing the risk of adverse nutritional reactions [9].

To ensure the effectiveness and safety of dialysis, proper dialysis nursing is essential. Nutritional nursing is a major component of dialysis nursing and a key factor affecting dialysis outcomes and nursing quality. Therefore, it is necessary to find an ideal nursing plan.

In this study, the treatment compliance of the observation group was higher than that of the control group, suggesting that progressive nutritional nursing can effectively improve patients' treatment compliance. The reason is that during conventional nursing, patients' physical and mental comfort and quality of life are adversely affected by uremia and dialysis treatment, which in turn affects their treatment compliance [10]. Progressive nutritional nursing is characterized by its humanity and scientific approach, allowing for targeted nursing based on patients' nutritional status. It determines the nutrient intake and precautions for patients at each stage, alleviating the problem of low compliance caused by insufficient knowledge and lack of emphasis on nutritional supplementation.

In this study, the quality of life and nutritional status of the observation group were higher than those of the control group, suggesting that progressive effect nutritional care can effectively improve patients' quality of life and nutritional status. The reason is that conventional nursing lacks specificity and fails to take into account the individual characteristics and nutritional status of each patient, resulting in generally moderate nursing outcomes

and a decline in patients' quality of life^[11]. Progressive effect nutritional care can adjust nursing intervention plans based on individual nutritional status and dynamic changes.

The core of this nursing approach is the stepwise escalation of nutritional support measures, which can meet the nutritional management needs of patients at different stages and of different types. It can gradually, scientifically, and effectively improve nutritional status, enhance patients' health conditions, improve the efficacy of dialysis treatment, and progressively enhance the quality of life^[12].

5. Conclusion

In summary, progressive effect nutritional care can improve the quality of life and nutritional status of uremic dialysis patients and enhance their treatment compliance. However, this study has limitations, including a lack of indicators such as complications and dietary management capabilities, as well as a relatively short observation period, which did not allow for verification of the impact of this nursing approach on patients' prognosis and long-term outcomes. Therefore, further in-depth clinical research and analysis are needed.

Disclosure statement

The authors declare no conflict of interest.

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Clinical Application Effect of Ciprofol Combined with Low-dose Esketamine in Painless Gastrointestinal Endoscopy

Dongyu Zhang, Qi Feng, Weiyan Huang, Xuefu Tang, Changhui Shao, Shan Ou*

Chengdu Integrated TCM & Western Medicine Hospital (Chengdu First People's Hospital, Chengdu Traditional Chinese Medicine Hospital), Chengdu 610000, Sichuan, China

*Author to whom correspondence should be addressed.

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Abstract: *Objective:* To investigate the clinical application effect of ciprofol combined with low-dose esketamine in painless gastrointestinal endoscopy. *Methods:* A retrospective analysis was conducted on the clinical data of 160 patients who underwent painless gastrointestinal endoscopy at the Digestive Endoscopy Center of Chengdu Integrated Traditional Chinese and Western Medicine Hospital from June 2023 to June 2024. The patients were divided into a control group (ciprofol + sufentanil, n=80) and a study group (ciprofol + esketamine, n=80) based on the anesthesia protocol they received. Hemodynamic indicators [mean arterial pressure (MAP), heart rate (HR), and blood oxygen saturation (SpO₂)], anesthesia-related indicators, sedation effectiveness, and the incidence of adverse events were observed and compared between the two groups at different time points during the examination. *Results:* The fluctuations in HR and MAP at three time points (after induction, during endoscope insertion, and during the examination) were significantly smaller in the study group than in the control group (all $P < 0.05$), indicating more stable hemodynamics. The total amount of sedative drugs used, the number of additional sedative doses administered, and the time spent in the post-anesthesia care unit were significantly lower in the study group than in the control group (all $P < 0.05$). There was no significant difference in the success rate of sedation between the two groups (98.75% vs. 96.25%, $P > 0.05$). The incidence of adverse events was lower in the study group than in the control group (3.75% vs. 13.75%, $P < 0.05$). *Conclusion:* The use of low-dose esketamine as an adjuvant analgesic drug based on ciprofol sedation can effectively maintain hemodynamic stability, reduce the amount of sedative drugs used, facilitate rapid recovery of patients, and lower the risk of adverse events.

Keywords: Ciprofol; Esketamine; Sufentanil; Painless gastrointestinal endoscopy; Hemodynamics

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1. Introduction

Gastrointestinal endoscopy plays a crucial role in the diagnosis and treatment of digestive system diseases in

modern medicine. However, traditional endoscopy can cause severe discomfort such as nausea, vomiting, and abdominal pain in patients, easily triggering negative emotions such as anxiety and fear, thereby reducing patient tolerance and compliance with follow-up examinations^[1]. Ciprofol, a novel GABAA receptor agonist, is a structurally modified version of propofol. It exhibits significantly superior anesthetic potency compared to propofol, while simultaneously reducing the risk of adverse events such as injection pain and hypotension, demonstrating enhanced safety. Its application in clinical anesthesia is becoming increasingly widespread. However, to suppress the stimulation caused by endoscopic procedures on patients, it is still routine clinical practice to combine other analgesic drugs. Commonly used drugs include sufentanil, and when used in combination with GABAA receptor agonists as opioid analgesics, they can produce a synergistic respiratory depressant effect, which remains a core concern for perioperative safety^[2]. In view of this, this study conducted a retrospective analysis of the clinical data of 160 patients who underwent painless gastrointestinal endoscopy at the Digestive Endoscopy Center of Chengdu Integrated Traditional Chinese and Western Medicine Hospital from June 2023 to June 2024. Based on ciprofol sedation, the study aimed to explore the clinical efficacy of its combined use with low-dose esketamine in painless gastrointestinal endoscopy, with the goal of providing more effective and safer anesthesia options for clinical practice.

2. Materials and methods

2.1. General information

A retrospective analysis was conducted on the clinical data of 160 patients who underwent painless gastrointestinal endoscopy at the Digestive Endoscopy Center of our hospital from June 2023 to June 2024. Patients were divided into a control group (ciprofol + sufentanil, n=80) and a study group (ciprofol + esketamine, n=80) based on the anesthesia regimen they received. A comparison of the general information between the two groups is shown in **Table 1**, indicating comparability. This study has been approved by the Medical Ethics Committee of Chengdu Integrated Traditional Chinese and Western Medicine Hospital (Ethics Approval Number: KT No. 017, 2022).

Table 1. Comparison of baseline demographic and clinical characteristics between the two groups [$\bar{x} \pm s$, n]

Group	n	Age	Gender (Male/Female, n)	Body Mass Index (kg/m ²)	ASA Physical Status (I/II, n)
Study Group	80	45.12 ± 11.28	38/42	23.45 ± 2.91	62/18
Control Group	80	46.35 ± 10.94	41/39	23.98 ± 3.35	59/21
χ^2/t		-0.700	0.225	-1.068	0.305
<i>P</i>		0.485	0.635	0.287	0.581

2.2. Inclusion criteria

① Patients who undergo elective diagnostic or therapeutic painless gastrointestinal endoscopy in our hospital; ② Aged between 18 and 65 years old; ③ Classified as American Society of Anesthesiologists (ASA) physical status I/II; ④ Complete clinical data, anesthesia records, and recovery room records.

2.3. Exclusion criteria

① Patients with allergies to drugs involved in this study; ② Patients with severe cardiovascular, respiratory, liver, or kidney diseases; ③ Pregnant or lactating women; ④ Patients with a history of drug abuse or alcohol dependence;

⑤ Patients with uncontrolled hypertension; ⑥ Patients with a history of mental disorders such as schizophrenia, severe depression, epilepsy, or neurological diseases.

2.4. Methods

Both groups of patients were routinely fasted for 8 hours and abstained from drinking for 4 hours. After entering the room, a peripheral intravenous access was established and connected to a monitor to routinely monitor the patient's vital signs. All patients received oxygen via nasal cannula with an oxygen flow rate set at 2 L/min. In the control group, 0.1 µg/kg of sufentanil was intravenously administered 2 minutes before anesthesia induction, followed by an intravenous injection of 0.4-0.5 mg/kg of ciprofol emulsion injection. Induction success was considered when the patient's eyelash reflex disappeared. During the procedure, intermittent additional doses of 5-10 mg of ciprofol were administered based on the patient's body movement, heart rate, and blood pressure changes to maintain the depth of sedation. In the study group, 0.2 mg/kg of esketamine was intravenously administered 2 minutes before anesthesia induction, followed by a slow intravenous injection of 0.4-0.5 mg/kg of ciprofol emulsion injection. Induction success was also considered when the patient's eyelash reflex disappeared. Intermittent additional doses of 5-10 mg of ciprofol were administered to maintain the depth of sedation.

2.5. Observation indicators

2.5.1. Hemodynamic parameters

The heart rate (HR), mean arterial pressure (MAP), and blood oxygen saturation (SpO₂) of the two groups of patients were monitored and compared at five time points: T0 (when entering the anesthesia room), T1 (immediately after successful induction), T2 (when inserting the endoscope), T3 (at the midpoint of the examination), and T4 (when withdrawing the endoscope).

2.5.2. Anesthesia-related indicators

The total dosage of sedative drugs (total administered dose of ciprofol), the number of additional doses of sedative drugs, and the duration of stay in the post-anesthesia care unit were recorded for both groups of patients.

2.5.3. Clinical sedation efficacy

The Modified Observer's Assessment of Alertness/Sedation (MOAA/S)^[3] was used for evaluation. Patients were classified into six levels ranging from 0 to 5 based on their responses to external stimuli, with higher scores indicating lower levels of sedation depth. In this study, successful sedation was defined as maintaining an MOAA/S score of 3 (responding only to loud or repeated vocal stimuli) or lower during endoscopic examination, without the need for auxiliary ventilation methods such as jaw thrust.

2.5.4. Adverse events

The occurrence of adverse events such as hypotension, respiratory depression, and psychotic-like symptoms was observed in both groups of patients.

2.6. Statistical methods

Data analysis was performed using SPSS 24.0 statistical software. After confirming normal distribution through the Shapiro-Wilk test, measurement data such as hemodynamic parameters and total dosage of sedative drugs

were expressed as mean \pm standard deviation ($\bar{x} \pm s$), and comparisons between groups were made using the independent samples t-test. Count data such as sedation success rate and incidence of adverse events were expressed as rates (%), and differences between the two groups were compared using the χ^2 test or Fisher's exact probability method. A P -value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of hemodynamic indicators between the two groups of patients

The SpO₂ levels of both groups of patients remained within the normal range at all observed time points in this study, with no statistically significant differences (all $P > 0.05$). At T0, the mean arterial pressure (MAP) and heart rate (HR) levels were comparable between the two groups. At T1, both groups showed a decrease, with the control group experiencing a greater decrease in MAP and HR than the study group (all $P < 0.05$). At T2 and T3, the MAP and HR levels in the study group were higher than those in the control group (all $P < 0.05$). At T4, both groups showed a trend towards recovery in MAP and HR, with the study group maintaining relatively higher levels (all $P > 0.05$). See **Table 2**.

Table 2. Comparison of hemodynamic indicators between the two groups at different time points ($\bar{x} \pm s$)

Indicator	Group	T0 (Pre-anesthesia)	T1 (Post-induction)	T2 (During Scope Insertion)	T3 (During Examination)	T4 (During Scope Removal)
MAP (mmHg)	Study (n=80)	94.28 \pm 8.15	88.15 \pm 7.92*	87.33 \pm 8.01*	89.24 \pm 7.55*	91.16 \pm 8.23
	Control (n=80)	93.95 \pm 8.33	80.48 \pm 9.14	81.05 \pm 8.86	82.81 \pm 8.49	89.52 \pm 8.57
HR (bpm)	Study (n=80)	75.82 \pm 10.21	72.11 \pm 9.85*	73.25 \pm 9.53*	74.39 \pm 9.17*	74.55 \pm 9.88
	Control (n=80)	76.45 \pm 10.56	65.56 \pm 10.12	67.88 \pm 9.94	68.17 \pm 9.76	73.81 \pm 10.03
SpO ₂ (%)	Study (n=80)	99.15 \pm 0.88	98.85 \pm 0.95	98.65 \pm 1.02	98.78 \pm 0.99	99.02 \pm 0.91
	Control (n=80)	99.27 \pm 0.85	98.58 \pm 1.10	98.41 \pm 1.19	98.55 \pm 1.08	98.95 \pm 0.96

Note: Compared with the control group in the same period, * $P < 0.05$.

3.2. Comparison of anesthesia-related indicators between the two groups

The total dosage of sedative drugs, the number of intraoperative top-ups, and the duration of stay in the post-anesthesia care unit were significantly lower in the study group than in the control group, with statistically significant differences (all $P < 0.05$). See **Table 3**.

Table 3. Comparison of anesthesia-related indicators between the two groups

Group	n	Total Sedative Dosage (mg)	Number of Supplemental Doses (times)	PACU Stay Time (min)
Study Group	80	35.88 \pm 8.14	1.15 \pm 0.88	20.36 \pm 4.58
Control Group	80	45.48 \pm 9.67	1.95 \pm 1.24	24.12 \pm 5.12
t -value		-6.793	-4.706	-4.896
P -value		< 0.001	< 0.001	< 0.001

3.3. Comparison of sedation efficacy between the two groups

According to the MOAA/S score, 79 patients in the study group were judged to have successful sedation, while 77 patients in the control group were judged to have successful sedation. The sedation success rate in the study group was higher than that in the control group (98.75% vs. 96.25%), but the difference was not statistically significant ($\chi^2=0.256$, $P=0.613$).

3.4. Comparison of the incidence of adverse events between the two groups

The incidence of adverse events in the study group was lower than that in the control group (3.75% vs. 13.75%), with a statistically significant difference ($P<0.05$). See **Table 4**.

Table 4. Comparison of the incidence of adverse events between the two groups (n, %)

Group	n	Hypotension	Respiratory Depression	Psychiatric-like Symptoms	Total Incidence
Study Group	80	1	1	1	3 (3.75%)
Control Group	80	6	4	1	11 (13.75%)
χ^2 value					5.010
P -value					0.025

4. Discussion

With the continuous development and deepening of the concept of comfortable medical care, the ideal anesthesia regimen for painless gastrointestinal endoscopy not only provides reliable sedative and analgesic effects but also minimizes interference with patients' physiological functions to ensure the stability of perioperative physiological indicators^[4]. This study, based on the new-generation sedative drug ciprofol, focuses on the selection of adjuvant analgesic drugs, aiming to clarify the clinical value of low-dose esketamine compared with the traditional opioid drug sufentanil^[5]. The results are as follows.

In this study, compared with the control group, the study group exhibited smaller fluctuations in MAP and HR during anesthesia induction and at key intraoperative stimulation stages (endoscope insertion, biopsy), along with a lower incidence of adverse events. This suggests that the anesthesia regimen combining ciprofol with low-dose esketamine offers better hemodynamic stability and higher safety. The underlying reason is that as a highly selective GABAA receptor agonist, Ciprofol exhibits weaker cardiovascular inhibitory effects compared to an equivalent dose of Propofol. Meanwhile, Esketamine can slightly increase heart rate and blood pressure through NMDA receptor antagonism and sympathetic nervous system activation, thereby counteracting, to a certain extent, the cardiovascular depression caused by Ciprofol^[6]. Compared to the control group using opioid drugs, the study group also avoided respiratory depression resulting from the activation of μ -opioid receptors, demonstrating better hemodynamic stability and reducing the risk of adverse events such as respiratory depression and hypotension^[7]. In terms of anesthetic efficacy, both groups achieved a high rate of successful anesthesia (both above 95%). The reason is that Ciprofol's unique cyclopropyl structure endows it with a receptor affinity and anesthetic potency approximately 4 to 5 times that of Propofol^[8]. Additionally, the use of Esketamine in the study group can reduce or reset central sensitization caused by continuous painful stimuli through NMDA receptor antagonism^[9]. The combination of these two agents produces a synergistic effect in sedation and analgesia, not only more effectively suppressing the noxious stimuli from endoscopic procedures but also reducing the dosage and frequency of additional

sedative drugs required to maintain sedation, thereby lowering the risk of accumulation and laying the foundation for faster recovery. The low dose of Esketamine used in this study resulted in no significant difference in the incidence of psychotomimetic symptoms between the study group and the control group, and the overall incidence of adverse events was lower. This finding is consistent with the study by Xue^[10] and, to a certain extent, alleviates clinical concerns regarding its psychiatric side effects.

5. Conclusion

In conclusion, the anesthetic regimen combining Ciprofol with low-dose Esketamine demonstrates definite anesthetic effects in painless gastrointestinal endoscopy procedures, along with excellent hemodynamic stability. It reduces the risk of adverse events such as respiratory depression and hypotension, facilitating rapid patient recovery.

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Dermatomyositis: Review and Considerations in Older Adults

Xiaoqing Wu¹, Jingtong Wang^{2*}

¹Gastroenterology Department, Peking University People's Hospital, Beijing 100000, China

²Geriatric Department, Peking University People's Hospital, Beijing 100000, China

*Corresponding author: Jingtong Wang, wangjingtong@pkuph.edu.cn

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Abstract: Dermatomyositis (DM) is an idiopathic inflammatory myopathy characterized by prominent skin lesions, muscle weakness, and clinically heterogeneous systemic manifestations. Among patients with DM, the male-to-female ratio is 2:1. Juvenile dermatomyositis (JDM) is most prevalent between the ages of 4 and 14 years, while adult-onset dermatomyositis typically occurs between the ages of 40 and 60 years. In a population-based study conducted in Olmsted County, Minnesota, USA, the risk of DM was found to increase with age across different age groups stratified by decade. The incidence rate of DM in individuals aged ≥ 80 years was 3.2 per 100,000 person-years. Dermatomyositis in elderly patients is characterized by unique clinical manifestations, pathogenic mechanisms, and therapeutic approaches. However, discussions regarding geriatric dermatomyositis are currently limited. Therefore, this article aims to review the epidemiology, clinical features, histopathology, and pathogenesis of dermatomyositis, with a particular focus on the unique clinical characteristics of geriatric dermatomyositis.

Keywords: Anti-MDA5 antibodies; Dermatomyositis; Interstitial lung disease; Geriatric; Myositis-specific autoantibodies

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1. Introduction

Dermatomyositis (DM) is an idiopathic inflammatory myopathy marked by distinctive cutaneous eruptions, progressive muscle weakness, and diverse systemic involvement. While the disease can occur at any age, its incidence demonstrates a notable increase with advancing age, particularly among the elderly population ^[1]. Geriatric dermatomyositis presents distinct clinical phenotypes, pathogenic mechanisms, and therapeutic challenges compared to younger-onset cases. This review aims to summarize the epidemiology, clinical manifestations, histopathology, and pathogenesis of dermatomyositis, with special emphasis on the unique characteristics of geriatric dermatomyositis.

2. Etiology and pathogenesis

The pathogenesis of dermatomyositis is complex and diverse, and it has not yet been fully elucidated. Based on current research, the underlying mechanisms can be broadly categorized into environmental, immunological, and genetic factors.

2.1. Environmental factors

Studies have suggested that various environmental factors may trigger chronic activation of the immune system in individuals. Potential environmental factors include viral infections, pharmacological agents, ultraviolet radiation, environmental pollution, and smoking, among others. In patients with dermatomyositis who are positive for anti-MDA5 antibodies, interstitial lung disease predominantly occurs in the autumn and winter seasons ^[2], indicating that seasonal respiratory viruses may influence disease pathogenesis. COVID-19 infection has been identified as a potential trigger in patients with anti-MDA5-positive dermatomyositis ^[2,3].

2.2. Genetic factors

Numerous studies published to date have demonstrated an association between major histocompatibility complex (MHC) polymorphisms and the development of DM. In Asian populations, several HLA alleles (primarily located in HLA-DRB1) have been identified as risk factors for the development of anti-MDA5-positive DM ^[4–6]. Epigenetic modifications may also play a role in the pathogenesis of DM.

2.3. Immunological factors

Compared to middle-aged and younger individuals, elderly patients exhibit significant features of immune senescence, which are influenced by multiple factors including inflammaging, genetic susceptibility, environmental exposures, and gut microbiota dysbiosis ^[7]. These factors promote the occurrence and progression of DM in elderly patients through direct or indirect mechanisms. Anti-MDA5 antibodies are common in elderly patients with DM, with a positivity rate of approximately 10%–30%. Other autoantibodies, such as anti-TIF1 γ antibodies, are associated with an increased risk of malignancy in elderly patients with DM ^[8].

3. Clinical manifestations

3.1. Cutaneous manifestations

In elderly patients, cutaneous manifestations can be diverse and variable, may not be exactly consistent with the time course or severity of muscle disease and systemic involvement. For instance:

- (1) Pathognomonic lesions: Gottron papules and Gottron's sign are classic. The heliotrope rash, characterized by violaceous periorbital edema and erythema, is another hallmark;
- (2) Characteristic lesions: These include the shawl sign, V sign, and mechanic's hands. Nailfold changes, such as periungual telangiectasia and infarcts, are also common;
- (3) Other cutaneous features: Patients may exhibit poikiloderma, calcinosis cutis, and panniculitis. It's important to note that the appearance of skin lesions may precede or follow muscle involvement, and their severity is not necessarily correlated with muscle involvement in elderly patients ^[9].

3.2. Muscular involvement

Muscle involvement is a defining feature of DM, with approximately 80% of elderly patients experiencing

myopathy^[10]. For example:

- (1) Proximal muscle weakness: The classic presentation is symmetric, proximal muscle weakness, affecting the limbs and trunk;
- (2) Dysphagia and dysphonia: These symptoms indicate possible involvement of pharyngeal and esophageal muscles, which are associated with a poor prognosis^[9,11].

3.3. Systemic involvement

DM can involve multiple organ systems, with significant systemic manifestations in elderly patients as outlined below:

- (1) Interstitial lung disease (ILD) is the most common systemic manifestation, affecting up to 78.9% of patients, and this proportion is even higher in elderly patients. Its characteristic feature is the rapid progression of pulmonary function deterioration within a short period (typically within 4 weeks);
- (2) Cardiac manifestations include arrhythmias, conduction defects, pericarditis, and cardiomyopathies;
- (3) Joint pain or arthritis, particularly involving the small joints of the hands and wrists, is common.

Elderly patients with DM are at risk for several complications due to the chronic nature of the disease and the use of immunosuppressive therapies:

- (1) The use of immunosuppressive agents increases the risk of infections, particularly viral and fungal infections;
- (2) Older age and immunosuppressive therapy for DM have been linked to an increased incidence of malignancy^[12]. Regular screening and monitoring are essential;
- (3) The risk of cardiovascular events, including myocardial infarction and heart failure, is elevated in DM patients;
- (4) Long-term use of corticosteroids for elderly patients can lead to complications such as osteoporosis, hypertension, and diabetes.

In summary, dermatomyositis in the elderly is a complex and multifaceted disease with significant cutaneous, muscular, and systemic manifestations. Early diagnosis and targeted treatment are crucial for managing the disease and mitigating complications.

4. Diagnosis and assessment

4.1. Laboratory investigations

4.1.1. Muscle Enzymes

Serum creatine kinase (CK) levels in patients vary widely. Therefore, there is no clear correlation between CK levels and the severity of muscle weakness. In elderly patients with reduced muscle mass or in those with advanced disease who have lost a substantial amount of muscle tissue, significant muscle weakness may occur with persistently low serum muscle enzyme levels.

CK-MB elevation can occur in the absence of myocarditis, typically due to increased enzyme expression in regenerating skeletal muscle affected by inflammatory disease, although in rare cases it may indicate cardiac involvement. Aldolase may be elevated in myositis patients with normal CK levels, particularly those with significant perifascicular atrophy. Elevated levels of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are common in myositis patients and often indicate a poorer prognosis and higher

mortality risk.

4.1.2. Inflammatory markers

Changes in C-Reactive protein (CRP) levels can be used to monitor disease activity and response to treatment. A marked increase in erythrocyte sedimentation rate (ESR) is closely associated with disease activity, particularly during acute inflammatory phases.

4.1.3. Autoantibodies

Extensive research has demonstrated that myositis-specific autoantibodies (MSAs) function as serum biomarkers in DM, aiding in clinical classification, diagnosis, and disease activity assessment. Autoantibodies include as follows:

- (1) Anti-Mi-2 antibodies occur in 4–20% of DM patients exhibiting classic skin manifestations like Gottron's sign and heliotrope rash;
- (2) Anti-NXP-2 antibodies are found in 3–24% of DM patients. These patients exhibit a distinct clinical phenotype, and in elderly patients, malignancy is more likely;
- (3) Anti-MDA5 antibodies are detected in approximately 13–30% of DM patients, and highly associated with ILD;
- (4) Consistent studies have identified anti-TIF1- γ as the strongest predictor of malignancy in adult DM patients;
- (5) Only a few cases have explored the relationship between anti-SAE serum levels and disease activity.

4.2. Imaging studies

High-Resolution Computed Tomography (HRCT) is particularly useful for the early diagnosis of dyspnea or chronic cough caused by ILD in elderly patients with DM. It allows for the early detection of pulmonary lesions and assessment of disease progression.

In MRI imaging, short tau inversion recovery (STIR) sequences exhibit a sensitivity of 89–100% for detecting inflammatory changes, outperforming muscle biopsy, which has a sensitivity of 66%. In the context of IIM, 18F-FDG PET/CT emerges as a valuable tool with multifaceted applications. Electromyography (EMG) is most helpful in differentiating myopathic weakness from myasthenia gravis and neurogenic weakness, such as in amyotrophic lateral sclerosis (ALS) and polyneuropathies. If physical examination is inconclusive regarding the presence of muscle weakness, EMG can be used to identify suitable muscles for biopsy^[13].

4.3. Muscle biopsy

The primary histological manifestations of dermatomyositis are perifascicular atrophy, reduced number of capillaries and perivascular, perimysial, T cells, B cells, macrophages and plasmacytoid dendritic cells infiltrates.

5. Treatment

The pharmacological management of geriatric DM patients requires a delicate balance between controlling disease activity and minimizing the risk of drug toxicity. Glucocorticoids and conventional synthetic disease-modifying antirheumatic drugs (csDMARDs), such as azathioprine and methotrexate, remain the mainstays of treatment.

However, liver and renal function should be closely monitored in elderly patients. For patients with refractory disease or high inflammatory activity, targeted therapies (e.g., JAK inhibitors, anti-CD20 monoclonal antibodies) offer effective alternatives, although potential risks of infection and metabolic complications must be carefully considered.

5.1. Conventional therapeutic agents

5.1.1. Glucocorticoids

Glucocorticoids are the cornerstone of DM treatment, especially during the acute phase of the disease. Long-term monotherapy with glucocorticoids is prone to adverse effects such as infections and metabolic disturbances, and thus they are often used in combination with other agents ^[14].

5.1.2. Immunosuppressive agents

Immunosuppressive agents are essential in the treatment of DM, particularly when glucocorticoids are ineffective or poorly tolerated.

5.1.3. Conventional synthetic disease-modifying antirheumatic drugs (csDMARDs)

CsDMARDs form the cornerstone of therapy for geriatric DM patients, controlling disease progression by modulating immune responses and reducing the release of inflammatory mediators. Hydroxychloroquine is the primary csDMARD used in DM treatment and can be employed as first-line therapy. However, its monotherapy efficacy is limited, and it is poorly tolerated by some patients. Studies have shown that monotherapy with hydroxychloroquine is associated with a higher risk of disease relapse in DM; therefore, it is often combined with other agents to enhance therapeutic efficacy ^[15].

Given the reduced liver and kidney function in elderly patients, treatment typically begins with lower doses (e.g., methotrexate at 7.5 mg/week). Patients with comorbid osteoporosis, cardiovascular disease, or high infection risk should undergo comprehensive evaluation to optimize their treatment plans. Close monitoring of drug toxicity and dose adjustment are crucial when using csDMARDs in elderly patients. Individualized treatment strategies can help optimize outcomes. Through the judicious use of csDMARDs, stable and long-term disease management can be achieved for geriatric DM patients.

5.2. Emerging therapeutic strategies

5.2.1. JAK inhibitors

JAK inhibitors are a novel class of therapeutic agents that target the JAK-STAT signaling pathway. Tofacitinib, a representative JAK inhibitor, has demonstrated promising efficacy in patients with refractory DM.

5.2.2. Biologics

Biologics have also shown potential in the treatment of DM. Rituximab, a chimeric monoclonal antibody targeting the CD20 antigen, effectively depletes B cells and reduces autoantibody production. Other biologics, such as tocilizumab and abatacept, have shown some efficacy in DM treatment, but further research is needed to optimize their use.

5.2.3. Plasma exchange and adsorption therapy

For refractory DM patients, plasma exchange and adsorption therapy can be used as adjunctive treatments. Polymyxin B (PMX), a blood purification technique that directly adsorbs endotoxins, effectively removes circulating endotoxins and inflammatory mediators.

5.2.4. Individualized treatment strategies for geriatric patients

Treatment of DM should be individualized, considering factors such as patient age, disease severity, and comorbidities. Geriatric patients often have multiple chronic conditions, and the benefits and risks of medications must be carefully weighed. For elderly DM patients with ILD, treatment strategies should focus on controlling pulmonary inflammation and improving lung function, with a preference for glucocorticoids combined with immunosuppressive agents. For those with prominent skin symptoms, topical glucocorticoids or calcineurin inhibitors can be used in addition to systemic therapy to control disease activity.

5.2.5. Future research directions

Despite significant progress in DM treatment, many challenges remain. Future research should focus on the following areas:

- (1) A deeper understanding of DM pathogenesis, particularly the role of anti-MDA5 antibodies in disease mechanisms, is needed;
- (2) More high-quality clinical trials should be conducted in geriatric patients to determine the optimal use and dosing of emerging therapeutic agents;
- (3) The exploration of biomarkers in DM diagnosis and treatment monitoring is essential for achieving precision medicine .

6. Conclusion

In summary, the treatment of geriatric DM requires a comprehensive consideration of multiple factors and individualized treatment plans. The combination of conventional therapies and emerging treatments holds promise for improving outcomes in elderly DM patients. As research continues to advance, more precise and effective therapeutic strategies will become available for this patient population.

Disclosure statement

The authors declare no conflict of interest.

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Application Effect of Risk Management in Nursing Work of Fever Clinics

Xiaoyang Chen, Ye Wu*

The Second Affiliated Hospital of Guilin Medical University, Guilin 541199, Guangxi, China

**Author to whom correspondence should be addressed.*

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Abstract: *Objective:* To observe the application effect of risk management in the nursing work of fever clinics, especially its effect on improving nursing satisfaction and the work quality of nursing staff, as well as reducing the incidence of nursing risk events, and to provide a scientific reference for future clinical research and practice. *Methods:* This study adopted a retrospective approach, fixing the research period from December 2024 to August 2025. A total of 110 patients admitted to the fever clinic of our hospital were selected as the research objects and divided into two groups (the control group and the experimental group) using the random number table method. Each group had 55 patients. Then, differentiated nursing strategies were implemented for the two groups. Both the control group and the experimental group received routine nursing. The difference was that the experimental group was additionally given risk management measures on the basis of routine nursing. After 7 days of intervention, the nursing satisfaction rate, nursing quality, cognitive score of fever clinic risks, nursing error rate, complaint rate, and incidence of risk events were compared and analyzed between the two groups. *Results:* The nursing satisfaction score, nursing complaint rate, incidence of nursing risk events, nursing error rate, nursing quality score, and cognitive score of fever clinic risks in the experimental group were significantly better than those in the control group. The differences were statistically significant ($P < 0.05$). *Conclusion:* Risk management has a significant application effect in the nursing work of fever clinics, playing a positive role for both patients and nursing staff. It is an effective measure to comprehensively improve nursing quality and an important means to greatly reduce the incidence of nursing risk events, thus having high clinical promotion value.

Keywords: Application effect; Fever clinics; Nursing work; Risk management

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1. Introduction

As an important window of a hospital, the outpatient department is also a crucial component of the hospital system. Among its various sections, the fever clinic receives a large number of febrile patients every day, characterized by high complexity and mobility. This situation inherently poses severe risks and enormous pressure on nursing management work. In particular, many diseases accompanied by fever symptoms are highly transmissible. This

can bring potential risks to medical staff and other patients, posing a great threat to their life and health. Moreover, the consultation process in fever clinics is generally complicated, which places higher requirements on the professional capabilities of nursing staff.

Improper nursing care or mistakes in any link can easily lead to medical disputes. This not only reduces patients' satisfaction with nursing work but may also restrict the sustainable development of the hospital in the long run. For these reasons, the top priority of the hospital's fever clinic is to strengthen risk management. By accurately identifying potential risk points in nursing work and proactively adopting scientific and effective intervention measures, it can significantly reduce the incidence of nursing-related risk events, improve the efficiency of patients' medical treatment, and ensure the personal safety of both medical staff and patients ^[1]. Therefore, this study was conducted and is reported as follows. It aims to explore the application effect of risk management in the nursing work of fever clinics, so as to provide references for relevant personnel.

2. Materials and methods

2.1. General information

This study adopted a retrospective research method, with the research period ranging from December 2024 to August 2025. A total of 110 patients from the fever clinic of our hospital were included as research subjects. These patients were divided into two groups with equal numbers using the lottery method, namely the control group and the experimental group, with 55 patients in each group.

In the control group, there were 22 male patients and 33 female patients. The maximum age was 80 years old, the minimum age was 5 years old, and the average age was (55.26 ± 1.05) years old. The patients' body temperature ranged from 38.55°C to 39.43°C, with an average temperature of (38.88 ± 0.22) °C.

In the experimental group, there were 23 male patients and 32 female patients. The maximum age was 79 years old, the minimum age was 4 years old, and the average age was (60.24 ± 9.22) years old. The patients' body temperature ranged from 38.6°C to 39.6°C, with an average temperature of (39.02 ± 0.22) °C. Statistical analysis showed that there were no statistically significant differences in the general information between the two groups of patients ($P > 0.05$), indicating good comparability ^[2,3].

2.2. Methods

Both the control group and the experimental group received conventional management, including temperature monitoring, pre-examination triage, and guiding patients to take medications standardized in accordance with medical orders. The difference was that the experimental group was additionally provided with a risk management model on the basis of conventional management. The details are as follows:

- (1) Establish a risk management team, where doctors and nurses with rich clinical experience can serve as members of the risk management team, responsible for planning and implementing risk management plans ^[4]. Team members regularly learn and understand professional knowledge of risk management and master the main content of relevant laws and regulations through training, lectures and other activities. The risk management team is responsible for optimizing the whole-process service chain covering patient admission, diagnosis and treatment, clinical nursing, and discharge follow-up. It focuses on identifying key links in this process that are most prone to risks, and formulates and implements targeted intervention measures to improve the risk response capability of the entire team and comprehensively enhance their

professional literacy. Medicine dispensing and infusion are the links most prone to risks in fever clinics. Therefore, the team implements a person-specific responsibility system; specifically, a designated person is fully responsible for the whole-process operation of medicine dispensing and infusion and records the relevant operations, aiming to reduce the possibility of problems caused by cross-operation ^[5];

- (2) Improve the professional literacy of nurses by establishing a systematic training mechanism. Head nurses or experienced senior nurses serve as training instructors, focusing on providing professional training in both theoretical and practical aspects for new nurses and those with insufficient experience. The training content not only includes basic training on routine operations, laws and regulations, core systems, and communication skills, but also covers special training specifically for special patient groups such as elderly patients and children. Professional training is used to improve nurses' risk prevention capabilities. In addition, a hierarchical nursing system was established and strictly implemented to ensure that refined nursing is implemented in every detail of the work. A positive atmosphere for team communication and experience sharing was created; nurses are encouraged to take advantage of favorable opportunities such as morning and evening meetings and handovers to share experience with each other and conduct in-depth discussions on special cases, so as to improve the professional literacy of the entire nursing team ^[6,7];
- (3) Establish and improve nursing work systems:
 - (i) The management and supervision of nurses' work were strengthened systematically to ensure that every piece of work meets the strict requirements of rules and regulations. For example, key systems such as shift handover, verification, rescue, and nursing technology operation were strictly implemented. Nurses are required to treat every detail with excellence, ensuring that potential risks and hidden dangers can be identified in the shortest possible time to achieve the goal of targeted intervention;
 - (ii) A special nursing safety management committee was set up. This organization is responsible for comprehensively updating and formulating systems related to nursing safety, determining quality control standards, and planning and implementing safety management training plans. In addition, the nursing safety management committee is also responsible for revising the complete nursing process of the fever clinic and formulating operation specifications by category, ensuring the standardized and reasonable use of safety inspection record forms. In particular, it should formulate emergency plans specifically for special situations in advance based on daily nursing work experience, such as febrile convulsions, drug side effects, and anaphylactic shock, so as to build a solid defense line for patients' lives and safety ^[8];
 - (iii) Eventually, incentive and restraint mechanisms were established and improved. A combination of process evaluation and result evaluation was adopted to scientifically and comprehensively assess the work effect of nurses. Their nursing performance was closely linked to performance appraisal, position promotion, etc., so as to arouse nurses' work enthusiasm and strengthen their subjective initiative. Among them, appropriate rewards were given to nurses with excellent performance; on the contrary, serious handling was given to those with poor performance. The combination of leniency and strictness was used to improve the overall safety level and nursing quality of the fever clinic nursing team;
- (4) Strengthen health education and improve communication skills by letting professional and humanized health education and communication services run through the whole process of patients from admission to discharge. The main content of health education includes key knowledge such as the cause, prevention,

and treatment of fever-related diseases. In addition, patients should also be educated on scientific and effective self-care methods and skills, so as to deepen patients' understanding and cognition of fever-related diseases and improve their self-management ability. Moreover, nurses need to provide timely and professional mental health services for patients based on their actual physical conditions, such as psychological counseling and emotional support, aiming to effectively alleviate patients' negative emotions and strengthen their confidence in treatment [9,10]. Rehabilitation training is crucial for patients' recovery; nurses can design targeted rehabilitation training plans for them to enhance the practical effect of nursing work.

2.3. Observation indicators

Nursing quality of the two groups includes service attitude, communication ability, work initiative and sense of responsibility, nursing operation skills, first-aid and emergency response ability, etc. Nursing satisfaction rate of the two groups includes nursing complaint rate, nursing error rate, incidence of risk events of the two groups, as well as the cognitive score of fever clinic-related risks among patients or nursing staff.

2.4. Statistical methods

SPSS 25.0 software was used for data processing and statistical analysis. Measurement data were expressed as mean \pm standard deviation (SD), and independent sample t-test was used for comparison between groups. Count data were described in the form of cases (percentage) [n (%)], and chi-square test (χ^2 test) was used for comparison between groups. A difference was considered statistically significant when $P < 0.05$.

3. Results

3.1. Comparison of nursing satisfaction rate between the two groups

Table 1. Comparison of nursing satisfaction rate between the two groups [n (%)]

Group	n	Very satisfied	Basically satisfied	Dissatisfied	Total satisfaction rate
Experimental group	55	34 (61.82)	20 (36.36)	1 (1.82)	54 (98.18)
Control group	55	30 (54.55)	15 (27.27)	10 (18.18)	45 (81.82)
χ^2	-	-	-	-	8.182
P	-	-	-	-	0.004

3.2. Comparison of nursing quality scores between the two groups

Table 2. Comparison of nursing quality scores between the two groups (mean \pm SD, points)

Group	n	Service attitude	Communication ability	Initiative and responsibility	Nursing technology	First-aid ability
Experimental group	55	98.15 \pm 1.27	96.27 \pm 1.05	92.58 \pm 1.35	93.67 \pm 1.51	91.25 \pm 1.77
Control group	55	82.51 \pm 1.39	79.29 \pm 1.77	78.51 \pm 1.78	79.51 \pm 1.08	80.29 \pm 1.33
t		61.604	61.189	46.707	56.566	36.713
P		0	0	0	0	0

3.3. Comparison of nursing complaint rate, nursing error rate, incidence of risk events and cognitive score of fever clinic risks between the two groups

Table 3 Comparison of nursing complaint rate, nursing error rate, incidence of Risk events and cognitive score of fever clinic risks between the two groups [n (%), mean \pm SD]

Group	n	Cognitive score of fever clinic risks (points)	Incidence of risk events	Nursing error rate	Nursing complaint rate
Experimental group	55	85.18 \pm 1.62	1 (1.82)	0 (0)	0 (0)
Control group	55	73.22 \pm 1.05	6 (10.91)	5 (9.09)	4 (7.27)
<i>t</i> / χ^2	-	45.945	3.814	5.238	4.151
<i>P</i>	-	0	0.050	0	0.042

Through the data analysis in **Table 1**, **Table 2**, and **Table 3**, the experimental group showed significantly better performance in all aspects compared with the control group.

4. Discussion

Patients admitted to hospital fever clinics usually suffer from sudden and acute diseases, with common conditions including influenza, pneumonia, hyperthyroidism, and others. The most common symptom of these diseases is high fever, and other symptoms such as fatigue, chills, and shortness of breath may also occur. Moreover, due to the characteristics of sudden onset and strong infectivity of such diseases, fever clinics may need to receive a large number of patients with similar symptoms in a short period of time, showing obvious aggregation characteristics from the perspective of time distribution. Under the influence of multiple factors, nursing work in fever clinics faces enormous pressure and burden. Sometimes, inadequate doctor-patient communication or untimely and incomplete information transmission may lead to a series of nursing risk events. This not only reduces patients' satisfaction with nursing work but may also directly affect the nursing effect^[11]. Based on this, fever clinics should implement the principle of "early detection, early diagnosis, and early treatment", scientifically apply the risk management model, and curb potential risks in nursing work at an early stage to reduce the incidence of nursing risk events.

With the continuous deepening of relevant clinical research, the application of risk management in nursing work of fever clinics has shown significant effects. Establishing a risk management team and improving the professional literacy of nurses can provide high-quality nursing services for patients, enhance nursing quality, and effectively reduce the incidence of nursing risk events. Establishing and improving nursing work systems requires nurses to perform various nursing operation procedures in accordance with rules and regulations, thereby promoting the overall nursing work of fever clinics to develop in a more standardized and systematic direction. Strengthening health education and improving communication skills can help nurses fully grasp patients' conditions, provide a scientific basis for formulating personalized nursing plans and rehabilitation training programs, improve patients' satisfaction with nursing work in fever clinics, and build a harmonious doctor-patient relationship^[12,13].

In this study, 110 febrile patients admitted to the fever clinic of our hospital from December 2024 to August 2025 were selected for comparative analysis, and the patients were divided into the control group and the

experimental group. Nursing satisfaction rate, nursing quality, nursing complaint rate, nursing error rate, incidence of risk events, and cognitive score of fever clinic risks were used as evaluation indicators. The research results showed that compared with the control group, the experimental group had a higher overall satisfaction rate with nursing work, significantly improved nursing quality and cognitive score of fever clinic risks, while the nursing complaint rate, nursing error rate, and incidence of risk events decreased significantly. All the above differences were statistically significant ($P < 0.05$)^[14].

In the past two years, with the wide application of the risk management model in the field of medical care, its advantages have become increasingly prominent and have been strongly recognized by the majority of medical staff and patients. On the one hand, the risk management model advocates systematic and professional training as well as standardized management, which is of great benefit to comprehensively improving the professional literacy of nurses, significantly enhancing the effect of nursing work, and promoting the overall progress and development of the nursing team. On the other hand, relying on scientific and complete management systems and standardized operating procedures, the non-standard operations and behaviors of nurses can be effectively restricted. This can minimize operational errors, improve patients' recognition and satisfaction with nursing work, and lay a foundation for building a harmonious doctor-patient relationship^[15].

5. Conclusion

In summary, risk management has a significant application effect in nursing work of fever clinics and has broad development prospects. To further expand the application scope of the risk management model in the medical field, relevant personnel should strengthen research on this model, actively summarize experiences and lessons, and enable it to play a greater role in clinical practice.

Disclosure statement

The authors declare no conflict of interest.

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Nursing Care of a Patient with Intracranial Aneurysm Rupture and Hemorrhage Complicated by Pulmonary Embolism After Surgery

Rong Zeng, Bingying Yan, Shanshan Ge

Taikang Xianlin Gulou Hospital Affiliated to Nanjing University School of Medicine, Nanjing 210048, Jiangsu, China

**Author to whom correspondence should be addressed.*

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Abstract: *Objective:* To summarize the nursing experience of a patient with intracranial aneurysm rupture and hemorrhage who developed pulmonary embolism after clipping surgery. *Methods:* A patient in our hospital, who had intracranial aneurysm rupture and hemorrhage and developed pulmonary embolism after clipping surgery, was selected as the research subject. Through multidisciplinary collaboration, standardized assessment and dynamic condition observation, various risks were identified early. Combined with the patient's individual characteristics, a personalized nursing plan was formulated. During the treatment process, emphasis was placed on strengthening the patient's airway management, closely monitoring various indicators, and preventing postoperative complications. Targeted nursing measures were adopted: reasonable airway humidification and effective lung care were used to gradually control the patient's pulmonary infection; fluid balance management and individualized care were implemented to ensure the patient's normal circulating blood volume, thereby optimizing cerebral perfusion and cerebral oxygenation. Since the patient had overlapping risk factors for bleeding and thromboembolic events, evidence-based nursing principles were followed for thromboembolism prevention, and anticoagulation strategies and nursing plans were dynamically adjusted to reduce the occurrence of postoperative complications. *Results:* The patient's condition improved and was successfully discharged on the 22nd day after surgery, and then transferred to a local rehabilitation hospital for further treatment. At the 1-month follow-up after discharge, the patient recovered well; at the 3-month follow-up after discharge, the patient had recovered and returned home. *Conclusion:* The results show that standardized assessment and condition observation, multidisciplinary collaboration, and personalized nursing plans can significantly reduce the occurrence of postoperative complications and improve the patient's prognosis. This nursing experience provides a reference for the nursing of similar patients in the future.

Keywords: Intermuscular venous thrombosis; Intracranial aneurysm; Nursing care; Pulmonary embolism

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1. Introduction

Intracranial aneurysm (IA) refers to a localized, pathological dilatation of the intracranial arterial wall that forms an aneurysmal protrusion ^[1]. It is the leading cause of subarachnoid hemorrhage, and surgical treatment is generally the primary approach. Among postoperative complications of IA, deep venous thrombosis (DVT) is common, with an incidence rate of up to 9.7%; the incidence of asymptomatic thrombosis can be as high as 24%, and calf muscle venous thrombosis (CMVT) is the most frequent type ^[2]. 80–90% of emboli in acute pulmonary embolism (APE) originate from the detachment and migration of lower extremity DVT ^[3]. Mild cases present with symptoms such as dyspnea, chest pain, hemoptysis, and fever, while severe cases may lead to cyanosis, shock, or even death. Early researchers believed that CMVT, which does not involve the main veins of the lower extremities, could dissolve or organize on its own without causing corresponding complications, so it has long been overlooked.

However, with the in-depth research on CMVT by scholars worldwide, there have been an increasing number of literature reports indicating that APE can be directly caused by CMVT, or by CMVT extending to cause main DVT in the thigh and then leading to APE ^[4]. Nevertheless, there are currently few studies on distal DVT, especially CMVT. There is significant controversy regarding the frequency and severity of CMVT complicated with APE, resulting in inconsistent treatment decisions made by clinicians when facing CMVT ^[4]. Meanwhile, nurses have insufficient understanding of CMVT and lack relevant nursing experience.

On 26 May 2024, our hospital admitted a patient with calf muscle venous thrombosis complicated by pulmonary embolism after surgery for ruptured intracranial aneurysm. After 22 days of multidisciplinary treatment and meticulous nursing care, the patient's condition stabilized and was transferred to a local rehabilitation hospital for further treatment. The nursing experience is reported as follows.

2. Clinical data

2.1. General information

A 70-year-old female patient was admitted to the emergency department on 26 May 2024, due to “sudden headache with unconsciousness for more than 1 hour”. She was in deep coma, with a Glasgow Coma Scale (GCS) score of 3T (E1VTM2). There was redness and swelling in the right temporal and parietal regions, without obvious subcutaneous pulsation. Both pupils were equal in size and round, with a diameter of approximately 3 mm, and the light reflex was dull. The bilateral nasolabial folds were symmetrical, and the corner of the mouth was centered. The muscle strength of the left limb was grade 0, and that of the right limb was approximately grade 1. The muscle tone of all limbs was normal, physiological reflexes were present, and pathological reflexes could not be elicited.

Cranial computed tomography angiography (CTA) combined with chest CT showed an irregular aneurysm at the M1 bifurcation of the right middle cerebral artery; right temporal lobe cerebral hemorrhage, subarachnoid hemorrhage, blood accumulation in the lateral ventricles and third and fourth ventricles, and mild ventricular dilatation; bilateral lower lung dependent inflammation. The patient was admitted to the hospital with a provisional diagnosis of “(right) middle cerebral artery aneurysm rupture complicated with subarachnoid hemorrhage”.

She had a history of uterine fibroid resection and blood transfusion. Her recent diet and sleep were normal, bowel and bladder functions were regular, and there was no significant change in body weight.

2.2. Treatment course and outcome

After admission, the patient was immediately placed in the emergency surgical green channel and underwent

general anesthesia for IA clipping, hematoma evacuation, decompressive craniectomy, third ventriculostomy, and aneurysm wrapping. The intraoperative blood loss was 490 ml, and she was transferred to the intensive care unit (ICU) for further treatment after surgery.

On the 8th postoperative day, the patient's condition was stable and she was transferred to the neurosurgery ward. Physical examination on admission to the ward showed coma, with a GCS score of 4T (E1V3M3). Both pupils were equal in size and round, with a diameter of approximately 2.0 mm, and the light reflex was dull. Vital signs were as follows: body temperature 37.6°C, heart rate 94 beats/min, respiratory rate 26 breaths/min, blood pressure 154/104 mmHg, and pulse oxygen saturation 99%. A size 7.5 tracheal cannula was in place, and sputum culture indicated *Acinetobacter baumannii* infection.

The nurse assisted the doctor in placing a lumbar cistern drainage tube at the bedside, and bloody turbid cerebrospinal fluid (CSF) was drained. The CSF pressure fluctuated between 100–105 mmH₂O. Treatment included anticoagulation, correction of electrolyte imbalance, combined intravenous and enteral nutritional support, and anti-infection therapy as prescribed by the doctor.

On the 10th postoperative day, re-examination of cranial and chest CT showed absorption of intracranial hemorrhage compared with the previous scan, and progression of bilateral lung inflammation. Lower extremity color Doppler ultrasound revealed local calf muscle venous thrombosis. The patient was given enoxaparin sodium 2000 units once daily (QD) combined with batroxobin 5 BU every other day (QOD) for anticoagulation, and 100 ml warm water via nasogastric tube every 8 hours (Q8h). A consultation with the rehabilitation department was requested, and early bedside rehabilitation was provided.

On the 12th postoperative day, the patient's respiratory rate was 35–40 breaths/min. Pulmonary artery CTA showed local branch embolism in the right middle and lower lobes of the lung, and suspected local branch embolism in the left lower lobe. A consultation with the respiratory department was requested. Emergency blood tests showed: fibrinogen 1.48 g/L, D-dimer 24.26 mg/L, sodium 155 mmol/L, and chlorine 126 mmol/L. Blood gas analysis showed: arterial partial pressure of oxygen 56.4 mmHg, partial pressure of carbon dioxide 46.7 mmHg (normal range 35–45 mmHg). The treatment was adjusted to enoxaparin sodium 4000 units QD, and 100 ml warm water via nasogastric tube every 4 hours (Q4h).

On the 16th postoperative day, re-examination of cranial and chest CT showed absorption of intracranial effusion and hemorrhage compared with the previous scan, absorption of bilateral lung inflammation, and improvement of all laboratory indicators. The lumbar cistern drainage tube was removed as prescribed by the doctor, and intravenous infusion of batroxobin injection was suspended. On the 22nd postoperative day, the patient was discharged from the hospital and transferred to a rehabilitation hospital for continued treatment.

3. Nursing care

3.1 Standardized and accurate assessment, dynamic condition observation, and early identification of various risks

Postoperative rebleeding is a key factor affecting the prognosis of aneurysmal subarachnoid hemorrhage. Studies have shown that approximately 13.6% of patients experience rebleeding ^[1,2]. Therefore, the following measures were implemented for this patient:

- (1) Various assessment scales, including the Barthel Index, Braden Scale, Caprini Risk Assessment Model, Morse Fall Scale, NRS 2002 Nutritional Risk Screening Scale, and Glasgow Coma Scale (GCS), were

used for standardized and accurate assessment to identify various risks at an early stage;

- (2) Continuous 24-hour electrocardiographic monitoring was provided to dynamically track the patient's heart rate, electrocardiogram, blood oxygen saturation, chest movement, as well as laboratory indicators and imaging findings;
- (3) Responsibility-based holistic nursing was implemented to ensure a coordinated emergency response between medical and nursing staff. First-aid equipment such as a simple manual resuscitator and defibrillator was prepared at the bedside. In case of changes in the patient's condition, the doctor was promptly notified for appropriate treatment, and a joint emergency nursing protocol for acute pulmonary embolism was developed;
- (4) By consulting experts and reviewing literature, combined with the patient's specific condition, the most common and severe postoperative complications of this patient were identified. The priorities and difficulties of nursing care were determined as early as possible, and corresponding intervention measures were provided.

3.2 Strengthening airway management, developing SOP for T-piece, and improving pulmonary infection

Respiratory system infection is one of the most common complications in stroke patients and a major cause of death ^[4]. After being transferred from the ICU to the neurosurgery ward, the patient's chest CT indicated pulmonary infection, with grade II yellow viscous sputum. Airway management was the focus of this nursing care. Relevant literature reviews suggested that the patient should receive low-flow continuous airway humidification instead of a heat and moisture exchanger; reasonable airway humidification for the patient is crucial to ensuring effective ventilation and preventing complications ^[5,6].

Specific measures were as follows:

- (1) The patient's heat and moisture exchanger was replaced with a T-piece device connected to an oxygen source. The oxygen flow rate was adjusted to 5 L/min, the oxygen concentration to 40%, and continuous airway humidification was provided using 0.45% sodium chloride solution as the humidifying fluid. A standard SOP for the use of the T-piece humidification device was developed;
- (2) Nebulization therapy was administered to the patient 3 times a day, with dynamic observation of sputum viscosity, volume, and the presence of cough reflex;
- (3) The head of the bed was elevated by 30–45°, and airbag pressure was monitored every 4 hours (Q4H), maintaining a pressure of 25–30 cmH₂O;
- (4) Tracheostomy care was performed once a day, with strict adherence to the principle of aseptic technique;
- (5) Airway suctioning was performed as needed. Each suctioning procedure was strictly completed within 15 seconds, with a maximum of 2 consecutive suction, and a suction pressure of 100 mmHg to avoid excessive negative pressure in the airway;
- (6) Oral care was provided to the patient every 8 hours (Q8H) using normal saline, povidone-iodine gargle, and a negative-pressure suction toothbrush. Changes in oral mucosa, odor, and pH were monitored. The patient's oral pH fluctuated between 6.6 and 7.0, and no oral inflammation occurred ^[4].

On the 16th postoperative day, re-examination CT showed that the patient's pulmonary infection gradually improved, and the sputum changed from grade II yellow viscous sputum to grade I white sputum.

3.3 Emphasizing postoperative volume management and implementing individualized care to prevent complications

Patients with aneurysmal subarachnoid hemorrhage require appropriate dehydrating agents to reduce intracranial hypertension and improve cerebral edema, which often leads to relative hypovolemia and hypotension. Therefore, postoperative volume management was also a focus of this nursing care. The latest evidence-based recommendations advocate maintaining normal circulating blood volume and conducting fluid balance management to optimize cerebral perfusion and cerebral oxygenation, which helps reduce the occurrence of various complications [7].

Combined with the patient's individual conditions and relevant literature, an individualized nursing plan was formulated as follows:

- (1) Early administration of nimodipine was initiated as prescribed by the doctor. The patient's vital signs, consciousness, pupil status were closely observed, and electrolyte levels, fluid intake/output, and body weight were monitored;
- (2) Fluid intake was adjusted based on indicators such as urine output, blood pressure, central venous pressure, and electrolyte levels. Fluid loss was assessed 2–3 times daily to determine the total fluid replacement volume [8]. On the 8th postoperative day, the patient's serum sodium level was 159.6 mmol/L. According to the fluid replacement principle for hypernatremic patients: Fluid replacement volume = Total Body Water (TBW) × (Serum sodium concentration/Target serum sodium concentration - 1) + Insensible water loss, TBW: 60% of body weight for males, 50% of body weight for females, Insensible water loss: usually 30–50 mL/h or 10 mL/(kg·d) [9,10]. The calculated total fluid replacement volume was: $(0.5 \times 65) \times (159.6/149.6 - 1) + 1200 = 3371$ mL. The total daily fluid replacement volume was dynamically adjusted according to the patient's condition to maintain a roughly balanced fluid intake and output. On the 16th postoperative day, the patient's serum sodium was 144.5 mmol/L and serum chlorine was 105.1 mmol/L. On the 22nd postoperative day, the patient was discharged without electrolyte disturbance, and no complications such as cerebral edema or cerebral infarction were found on cranial CT.

3.4. Preventing thromboembolism to maximize patient benefits

Patients with aneurysmal subarachnoid hemorrhage are at high risk of thromboembolism, while rebleeding of intracranial aneurysm is an important factor affecting their prognosis [11]. Therefore, dynamically adjusting anticoagulation strategies to prevent both bleeding and thromboembolism was the difficulty of this nursing care. On the 2nd postoperative day, lower extremity color Doppler ultrasound showed local calf muscle venous thrombosis in the right leg; on the 7th postoperative day, re-examination of lower extremity color Doppler ultrasound showed no abnormalities. On the 8th postoperative day, the patient was transferred to our ward.

Assessment indicated she was a postoperative patient with disturbance of consciousness, a history of deep vein catheterization, and long-term bed rest. Laboratory indicators showed: D-dimer 13.56 mg/L, fibrinogen 6.06 g/L. Therefore, the following measures were taken:

- (1) Dynamic re-evaluation of Caprini thromboembolism risk score, monitoring of blood indicators, and re-examination of lower extremity color Doppler ultrasound;
- (2) A consultation with the rehabilitation department was requested to implement early bedside rehabilitation;
- (3) Basic prevention: 100 mL warm water via nasogastric tube every 8 hours (Q8h), elevation of both lower extremities, measurement of leg circumference, regular observation of dorsalis pedis artery pulse, skin

color, and temperature;

- (4) Mechanical prevention: wearing elastic stockings on both lower extremities, and 30-minute air pressure therapy twice a day (BID). On the 10th postoperative day, re-examination of lower extremity color Doppler ultrasound showed local calf muscle venous thrombosis in the right leg. Relevant consensus point out that to reduce the occurrence of thromboembolism, unfractionated heparin or low-molecular-weight heparin sodium can be used as appropriate after aneurysm clipping until the patient can ambulate, and intermittent pneumatic compression should be performed within 24 hours^[11].

Therefore, treatment included subcutaneous injection of enoxaparin sodium 2000 units once daily (QD) and intravenous administration of batroxobin injection 5 BU every other day (QOD) as prescribed. Additional nursing measures were:

- (1) Observing the injection site for petechiae, and checking for gingival bleeding, hematemesis, and hematochezia;
- (2) Maintaining skin cleanliness; prohibiting hot compresses, massages, and air pressure therapy on the affected limb to prevent thrombus dislodgment;
- (3) Performing air pressure therapy on the patient's unaffected lower extremity for 18 hours/day, with an inflation pressure of 35–40 mmHg and a leg cuff length reaching the root of the thigh;
- (4) Ensuring the elastic stockings were removed for no more than 30 minutes per day^[12–14].

On the 12th postoperative day, pulmonary artery CTA showed local branch embolism in the right middle and lower lobes of the lung. The D-dimer level was 24.26 mg/L, and fibrinogen was 1.48 g/L. A consultation with the respiratory department was requested, and the patient's anticoagulation strategy was adjusted: enoxaparin sodium was changed to 4000 units QD subcutaneously as prescribed. Additional nursing measures included:

- (1) Preparing a simple manual resuscitator and defibrillator at the bedside;
- (2) Closely monitoring the patient's vital signs, with particular attention to respiration, heart rate, and blood pressure;
- (3) Strengthening airway management; prohibiting back patting and deep suctioning;
- (4) Immediately reporting to the doctor and actively cooperating with rescue if the patient developed dyspnea, chest pain, hemoptysis, or arrhythmias of varying degrees such as tachycardia or atrial fibrillation;
- (5) Maintaining timely communication between medical and nursing staff, dynamically monitoring indicators such as D-dimer, prothrombin time, fibrinogen, and platelets, and adjusting the treatment plan promptly.

No further bleeding events or new thrombi occurred during the patient's subsequent treatment.

4. Conclusion

Patients with PE complicated by ruptured IA after clipping surgery have complex conditions, with high mortality and disability rates. The overlapping risk factors of bleeding and thromboembolic events in this patient posed challenges to the nursing care. Based on standardized assessment and close condition observation, an individualized nursing plan was formulated for the patient. Meanwhile, through multidisciplinary collaboration and dynamic adjustment of anticoagulation strategies and nursing plans, the occurrence of postoperative complications was reduced, and the patient's hospital stay was shortened. In addition, by analyzing the shortcomings in the nursing process of this patient, we recognized that formulating nursing measures based on evidence-based practice is crucial for promoting patient recovery. The department organized learning and training on evidence-

based nursing knowledge, which ensured the scientificity, effectiveness, and orderliness of nursing work, and also provided a reference for the nursing of similar patients in the future.

Disclosure statement

The authors declare no conflict of interest.

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The Influence of Psychological Security on Quality of Life in Patients Undergoing Hysteroscopic Surgery–The Mediating Effect of Social Support

Surong Xu¹, Xiuyun Li^{2*}

¹Department of Gynecology, The Fifth Affiliated Hospital of Guangzhou Medical University, Guangzhou 510700, Guangdong, China

²Macau University of Science and Technology, Macau 999078, China

**Author to whom correspondence should be addressed.*

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Abstract: With the development of minimally invasive gynecological technology, hysteroscopic surgery has been widely used in the treatment of gynecological diseases due to its advantages of rapid recovery and minimal trauma. From the perspective of patients undergoing hysteroscopic surgery, this paper explores the influence of their psychological security on quality of life, analyzes the mediating effect of social support, and puts forward specific countermeasures and suggestions. The purpose is to improve the psychological security and quality of life of patients undergoing hysteroscopic surgery, and provide reference for the subsequent development of hysteroscopic surgery.

Keywords: Patients undergoing hysteroscopic surgery; Psychological security; Mediating effect

Online publication: Nov 10, 2025

1. Introduction

Clinical medical work usually focuses on patients' physical treatment and postoperative rehabilitation, while lacking attention to patients' psychological state and quality of life. Psychological security is an important manifestation of an individual's mental health, which not only affects the patient's mood, but also relates to their subsequent quality of life and rehabilitation. Social support, as an important resource for individuals to cope with stress, can help patients alleviate negative emotions and continuously improve their psychological adaptability. Based on this, in-depth research on the relationship between psychological security, social support and quality of life of patients undergoing hysteroscopic surgery can help patients improve their physical and mental status and promote the improvement of clinical medical service quality.

2. The influence of psychological security on quality of life in patients undergoing hysteroscopic surgery and the test of the mediating effect of social support

2.1. The influence of psychological security on quality of life in patients undergoing hysteroscopic surgery

Psychological security of patients undergoing hysteroscopic surgery can regulate their emotional state and affect the psychological dimension of quality of life. Among them, patients lacking psychological security may experience emotions such as anxiety before and after surgery; some may even fall into depression due to physical discomfort and excessive worry about their condition ^[1]. Negative emotions directly reduce the psychological state dimension of quality of life, and may even cause patients to develop resistance to postoperative rehabilitation. In contrast, patients with high psychological security have stronger confidence in medical treatment and rehabilitation, can view the risks of surgery rationally, and adjust their emotions flexibly ^[2]. Stable emotions can improve patients' psychological satisfaction with life, help avoid the interference of negative emotions, and lay a solid psychological foundation for quality of life.

In addition, psychological security can affect the degree of cooperation in rehabilitation, which is related to the physical dimension of quality of life. From the perspective of the physical dimension of quality of life, its core lies in the state of the patient's physical functions. The rehabilitation cooperation of patients undergoing hysteroscopic surgery directly affects the speed and effect of recovery ^[3]. Some patients with low psychological security lack trust in medical plans and enthusiasm for cooperating in rehabilitation activities. Their improper behaviors may lead to low scores in the physical function dimension, restricted physical functions, and even reduced quality of life. Patients with strong psychological security recognize the professionalism of medical staff and actively cooperate with the rehabilitation process, such as taking medicine as prescribed by doctors and conducting rehabilitation training ^[4]. Their active cooperation can significantly shorten the recovery cycle of physical functions and lay a physical foundation for improving the patients' quality of life.

2.2. The test of the mediating effect of social support

First, steps for testing the mediating effect. Based on Wen Zhonglin's mediating effect test procedure, regression analysis can be divided into three steps. First, psychological security (X) can be taken as the independent variable and quality of life (Y) as the dependent variable, and a regression model M1 can be established to effectively test the relationship between the independent variable and the dependent variable ^[5]. Second, psychological security (X) can be used as the independent variable and social support (M) as the dependent variable, and a regression model M2 can be built to verify the relationship between psychological security and social support. Finally, psychological security (X) and social support (M) are taken as joint independent variables, and quality of life (Y) as the dependent variable to construct a regression model M3, so as to identify the mediating role of social support between psychological security and quality of life.

Second, analysis of mediating effect results. Tests were conducted on the mediating effects of different dimensions of social support, such as emotional support, informational support, and practical support ^[6]. Mediating effect under emotional support: Regression analysis shows that psychological security has a positive effect on emotional support. Mediating effect under practical support: Psychological security has a positive predictive effect on practical support. Mediating effect under informational support: Psychological security has a positive predictive effect on informational support ^[7]. In conclusion, all dimensions of social support play a mediating role between psychological security and quality of life, among which emotional support has the strongest mediating effect.

3. Countermeasures and suggestions for improving psychological security and quality of life in patients undergoing hysteroscopic surgery

3.1. Intervention strategies for enhancing psychological security

The preoperative period is a critical stage for patients to develop psychological security. Medical staff can effectively alleviate patients' fear through systematic health education and psychological counseling, with specific methods as follows: First, attach importance to the implementation of personalized health education. Medical workers need to understand patients' educational background and disease type to formulate differentiated health education plans ^[8].

For patients with lower educational background, short videos, pictures and texts can be mainly used to explain knowledge about hysteroscopic surgery. For patients with higher educational background, relevant medical literature can be provided to help them understand the risks of the surgery. Second, conduct cognitive behavioral therapy intervention. Patients with anxiety and fear can be referred to psychological nurses or psychological counselors for cognitive behavioral therapy ^[9]. Through communication with patients, medical workers can identify their negative cognitions, such as the concern that a long postoperative recovery period may easily affect normal work. At the same time, medical workers need to encourage patients to master relaxation training skills to help them relieve tension and improve their emotional control ability.

3.2. Intervention strategies for optimizing social support

First, build a diversified social support system. Emphasis should be placed on strengthening family support capabilities: medical workers need to enhance communication with patients' family members to help them master ways to provide medical and nursing support. For example, before surgery, they should explain the possible psychological needs of patients and how to identify preoperative anxiety, so that family members can provide emotional companionship to patients and avoid excessive pressure ^[10].

After surgery, family members can be guided to assist with patients' daily care and encouraged to participate in rehabilitation activities, such as accompanying patients in appropriate postoperative exercises which use to enhance patients' emotional attachment and stimulate their motivation for recovery. Medical workers also need to provide family members with postoperative rehabilitation manuals to help them familiarize themselves with key nursing points. Meanwhile, improve medical and nursing support. Medical institutions should strengthen training for medical staff on communication skills and humanistic care to enhance their ability to provide social support ^[11]. In daily diagnosis and treatment, medical staff should take the initiative to build a good doctor-patient relationship: through patient listening and gentle communication, patients can feel respected and understood.

When providing information support, medical staff should use easy-to-understand language and avoid excessive professional terminology that may cause comprehension difficulties. For instance, when explaining postoperative review items, a table can be used to list the review time, item name, and purpose, making it clear at a glance for patients. A "Medical and Nursing Support Consultation Desk" can be set up in gynecological wards, where experienced medical staff answer questions from patients and their families and provide personalized support suggestions ^[12]. In addition, attach importance to enriching social support channels. Medical institutions need to focus on building patient communication platforms, such as establishing online platforms for patients who have undergone hysteroscopic surgery to encourage patients to share rehabilitation experiences and insights, providing references for newly operated patients. They can also organize offline patient exchange activities and encourage medical staff to participate in answering questions, so as to strengthen communication and interaction

among patients. For the introduction of volunteer services, medical institutions should cooperate with universities and social organizations to recruit volunteers with basic medical knowledge. These volunteers can provide services such as preoperative companionship and postoperative rehabilitation support, for example, accompanying patients to familiarize themselves with the hospital environment, to effectively alleviate patients' fear and expand the sources of social support.

Second, provide personalized social support services. Provide support stratified by age: For young patients (≤ 35 years old), focus on information support, such as pushing information on the latest hysteroscopic surgery technologies, postoperative rapid rehabilitation skills, and fertility protection through short videos and online courses, to meet their needs for professional knowledge. For middle-aged patients (36–50 years old), provide more emotional support, by organizing exclusive psychological counseling groups for middle-aged patients to allow them to share rehabilitation experiences under family and work pressure within the same age group, and provide suggestions on balancing “family-work-rehabilitation” to help alleviate the pressure caused by multiple roles^[13]. For elderly patients (> 50 years old), strengthen practical support: provide postoperative life care services (such as assisting in purchasing daily necessities and meal delivery) and simplify the postoperative rehabilitation process, for example, creating picture-based rehabilitation step guides for elderly patients to avoid operational difficulties caused by complex procedures. Provide support stratified by disease severity: For patients with mild conditions such as simple endometrial polyps, basic social support can be provided through online platforms such as regular rehabilitation reminders and online Q&A can use to reduce the inconvenience of patients traveling to the hospital. For patients with moderate conditions including single submucous uterine fibroids, in addition to online support, regular follow-ups by medical staff can be arranged to adjust the support plan based on patients' recovery status. For patients with severe conditions such as intrauterine adhesions combined with infertility or malignant tumors, provide “one-on-one” exclusive support services with a support team composed of medical staff and volunteers provides full-process emotional support, information support, and practical help, such as assisting in booking specialist outpatient appointments and providing fertility consultation can help patients cope with multiple pressures caused by the disease.

3.3. Comprehensive intervention strategies for improving quality of life

First, improve physical function. Attach importance to the adjustment of postoperative care plans: medical institutions need to grasp the characteristics of hysteroscopic surgery and establish standardized postoperative care procedures. After surgery, personalized pain management plans can be provided for patients. Based on specific pain scores, the causes of pain can be identified in a timely manner, and treatment methods can be adjusted appropriately to effectively relieve patients' postoperative discomfort. Medical workers should pay attention to patients' postoperative diet and rest, formulate scientific and appropriate diet plans, help patients arrange their rest time, and avoid overwork^[14].

Meanwhile, conduct guidance on postoperative rehabilitation training: medical workers need to develop progressive rehabilitation plans. 1–2 hours after surgery: mainly guide patients to perform in-bed turning exercises to effectively promote blood circulation and prevent thrombosis. 1–7 days after surgery; if patients recover well, they can take appropriate short walks. 2 weeks after surgery: medical workers can guide patients to perform Kegel exercises to improve their pelvic floor muscle function. During the actual rehabilitation training, medical staff need to regularly evaluate patients' training effects and physical reactions, and adjust the training intensity in a timely manner to avoid physical injuries caused by improper training.

Second, enhance psychological and social functions. Organize postoperative psychological counseling activities: medical institutions can invite psychological counselors to carry out popular science activities such as emotional regulation and stress coping to improve patients' psychological adjustment ability. Among these activities, mindfulness meditation training can help patients stay more focused, and recognize and manage their own emotions^[15]. Medical institutions can encourage patients to participate in social activities. Once after surgery, encourage patients to resume normal social interactions such as gatherings with friends to avoid the decline of social skills caused by long-term home isolation. They can also strengthen cooperation with communities, organize social activities for postoperative patients such as community development projects, expand patients' social circles, and improve their social adaptability.

4. Conclusion

In summary, this study analyzes the relationships among psychological security, social support, and quality of life in patients undergoing hysteroscopic surgery. It clarifies the impact of psychological security on quality of life and explores the mediating role of social support. To improve the postoperative satisfaction of patients undergoing hysteroscopic surgery, efforts can be made from the perspectives of enhancing psychological security and optimizing social support. This provides a reference for the development of medical and nursing work, promotes the physical and mental well-being of patients undergoing hysteroscopic surgery, and helps them achieve better postoperative rehabilitation.

Disclosure statement

The authors declare no conflict of interest.

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Evaluation of the Application Effect of Nursing Risk Management in Preventing Falls among Inpatients

Chenxi Zhang, Yiyang Rong, Peitong Du, Chen Zhu, Zihan Wu, Chongyang Li, Liling Cui, Huijie Yao

School of Nursing, Tianjin Medical University, Tianjin 300070, China

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Abstract: *Objective:* To evaluate the practical application effect of nursing risk management in preventing falls among inpatients, and to provide a reference for optimizing clinical safety management strategies for inpatients. *Methods:* A total of 428 inpatients in our hospital from January 2021 to December 2023 were selected as the research objects. They were divided into a control group (218 cases) and a study group (210 cases) according to the nursing management method. The control group received routine fall prevention nursing, while the study group implemented systematic nursing risk management. The fall rate and post-fall injury rate during hospitalization were compared between the two groups. *Results:* The fall rate of the study group was significantly lower than that of the control group, and the difference was statistically significant ($p < 0.05$). *Conclusion:* Nursing risk management can effectively reduce the fall rate and post-fall injury rate of inpatients through systematic risk identification, targeted intervention and continuous quality improvement. It also improves patients' awareness of fall prevention and nursing satisfaction, and promotes the improvement of nurses' risk management ability, which has important clinical promotion value.

Keywords: Nursing risk management; Inpatients; Fall prevention; Application effect; Patient safety

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1. Introduction

Falls are one of the most common adverse nursing events among inpatients. They not only cause physical injuries such as fractures and soft tissue damage to patients, but also may trigger psychological problems like anxiety and fear. In severe cases, falls can even prolong the length of hospital stay, increase medical expenses, and even threaten patients' lives ^[1]. Globally, falls have become a major hidden danger threatening the health of the elderly. According to data from the World Health Organization (WHO), approximately 684,000 people die each year due to fall-related injuries, with adults aged 60 and above accounting for the largest proportion. In China, falls are even the leading cause of injury-related deaths among the elderly aged 65 and above ^[2]. At present, most hospitals in China mainly rely on routine nursing to prevent inpatients from falling. The main measures include verbal

education and reporting and filing after fall incidents. However, this type of management model lacks systematic risk assessment, dynamic intervention and continuous improvement mechanisms, resulting in poor fall prevention effects [3].

In recent years, a number of studies have confirmed the role of nursing risk management in reducing the incidence of falls in inpatients. However, most studies have small sample sizes or single intervention measures, and lack a comprehensive evaluation of the improvement of nurses' capabilities and the long-term benefits of patients [4]. Based on this, this study constructed a systematic nursing risk management system and compared and analyzed its application effect with routine nursing in preventing inpatients from falling, aiming to provide more comprehensive and scientific practical basis for the safety management of clinical inpatients.

2. Materials and methods

2.1. Study subjects

A total of 428 inpatients in our hospital from January 2021 to December 2023 were selected as the study subjects, and they were divided into the study group (218 cases) and the control group (210 cases) according to the management method.

2.1.1. Inclusion criteria

Aged ≥ 18 years; length of hospital stay ≥ 72 hours; score ≥ 45 points on the Morse Fall Risk Assessment Scale (determined as high-risk patients for falls); and patients and their family members voluntarily participating in the study and signing the informed consent form.

2.1.2. Exclusion criteria

Complicated with severe mental disorders (such as schizophrenia and severe cognitive impairment) and unable to cooperate with nursing management; unable to move independently due to physical disability, paralysis, or more; occurrence of severe complications such as acute myocardial infarction and stroke during hospitalization requiring absolute bed rest; and incomplete clinical data.

2.1.3. Control group

There were 11 male and 12 female patients with falls, aged 46–89 years, with an average age of (75.11 ± 8.08) years; in the study group, there were 5 male and 7 female patients with falls, aged 47–89 years, with an average age of (75.23 ± 8.23) years.

There were no statistically significant differences in baseline data such as gender, age, department distribution and underlying diseases between the two groups ($p > 0.05$), indicating comparability.

2.2. Methods

2.2.1. Control group: Routine fall prevention nursing

The traditional routine nursing model was adopted, with specific measures as follows.

- (1) At admission, nurses verbally informed patients and their family members of fall prevention precautions, for example, getting up slowly, avoiding going to the toilet alone.
- (2) For patients who fell, nurses provided verbal health education again and reported the incident to the

Nursing Department for filing in accordance with hospital regulations, but no in-depth cause analysis or feedback was conducted^[5].

- (3) Conducted regular ward rounds (3 times a day) to check for obvious environmental hazards including floor stains.
- (4) Placed “Fall Prevention” warning signs at the bedside, but there were no unified educational materials or personalized guidance.

2.2.2. Study group: Systematic nursing risk management

A full-process nursing risk management system covering “Organization–Assessment–Intervention–Feedback–Improvement” was constructed, with specific measures.

2.2.3. Establishment of a specialized nursing risk management team

The team consisted of 20 members, with the director of the Nursing Department as the team leader, head nurses of each department as deputy leaders, and frontline clinical nurses (with ≥ 3 years of work experience and fall prevention experience) as core members. The team’s responsibilities included as followed.

- (1) Formulating the Nursing Risk Management Standards for Inpatient Falls, clarifying the risk assessment process, intervention measures and emergency response plans.
- (2) Holding monthly team meetings to analyze fall incident cases and discuss problems in risk management.
- (3) Conducting fall risk management training for all nurses (twice a quarter), covering content such as the use of the Morse Scale, identification of drug side effects, and environmental risk inspection^[6].
- (4) Conducting regular quality control inspections on the implementation of risk management in each department (once a month) to ensure the effective implementation of measures.

2.2.4. Dynamic risk assessment

- (1) Admission assessment

Within 2 hours of a patient’s admission, the responsible nurse conducted the first assessment using the Morse Fall Risk Assessment Scale, covering items such as fall history, disease impact, medication use, and balance ability. Patients were classified into low-risk (< 25 points), medium-risk (25–44 points), and high-risk (≥ 45 points) based on the score. Only high-risk patients were included in this study.

- (2) Dynamic re-assessment

Daily re-assessment was conducted within 3 days after admission, and weekly re-assessment was conducted after 3 days. If a patient had a change in condition such as blood pressure fluctuation, medication adjustment, department transfer, or surgery, re-assessment must be conducted immediately.

- (3) Establishing a “Patient Fall Risk File”

To record each assessment result, intervention measures, and patient cooperation status, realizing dynamic management of “one file per patient”.

2.2.5. Multi-dimensional risk intervention

- (1) Environmental intervention

Systematic transformation of the ward environment was carried out. Handrails and emergency call bells were installed in restrooms; toilets in restrooms were replaced with sitting ones and anti-slip mats were

laid. Sufficient lighting was maintained in wards and corridors. Bed rails were installed on hospital beds and kept activated throughout the hospitalization period, with the bed height adjusted to allow patients' feet to touch the ground stably when sitting up. Handrails were installed on both sides of corridors, and obstacles in passageways were removed. The humidity of the ground was checked regularly twice a day; anti-slip agents were used to treat slippery areas, and "Caution: Wet Floor" warning signs were placed.

(2) Health education intervention

A "multi-format, personalized" education model was adopted. Inpatient Fall Prevention Manuals were distributed to patients and their family members. A 30-minute fall prevention health lecture was organized once a week, where members of the risk management team explained cases and key prevention points ^[7]. Short fall prevention videos (10 minutes each, with simple language and concise images) were played for elderly patients. Responsible nurses provided one-on-one guidance based on patients' underlying diseases and risk factors such as avoiding standing up within 30 minutes after taking antihypertensive drugs, preventing hypoglycemia-related falls in diabetic patients. Family members were given accompanying training to emphasize the importance of nighttime care ^[8].

(3) Medication and condition intervention

Nurses collaborated with physicians to sort out patients' medication status, identify drugs that might increase the risk of falls, and suggest physicians adjust medication dosage or timing. For patients with orthostatic hypotension, they were instructed to use the "three-step standing method" (lying flat for 30 seconds → sitting up for 30 seconds → standing for 30 seconds). Walking aids (e.g., canes, walkers) were provided to patients with walking difficulties, and correct usage methods were instructed. The frequency of rounds for high-risk patients was increased (once per hour), with focus on morning and nighttime toilet visits ^[9].

2.2.6. Closed-loop management of fall incidents

In case of a fall incident, the below emergency plan was activated immediately.

(1) On-site handling

Nurses arrived at the scene within 5 minutes to assess the patient's consciousness, vital sign, and injury status. If necessary, physicians were notified for emergency treatment such as fracture fixation, head CT examination ^[10].

(2) Incident reporting

A Nursing Adverse Event Report Form was filled out within 24 hours, with detailed records of the fall time, location, cause, handling measures, and patient prognosis, which was then submitted to the risk management team

(3) Root cause analysis

Within 3 working days, the team organized a case discussion meeting and used the "fishbone diagram" analysis method to identify the root cause from four dimensions: patients including insufficient awareness, limited mobility; nursing care such as delayed assessment, inadequate education; environment including wet floors, insufficient lighting; and management for example lax implementation of systems ^[11]

(4) Improvement measures

Targeted improvement plans were formulated based on the causes, such as increasing the frequency of nighttime rounds, supplementing educational materials; and the implementation effect was tracked to

reduce the risk of similar incidents recurring.

2.3. Outcome indicators

(1) Fall incidence rate

The number of fall cases among patients in both groups during hospitalization was counted. The calculation formula is “Fall incidence rate = Number of fall cases / Total number of cases × 100%”

(2) Post-fall injury rate

The number of injured cases such as abrasions, fractures, intracranial hemorrhage among patients who fell was counted. The calculation formula is “post-fall injury rate = Number of injured cases / Number of fall cases × 100%”. Nurses counted the number of falls of patients in both groups during hospitalization, recorded the severity of injuries caused by falls, and finally compared the fall rate and post-fall injury rate between the two groups.

2.4. Statistical methods

SPSS 26.0 statistical software was used for data processing. Measurement data were expressed as “mean ± standard deviation ($\bar{x} \pm s$)”, and inter-group comparison was conducted using the *t*-test; count data were expressed as “number of cases (percentage) [n (%)]”, and inter-group comparison was conducted using the chi-square test. A *p* value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of fall incidence rate and post-fall injury rate between the two groups

The fall incidence rate of patients in the study group was significantly lower than that in the control group, and the difference was statistically significant (*p* < 0.05). Specific data are shown in **Table 1**.

Table 1. Comparison of fall incidence rate and post-fall injury rate between the two groups

Group Name	n	Number of falls	Number of fall injuries
Control Group	210	23 (10.95%)	15 (65.22%)
Study Group	218	12 (5.50%)	3 (25.00%)
χ^2	/	4.23	5.11
<i>p</i>	/	0.04	0.02

4. Discussion

4.1. Mechanism analysis of nursing risk management in reducing fall risks of inpatients

The results of this study showed that after the implementation of nursing risk management, the fall incidence rate and post-fall injury rate of patients in the study group were significantly lower than those in the control group, which confirmed the effectiveness of nursing risk management in preventing falls among inpatients. Its core mechanism can be analyzed from the following three aspects:

First, dynamic risk assessment enables accurate understanding of patients' conditions. In routine nursing, risk assessment is only conducted once at admission, which is difficult to address dynamic risk factors such as changes

in patients' conditions and medication adjustments. However, in this study, through the model of admission assessment, dynamic re-assessment, and immediate assessment in special cases, combined with the quantitative evaluation of the Morse Scale, changes in patients' fall risks can be timely grasped, providing accurate basis for subsequent interventions^[12].

Second, multi-dimensional intervention covers the entire chain of risks. Risk factors for inpatients' falls include multiple dimensions such as environment, patients themselves, and nursing operations. Routine nursing only focuses on a single factor, making it difficult to form comprehensive protection^[13]. In this study, physical hazards were eliminated through environmental modifications such as anti-slip floors and installation of handrails; patients' and their family members' awareness of prevention was improved through personalized health education; and internal risks were reduced through medication and condition interventions^[8].

Third, closed-loop management promotes continuous improvement. In routine nursing, fall incidents are only reported and filed, lacking cause analysis and improvement measures, leading to repeated occurrence of similar incidents. In this study, however, potential risk loopholes were fundamentally identified through closed-loop management including incident handling, cause analysis, and improvement tracking^[14].

4.2. Clinical application value and limitations of nursing risk management

In terms of clinical application value, nursing risk management not only significantly reduces the fall risk of inpatients, but also improves nursing satisfaction, which is of great significance for improving doctor-patient relationships and enhancing the service quality of hospitals. At the same time, the construction of the risk management system has also standardized the nursing operation process and promoted the standardization of nursing quality management^[15].

This study still has certain limitations. First, it is a single-center study with a relatively limited sample size, and the results may have regional limitations. In the future, multi-center and large-sample studies need to be carried out for verification. Besides, the observation time is short, and no long-term follow-up of patients' fall risks after discharge was conducted. In subsequent studies, the observation period can be extended to evaluate the long-term effect of risk management. Thirdly, the differences in fall risks among patients with different disease types were not analyzed. For example, the risk factors of internal medicine patients and surgical patients may be different. In the future, the research objects can be further subdivided to develop more personalized management plans.

5. Conclusion

By constructing a full-process management system covering "Organization–Assessment–Intervention–Feedback–Improvement", nursing risk management can effectively reduce the fall incidence rate and post-fall injury rate of inpatients, while promoting the improvement of nurses' risk management capabilities. This model features systematicness, targeting and sustainability, and is suitable for fall prevention work of inpatients in hospitals at all levels. It is of great guiding significance especially for the management of high-risk groups such as the elderly and pediatric patients. In the future, the risk management plan should be further optimized, personalized measures formulated for different departments and populations, and its long-term effects verified through multi-center studies, so as to provide a more comprehensive practical basis for the safety management of inpatients.

Disclosure statement

The authors declare no conflict of interest.

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Research on the Correlation between *Mycoplasma Pneumoniae* Infection and Childhood Asthma

Wenxiu Qian, Li Pan*, Min Zhu, Kai Chen

Department of Pediatrics, Jintan First People's Hospital, Changzhou 213000, Jiangsu, China

*Author to whom correspondence should be addressed.

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Abstract: *Objective:* To investigate the correlation between *Mycoplasma pneumoniae* infection and childhood asthma, and to explore the impact of Mp infection on airway inflammation and airway hyperresponsiveness in children with asthma. *Methods:* 58 children with bronchopneumonia admitted to the First People's Hospital of Jintan, Changzhou from April 2024 to October 2024 were selected as the study subjects. The levels of cytokines IL-4, IL-17, TGF- β 1, and INF- γ in the serum were compared between the MP group and non-MP group, as well as between the MP wheezing group and MP non-wheezing group. *Results:* The levels of IL-17 and IL-4 in the MP group were significantly higher than those in the non-MP group ($P < 0.05$), while there was no statistically significant difference in the other indicators ($P > 0.05$). Statistically significant differences in IL-17 and IL-4 were observed between the wheezing and non-wheezing groups ($P < 0.05$), while there was no statistically significant difference in the other indicators ($P > 0.05$). There was a significant difference in IL-17 among the groups ($P < 0.05$). The difference in IL-17 between the MP group and non-MP group was significant ($P < 0.05$), and the difference between the wheezing and non-wheezing groups was marginally significant ($P < 0.05$). *Conclusion:* *M. pneumoniae* infection may be one of the risk factors for the onset of childhood asthma, but its mechanism remains unclear. Further research is needed to determine whether Mp infection can serve as a biomarker for childhood asthma and to elucidate its underlying mechanism.

Keywords: Childhood asthma; Cytoplasmic nuclear transcription factor; *Mycoplasma pneumoniae* infection

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1. Introduction

Asthma is a common chronic respiratory disease in children that severely affects patients' quality of life. In recent years, the prevalence of childhood asthma has shown an increasing trend year by year, imposing a significant burden on families and society. Research has found that *Mycoplasma pneumoniae* infection can lead to a decline in the body's immune function, thereby promoting the onset and progression of asthma^[1]. Mp infection can trigger multisystem inflammatory responses, induce the production of various inflammatory mediators

related to the pathogenesis of asthma, and cause pathological changes such as airway epithelial damage and airway remodeling ^[2]. Therefore, Mp infection plays a significant role in asthma.

Currently, most studies on the correlation between Mp and asthma have focused on adults, with varying conclusions and no consensus reached yet ^[3]. Our research group previously conducted a survey on mycoplasma infection in children in China, and the results showed a high positive rate of mycoplasma infection in children, which can cause upper and lower respiratory tract infections in all age groups. At present, many scholars believe that infection is the main pathogenic factor of asthma. Given this, this study aims to investigate the correlation between Mp infection and childhood asthma, elucidate the role of Mp infection in the onset and progression of asthma, and provide references for clinical treatment.

2. Materials and methods

2.1. General information

58 children with bronchopneumonia admitted to Changzhou Jintan First People's Hospital from April 2024 to October 2024 were selected as the study subjects, including 34 boys and 24 girls, aged 1–12 years (average 5.58 years). They were divided into a mycoplasma infection group (MP group) and a non-mycoplasma infection group (non-MP group).

The MP group consisted of 48 cases, including 29 boys and 19 girls, aged 1–12 years (average 5.4 years), while the non-MP group consisted of 10 cases, including 5 boys and 5 girls, aged 1–11 years (average 6 years). Additionally, the MP group was further divided into an MP wheezing group with 26 cases, including 17 boys and 9 girls, aged 1–12 years (average 5.32 years), and an MP non-wheezing group with 22 cases, including 12 boys and 10 girls, aged 2–11 years (average 5.68 years). Meanwhile, 10 healthy children undergoing physical examinations at the pediatric outpatient clinic of our hospital during the same period were selected as the control group.

There was no statistically significant difference in general information between the two groups ($P > 0.05$), indicating comparability. The families of the children provided informed consent and signed the agreement for this study. This study was reviewed and approved by the hospital's ethics committee.

Inclusion criteria are as follows:

- (1) Diagnostic criteria for children with bronchopneumonia are based on those outlined in the 8th edition of “Zhu Futang Practical Pediatrics,” which include respiratory symptoms such as fever, cough, and lung rales, accompanied by unilateral or bilateral abnormal changes on chest imaging. Diagnostic criteria for children with *M. pneumoniae* pneumonia (MP) are established based on the diagnosis of bronchopneumonia plus a single serum MP-IgM antibody titer of $\geq 1:160$ or a positive result for *M. pneumoniae* nucleic acid detection in throat swabs;
- (2) Complete clinical data.

Exclusion criteria:

- (1) Patients with underlying diseases;
- (2) Patients with concurrent immune system disorders;
- (3) Patients who have used immunosuppressants, hormones, or other drugs that may interfere with the study results within the past 2 weeks;
- (4) Patients who have already participated in similar studies.

2.2. Methods

Peripheral cubital venous blood (2 mL) was collected from hospitalized children with bronchopneumonia. A total of 58 patients were selected as subjects and divided into the MPPMP group and the non-MPPMP group. The MPPMP group was further divided into the MPPMP wheezing group and the MPPMP non-wheezing group.

Additionally, 58 hospitalized children with *M. pneumoniae* pneumonia were selected as subjects for the MP group, which was divided into the MP wheezing group and the MP non-wheezing group. All participants had blood samples collected in the morning, with 6 mL of peripheral cubital venous blood drawn from each.

ELISA was used to measure the levels of serum cytokines IL-4, IL-17, TGF- β 1, and INF- γ , TWEAK concentration, and the nuclear and cytoplasmic values of the nuclear transcription factor KB (NF-KB) in peripheral blood mononuclear cells (PBMCs). 10 healthy children undergoing physical examinations at the pediatric outpatient clinic of our hospital during the same period were selected as the non-MP control group.

For these children, 6 mL of peripheral cubital venous blood was also drawn, and ELISA was used to measure the levels of serum cytokines IL-4, IL-17, TGF- β 1, and INF- γ , TWEAK concentration, and the nuclear and cytoplasmic values of the nuclear transcription factor KB (NF-KB) in PBMCs.

2.3. Observation indicators

The observation indicators are as follows:

- (1) Comparison of the serum levels of cytokines IL-4, IL-17, TGF- β 1, and INF- γ between the MPPMP group and the non-MPPMP group;
- (2) Comparison of the levels of IL-4, IL-17, TGF- β 1, and INF- γ between the MPPMP wheezing group and the MPPMP non-wheezing group, along with a comparison of TWEAK and NF-KBMP levels between the two groups.

2.4. Statistical methods

Statistical analysis of the collected data was performed using SPSS 26.0 software. Measurement data were described using mean \pm standard deviation (SD), and a completely randomized design two independent samples t-test was employed. Between-group analysis was conducted using one-way analysis of variance, while pairwise comparisons within groups were performed using the LSD-t test. A *P*-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of cytokines between the MPPMP group and the non-MPPMP group

The levels of IL-4 and IL-17 in the MPPMP group were significantly lower/higher than those in the non-MPPMP group ($P < 0.05 = 0.041$), while no statistically significant differences were observed for the other indicators ($P > 0.05$), as shown in **Table 1**.

Table 1 Comparison of cytokines between the MPPMP group and the non-MPPMP group (mean \pm SD)

Indicator	MP group (n=48)	Non-MP group (n=10)	t-value	P-value
IL-4	568.12 \pm 78.34	440.15 \pm 65.28	6.667	< 0.05
IL-17	368.45 \pm 72.16	213.87 \pm 85.24	7.855	< 0.05
TGF- β 1	573.24 \pm 162.47	560.13 \pm 158.36	0.233	> 0.05
IFN- γ	223.15 \pm 56.78	218.86 \pm 54.32	0.219	> 0.05

3.2. Comparison of cytokines between the MPPMP wheezing group and the non-wheezing group

The levels of IL-4 and IL-17 in the wheezing group were significantly higher than those in the non-wheezing group ($P < 0.05$), while no statistically significant differences were observed for the other indicators between the two groups ($P > 0.05$), as shown in **Table 2**.

Table 2 Comparison of cytokines between the MPPMP wheezing group and the non-wheezing group (mean \pm SD)

Indicator	Wheezing group (n=24)	Non-wheezing group (n=22)	t-value	P-value
IL-4	592.47 \pm 65.32	489.83 \pm 72.45	5.053	< 0.05
IL-17	291.36 \pm 68.24	200.12 \pm 73.56	4.364	< 0.05
TGF- β 1	598.15 \pm 155.36	518.42 \pm 148.27	1.777	> 0.05
IFN- γ	215.78 \pm 52.47	227.36 \pm 55.18	0.729	> 0.05

3.3. One-way analysis of variance

Significant differences in IL-17 levels were observed between groups ($P < 0.05$), as shown in **Table 3**.

Table 3. One-way analysis of variance (ANOVA) between groups

Indicator	F-value	P-value
IL-4	2.147	0.126
IL-17	3.452	0.038
TGF- β 1	1.836	0.175
IFN- γ	0.528	0.592

Further pairwise comparisons using the LSD-t test revealed significant differences in IL-17 levels between the MP group and the non-MP group ($P < 0.05$), as well as marginally significant differences between the wheezing group and the non-wheezing group ($P < 0.05$), as shown in **Table 4**.

Table 4. LSD-t test (pairwise comparisons between IL-17 groups)

Comparison groups	Mean difference	P-value
MP wheezing vs non-wheezing group	91.24	0.066
MP vs non-MP group	154.58	0.041

4. Discussion

Immune damage caused by MP infection may lead to the occurrence of various diseases, particularly in pediatric respiratory diseases such as wheezing bronchitis, bronchopneumonia, and asthma^[4]. MP can be directly inhaled through respiratory secretions or contracted through close contact, and it can also spread via aerosols. Humans are the only natural host for *M. pneumoniae*, and individuals are generally susceptible to MP, with school-aged children being the most vulnerable^[5]. Several epidemiological studies have established a significant association between *M. pneumoniae* infection and the development of asthma in children. It is reported that approximately 50%–70% of children with asthma have MP infection^[6].

Unlike ordinary bronchopneumonia, the pathogenesis of *M. pneumoniae* is not directly caused by pathogen damage but is related to the overactivation of the host immune response. It can stimulate various immune cells (such as T lymphocytes and macrophages), leading to abnormal secretion of a series of cytokines, causing lung tissue damage and systemic inflammatory responses, thereby resulting in immune dysfunction. This affects the body's response to foreign substances and triggers related allergic diseases, such as allergic rhinitis, allergic asthma, and allergic conjunctivitis^[7]. However, the impact of MP infection on asthma has not been fully studied.

The results of this study showed that the IL-4 levels in children with positive MP infection were higher than those in non-MP pneumonia patients, and within the MP group, the wheezing group had higher levels than the non-wheezing group. This suggests that IL-4 plays a crucial role in the immune response to *M. pneumoniae* and may be associated with wheezing.

Studies have shown that IL-4, as one of the Th2-type cytokines, exhibits significantly high expression in *M. pneumoniae*. This indicates that MP infection can induce T lymphocytes to differentiate towards the Th2 direction, leading to excessive secretion of IL-4, promoting B cell proliferation and IgE production. Simultaneously, it can induce excessive airway mucus secretion and airway hyperresponsiveness, triggering wheezing attacks^[8].

As a pro-inflammatory cytokine, IL-17 was found to be higher in children with positive *M. pneumoniae* infection than in those with non-Mp pneumonia in our experimental results, and higher in the wheezing group than in the non-wheezing group within the Mp-infected cohort. This similarly indicates that IL-17 not only participates in the inflammatory response of *M. pneumoniae* but may also play a significant role in inducing wheezing. Studies have shown that IL-17 can participate in pulmonary inflammatory injury in *M. pneumoniae* through multiple pathways.

On one hand, IL-17 can activate inflammatory cells such as neutrophils and macrophages, promoting the release of inflammatory cytokines such as IL-6, IL-8, and TNF- α , thereby triggering a heightened inflammatory response^[9]. On the other hand, IL-17 can directly damage airway epithelial cells, increase vascular permeability, and exacerbate airway mucus secretion, thereby inducing wheezing. Additionally, some studies have demonstrated a significant positive correlation between the serum levels of IL-17 and IL-4, with both cytokines jointly promoting the production of IgE and the activation of eosinophils, leading to a mixed inflammatory response characterized by simultaneous infiltration of neutrophils and eosinophils.

This suggests a potential synergistic effect between IL-17 and IL-4 in *M. pneumoniae*^[10]. Previous literature has reported that in school-aged children, Mp infection can cause airway inflammation, airway remodeling, and airway dysfunction, increasing the risk of asthma development. In adults and the elderly, Mp is more likely to promote asthma by activating inflammatory pathways mediated by epithelial cells, immune cells, and monocytes/macrophages^[11]. Some studies suggest that in the Chinese population, Mp infection is an independent risk factor for the progression of chronic obstructive pulmonary disease (COPD) to asthma^[12]. However, these studies did not

involve long-term follow-up of children with wheezing after Mp infection, and whether persistent or irreversible airway inflammation and airway hyperresponsiveness exist remain to be further investigated.

In this study, the results for TGF- β 1 and INF- γ showed no statistical significance, and several limitations were identified in the analysis:

- (1) The small number of included cases limited a comprehensive assessment of the clinical significance of Mp infection;
- (2) The short duration of specimen collection and the lack of pre- and post-treatment comparisons prevented an analysis of inflammatory factor levels during the acute and recovery phases and their impact on wheezing outcomes;
- (3) The case selection was biased toward urban areas, and rural regions, with relatively lower medical standards, were not included in this study. Therefore, it is necessary to further expand the sample size and employ more sensitive detection methods, such as high-throughput sequencing, to evaluate whether Mp infection is an independent inducer of childhood asthma, thereby further elucidating its underlying mechanisms. The asthmatic children included in this study were all inpatients, with relatively few visits at home or outpatient clinics, which may lead to bias in some test results.

Due to the small sample size and short duration of this study, no long-term follow-up was conducted on the relationship between MP infection and asthma, which limits our ability to further explore this issue. Additionally, as this study was retrospective, there was no clear record of whether patients received antimicrobial therapy, making it impossible to assess the impact of antimicrobial drugs on the onset and progression of childhood asthma.

In the future, prospective cohort studies should be conducted to further explore the correlation and mechanisms between Mp infection and childhood asthma, as well as to understand the role of antimicrobial drugs in this context, thereby guiding rational clinical drug use.

5. Conclusion

In conclusion, *M. pneumoniae* infection may serve as a potential risk factor for the development of childhood asthma, although the underlying mechanisms remain unclear. Further research is essential to determine whether *M. pneumoniae* infection can be utilized as a reliable biomarker for asthma in children and to elucidate the pathogenic pathways involved.

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The Application of TCM's "Preventive Treatment of Diseases" Concept in Daily Hospital Infection Management

Qun Liang

Changning District Maternity and Infant Health Hospital, Shanghai 200050, China

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Abstract: With the development and popularization of modern medicine, the importance of daily hospital infection management has been continuously enhanced, making it a key approach to improving hospital safety standards and safeguarding patients' lives. This paper explores the core connotation of the "Preventive Treatment of Diseases" concept in Traditional Chinese Medicine (TCM) and integrates it into the practice of modern hospital infection management. On one hand, it analyzes the current dilemmas in daily hospital infection management from dimensions such as frequent personnel flow, difficulties in disinfection and isolation, risks of antimicrobial abuse, and limited awareness of medical staff. On the other hand, it proposes the application scope of TCM's "Preventive Treatment of Diseases" concept from aspects including preventive culture, environmental infection control, early warning mechanisms, and health education. Based on this, a more forward-looking, systematic, and humanistic hospital infection management system is constructed to achieve the transformation from passive response to active intervention.

Keywords: Traditional Chinese Medicine (TCM); "Preventive Treatment of Diseases" concept; Hospital infection management

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1. Introduction

Hospital infection management is the guarantee of medical quality and the prerequisite for patient safety. Particularly in maternal and child health institutions, pregnant and lying-in women are in a special physiological stage, while newborns have not yet established a sound immune system, both groups belong to the population vulnerable to infections. Thus, the significance of infection management is even more prominent. At present, China's hospital infection management model mainly relies on "monitoring, isolation, and disinfection technologies" as basic means, which have achieved remarkable application effects. However, this infection management model also faces challenges such as high costs, the emergence of drug-resistant bacteria, and passive response. Against this background, this paper introduces TCM's "Preventive Treatment of Diseases" concept,

and through prevention and intervention before the occurrence of diseases, constructs a daily hospital infection management paradigm featuring “prevention first” and “prevention is more important than treatment,” so as to open up new ideas for improving the hospital’s infection control level.

2. Overview of TCM’s “Preventive Treatment of Diseases” concept

TCM’s “Preventive Treatment of Diseases” concept refers to taking corresponding measures in daily work to prevent the occurrence and progression of diseases in advance ^[1]. This concept can be analyzed from three dimensions. The first is “prevention before disease onset”, which means improving patients’ ability to resist diseases and reducing infection risks through methods such as “enhancing physical fitness, regulating mental state, maintaining a reasonable diet, and adapting to the environment” before a disease occurs, so as to achieve the effect of universal prevention. The second is “prevention of disease progression after onset”, which involves avoiding the in-depth development and transmission of diseases through “early diagnosis and early treatment” in the initial stage of a disease, thereby realizing the infection management goals of “early detection, early reporting, early isolation, and early treatment”. The third is “prevention of recurrence after recovery”, which refers to preventing disease recurrence through “scientific nursing and consolidating curative effects” after a disease is cured; under the infection management model, this can be achieved by providing “rehabilitation guidance and follow-up” to discharged patients and those who have recovered from infections, so as to prevent secondary infections or their transformation into infection sources.

3. Dilemmas in daily hospital infection management

3.1. Specificity of the population and complexity of environmental management

From the perspective of patients, most patients are in a period of weak immunity and resistance due to disease invasion or other physiological reasons during hospitalization, making them more prone to infections. Especially in maternal and child health hospitals, pregnant and lying-in women have significant differences in their endocrine systems compared with usual times, and their immune systems are in a sensitive period, so they are typical vulnerable groups ^[2]. At the same time, newborns have not yet established a sound skin protective barrier and self-immune system, and are highly sensitive to various pathogenic bacteria.

From the perspective of the environment, hospitals have a variety of patients, and there are also family visits, which pose a high risk of cross-infection. In maternal and child health hospitals, areas such as delivery rooms, neonatology departments, and mother-and-baby rooms have higher requirements for the environment. This requires hospitals to establish a more complete infection management mechanism to avoid the formation of high-risk infection areas.

From the perspective of management, infection management work needs to find a balance between disinfection and isolation systems and humanistic care culture. It is necessary to achieve the due infection prevention effect while making patients and their families feel the hospital’s humanized services.

3.2. Challenges in the rational use of antibacterial drugs

With the overuse of antibacterial drugs, hospitals currently face the problem of an increase in drug-resistant bacteria, which further increases the difficulty of infection management work. On one hand, some hospitals have

the wrong idea of confusing treatment with prevention. The preventive use of antibacterial drugs is common, but the “indication grasp, drug selection, and course duration” of drugs have not been scientifically determined ^[3]. Irregular use is more likely to lead to flora imbalance and the emergence of drug-resistant bacteria.

On the other hand, the excessive use of broad-spectrum antibacterial drugs has led to the widespread emergence and spread of drug-resistant strains such as MRSA and ESBLs in hospitals, which further increases the difficulty of treating infected patients ^[4].

3.3. Limitations in medical staff's concepts and behaviors

In daily hospital infection management, medical staff also have certain issues with conceptual cognition and limitations in behaviors. From the perspective of cognitive bias, some medical staff regard infection control management as the full-time responsibility of the “infection control department”. They lack the awareness to take the initiative to participate in relevant actions, fail to establish the self-role positioning of “everyone is an infection control practitioner”, and do not proactively learn or understand relevant knowledge, this leads to their failure to implement infection prevention measures throughout all aspects of daily work.

From the perspective of behavioral compliance, medical staff currently face high work intensity. Some of them compromise on basic systems such as aseptic operation and hand hygiene maintenance in clinical work, and fail to attach importance to infection prevention-related rules and systems in all details.

From the perspective of staff training, hospitals at this stage mainly focus on publicizing relevant rules and regulations in infection control training, and adopt a single-form training model. This not only makes it difficult to correct the wrong cognition of some medical staff, but also fails to cultivate their sense of self-discipline and responsibility, and struggles to establish their belief in infection prevention.

3.4. Passivity and lag of the monitoring and early warning system

Monitoring and early warning are the basic means to achieve the goals of hospital infection management, but the existing monitoring and early warning system has problems such as passivity and lag.

First, its monitoring behavior is passive. Most of the existing infection monitoring work adopts a post-event review method. Intervention measures are only taken immediately when infection cases are found, resulting in the lack of preventive effect.

Second, its early warning effect is poor. Currently, hospitals have not established a risk factor monitoring and investigation system in infection management work. This makes it impossible for hospitals to timely understand the risk factors faced by infection control work, and thus unable to establish a forward-looking early warning system. For example, no real-time monitoring platform for patient information has been established, making it impossible to obtain real-time information such as patients' nutritional status, stress level, and environmental microbial data ^[5]. As a result, the “pre-disease” signs cannot be incorporated into the early warning system.

Third, its data application effect is not good. Hospitals do not conduct in-depth analysis of the monitoring data of patients and hospital environment. Most of them only use the data change rate as a reference value, fail to deeply explore characteristics such as its occurrence trend and development law, and even do not give play to the auxiliary advantages of big data and artificial intelligence technology.

4. Application strategies of TCM’s “Preventive Treatment of Diseases” concept in daily hospital infection management

4.1. Constructing an infection control culture system of “Prevention Before Disease Onset”: strengthening “Righteous Qi” and “Pathogen Prevention”

For daily hospital infection management, it is not an exclusive responsibility of the hospital’s infection control department, but a systematic and regular project involving all medical staff in the hospital. Guided by TCM’s “Preventive Treatment of Diseases” concept, hospitals should start from top-level design and give priority to building an infection control culture system of “prevention before disease onset”, so as to help medical staff correct their cognition and attitude and participate in infection management work collectively.

First, for medical staff, a comprehensive infection control training system based on the “Preventive Treatment of Diseases” concept should be established. Through special courses, online expert lectures, infection control common sense education, and reforms of assessment and incentive mechanisms, medical staff can fully recognize the importance of infection control work, and consciously maintain correct and scientific behavioral habits in daily work ^[6]. This elevates infection control to the level of medical ethics and professional honor, and guides medical staff to develop the proactive awareness of “I need to do infection control”.

Second, for patients and their families, a systematic health education system should be established, with TCM health preservation concepts integrated into it. Taking maternal and child health hospitals as an example, in addition to conducting daily anti-infection behavior education and standardized guidance, medical staff can also guide pregnant women to maintain a reasonable diet to achieve the goal of “nourishing qi and blood”, and help them “regulate qi movement” by relieving emotions, so as to enhance patients’ anti-infection ability and physical fitness ^[7].

Third, it is necessary to establish the infection control culture system and management measures of “prevention before disease onset”. On one hand, infection control behavior indicators such as hand hygiene compliance rate should be linked to the performance of departments and individual medical staff; medical staff with poor daily performance should be penalized and provided with training. On the other hand, an honorary selection mechanism such as “Infection Control Model” should be established: medical staff who excel in implementing daily infection control behaviors should be awarded honors and bonuses, and a positive preventive culture atmosphere should be created through daily promotion and guidance ^[8].

4.2. Implementing precise intervention measures of “Preventing Disease Progression After Onset”: Achieving “Early Detection” and “Prevention of Transmission”

Daily hospital infection management cannot completely eliminate infection issues. Therefore, when infections occur, medical staff should adhere to the concept of “preventing disease progression after onset” and achieve the goals of “early detection” and “prevention of transmission” through precise intervention measures. Under the guidance of TCM’s “Preventive Treatment of Diseases” concept, hospitals should thus prevent the spread and deterioration of infections through improved identification, management, and intervention methods.

First, an early identification mechanism should be established. Hospitals should refer to TCM’s diagnostic methods of “observation, auscultation & olfaction, inquiry, and pulse-taking” to guide all medical staff in enhancing their sensitivity to early infection signals and symptoms. For example, in maternal and child health hospitals, medical staff should observe parturients’ lochia and tongue coating daily, proactively listen to newborns’ cries and breathing sounds, and understand patients’ discomfort through inquiries, all to detect early signs of

infection in a timely manner^[9].

Second, a hierarchical management mechanism should be established. Hospitals should classify patients' infection risks and develop corresponding assessment systems. Taking maternal and child health hospitals again as an example, pregnant and lying-in women with high-risk factors such as advanced age, cesarean section, malnutrition, and use of immunosuppressants should be identified as key groups for "preventing disease progression after onset," and a more comprehensive and strict monitoring and intervention system should be established specifically for this group^[10].

Third, a rational medication mechanism should be established. The overuse of antibacterial drugs continuously increases the difficulty of hospital infection management; thus, hospitals should also introduce TCM's "syndrome differentiation and treatment" concept to optimize the antibacterial drug management mechanism. On one hand, it is advisable to advocate the combination of TCM methods when antibacterial drugs are used with clear indications, while eliminating and cleaning harmful bacteria, probiotics should also be cultivated to "strengthen the body's vital qi and consolidate the root"^[11]. On the other hand, a sound regulation for antibacterial drug use should be established, setting restrictive conditions for the use of antibacterial drugs at different levels. Through control measures such as time intervals, dosage, and application areas, the risks of flora imbalance and secondary infections can be reduced^[12].

4.3. Optimizing infection control environment management based on "Harmony Between Human and Nature": Achieving "Alignment with Seasons" and "Avoidance of Impurities"

Infection control environment management is a key component of daily hospital infection management. Hospitals should center on TCM's "Preventive Treatment of Diseases" concept and establish an environmental management strategy based on "harmony between human and nature".

First, optimize the environmental layout and ventilation design. Hospitals should adjust ward layouts to ensure good indoor lighting and ventilation. Meanwhile, during seasonal transitions or peak influenza periods, regular disinfection should be conducted in wards using TCM herbal air fumigation, which optimizes the environment in a relatively gentle way^[13].

Second, apply appropriate TCM techniques. Hospitals can recommend or provide TCM anti-epidemic sachets to all medical staff and infection-vulnerable patients, or conduct interventions through non-pharmaceutical methods such as drinking TCM preventive herbal infusions. These measures supplement and improve standard protective methods.

Third, establish a microenvironment control mechanism. Hospitals should use modern microbial monitoring technology, integrate TCM's "Five Elements and Six Climates" theory, and conduct in-depth research on the growth rules and spread paths of pathogenic microorganisms in hospitals under different climatic conditions^[14]. On this basis, a forward-looking environmental disinfection and sterilization mechanism can be established.

4.4. Establishing a whole-process management model of "Prevention of Recurrence After Recovery": Focusing on "Strengthening Vital Qi" and "Preventing Recurrence"

The "Preventive Treatment of Diseases" concept in Traditional Chinese Medicine (TCM) not only emphasizes early prevention before the onset of disease, but also focuses on secondary protection after recovery. Therefore, in daily hospital infection management, a whole-process management model for "prevention of recurrence after recovery" should also be established.

First, establish discharge guidance standards. For patients discharged after recovering from infections, hospitals should provide personalized TCM rehabilitation guidance and education. For example, for parturients with wound infections or mastitis, a guidance manual and courses covering “dietary regulation, emotional adjustment, and simple acupoint massage” can be provided to help them recover quickly^[15].

Second, establish a follow-up monitoring mechanism. Follow-up files should be created for patients discharged after infections, and their recovery effects should be tracked and observed through methods such as phone calls and WeChat, while answering patients’ questions.

Third, pay attention to the health of medical staff. Hospitals should establish health records for employees, and in particular, provide TCM health consultation and conditioning support for overworked medical staff to reduce their risk of infection.

5. Conclusion

In summary, TCM’s “Preventive Treatment of Diseases” concept is a kind of preventive wisdom, which provides important theoretical guidance for modern hospital infection management. Integrating the “Preventive Treatment of Diseases” concept into daily hospital infection management can not only improve the existing infection control technology system, but also establish an active health management system featuring the harmony of “human-machine-environment”. In addition, TCM’s “Preventive Treatment of Diseases” concept also has higher humanistic care and practical value, and it is an inevitable trend to build a more resilient and high-quality hospital infection prevention and control system.

Disclosure statement

The author declares no conflict of interest.

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A Study on the Application Effect of the Joint Rehabilitation Intervention Based on the Hospital-Community-Family Model for Middle-Aged and Elderly Patients with Chronic Kidney Disease

Meijie Zheng¹, Wenxiu Liu¹, Bohan Qu¹, Qiong Meng¹, Ziyi Chen¹, Xinping Zhang², Xian Li^{1*}

¹Hebei General Hospital, Shijiazhuang 050000, Hebei, China

²Hebei Provincial Children's Hospital, Shijiazhuang 050000, Hebei, China

*Corresponding author: Xian Li, Lixian1966@126.com

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Abstract: *Objective:* To explore the application effect of the hospital-community-family model-based combined rehabilitation exercise intervention on middle-aged and elderly patients with chronic kidney disease. *Methods:* Using the convenience sampling method, 80 patients in the stable stage of CKD who were treated in the nephrology department of a tertiary hospital from May 2022 to June 2023 were selected as the research subjects. They were divided into the experimental group (40 cases) and the control group (40 cases) by random number table method. The control group received conventional exercise intervention plus telephone follow-up, while the experimental group received combined hospital-community-family model-based exercise intervention in addition to the control group, using remote medical guidance and monitoring of the application effect of exercise rehabilitation on middle-aged and elderly patients with chronic kidney disease. The glomerular filtration rate, 6-minute walking distance, fatigue and social support scores of the two groups of patients were measured before the intervention, 4 weeks after the intervention, and 12 weeks after the intervention. *Results:* Before the intervention, there were no statistically significant differences in glomerular filtration rate, 6-minute walking distance, fatigue and social support scores between the two groups ($p > 0.05$). After 12 weeks of intervention, the glomerular filtration rate, 6-minute walking distance and social support scores of the experimental group were higher than those of the control group; the differences were statistically significant ($p < 0.05$). The behavioral, emotional, sensory and cognitive scores of the Piper-Fatigue Revised Scale of the experimental group were lower than those of the control group, and the differences were statistically significant ($p < 0.05$). *Conclusion:* Based on the hospital-community-family model combined rehabilitation exercise, using remote medical guidance for the continuous care of middle-aged and elderly patients in the stable stage of chronic kidney disease can effectively improve the exercise endurance and social support level of patients, improve the fatigue condition, and the implementation effect is positively correlated with the intervention time.

Keywords: Hospital-community-family model; Remote medical care; Middle-aged and elderly people; Chronic kidney disease patients; Rehabilitation exercise

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1. Introduction

Chronic kidney disease (CKD) refers to a decline in kidney function, characterized by a glomerular filtration rate (GFR) lower than 60 mL/min/1.73 m², or the detection of kidney damage markers, with a duration of at least 3 months^[1]. The global prevalence of CKD is 9.1%, and the prevalence in China is 8.2%^[2,3]. The average age of patients with CKD is 43.8 years, and middle-aged and elderly patients have become the main population of CKD in China. CKD can lead to a decline in patients' self-care ability, and restricting activities can cause muscle atrophy, fatigue, and more, further aggravating the patient's condition and reducing their quality of life, and making the physiological and psychological dysfunction problems of patients increasingly prominent^[4-7].

The construction of the hospital-community-family linkage model not only improves the treatment level of nurses at the community and other grassroots levels, but also enables the three to coordinate and develop, allowing the community and family to fully play their roles and provide effective continuous care for patients^[8]. Through remote medical forms such as remote assessment, remote monitoring, remote diagnosis, and remote rehabilitation^[9]. It effectively improves the treatment effect of patients and delays the progression of the disease^[10-13].

In the 2021 "Clinical Practice Guidelines for Exercise and Lifestyle in Chronic Kidney Disease" issued by the British Kidney Society, it is emphasized that CKD patients should, when their physical conditions permit, use low-intensity activities to break the long-term sedentary state. In the expert consensus on exercise rehabilitation for adult patients with chronic kidney disease in China, it is pointed out that regular exercise can improve the body function, muscle strength, and health-related quality of life of CKD patients^[14-15].

This study conducts rehabilitation exercise intervention guidance and monitoring for CKD patients based on the hospital-community-family model to help patients undergo exercise rehabilitation and then assess the rehabilitation effect of the combined rehabilitation exercise intervention based on the hospital-community-family model for patients.

2. Objectives and methods

2.1. Research subjects

This study continuously included 80 middle-aged and elderly patients with stable CKD who were treated in the nephrology ward of a tertiary hospital in Hebei Province from May 2022 to June 2023 as the research subjects. Using the random number table method, the enrolled patients were divided into the experimental group and the control group, with 40 patients in each group.

2.1.1. Inclusion criteria

Meeting the definition of CKD proposed by the American Kidney Disease Prognosis Quality Guidelines, with a disease course of ≥ 3 months; clinically diagnosed stable CKD stages 1 to 4, and not undergoing maintenance dialysis treatment; middle-aged and elderly patients aged ≥ 45 years; having independent walking ability and being able to complete the individualized exercise prescription as required under guidance; long-term residence after discharge within the community covered by the hospital's remote medical platform; being able to communicate without obstacles with the researchers, voluntarily participating throughout the study, and signing an informed consent form.

2.1.2. Exclusion criteria

Unconsciousness, patients with mental disorders; those who cannot cooperate with exercise due to other reasons, such as post-stroke sequelae, fractures, or severely deformed limbs due to deformities; those with severe heart, liver, brain, lung and other serious kidney diseases; those currently participating in clinical trials. There was no statistically significant difference in the general data between the two groups ($p > 0.05$).

2.2. Intervention methods

Development of exercise prescription: The exercise prescription was formulated based on the “Clinical Practice Guidelines for Exercise Rehabilitation in Chronic Kidney Disease”^[15].

(1) Exercise form

Mainly aerobic exercises, including resistance training such as gymnastics, walking, cycling, and swimming; flexibility training such as sandbags, elastic bands, Tai Chi, yoga, and Baduanjin.

(2) Exercise intensity

Adjust the exercise intensity according to the results of the exercise test. Start with activities within the subjective exertion score range of 11–13, gradually increasing to a subjective exertion score range of 11–16.

(3) Exercise frequency

Aerobic exercise starts with 2 times per week, gradually increasing to 3–5 times per week; resistance training starts with 2 non-consecutive days per week, and can be increased to 3 times per week; flexibility training is 5 times per week.

(4) Exercise duration

Including 5–10 minutes of warm-up before exercise, 20–30 minutes of exercise duration, and 5–10 minutes of relaxation after exercise. The total duration of each session is 30–60 minutes.

2.2.1. Control group

The control group received routine care from the nephrology department. The routine care measures included as follow.

- (1) When the patient was admitted, the nephrology nurses introduced the department environment to the patient and their family members, assisted the patient in undergoing relevant examinations, established a good nurse-patient relationship, and understood the patient’s health needs.
- (2) During hospitalization, the physician and rehabilitation therapist formulated an appropriate exercise prescription for the patient, and the nephrology nurses provided exercise guidance and routine post-discharge health education to the patient; the researchers introduced the characteristics, complications, and adverse outcomes of chronic kidney disease to the patient and their caregivers, enhancing the patient’s understanding of the disease.
- (3) After discharge, they received routine community services, including chronic disease-specific management provided by the community health center and monthly health education classes
- (4) For patients with chronic kidney disease at home, the nephrology nurses provided a one-time telephone follow-up service, mainly educating the patient on precautions for home exercise.

2.2.2. Experimental group

On the basis of conventional treatment and care, a combined rehabilitation program based on the hospital-community-family model is implemented, and intervention care is carried out through a remote medical platform. The specific intervention measures are as follows.

(1) Establish a remote platform and a movement intervention team

The team members consist of 2 nephrology specialists, 1 exercise rehabilitation therapist, 2 nephrology nurses, 2 community nurses, and 1 remote platform engineer. The nephrology specialists and exercise rehabilitation therapists are responsible for prescribing individualized exercise regimens for patients based on their conditions and exercise capabilities; the nephrology nurses are responsible for providing relevant education before exercise training, explaining the content and precautions of the exercise prescription, and coordinating the time and content of regular video conferences between the remote platform and the patients after the patients are discharged; the remote platform engineer is responsible for the use and maintenance of the platform.

(2) Remote exercise and health management content

Two remote exercise supervision and follow-up sessions are conducted every week. Online exercise supervision and guidance. Firstly, warm-up exercise for each session lasts for 10 minutes. Secondly, aerobic exercise by brisk walking or cycling exercise.

The brisk walking exercise is carried out at a rate of 100–200 steps per minute; cycling exercise is done 5 km each time, 2 times a day, 10 minutes each time; c. Resistance exercise: elastic band exercise or dumbbell exercise. Pull the elastic band with both hands forcefully, parallelly raise when inhaling, and return to the original position when exhaling; perform left and right stretching, one arm pulling the other arm, stretching the outer side of the upper arm and extending the armpit.

Pull with force when inhaling, and return when exhaling. 3 sets per day, 10 per set; d. Stretching exercise: After each exercise session, patients perform 15 minutes of stretching exercise. The rehabilitation therapist checks the accuracy of the patient's exercise prescription and asks the patient if their daily exercise meets the prescription standards, supervises their exercise compliance, and asks if they experience any physical discomfort during the exercise. Adjust according to the changes in the patient's exercise ability.

Online consultation, for example patients can consult hospital or community medical staff via remote platform in the form of text, language, pictures or videos

Online health education, for example, nephrology specialist nursing experts can conduct online education lectures every month. The lecture content is determined according to the patients' needs, mainly focusing on the prevention of acute and chronic complications and lifestyle guidance for middle-aged and elderly CKD patients.

(3) Patient-side operation of the remote platform

Researchers release videos related to chronic kidney disease rehabilitation exercise on the remote medical platform of a tertiary hospital in Hebei Province every Monday, Wednesday and Friday, for patients, community medical staff and caregivers to learn, to increase the enthusiasm of patients to participate in exercise rehabilitation training.

2.3. Observation indicators

During the follow-up visit of the patient, data collection was conducted. The observation indicators included as below.

(1) Glomerular Filtration Rate

Glomerular Filtration Rate (GFR) refers to the volume of ultrafiltrate produced by both kidneys within a unit of time, and is used to evaluate the filtration function of the kidneys. The calculation method for estimated glomerular filtration rate (eGFR): The Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation is adopted (**Table 1**).

Table 1. CKD-EPI equations for estimating GFR based on gender, serum creatinine (Scr), and age

Gender	Scr($\mu\text{mol/L}$)	GFR(CKD-EPI) [$\text{mL}^{-1} \times (1.73\text{m}^2)^{-1}$]
Female	≤ 62	$144 \times (\text{Scr}/62)^{-0.329} \times 0.993^{\text{age}}$
	> 62	$144 \times (\text{Scr}/62)^{-1.209} \times 0.993^{\text{age}}$
Male	≤ 80	$144 \times (\text{Scr}/80)^{-0.411} \times 0.993^{\text{age}}$
	> 80	$144 \times (\text{Scr}/80)^{-1.209} \times 0.993^{\text{age}}$

(2) 6-minute walk test

The 6-minute walk test (6MWT) is an effective assessment tool for chronic diseases, evaluating the patient's exercise endurance by measuring the distance they can walk in 6 minutes, and determining the exercise function and rehabilitation effect.

(3) Fatigue

The Piper-Fatigue Revised Scale is used to evaluate the degree of fatigue of the patients. This scale consists of 22 items, divided into 4 dimensions (behavior, emotion, perception, and cognition). The scoring method for the items is a 0–10 points grading system. The total score of the scale is calculated as the average score of the included items. Fatigue is classified into four levels based on the score: none (0 points), mild (1–3 points), moderate (4–6 points), and severe (7–10 points). The score range is from the lowest 0 points to the highest 10 points. The higher the score, the heavier the perceived fatigue. The Cronbach's α coefficient of this scale is 0.97, indicating good reliability and validity ^[16].

(4) Social support

The Social Support Rating Scale (SSRS) compiled by Xiao Yuanwater et al. is used to assess the degree of social support ^[17]. This scale includes 3 dimensions: "objective support, subjective support, and utilization of social support", with a total of 10 items. It uses a 4-point rating system, with a total score ranging from 10 to 40 points. The higher the score, the higher the degree of social support.

2.4. Statistical methods

The data were analyzed using SPSS 25.0 statistical software. For the measurement data that conformed to the normal distribution, the mean \pm standard deviation was used to represent them. Paired *t*-test was employed for comparisons between groups; repeated measures analysis of variance was used for comparisons within the three different time groups. A difference was considered statistically significant when $p < 0.05$.

3. Results

3.1. Comparison of glomerular filtration rate between the two groups of patients

The comparison of glomerular filtration rate between the two groups of patients before intervention, 4 weeks after intervention, and 12 weeks after intervention is shown in **Table 2**.

Table 2. Comparison of glomerular filtration rate before and after intervention between the two groups of patients (mL/min, $\bar{x} \pm s$)

Time	Prior treatment	Treatment for 4 weeks	Treatment for 12 weeks
Experimental group	86.867 \pm 12.772	87.006 \pm 12.648	99.367 \pm 8.349
Control group	87.172 \pm 12.710	87.097 \pm 12.648	84.007 \pm 9.286
<i>F</i> value	<i>F</i> _{Intergroup} 4.074	<i>F</i> _{Time} 31.447	<i>F</i> _{Interaction} 85.872
<i>t</i> value	-0.515	-0.146	13.112
<i>p</i> value	0.609	0.885	< 0.001

Before intervention in both groups of patients, the glomerular filtration rate was compared, and the difference was not statistically significant ($p > 0.05$); at 4 weeks after intervention, the glomerular filtration rate of patients in the experimental group and those in the control group was compared, and the difference was statistically significant ($p < 0.05$); after 12 weeks of intervention, the glomerular filtration rate of patients in the experimental group and those in the control group was compared, and the difference was statistically significant ($p < 0.05$).

3.2. Comparison of 6-minute walking distance indicators between the two groups of patients

The comparison of 6MWD between the two groups of patients including 3 timelines, first before intervention, second, 4 weeks after intervention, and third, 12 weeks after intervention is shown in **Table 3**.

Table 3. Comparison of 6MWD before and after intervention between the two groups (m, $\bar{x} \pm s$)

Time	Prior treatment	Treatment for 4 weeks	Treatment for 12 weeks
Experimental group	316.545 \pm 29.218	335.295 \pm 28.296	370.570 \pm 24.636
Control group	311.195 \pm 22.652	320.920 \pm 22.888	320.920 \pm 24.636
<i>F</i> value	<i>F</i> _{Intergroup} 23.197	<i>F</i> _{Time} 320.931	<i>F</i> _{Interaction} 152.641
<i>t</i> value	1.332	5.928	14.025
<i>p</i> value	0.191	< 0.001	< 0.001

Before intervention, a comparison of 6MWD was conducted between the two groups of patients, and the difference was not statistically significant ($p > 0.05$); at 4 weeks after intervention, the 6MWD comparison between the patients in the experimental group and the control group showed a statistically significant difference ($p < 0.05$); after 12 weeks of intervention, the 6MWD comparison between the patients in the experimental group and the control group yielded a statistically significant result ($p < 0.05$).

3.3. Comparison of fatigue conditions between the two groups of patients

The comparison of fatigue scores of the two groups of patients before the intervention, 4 weeks after the intervention, and 12 weeks after the intervention is presented (see **Table 4**). Before the intervention, the scores of each dimension of fatigue and the total score of the two groups of patients were compared, and the difference was not statistically significant ($p > 0.05$); 4 weeks after the intervention, the scores of the two groups of patients in the two fatigue dimensions (behavior, emotion) and the total score showed a statistically significant difference ($p > 0.05$); 12 weeks after the intervention, compared with the control group, the scores of each dimension and the total score of fatigue in the experimental group showed statistically significant differences ($p < 0.05$).

Table 4. Comparison of fatigue levels before and after intervention in the two groups of patients (points, $\bar{x} \pm s$)

Measure	Time	Experimental group	Control group	<i>F</i> value	<i>t</i> value	<i>p</i> value
Behavioral	Prior treatment	3.024 ± 0.762	3.143 ± 0.897	$F_{\text{Intergroup}}$ 21.874	-0.421	0.676
	Treatment for 4 weeks	2.486 ± 0.718	3.018 ± 1.086	F_{Time} 51.470	-3.418	0.001
	Treatment for 12 weeks	1.364 ± 0.513	2.898 ± 1.019	$F_{\text{Interaction}}$ 29.056	-8.809	< 0.001
Affective	Prior treatment	3.440 ± 0.879	3.623 ± 1.037	$F_{\text{Intergroup}}$ 16.462	-1.656	0.106
	Treatment for 4 weeks	2.890 ± 0.998	3.491 ± 1.020	F_{Time} 92.215	-4.187	< 0.001
	Treatment for 12 weeks	1.784 ± 0.498	3.340 ± 1.068	$F_{\text{Interaction}}$ 42.278	-9.452	< 0.001
Sensory	Prior treatment	3.213 ± 0.733	3.414 ± 0.602	$F_{\text{Intergroup}}$ 20.407	-2.001	0.052
	Treatment for 4 weeks	3.186 ± 0.651	3.273 ± 0.538	F_{Time} 136.189	-0.797	0.430
	Treatment for 12 weeks	1.828 ± 0.611	3.264 ± 0.609	$F_{\text{Interaction}}$ 107.753	-12.847	< 0.001
Cognitive	Prior treatment	2.007 ± 0.566	2.038 ± 0.563	$F_{\text{Intergroup}}$ 4.983	-0.621	0.538
	Treatment for 4 weeks	1.911 ± 0.555	1.975 ± 0.553	F_{Time} 20.071	-1.688	0.990
	Treatment for 12 weeks	1.279 ± 0.737	1.998 ± 0.791	$F_{\text{Interaction}}$ 18.419	-5.007	< 0.001
Total Score	Prior treatment	2.930 ± 0.427	3.055 ± 0.370	$F_{\text{Intergroup}}$ 59.800	-1.846	0.073
	Treatment for 4 weeks	2.619 ± 0.420	2.939 ± 0.375	F_{Time} 77.00	-5.489	< 0.001
	Treatment for 12 weeks	1.564 ± 0.301	2.875 ± 0.438	$F_{\text{Interaction}}$ 77.00	-16.042	< 0.001

3.4. Comparison of social support between the two groups of patients

Comparison of social support between the two groups of patients before intervention, 4 weeks after intervention, and 12 weeks after intervention (see **Table 5**).

Table 5. Comparison of social support levels before and after intervention in the two groups of patients (points, $\bar{x} \pm s$)

Time	Prior treatment	Treatment for 4 weeks	Treatment for 12 weeks
Experimental group	33.717 ± 1.540	33.737 ± 1.270	37.755 ± 1.748
Control group	34.165 ± 1.357	34.206 ± 1.270	34.492 ± 1.609
<i>F</i> value	$F_{\text{Intergroup}}$ 7.577	F_{Time} 147.091	$F_{\text{Interaction}}$ 109.031
<i>t</i> value	-1.481	-1.774	9.292
<i>p</i> value	0.147	0.084	< 0.001

Before intervention, the scores of social support for the two groups of patients were compared, and the difference was not statistically significant ($p > 0.05$); at 4 weeks after intervention, the social support situation of the two groups of patients was compared, and the difference was not statistically significant ($p > 0.05$); after 12 weeks of intervention, the social support situation of the patients in the experimental group and the control group was compared, and the difference was statistically significant ($p < 0.05$).

4. Discussion

4.1. The joint rehabilitation exercise intervention based on the hospital-community-family model can effectively improve the renal function of CKD patients

The research results indicated that after 12 weeks of intervention, the GFR of the experimental group was higher than that of the control group, and the difference was statistically significant ($p < 0.05$). This suggests that the hospital-community-family model combined with rehabilitation exercise intervention can effectively improve the renal function of patients, and the improvement degree is higher than that of conventional exercise intervention combined with telephone follow-up. The possible reason for this is that the hospital-community-family model combined with rehabilitation exercise intervention utilizes both remote monitoring and remote rehabilitation in telemedicine, which makes patients more compliant with exercise, more confident, and more likely to complete the designated exercise intervention plan.

4.2. The combined rehabilitation program based on the hospital-community-family model can effectively enhance the exercise endurance of patients with chronic kidney disease

The clinical characteristics of CKD patients show that as renal function declines, cardiopulmonary endurance begins to deteriorate, and muscle atrophy leads to a decrease in self-care ability, seriously affecting the quality of life of patients. Studies^[18–20] have shown that appropriate aerobic exercise combined with resistance exercise can effectively improve the activity ability and quality of life of patients.

Low physical activity can effectively delay the further development of CKD, but excessive physical activity can also increase the burden on the kidneys. The lack of professional exercise guidance and examination after discharge can lead to impaired exercise ability and decreased physical function in CKD patients, resulting in periodic decreases in physical activity levels and ultimately functional disorders^[21]. The results of this study show that the 6-minute walking distance of patients in the experimental group was higher than that of the control group, indicating that the exercise endurance of patients was effectively improved, which is consistent with the research results of Chen Jiale et al^[22].

The possible reason for this is that the joint rehabilitation exercise intervention based on the hospital-community-family model can effectively supervise patients to carry out rehabilitation training through the remote medical platform, and the exercise compliance of patients may be higher than that of conventional exercise intervention and telephone follow-up supervision.

4.3. The combined rehabilitation program based on the hospital-community-family model can effectively alleviate the fatigue symptoms of patients with chronic kidney disease

The main effects of total score of the fatigue scale over time, intervention, and the interaction between time and intervention were statistically significant ($p < 0.05$). This indicates that fatigue will alleviate over time and also will

be alleviated as the exercise intervention progresses. Moreover, the combined rehabilitation exercise intervention based on the hospital-community-family model has a proportional improvement effect on the fatigue level of CKD patients with the intervention time. The longer the intervention time, the better the improvement effect.

4.4. The combined rehabilitation intervention based on the hospital-community-family model can effectively enhance the social support level of CKD patients

Social support is an independent risk factor for anxiety and depression in CKD patients^[23]. Improving the level of social support for patients can effectively reduce their risk of depression, slow down the progression of the disease, and improve their quality of life. The results of the repeated-measures variance analysis in this study showed that the social participation scores of both groups were higher than those before the intervention after 4 weeks and 12 weeks of intervention, proving that both exercise intervention programs can effectively improve the social support level of patients. There was a statistically significant difference in the total social participation scores of the two groups after 4 weeks and 12 weeks of intervention ($p < 0.05$).

The social participation score of the experimental group was higher than that of the control group, indicating that the combined rehabilitation exercise intervention based on the hospital-community-family model is more effective in improving the social support level of patients than the conventional method. The possible reason for this is that the remote medical platform enables the family members of patients to effectively participate in the entire process of the exercise rehabilitation treatment of the patients, allowing the patients to receive more encouragement and assistance from family members, community staff, and medical staff.

5. Conclusion

In conclusion, this study provides exercise guidance to CKD patients through a combined rehabilitation exercise intervention based on the hospital-community-family model. By using a three-dimensional linkage system of hospital-community-family, it achieves full-process care for CKD patients, improves their renal function, enhances their exercise endurance, reduces fatigue, improves social support levels, and comprehensively improves their physical and mental health levels and quality of life. However, the current scope of hospital-community-family linkage is relatively small, and the results may be biased. In the future, multi-center, stratified sampling studies can be conducted to make the results more extensible and scientific.

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Effect of MDT-Oriented CBL Model in Teaching Nursing Students in Cardiology

Qin Hu

Department of Cardiovascular Medicine, Deyang People's Hospital, Deyang 618000, Sichuan, China

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Abstract: *Objective:* To investigate the impact of MDT-oriented CBL model on teaching for cardiac nursing interns. *Methods:* A convenience sampling study was conducted with 100 cardiac nursing interns from September 2023 to June 2024 as subjects. The cohort was divided into two groups: 50 interns (control group, traditional teaching method) from September 2023 to January 2024, and 50 interns (experimental group, MDT-oriented CBL model) from February 2024 to June 2024. Comparative analyses were performed on theoretical assessments, practical skill evaluations, and teaching satisfaction. *Results:* The experimental group demonstrated higher scores in both theoretical and practical knowledge assessments ($p < 0.05$) compared to the control group. The experimental group also scored higher in all skill assessment categories (communication, teamwork, emergency response, medical history acquisition, organizational skills, humanistic care, and clinical competence) ($p < 0.05$). Satisfaction ratings for teaching objectives, content, methods, process, and outcomes were significantly higher in the experimental group ($p < 0.05$). *Conclusion:* Implementing the MDT-oriented CBL model in cardiac nursing education significantly improves interns' theoretical and practical knowledge assessment scores, enhances nursing skills, and increases teaching satisfaction. This teaching model demonstrates significant potential for widespread application.

Keywords: Cardiology nursing students; Multidisciplinary collaboration; Case teaching method; Satisfaction; Theory and skill assessment

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1. Introduction

Cardiovascular and internal medicine encompass diverse and complex conditions, often accompanied by multi-organ dysfunction. Clinical interventions require interdisciplinary collaboration, demanding cardiac nursing staff to possess multidisciplinary knowledge^[1]. Against the backdrop of sustained national economic development, medical technologies are constantly evolving with expanding knowledge and information. Coupled with the intensifying issue of population aging, the integration of various disciplines has raised higher requirements for clinical and nursing practices^[2]. Nursing students act as fresh blood in departments, their participation enhancing the quality of care. However, clinical teaching methods for nursing students have drawn significant attention.

Traditional teaching approaches exhibit shortcomings, with students passively absorbing knowledge and teaching efficiency needing improvement, thus necessitating efficient and student-friendly teaching methods ^[3]. Multi-disciplinary team (MDT) collaboration, a novel clinical approach, enhances nursing staff's initiative and optimizes clinical work efficiency ^[4]. Case-based learning (CBL), a method grounded in classic cases, aims to improve students' basic skills and strengthen clinical practice capabilities ^[5]. Although MDT and CBL are widely used in clinical practice, there are few studies on their combination. Therefore, this study included 100 nursing students in cardiology department from September 2023 to June 10, 2024 as the subjects to deeply explore the teaching effect of MDT-oriented CBL model on nursing students. The report is as follows.

2. Data and methods

2.1. General information

The study was conducted on 100 nursing interns in the Department of Cardiology of Deyang People's Hospital from September 2023 to June 2024, 50 nursing interns in the control group from September 2023 to January 2024, and 50 nursing interns in the experimental group from February 2024 to June 2024. The age and gender data of the two groups of nursing interns (see **Table 1**) showed no statistical significance ($p > 0.05$).

Table 1. General information

Group name	Sex [% (n)]		Age ($\bar{x} \pm s$), years
	Masculinity	Femininity	
Control group	20.00 (10/50)	80.00 (40/50)	24.52 \pm 1.25
Test team	24.00 (12/50)	76.00 (38/50)	24.55 \pm 1.22
χ^2/t value	0.233		0.121
p	0.629		0.904

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

- (1) Full-time nursing interns
- (2) Complete documentation; informed consent and voluntary participation in the study
- (3) Normal cognitive, language, and thinking abilities
- (4) High compliance with actively completing all teaching tasks

2.2.2. Exclusion criteria

- (1) Poor cooperation
- (2) Failure to attend classes as scheduled
- (3) Withdrawal from the study midway
- (4) Other reasons preventing full participation in learning activities

2.3. Methodology

2.3.1. Control group

The traditional teaching methodology, encompassing lecture-based instruction and demonstration teaching, is

implemented through a well-structured curriculum designed by supervising instructors based on the internship syllabus for cardiac medicine nursing students. Upon entering the department, students receive one-on-one mentoring and hands-on skill demonstrations from their instructors. Concurrently, supervising instructors collaborate with teaching coordinators to deliver theoretical lectures and practical training sessions. The four-week program culminates in clinical rounds and mini-lectures during the final week, followed by comprehensive assessments upon completion of the curriculum.

2.3.2. Test group

The MDT-Oriented Clinical Case-Based Learning (CBL) Model

(1) Formation of an MDT-CBL Team

The head nurse of the cardiology department organizes a teaching team comprising the department head, ward teaching supervisors, and clinical instructors. Teaching supervisors from related departments such as respiratory medicine, nephrology, and endocrinology are also invited to participate. All members undergo specialized training and pass assessments to demonstrate strong teaching capabilities. The team collaboratively identifies classic clinical cases, designs teaching content based on case scenarios, and formulates teaching questions. The four-week program follows weekly learning themes outlined in the internship curriculum for nursing students. Representative clinical cases such as myocardial infarction and chronic heart failure nursing knowledge are uploaded to the nursing students' WeChat group one week before instruction begins, allowing students to study and research materials according to their schedules.

(2) Curriculum Development

Based on the internship curriculum for nursing students, the program focuses on key challenges and priorities in cardiovascular nursing education. Typical cases are selected following holistic nursing principles, incorporating relevant interdisciplinary content. Clear objectives, schedules, locations, and progress milestones for case-based teaching are established. The department head reviews and supplements the curriculum content to create a comprehensive framework.

(3) Implementation

Nursing students are divided into five groups. Basic nursing knowledge is assessed through question-and-answer sessions, with group leaders selected based on evaluation results. When the supervising instructor shares classic case materials in the WeChat group, they instruct the head of the nursing student team to guide and coordinate discussions. Students are organized to analyze cases by consulting textbooks, literature, and reference materials, then compile nursing methods for submission. The supervisor reviews each team's summary, highlighting strengths with encouragement while addressing areas needing improvement, guiding students to reflect and improve. After summarizing current teaching progress, the course coordinator reiterates essential nursing knowledge points. Other specialized nursing instructors within the teaching team provide additional guidance, helping students master department-specific care protocols and stay updated with cutting-edge nursing practices.

(4) Post-class Practice

Following group evaluations, clinical training begins under instructors' supervision. Students develop care plans based on their assigned patient cases and conduct practical operations. Instructors monitor progress in real-time, offering feedback and suggestions to continuously enhance care quality.

2.4. Observing indicators

2.4.1. Theoretical assessment

The entire teaching team collaboratively developed the cardiac nursing assessment framework, implemented through electronic questionnaires with identical content for both control and experimental groups. A total of 100 electronic questionnaires were distributed and fully recovered, achieving a 100% response rate. The examination comprised two components: theoretical knowledge assessment (0–100 points) and practical skills evaluation (0–100 points), where higher scores indicated better performance in the nursing students' theoretical examinations.

2.4.2. Skills assessment

The modified Mini Clinical Evaluation Exercise (Mini-CEX) scale was employed to assess nursing interns' competencies across seven dimensions: communication, teamwork, emergency response, medical history acquisition, organizational skills, humanistic care, and clinical competence. Each dimension is rated on a 0–9 point scale, with results categorized into four levels: Excellent (7–9 points), Satisfactory (4–6 points), and Need Improvement (1–3 points). A score of 5 or higher is deemed passing, with evaluations jointly conducted by the teaching supervisor, attending instructors, and ward teaching coordinator.

2.4.3. Instructor satisfaction

The teaching satisfaction survey was developed by the teaching team and administered anonymously to nursing students. The questionnaire evaluated four dimensions: teaching objectives (0–100 points), course content (0–100 points), teaching methods (0–100 points), and instructional process (0–100 points), with higher scores indicating greater satisfaction. A total of 100 questionnaires were distributed, all 100 returned, achieving a 100% response rate.

2.5. Data statistics and processing

All data from this study were processed using SPSS 25.0 software system. Numerical data were described as [% (n)] with χ^2 tests; measurements meeting normal distribution were presented as $\bar{x} \pm s$ (mean \pm standard deviation), using t -tests; non-normal distributions were analyzed with non-parametric tests. Differences were considered statistically significant when $p < 0.05$.

3. Results

3.1. Theoretical assessment

The theoretical knowledge assessment and practical knowledge assessment scores of the intern students in the experimental group were higher than those in the control group, with statistical significance ($p < 0.05$). Detailed data are shown in **Table 2**.

Table 2. Theoretical assessment [$(\bar{x} \pm s)$, score]

Group name	Theoretical knowledge assessment	Assessment of practical knowledge
Control group (n = 50)	95.65 \pm 1.22	96.88 \pm 1.06
Test group (n = 50)	98.75 \pm 1.16	98.97 \pm 1.02
t	13.021	10.046
p	< 0.001	< 0.001

3.2. Skills assessment

The assessment scores of communications, teamwork, emergency treatment, medical history acquisition, organizational ability, humanistic care and clinical competence of the intern nurses in the experimental group were higher than that of the control group, and the difference was statistically significant ($p < 0.05$). Detailed data are shown in **Table 3**.

Table 3. Skill assessment [$(\bar{x} \pm s)$, $n = 50$, score] C: control group; T: test team

Group	Commu-nicate	Teamwork	Emergency handling	History taking	Organizing ability	Humani-stic concern	Clinical compete-nce
C	8.12 ± 0.28	8.15 ± 0.12	8.25 ± 0.12	8.26 ± 0.16	8.24 ± 0.22	8.38 ± 0.17	8.17 ± 0.20
T	8.76 ± 0.22	8.85 ± 0.13	8.89 ± 0.10	8.85 ± 0.14	8.77 ± 0.20	8.82 ± 0.16	8.85 ± 0.14
<i>t</i>	12.709	27.978	28.971	19.623	12.605	13.327	19.696
<i>p</i>	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.3. Teaching satisfaction

The satisfaction scores of teaching objectives, teaching content, teaching methods, teaching process and teaching effect in the experimental group were higher than those in the control group, and the difference was statistically significant ($p < 0.05$). Detailed data are shown in **Table 4**.

Table 4. Teaching satisfaction [$(\bar{x} \pm s)$, $n = 50$, points]

Group name	Instructional objectives	Content of courses	Teaching method	Teaching process	Teaching efficiency
Control group	95.56 ± 1.27	95.46 ± 1.33	95.75 ± 1.20	95.86 ± 1.15	95.66 ± 1.22
Test team	98.66 ± 1.25	98.58 ± 1.31	98.67 ± 1.22	98.85 ± 1.16	98.77 ± 1.21
<i>t</i>	12.301	11.818	12.066	12.944	12.798
<i>p</i>	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

4. Discussion

Cardiology departments primarily treat cardiovascular disease patients, whose conditions are complex and variable with high recurrence risks, significantly increasing clinical care challenges ^[6]. Moreover, most cardiovascular patients are elderly individuals with multiple comorbidities. As health awareness continues to grow, the demand for high-quality cardiac nursing care has become increasingly urgent. Providing comprehensive, well-structured, and scientifically grounded nursing services has become a key focus in cardiac care ^[7].

Clinical nursing instruction constitutes a vital component of cardiology nursing practice. Enhancing the quality of clinical mentoring for intern nurses not only strengthens their comprehensive competencies and professional ethics but also fully leverages their initiative, fostering proactive engagement in clinical work ^[8]. However, traditional teaching methods alone can no longer meet modern cardiac disease care demands, resulting in suboptimal mentoring outcomes. With continuous advancements in medical technologies and knowledge systems, there is an urgent need for efficient and high-quality mentoring models to optimize cardiac nursing education ^[9]. The Case-Based Learning (CBL) model has become widely adopted across clinical departments, with growing evidence confirming its effectiveness in improving interns' skills and developing critical thinking

abilities ^[10]. Meanwhile, the Multidisciplinary Team (MDT) approach, a novel strategy for managing diverse patient conditions, has demonstrated significant improvements in care quality and satisfaction, earning widespread patient recognition. Integrating MDT into CBL programs enhances both the scientific rigor and clinical relevance of mentoring practices ^[11].

In this study, the experimental group demonstrated higher scores in both theoretical and practical knowledge assessments compared to the control group ($p < 0.05$). The experimental group also scored higher in skill assessment ($p < 0.05$) and teaching satisfaction ($p < 0.05$), indicating that the MDT-guided CBL model effectively enhances teaching outcomes for cardiology nursing interns, improves their nursing skills, and achieves high satisfaction. Analysis reveals that using MDT as a framework deepens interns' understanding of various cardiovascular diseases, broadens their perspectives when caring for patients, facilitates comprehensive grasp of pathological concepts, and cultivates awareness of integrating theory with practice while strengthening integrated nursing competencies ^[12]. Furthermore, collaboration with other hospital departments helps interns acquire more disease-related nursing knowledge, expand their knowledge systems, enhance knowledge retention capabilities, and improve clinical decision-making abilities ^[13]. Moreover, the MDT-oriented CBL model transforms passive learning into active engagement, compensates for shortcomings in traditional teaching methods, boosts interns' initiative, develops critical thinking skills, and enables them to analyze and solve problems based on patients' actual conditions when addressing cardiovascular diseases ^[14]. It can be said that MDT + CBL aligns closely with the characteristics of cardiology nursing education. While instructors impart experience through classic cases, this approach enhances nursing students' understanding of case scenarios and reinforces their awareness of teamwork, nurse-patient communication, and humanistic care in nursing practice. This comprehensive optimization of integrated skills holds significant importance for cultivating well-rounded nursing professionals in cardiology ^[15].

5. Conclusion

In summary, the MDT-oriented CBL model has a significant effect on the teaching of nursing students in cardiology department, with high teaching satisfaction and worthy of promotion.

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Disclosure statement

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Research on the Path to Improving Humanistic Literacy of Operating Room Nursing Students–Application and Practice of the ORTCC Model

Feng Ren

Deyang People's Hospital, Deyang 618000, Sichuan, China

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Abstract: *Objective:* To explore the application effect of the path for improving humanistic literacy of operating room nursing students based on the ORTCC model, in order to make up for the deficiency of systematic humanistic education in the traditional teaching model. *Methods:* 120 nursing students who practiced in the operating room from June 2023 to June 2024 were randomly divided into the experimental group and the control group, with 60 students in each group. The control group received routine teaching, while the experimental group applied the ORTCC model on the basis of routine and intervened through setting humanistic literacy goals, formulating behavioral norms, conducting diversified training, implementing two-way assessment, and creating departmental culture. The effect of the intervention was evaluated using the Nurse Humanistic Quality Scale, the Clinical Communication Ability Assessment Scale for Operating Room Nursing Students, and a self-made nursing satisfaction questionnaire. *Results:* After the intervention, the total score of humanistic literacy in the experimental group (4 weeks of intervention: 161.43 ± 10.06 points, 12 weeks of intervention: 165.71 ± 9.45 points) was significantly higher than that in the control group (139.38 ± 10.95 points, 143.31 ± 10.52 points) (all $p < 0.001$); The total score of clinical communication ability in the experimental group (109.69 ± 8.05 points for 4 weeks of intervention, 116.90 ± 7.21 points for 12 weeks of intervention) was also significantly better than that in the control group (99.14 ± 9.23 points, 103.03 ± 8.78 points) (all $p < 0.001$); The total score of patient care satisfaction in the experimental group (94.2 ± 4.3) was significantly higher than that in the control group (82.6 ± 5.7) ($p < 0.001$). *Conclusion:* The ORTCC model can systematically enhance the humanistic literacy, clinical communication skills and patient satisfaction of operating room nursing students, providing an effective approach for optimizing clinical teaching in the operating room.

Keywords: ORTCC model; Operating room; Nursing students; Humanistic literacy

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1. Introduction

Intensive care units are important bases for the centralized treatment and care of critically ill patients. They require enclosed treatment Spaces and high-intensity workflows, and impose very high demands on the professional skills and comprehensive qualities of nurses. Nursing students, as reserve talents for nursing staff, are required

not only to have operational skills during their internship in the intensive care unit, but also to have the ability of humanistic care, so as to better relieve the psychological stress of patients during the perioperative period and thereby maintain the nurse-patient relationship. However, in the past teaching process, the instructors only focused on imparting skills and lacked ways to cultivate humanistic abilities, resulting in a widespread phenomenon of “emphasizing professional skills but neglecting humanistic skills” in the humanistic training of nursing students.

The ORTCC model is a perfect management model that includes five factors: objectives, rules, training, assessment, and culture ^[1]. It is widely used in business management, but has not yet been attempted to be adopted in the cultivation of humanistic qualities of nursing students in operating rooms. This study attempts the effects and methods of using the ORTCC model as a structured way to cultivate humanistic literacy among nursing students.

2. Data and methods

2.1. General information

A total of 120 nurse interns who practiced in the operating room of our hospital from June 2023 to June 2024 were included as the study subjects. The nursing students were randomly divided into the experimental group and the control group by random number table method, with 60 students in each group.

2.1.1. Inclusion criteria

- (1) Full-time undergraduate or junior college nursing interns
- (2) At least 4 weeks of internship in the operating room
- (3) Be aware of the study and participate voluntarily

2.1.2. Exclusion criteria

- (1) Nurse interns who have previously interned in the operating room
- (2) Those who interrupted their internship for some reason after being included

2.1.3. Experimental group

8 male nursing students, 52 female nursing students; The average age was (21.45 ± 1.12) years; Distribution of educational qualifications: 38 bachelor's degree, 22 associate degree; Control group: 7 male nursing students, 53 female nursing students; Average age (21.38 ± 1.20) years; Education distribution: 36 bachelor's degree, 24 associate degrees. There was no statistically significant difference in general information between the two groups of nursing students ($p > 0.05$), and they were comparable.

2.2. Methods

2.2.1. Teaching methods for the control group

The conventional operating room teaching model was implemented. The content includes introduction to the operating room environment and rules and regulations, recognition of common surgical instruments, aseptic technique operations, job responsibilities of itinerant nurses and instrument nurses, etc. Taught by a designated instructor, with a focus on the mastery of skills and procedures.

2.2.2. Experimental group teaching methods

On the basis of regular teaching, implement a systematic humanistic quality improvement path based on the ORTCC model. The specific contents are as follows.

(1) O (Objectives)

Clearly define the overall and sub-objectives for improving the humanistic literacy of operating room nursing students. General Objective: To cultivate outstanding prospective operating room nurses with traits of “benevolence, self-discipline, empathy, and communication”^[2]. Sub-objectives: Recognize and master the theoretical knowledge of humanistic care in operating room nursing (cognitive objectives); Behavioral manifestations of humanistic care in preoperative visits, intraoperative care, and postoperative follow-ups (skill objectives).

(2) R (Rules)

Develop a manual of Humanistic behavioral norms for operating room nursing students. The content includes: standardized communication language (SOP) for preoperative visits, specific measures for intraoperative privacy protection (such as standard coverings), skills for non-verbal communication with patients in the anesthesia recovery period, etiquette for collaborating with surgical team members and more. Give human care a set of rules.

(3) T (Training)

First, theoretical education, by organizing 4 hours of medical humanities training, including topics such as introduction to medical humanities, psychological characteristics and needs of surgical patients, nurse-patient communication with surgical patients, medical ethics and law. Next is the practical education, by implementing the scenario teaching method, through simulated situations such as “visiting anxious preoperative patients”, “How to deal with conscious intraoperative surgeons”, “How to communicate with uneasy surgeons”, role-playing, on-site operations, etc.

(4) C (Assessment)

Implement a two-way assessment and feedback mechanism. Firstly, the process assessment, where the instructor records and scores the daily performance of the nursing students based on the Human Behavior Observation Checklist. Then is the final assessment, at the end of the internship, a humanities examination station is designed and an Objective Structured clinical Examination (OSCE) is conducted for the final assessment to evaluate the comprehensive application ability of the nursing students.

(5) C (Culture)

Create a humanistic and caring departmental environment. Play the role of a role model for the teaching staff, such as demonstrating humanistic care behaviors during normal work. Conduct a monthly selection of “Humanistic Care Stars” and give recognition and rewards to nursing students who perform outstandingly during the teaching process each month.

2.3. Evaluation criteria

(1) Humanistic literacy

The Nurse Humanistic Quality Scale, with a Cronbach’s α coefficient of 0.92, consists of three dimensions: humanistic knowledge (15 items), humanistic spirit (10 items), and humanistic behavior (15 items), totaling 40 items, and is scored on a Likert 5-level scale, with a total score of 40 to 200 points. The higher the score, the higher the level of humanistic literacy.

(2) Clinical communication skills

The Operating Room Nursing Student Clinical Communication Skills Assessment Scale, with a Cronbach's α coefficient of 0.89, consists of five dimensions: establishing harmonious relationships, confirming patient needs, effectively communicating information, jointly participating in decision-making, and coping with communication difficulties, totaling 25 items, with a total score of 25–125 points.

(3) Nursing satisfaction

A self-made satisfaction questionnaire was used for the survey at discharge, including four dimensions of service attitude, communication effect, pain management, and health guidance, with a total of 10 items, and a Likert 5-level score of 100 points was used, with higher scores indicating greater satisfaction. The Cronbach's α coefficient of the questionnaire was 0.912.

2.4. Statistical methods

Data analysis was performed using SPSS25.0 software. Measurement data were expressed as ($\bar{x} \pm s$) and independent sample t -tests were used for comparisons between groups; Count data were expressed as percentages, and the χ^2 test was used for comparison between groups. A difference was considered statistically significant when $p < 0.05$ [3].

3. Results

3.1. Comparison of humanistic literacy scores of the two groups of nursing students before and after the intervention

As shown in **Table 1**, before the trial intervention, there was no statistically significant difference in the total humanistic quality scores between the two groups of nursing students ($t = 0.179$, $p = 0.858$), and the baseline levels were comparable. After 4 and 12 weeks, the total scores of both groups of nursing students were higher than those before the intervention ($p < 0.05$), and the total scores of the experimental group at 4 and 12 weeks of intervention were significantly higher than those of the control group at the same period, and the differences were statistically significant (all $p < 0.001$).

Table 1. Comparison of humanistic literacy scores of the two groups of nursing students before and after intervention ($\bar{x} \pm s$, points)

Group	Number of cases	Before intervention	4 weeks after the intervention	After 12 weeks of intervention
Experimental group	60	130.35 \pm 12.45	161.43 \pm 10.06 * #	165.71 \pm 9.45 * #
Control group	60	129.95 \pm 11.88	139.38 \pm 10.95*	143.31 \pm 10.52*
t value		0.179	11.267	12.845
p value		0.858	< 0.001	< 0.001

Note: Compared with the group before intervention, $p < 0.05$; Compared with the control group at the same period, # $p < 0.05$ *

3.2. Comparison of clinical communication ability scores between the two groups of nursing students after intervention

There was no significant difference in the total score of clinical communication ability between the two groups of

nursing students before the intervention ($t = 0.235, p = 0.815$). After different teaching modes, as shown in **Table 2**, the total communication ability scores of the experimental group were significantly higher than those of the control group after 4 weeks and 12 weeks of intervention, and the differences were statistically significant (all $p < 0.001$).

Table 2. Comparison of clinical communication ability Scores of the two groups of nursing students after intervention ($\bar{x} \pm s$, points)

Group	Number of cases	Before intervention	4 weeks after the intervention	After 12 weeks of intervention
Experimental group	60	89.58 \pm 10.02	109.69 \pm 8.05 * #	116.90 \pm 7.21 * #
Control group	60	89.14 \pm 10.47	99.14 \pm 9.23*	103.03 \pm 8.78*
<i>t</i> value		0.235	6.445	9.128
<i>p</i> value		0.815	< 0.001	< 0.001

Note: Compared with the group before intervention, $p < 0.05$; Compared with the control group at the same period, # $p < 0.05$ *

3.3. Comparison of student satisfaction between the two groups

The scores of the experimental group in each dimension of service attitude, communication effect, pain management, health guidance and the total score were significantly higher than those of the control group, and the difference was statistically significant ($p < 0.01$). See **Table 3**.

Table 3. Comparison of satisfaction scores between two groups of nursing students ($\bar{x} \pm s$, points)

Group	Service attitude	Communication effect	Pain management	Health Guidance	Total score
Experimental Group	23.8 \pm 2.1	24.1 \pm 1.8	23.5 \pm 2.0	22.8 \pm 1.9	94.2 \pm 4.3
Control Group	20.5 \pm 2.5	20.8 \pm 2.7	20.9 \pm 2.4	20.4 \pm 2.6	82.6 \pm 5.7
<i>t</i> value	10.842	10.125	8.934	7.856	16.327
<i>p</i> value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

4. Discussion

This study innovatively applies the ORTCC model in enterprise management to the cultivation of humanistic literacy among operating room nursing students. The results show that the model can build a closed-loop management system from goal orientation to cultural edification, significantly improving the humanistic literacy level, clinical communication ability and patient satisfaction of nursing students.

The ORTCC model provides a systematic management procedure for humanistic education in operating rooms, transforming intangible humanism into tangible management. The model is goal-oriented and regulates learning purposes; Rules refine management behavior; Training uses situational simulation for internalization; Assess the use of immediate feedback for behavioral correction. Culture uses the spiritual atmosphere to internalize the spirit.

The model can also achieve consistency between humanistic knowledge and humanistic practice of nursing students. Nursing students use humanistic knowledge to solve problems in simulated scenarios and complete the transformation from “knowledge” to “action”. Feedback from the process assessment can also further enhance

their ability to practice clinical humanities. In addition, the implementation of the model also promotes the emphasis on teaching and learning, and drives the reform of the department's humanistic culture. The teaching staff also gained and improved during the teaching and assessment process, and the creation of a humanistic atmosphere further enhanced the team's value recognition and ultimately formed a harmonious and mutually supportive operating room culture, from which patients also benefited.

5. Conclusion

In summary, the pathway program for improving humanistic literacy of operating room nursing students in the context of the ORTCC model is a targeted and feasible intervention procedure that compensates for the deficiencies of conventional teaching methods, promotes the development of humanistic literacy and the improvement of clinical practice ability of nursing students, enhances the quality of medical services, and can be promoted and applied in clinical teaching. This study is a single-center study, and its long-term utility still needs to be further explored. In the future, more multi-center, large-sample and longer-term studies will be needed to confirm its value in the long term.

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Disclosure statement

The author declares no conflict of interest.

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Study on a Rapid Extraction and Detection Method for 16S rRNA of Intestinal Flora

Yuanyuan Wang

Fujian Shukangsi'er Biotechnology Co., Ltd., Fuzhou 350199, Fujian, China

**Author to whom correspondence should be addressed.*

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Abstract: This study established a rapid extraction method for the 16S rRNA gene of intestinal flora. Combined with next-generation sequencing (NGS) technology, this method can be applied to intestinal microbial ecology analysis. The fecal sample was mixed with lysis buffer, incubated at 90°C for 15 minutes, vortexed, and then centrifuged. The supernatant was collected, and specific primers were added for PCR amplification. The PCR products were purified, and index tags were established for the targets to obtain libraries. After library purification and quality inspection, the libraries could be loaded for sequencing. Under optimized conditions: when the number of PCR cycles was 25 and the initial amount of DNA for library construction was 12.5 ng, fewer chimeras were generated. The library size was 500–700 bp, and there were no primer dimers of approximately 120 bp. This method is rapid, accurate, and sensitive, and can be used for the analysis and detection of the 16S rRNA gene of intestinal flora.

Keywords: Extraction; Intestinal flora; Sequencing; 16S rRNA

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1. Introduction

A complex microbial ecosystem exists in the human intestine, mainly including bacteria, fungi, archaea, and viruses, which are collectively referred to as intestinal flora^[1]. These intestinal floras perform important physiological functions such as digestion, nutrition, immunity, and symbiosis. A large number of studies have shown that intestinal microorganisms have an important impact on intestinal function^[2]. From a genetic perspective, the human genome carries approximately 25,000 genes, while the total number of genes encoded by human intestinal microorganisms is about 150 times that of human genes. All genetic information of human intestinal microorganisms is called the human intestinal metagenome^[3]. Therefore, studying the composition of intestinal flora and its correlation with the occurrence of diseases through intestinal microbial metagenomics has become a research focus nowadays.

At present, the main methods for extracting microbial DNA include thermal lysis, chemical method, and

enzymatic lysis. Thermal lysis directly heats the sample for lysis to extract genomic DNA. This method is simple with high recovery rate, but the purity of microbial DNA is low. The chemical method generally adopts the phenol/chloroform extraction method, which has complex operation steps, requires a large amount of sample, and has low DNA yield. The enzymatic lysis uses lysozyme for microbial wall breaking, with mild conditions and high recovery rate of microbial DNA, but more impurities.

Currently, commercial kits generally use the enzymatic lysis method, followed by centrifugal filtration with a silica column membrane. This method can obtain microbial DNA with high purity, but has complex operation, long time consumption, and low yield. In this study, a method for extracting the 16S rRNA gene of intestinal flora was established by combining the chemical method and thermal lysis method. Combined with next-generation sequencing technology, the difference between this method and the conventional spin column method was analyzed, aiming to establish a detection method suitable for large-scale sample extraction and analysis of the 16S rRNA gene.

2. Materials and methods

2.1. Materials and instruments

The materials are as follows:

- (1) PCR Amplification Mix Kit: Nanjing Vazyme Biotechnology Co., Ltd;
- (2) Taq Enzyme, dNTP, Agarose, D2000 Ladder: Products of Beijing Solarbio Science & Technology Co., Ltd;
- (3) Qubit 3.0 Fluorometer (with Qubit dsDNA HS Assay Kit): Product of Thermo Fisher Scientific, USA;
- (4) 2200 High Sensitivity D1000 Assay Kit: Product of Agilent Technologies, USA;
- (5) Nextera Index Kit – PCR Primers: Product of Illumina, USA;
- (6) AMPure XP Beads: Product of Beckman Coulter, USA;
- (7) Fecal DNA Extraction Kit: Product of Fujian Xilong Biotechnology Co., Ltd;
- (8) Primers: Synthesized by Fuzhou Shangya Biotechnology Co., Ltd.;
- (9) Other reagents: All of analytical grade.

The instruments are as follows:

- (1) T100-PCR Amplifier;
- (2) Mini-sub Cell GT System Electrophoresis Apparatus;
- (3) Gel Doc XR+ Gel Imaging Analyzer: All products of Bio-Rad Laboratories, USA;
- (4) Miseq Sequencer: Product of Illumina, USA.

2.2. Detection methods

2.2.1. Extraction method of fecal sample DNA

The lysis buffer was prepared according to Song *et al.* ^[4]. A total of 1.2 mL of lysis buffer was added to the fecal sample and oscillated intermittently for 1–2 minutes until the sample was mixed uniformly. It was incubated at 90°C for 15 minutes, vortexed for 30 seconds, and centrifuged at 12,000 rpm for 10 minutes. After centrifugation, 700 µL of the supernatant was transferred to a new centrifuge tube. The spin column method of the kit was operated with reference to the instruction manual.

2.2.2. PCR amplification and electrophoresis

The sequence of the primers are as follows:

- (1) Upstream primer F: TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGACTCCTACGGGA GG - CAGCAG
- (2) Downstream primer R: GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGGGACTACH -VGGGTWTCTAAT

For the PCR reaction system, 2.5 μ L of DNA extracted from the above sample, 1 μ L of primer mixture, 12.5 μ L of PCR Amplification Mix (2X), and 9.0 μ L of ddH₂O was mixed and gently pipetted 10 times to mix uniformly. It was then placed in the PCR amplifier, and the reaction conditions are as follows: initial denaturation at 95°C for 3 minutes; followed by 25–30 cycles of denaturation at 95°C for 15 seconds, annealing at 60°C for 15 seconds, and extension at 72°C for 45 seconds; final extension at 72°C for 5 minutes; and holding at 4°C.

After the reaction, 2 μ L of the PCR product was taken for agarose gel electrophoresis. The electrophoresis conditions were: 1% agarose, D2000 Ladder, 120V, and 20 minutes.

2.2.3. Purification of PCR products

The AMPure XP beads were took out from the 4°C refrigerator in advance and equilibrated at room temperature for 30 minutes, and oscillated to mix well before use. A new 1.5 mL centrifuge tube was taken, 18.4 μ L of beads were added and 23 μ L of the PCR product from the previous step was added. The mixture was gently pipetted to mix well, and stood at room temperature for 5 minutes. After centrifugation, the centrifuge tube was placed on a magnetic rack for 10 minutes until the liquid became clear. The supernatant was carefully removed, and the beads were not aspirated as much as possible. The centrifuge tube was kept on the magnetic rack, and 200 μ L of 80% ethanol was slowly added along the tube wall, pipetted and stood for 30 seconds. The supernatant was removed, the washing step was repeated once, and any residual ethanol was removed as much as possible when removing the supernatant. The centrifuge tube was kept on the magnetic rack, and stood for 4 minutes at room temperature to dry the beads. After that, 32 μ L of resuspension buffer was added and pipetted to mix the beads well, and stood for 2 minutes at room temperature. Following instantaneous centrifugation, the centrifuge tube was placed on the magnetic rack until the liquid became clear, while 30 μ L of the supernatant was transferred to a new 1.5 mL centrifuge tube.

2.2.4. Establishment of index tags

PCR amplification mix (2X) was mixed with 10 μ mol/ μ L Indexed PCR primer i5 and Indexed PCR primer i7, and they were thawed on ice. Only one set of Index sequences was listed below; the remaining sequences can be found in the Nextera Index Kit-PCR Primers.

i5: AATGATACGGCGACCAACCGAGATCTACACCTCTCTATTCGTCGGCAGCGT;

i7: CAAGCAGAAGACGGCATAACGAGATTCGCCTTAGTCTCGTGGGCTCGG.

The reaction system was prepared in a 0.2 mL centrifuge tube as follows: 5 μ L of purified PCR product, 5 μ L of Indexed PCR primer i5 (10 μ mol/ μ L), 5 μ L of Indexed PCR primer i7 (10 μ mol/ μ L), 25 μ L of PCR Amplification Mix (2X), and 10 μ L of ddH₂O. The mixture was gently pipetted 10 times to mix well, and placed in a PCR amplifier. The conditions were the same as described above, with the number of cycles set to 8.

2.2.5. Library purification and quality inspection

A new 1.5 mL centrifuge tube was taken, and 50 μ L of beads equilibrated at room temperature was added. The PCR product from the previous step was added, pipetted 10 times to mix well, and stood for 5 minutes at room temperature. After instantaneous centrifugation, the centrifuge tube was placed on a magnetic rack until the liquid became clear. The supernatant was carefully removed, and the PCR tube was kept on the magnetic rack. A total of 200 μ L of 80% ethanol was added, pipetted, and stood for 30 seconds. The supernatant was removed, washing step was introduced once, and any residual ethanol was removed as much as possible when removing the supernatant. The centrifuge tube was kept on the magnetic rack, and stood at room temperature for 4 minutes to dry the beads. A volume of 27 μ L of resuspension buffer was added and pipetted to mix the beads well, followed by standing at room temperature for 2 minutes. After instantaneous centrifugation, the centrifuge tube was placed on the magnetic rack until the liquid became clear. The supernatant (25 μ L) was transferred to a new 1.5 mL centrifuge tube. Only 1 μ L of the supernatant was taken to detect the concentration using a Qubit 3.0 Fluorometer (Qubit dsDNA HS Assay Kit) and the concentration was not recorded. The Agilent 2200 High Sensitivity D1000 kit was used to detect the band distribution of the library.

2.2.6. Library sequencing

According to the requirements of sequencing data volume, this experiment was set to 30,000 tags per sample, and the libraries were mixed. After mixing, perform quality inspection using Qubit 3.0 and Agilent 2200 Bioanalyzer, and dilute the library to the on-machine concentration with Hyb Buffer.

The library was denatured with 0.2N NaOH for 5 minutes, neutralized with 0.2 M Tris-HCl (pH 7.0), and diluted with Hyb buffer. The final on-machine dilution of the library was performed with Hyb buffer, where the on-machine diluted library was put into the reagent tank, placed into the Miseq sequencer together with the chip. The sample sheet was imported, and sequencing was performed.

3. Results and analysis

3.1. Comparison of sample extraction methods

The 16S rRNA genes of fecal samples were extracted using the lysis and the spin column method respectively, and the results are shown in Table 1.

Table 1. Comparison of extraction effects between lysis and column-passing method

Sample	DNA concentration (ng/ μ L)		Total DNA amount (ng)	
	Lysis	Column-passing	Lysis	Column-passing
1	2.43	2.75	127.2	133.5
2	2.89	3.12	158.7	165.3
3	2.64	2.95	169.1	177.6

The DNA concentration extracted by the lysis method is lower than that by the column-passing method. This is mainly because the column-passing method adsorbs the extracted DNA on the column and then elutes it, which plays a concentration role and significantly increases the DNA concentration. In terms of the total amount of DNA extracted from the samples, there is no significant difference between the two methods. However, the lysis method

can greatly shorten the extraction time and improve the experimental efficiency. In this experiment, the 16S rRNA of the samples extracted above was used for subsequent amplification experiments.

3.2. Experimental results of PCR cycle number optimization

A higher number of PCR cycles leads to the generation of more chimeras, which reduces the amount of valid data. Therefore, in this experiment, 3 different cycle numbers were designed to explore the experimental system and investigate the effect of PCR cycle number on the products. The experimental results are shown in **Table 2**. The results indicate that when the PCR cycle number is 25, fewer chimeras are generated; thus, 25 PCR cycles were selected.

Table 2. Experimental results of different PCR cycle numbers

Cycle number	Total library amount (ng)	Assembly rate (%)	Chimera rate (%)
25	29.5	67.48	1.41
28	175	64.41	1.57
30	400	68.39	3.01

3.3. Electrophoretogram of the first-round PCR products

The DNA of the aforementioned PCR products was analyzed by electrophoresis, and the results are shown in the figure below.

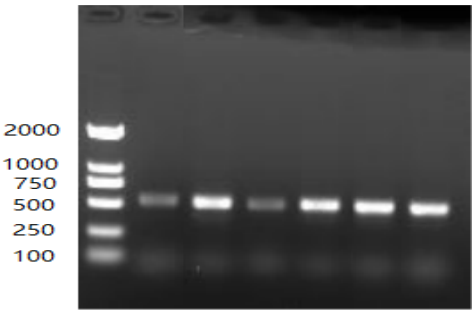


Figure 1. Electrophoretogram of PCR amplification products.

The first lane is Marker DL2000, and the band sizes from top to bottom are 2000, 1000, 750, 500, 250, and 100 bp in sequence. The electrophoresis bands of the post-PCR products are all clear, and the DNA molecular weight is approximately 500 bp.

3.4. Optimization of Initial DNA Amount for Library Construction

The results of exploring the experimental systems with initial DNA amounts of 12.5 ng and 25 ng for library construction are shown in **Table 3**. When the initial DNA amount was 12.5 ng, fewer chimeras were generated; therefore, 12.5 ng was finally selected as the initial DNA amount for library construction.

Table 3. Experimental results of different initial DNA amounts for library construction

Initial amount (ng)	Total library amount	Assembly rate (%)	Chimera rate (%)
12.5	25	66.97	1.12
25	31.25	67.62	1.86

3.5. Electrophoresis of the second-round PCR

The DNA of the aforementioned PCR products was analyzed by electrophoresis, and the results are shown in the figure below.

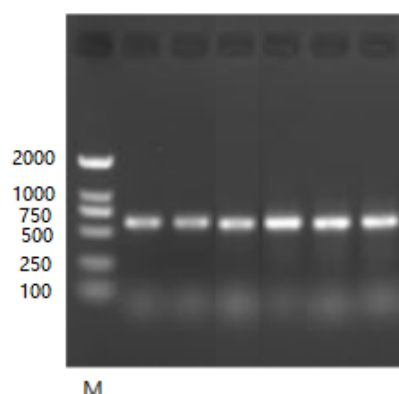


Figure 2. Electrophoretogram of the second-round PCR amplification products.

In the above figure, the first lane is Marker DL2000, and the band sizes from top to bottom are 2000, 1000, 750, 500, 250, and 100 bp in sequence. The electrophoresis bands of the post-PCR products are all clear, and the DNA molecular weight is approximately 600 bp.

3.6. Library purification and quality inspection results

After the library was purified by the bead method, primer dimers could be removed. The constructed library was subjected to quality inspection using an Agilent 2200 Bioanalyzer, and the results are shown in **Figure 3**. The library size was 500–700 bp, and there were basically no primer dimers of approximately 120 bp. The quality of the library constructed from DNA obtained by the lysis method was basically consistent with that of the library obtained from DNA extracted by the bead method or spin column method. Therefore, lysis method can be used to obtain DNA for library construction.

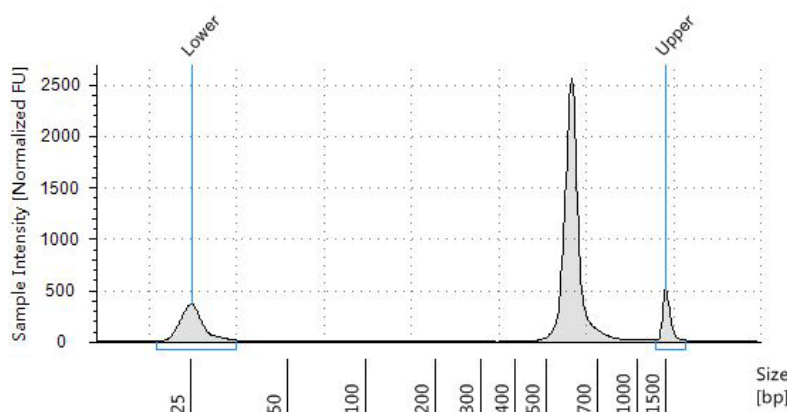


Figure 3. Library quality inspection results

3.7. Comparison of sequencing results between lysis and column-passing method

The Miseq PE250 sequencing results of the lysis method and column-passing method were compared, and

the findings are presented in **Table 4**. As indicated in the table, there was no significant difference in library concentration between the two methods. For the lysis method, the number of valid Tags obtained via Miseq PE250 ranged from 32,000 to 35,000, with Q30 values between 78% and 81% and an average of 79.13%. For the column-passing method, the valid Tags obtained by Miseq PE250 were in the range of 33,000 to 35,000, and the Q30 values varied from 77% to 80%, with an average of 78.53%. Throughout the entire sequencing run, all Q30 values exceeded 75%, demonstrating good base quality. It is evident that the sequencing results of the lysis method and column-passing method showed no significant difference. However, the lysis method reduced experimental steps, shortened sample pretreatment time, and significantly improved experimental efficiency.

Table 4. Comparison of sequencing results between lysis and column-passing method

Sample	Library concentration (ng/μL)		Number of tags		≥ Q30 (%)	
	Lysis	Column-passing	Lysis	Column-passing	Lysis	Column-passing
1	12.3	11.37	32364	33679	78.42	79.24
2	9.34	10.81	33701	33177	78.54	77.80
3	15.8	15.61	34943	34506	80.42	78.54

4. Discussion

With the rapid development of biological sciences, research methods for intestinal flora have advanced from traditional microbial isolation and culture to molecular biology-based detection. The normal intestinal flora consists of 500 to 1,500 different bacterial species, with the vast majority being anaerobic bacteria. The genome encoded by the human intestinal flora can be regarded as the “second human genome”; it participates in human nutrition, metabolism, and immune processes, and is one of the most important factors affecting human health^[5]. Due to the large quantity and high diversity of intestinal flora, traditional microbiological detection is time-consuming, easily affected by operating methods, and cannot fully reflect the true interactions between intestinal microorganisms and between microorganisms and the host. The field of microbiology increasingly relies on molecular biology techniques to study the diversity and complexity of intestinal microorganisms^[6].

The latest research by Alexandre *et al.* showed that 1,952 uncultured candidate bacterial species were identified by reconstructing 92,143 metagenomically assembled genomes from 11,850 human gut microbiomes^[7]. Samuel *et al.* isolated 737 bacterial strains for culture, growth, and DNA sequencing studies, which were classified into 273 different bacterial groups. This included 173 bacterial types that had not been sequenced before, and among these 173 types, 105 had not been successfully isolated by researchers previously^[8]. The complexity and diversity of intestinal microorganisms are closely related to human physiological and metabolic functions. By studying the composition of intestinal microbial flora, we can improve the analysis of the relationship between intestinal microorganisms and various diseases. Currently, intestinal microorganisms have been found to be associated with obesity, diabetes, intestinal diseases, allergies, autism, and mental illnesses^[9].

The 16S rRNA gene is suitable for large-scale sample screening but provides limited taxonomic and functional resolution^[10]. High-throughput 16S rRNA sequencing technology has many advantages: it can not only conduct in-depth analysis of intestinal flora structure and diversity but also combine with other “omics” technologies to further understand the genetic functions and metabolic pathways of intestinal microorganisms^[5,11].

It is currently one of the most important detection methods. The 16S rRNA gene is suitable for large-scale sample screening, and the extraction method of the 16S rRNA gene from intestinal flora is one of the key technologies at present.

Tian *et al.* used the thermal lysis column-passing method and direct thermal lysis method to extract and detect the bacterial DNA of *Staphylococcus aureus* from pure cultured and artificially contaminated fish samples, with the kit method used as a control for DNA extraction. The results showed that the thermal lysis column-passing method was only one gradient lower than the kit method, demonstrating its good stability, efficiency, and practicality^[12]. Peng *et al.* compared the differences between the thermal lysis method and commercial kit method in extracting fecal microbial DNA for 16S rRNA sequencing. OTU (Operational Taxonomic Unit) determination results showed that the thermal lysis method was highly consistent with the commercial kit method. The thermal lysis method can be used for fecal microbial determination, significantly reducing sample preparation costs and improving sample processing efficiency^[13].

In this study, a combination of lysis buffer and thermal lysis method was used. This method features simple operation, high DNA purity, and high extraction rate. There was no significant difference in sequencing results between the lysis method and the column-passing method. Additionally, the lysis method shortened sample pretreatment time and greatly improved experimental efficiency.

5. Conclusion

In this study, the method of direct fecal lysis was used to obtain DNA from intestinal flora. This method is more simple and rapid, and the quality of the constructed library is notable, which is basically consistent with the quality of libraries constructed from DNA obtained by traditional DNA extraction methods. It shortens the sample pretreatment time and greatly improves the experimental efficiency.

Disclosure statement

The authors declare no conflict of interest.

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Analysis of Influencing Factors and Nursing Countermeasures for Hypoglycemia in Inpatients with Diabetes Mellitus

Yun Gao

School of Medicine, Tianjin Tianshi College, Tianjin 301799, China

**Author to whom correspondence should be addressed.*

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Abstract: Studies have shown that the implementation of targeted nursing countermeasures can significantly reduce the incidence of hypoglycemia in inpatients with diabetes mellitus, improve patients' quality of life, and promote the stable control of their condition. This paper conducts an in-depth analysis on the influencing factors of hypoglycemia in inpatients with diabetes mellitus and the corresponding nursing countermeasures. It expounds the main factors affecting hypoglycemia in inpatients with diabetes mellitus, and then puts forward effective nursing countermeasures. The purpose is to provide valuable references for promoting the innovative development of clinical nursing work.

Keywords: Inpatients with diabetes mellitus; Hypoglycemia; Influencing factors; Nursing countermeasures

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1. Introduction

Diabetes mellitus is a common chronic metabolic disease, and its incidence is on the rise worldwide^[1]. According to the data released by the Chronic Disease Center of the Chinese Center for Disease Control and Prevention in June 2025, the number of diabetes patients in China had exceeded 230 million by 2023, accounting for a quarter of the global diabetes patient population. These data fully highlight the urgency and necessity of diabetes prevention and control. With the continuous development and improvement of modern medical technology, the survival period of diabetes patients has been significantly prolonged. However, during the specific treatment process, hypoglycemia, as one of the common acute complications of diabetes, has a great impact on patients' physical health and life safety, especially for inpatients with diabetes mellitus.

Due to complex conditions, differences in patients' own factors, and the need for frequent adjustments of treatment plans, the risk of hypoglycemia is gradually increasing. When hypoglycemia occurs, patients may experience symptoms such as palpitations, dizziness, and cold sweats. In severe cases, symptoms such as coma, brain damage, and arrhythmia may occur, and even the patient's life safety may be threatened. Therefore, in-

depth analysis of the influencing factors of hypoglycemia in inpatients with diabetes mellitus and the adoption of effective nursing countermeasures are of great significance for maintaining the health of diabetes patients and reducing the incidence of hypoglycemic symptoms.

2. Analysis of influencing factors for hypoglycemia in inpatients with diabetes mellitus

2.1. Patient-related factors

2.1.1. Age factor

With the continuous increase of age, the function of various organs in the human body gradually declines. Especially for elderly diabetic patients, their liver glycogen storage and decomposition capacity decrease significantly, making it difficult for them to effectively cope with fluctuations in body glycogen ^[2]. In addition, as age increases, the body's ability to perceive hypoglycemia also weakens, leading to delayed detection of hypoglycemic symptoms and thus an increased risk of hypoglycemic events. This perception ability is closely related to the nervous system. As age grows, the human nervous system degenerates, preventing patients from receiving early warning signals of initial hypoglycemia. Therefore, targeted nursing countermeasures and intervention methods should be adopted for hypoglycemic patients of different age groups to effectively reduce the incidence of hypoglycemic symptoms.

2.1.2. Diabetes duration factor

With the prolonged duration of diabetes, patients' islet function continues to weaken, which further impairs their own blood glucose regulation ability ^[3]. Long-term hyperglycemia may cause irreversible damage to pancreatic β -cells in patients' bodies, thereby further affecting blood glucose regulation function. On top of that, patients with a long disease course often experience metabolic disorders, such as abnormal lipid metabolism and abnormal protein metabolism, which also increase the risk of hypoglycemia. Furthermore, patients with a long disease course usually take blood glucose-lowering drugs or inject insulin to regulate blood glucose. However, once the drug dosage or treatment plan changes, the risk of hypoglycemia will increase.

2.1.3. Comorbidity factor

Inpatients with diabetes often suffer from other underlying diseases besides diabetes, such as hypertension, renal insufficiency, and liver dysfunction. These underlying diseases also affect the effective regulation of blood glucose ^[4]. For example, if an inpatient with diabetes has renal insufficiency, it will be difficult for the patient to clear insulin from the body, prolonging the action time of blood glucose-lowering drugs and increasing the risk of hypoglycemia. Furthermore, certain chronic diseases like hypertension require patients to take medications for condition control, and these medications may interact with blood glucose-lowering drugs, thereby reducing the blood glucose control effect. Therefore, during the nursing process, the physical condition of inpatients with diabetes should be scientifically evaluated, and personalized nursing plans should be formulated to effectively reduce the occurrence of hypoglycemic symptoms.

2.2. Treatment-related factors

2.2.1. Medication factor

Inpatients with diabetes often use medications during treatment, which is one of the main causes of

hypoglycemia. Different types of blood glucose-lowering drugs have different mechanisms of action. Taking some of these drugs may cause a rapid drop in blood glucose, especially when the dosage is improper or meals are not taken on time ^[5]. Moreover, when some new-type blood glucose-lowering drugs are used in combination with other medications, drug interactions may occur, thereby increasing the risk of hypoglycemia. Therefore, during nursing care, medical staff should select appropriate types and dosages of drugs based on the patient's condition severity to reduce the incidence of hypoglycemic symptoms.

2.2.2. Dietary factor

Diabetes treatment is closely related to dietary control ^[6]. A scientific and reasonable diet plays an important role in maintaining the balance of blood glucose in the human body. For inpatients with diabetes, factors such as an unscientific diet structure and irregular eating can also increase the risk of hypoglycemia.

2.2.3. Exercise factor

Proper physical exercise can strengthen the body and improve insulin sensitivity in diabetic patients. However, excessive exercise can lead to hypoglycemia. Once inpatients with diabetes exercise excessively, a large amount of glucose in the body will be consumed. If energy is not supplemented in a timely manner, hypoglycemia is very likely to occur. Other than that, some patients have a gradual decline in physical function due to long-term lack of appropriate exercise, which affects the stability of blood glucose.

2.3. Nursing-related factors

2.3.1. Blood glucose monitoring factor

Blood glucose monitoring is one of the effective methods to detect patients' blood glucose levels, adjust treatment plans, and prevent hypoglycemia ^[7]. If nursing staff have problems such as insufficient monitoring frequency or non-standardized operation during blood glucose testing for inpatients with diabetes, it will affect the formulation of treatment plans and the identification of hypoglycemic symptoms. Additionally, some nursing staff lack professional literacy and are not proficient in operating new-type blood glucose monitoring equipment, which hinders the improvement of blood glucose testing quality.

2.3.2. Health education factor

Some nursing staff have problems in health education. They fail to explain in detail knowledge about hypoglycemia, such as its symptoms, hazards, and inducing factors, to inpatients with diabetes. This leads patients to pay no attention to dietary, exercise, and medication standards in daily life and treatment, thereby increasing the incidence of hypoglycemia.

3. Effective nursing countermeasures

3.1. Strengthen patient assessment and develop individualized nursing plans

To improve the nursing effect for inpatients with diabetes mellitus, it is essential to conduct a thorough assessment of the patient's condition ^[8]. A comprehensive understanding and evaluation should be made of factors such as the patient's age, disease duration, and comorbidities. For elderly patients, special attention should be paid to the degree of organ decline and the weakening of their ability to perceive hypoglycemia, so as to develop personalized

and refined nursing plans for them. For patients with a long disease course, the focus should be on evaluating their metabolic status and islet function, and targeted nursing countermeasures should be formulated based on their actual needs.

If the patient has other comorbidities, a comprehensive analysis of how these diseases affect the blood glucose regulation mechanism is required, and a more scientific and reasonable nursing plan should be developed on this basis. In short, patient assessment should be strengthened, and personalized and refined nursing plans should be formulated according to the actual situation and diverse needs of each patient.

3.2. Standardize pharmaceutical management to ensure medication safety

In clinical nursing work, nursing staff play an important and crucial role, especially in pharmaceutical management, where they must strictly follow medical orders to perform all operations ^[9]. In practice, nursing staff should first conduct information verification, including checking the type, dosage, and administration time of medications. They can only proceed with medication administration after confirming that all information is correct. At the same time, nursing staff should provide medication guidance, clearly informing patients about the mechanism of action of the drugs, potential side effects, and scientific administration methods. This ensures patients fully understand and helps them recognize the importance of taking medications as prescribed. When there is a change in medication dosage or type, nursing staff should promptly communicate with the attending physician, comprehensively assess the patient's condition, and develop personalized nursing measures based on the actual situation. Besides, a sound pharmaceutical management recording system should be established to keep detailed records of the patient's medication status, thereby providing more reliable medical security for patients.

3.3. Enhance dietary guidance to maintain blood glucose stability

Diet is one of the important factors leading to hypoglycemia. In this regard, nursing staff should develop a scientific and reasonable dietary plan for patients based on factors such as their weight, exercise volume, and condition ^[10]. The plan should include reasonable food collocation to ensure balanced nutrition while maintaining stable blood glucose. At the same time, nursing staff should emphasize the importance of regular eating to help patients develop good eating habits and avoid situations such as overeating, delayed meals, or missed meals. For patients using blood glucose-lowering drugs, medication guidance should be provided to ensure they eat on time after insulin injection. If they cannot eat on time, they should promptly communicate with the attending physician or nursing staff to facilitate the adoption of effective measures.

3.4. Provide scientific exercise guidance to avoid exercise-induced hypoglycemia

Inpatients with diabetes should fully recognize the importance of exercise and receive scientific guidance and support on exercise to avoid hypoglycemia caused by excessive exercise. Nursing staff should formulate personalized exercise plans for patients, taking into account their physical condition, disease duration, and age. For elderly patients or those with weak physical fitness, high-intensity exercise should be avoided. Low-intensity activities such as walking and jogging are recommended, and exercise duration should also be shortened to prevent excessive blood glucose consumption from prolonged exercise. For patients with a short disease duration and good physical fitness, exercise volume can be increased gradually, but sudden strenuous exercise must be avoided.

In terms of exercise type, aerobic exercises such as tai chi and jogging are recommended. These exercises not only improve patients' physical fitness and strengthen cardiopulmonary function but also enhance insulin

sensitivity. In addition, nursing staff should inform patients of precautions before and after exercise. For example, patients should check their blood glucose level before exercise; if blood glucose is low, they need to supplement energy before starting exercise. After exercise, they should also replenish water in a timely manner and eat appropriately to prevent hypoglycemia.

3.5. Strengthen blood glucose monitoring for early identification of hypoglycemia

Nursing staff should attach great importance to blood glucose monitoring for patients and formulate personalized blood glucose monitoring plans based on the patient's condition and treatment plan. The frequency of blood glucose monitoring should be increased for critically ill patients to ensure timely detection of abnormal blood glucose and reduce the occurrence of hypoglycemia. At the same time, nursing staff should continuously learn and train through various methods, such as participating in special training, online courses, and reading books, to ensure proficient use of new blood glucose monitoring equipment and ensure the authenticity and accuracy of monitoring results. In daily nursing work, they should also pay attention to observing subtle changes in the patient's body, such as whether early hypoglycemic symptoms (e.g., dizziness, palpitations, fatigue) appear. Once detected, effective intervention measures should be taken to prevent hypoglycemia. Besides, nursing staff should maintain good communication with patients' family members and caregivers, popularize the importance of blood glucose monitoring to them, and guide them on how to cooperate with monitoring work correctly.

3.6. Improve health education to enhance patients' self-management ability

Based on the patient's educational level and acceptance ability, nursing staff should use simple and easy-to-understand language to conduct health education for patients and their family members. The educational content should include the pathogenesis of diabetes, treatment methods, symptoms of hypoglycemia, and the importance of diet, so as to strengthen patients' awareness and help them develop good habits. At the same time, regular activities such as health mutual-aid groups and health seminars can be organized to encourage patients to share their disease experiences and self-management skills, promote mutual learning, and enhance patients' confidence. In addition, nursing staff can create short videos of the educational content and upload them to new media platforms such as Douyin, Kuaishou, and Weibo for health education. This expands the coverage of education and ensures that all patients can master health management skills and improve self-management ability. Meanwhile, nursing staff need to pay attention to the patient's psychological state, promptly alleviate anxiety or fear caused by the disease, and enhance their confidence in overcoming the disease.

4. Conclusion

In conclusion, the occurrence of hypoglycemia in inpatients with diabetes mellitus is the result of the combined effect of multiple factors. To improve the effectiveness of nursing care and protect patients' health, nursing staff should deeply recognize the hazards of hypoglycemia, conduct in-depth analysis of the factors causing hypoglycemia, and formulate personalized nursing plans according to the different conditions of patients. By doing so, the quality of nursing work can be improved, and high-quality nursing services can be provided to patients.

Disclosure statement

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Strategies to Overcome Challenges in Real-World Value Assessment amid Full DRG Implementation

Li Zhao, Xiaolei Liu*, Xinqi Tian, Yang Liu, Xiaochun Li

The First Affiliated Hospital of Air Force Medical University, Xi'an 710832, Shaanxi, China

**Author to whom correspondence should be addressed.*

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Abstract: Against the backdrop of the comprehensive implementation of Diagnosis-Related Groups (DRG), Real-World Value Assessment (RWVA) has become a crucial support for driving healthcare payment system reform and value-oriented decision-making. This paper systematically reviews the evolving trends in international Real-World Evidence (RWE) methodology from 2020 to 2025, analyzing its integration pathways with health economics and the development direction of dynamic value assessment models. Within the context of China's DRG-based payment policy implementation, it explores the application bottlenecks of Real-World Data (RWD) in technology access and price negotiations, proposing optimization strategies from three dimensions: data, methodology, and policy. The study argues that high-quality, interoperable data infrastructure should be constructed, models integrating RWE and health economics should be refined, and a value-oriented payment decision-making system should be established to optimize healthcare resource allocation and enhance the scientific nature of medical insurance payments. By implementing these strategies, the study anticipates the establishment of a closed-loop mechanism linking evidence generation, value assessment, and payment decision-making, thereby improving the transparency, efficiency, and sustainability of China's healthcare payment system. The expected outcome is a more data-driven and outcome-oriented policy framework that aligns real-world clinical performance with medical insurance value recognition.

Keywords: DRG payment; Health economics, Real-world data (RWD); Real-world evidence (RWE)

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1. Introduction

As global healthcare systems transition from “cost control” to “value orientation,” the strategic importance of Real-World Evidence (RWE) in drug regulation, medical insurance payment, and clinical decision-making has become increasingly prominent. Since 2020, the United States, the European Union, and the Asia-Pacific region have successively promoted the implementation of RWE policies, providing a new methodological foundation for the entire life-cycle management of pharmaceuticals. In this context, China is comprehensively advancing

DRG payment reform, aiming to standardize medical services and achieve refined allocation of resources through case-based payment. However, the current variable quality of Real-World Data, disconnects between assessment models and payment mechanisms, and unclear policy pathways limit the effective application of RWE in practical decision-making.

Based on the evolution of international methodologies and domestic policy practices, this paper systematically analyzes the current status, challenges, and optimization strategies for Real-World Value Assessment in China, providing references for constructing a value-oriented payment system based on real-world evidence.

2. Current status of real-world value assessment

2.1. International trends in RWE methodology development (2020–2025)

Between 2020 and 2025, RWE has evolved from a supplementary to a decisive component in global regulatory and health technology assessment decisions. Agencies like the US FDA, EMA, and Japan’s PMDA have issued guidelines, formally integrating RWE into areas such as post-market evaluation and indication expansion ^[1]. While this trend is global, regional differences are pronounced. The US FDA adopts a pragmatic, case-by-case approach, granting RWE significant weight. The EMA employs a more standardized model via the DARWIN EU network, prioritizing data harmonization but maintaining RWE as a complement to clinical trials ^[2].

Japan’s PMDA demonstrates greater caution, using RWE primarily for safety and rare-disease assessment. Methodologically, RWE has deepened its integration with health economics, forming a comprehensive framework for “dynamic value assessment.” The application of big data, AI, and causal inference has significantly enhanced the scientific rigor and reproducibility of studies. The emergence of patient-centered tools and lifecycle value models has shifted drug assessment towards continuously updated evaluations. Overall, this period has seen systematic advancements in RWE methodology, policy, and technology, laying a solid foundation for a value-oriented healthcare system ^[3].

2.2. Application progress of domestic real-world data and value assessment in China

Under the “Healthy China 2030” strategy, China is advancing the use of Real-World Data (RWD) for regulation and payment ^[4]. Agencies like the NMPA and NHSA are promoting multi-center RWD platforms. For instance, Zhejiang Province has integrated data from over 80 hospitals, which has supported evidence generation for 35+ drugs during national reimbursement negotiations ^[5]. Shenzhen pilots a similar model for DRG payment. RWE is increasingly used to verify real-world drug efficacy and inform pricing. However, applications remain largely exploratory, transitioning from pilots to normalization. The focus is shifting from “data construction” to “value enablement,” as China develops a distinctive value assessment framework driven by integrated policy and methodological efforts ^[6].

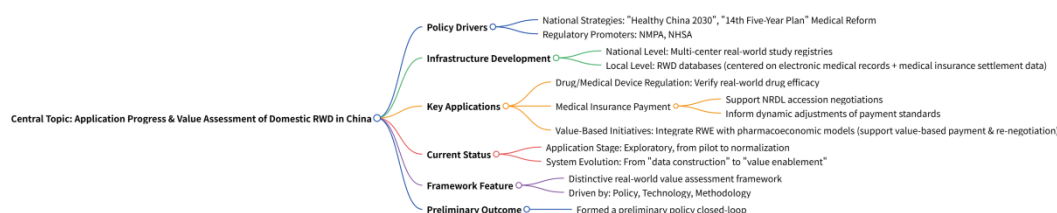


Figure 1. Application progress and value assessment framework of China’s domestic RWD.

Figure 1 was sourced and compiled from NMPA and NHSA policy documents (2018–2024), provincial pilot project reports, and peer-reviewed literature ^[4–6]. The framework illustrates the logical flow from policy and institutional drivers → data infrastructure and technical platforms → application scenarios and value realization. Arrows represent the dynamic feedback loop between data application and policy refinement, indicating how RWD supports iterative improvement in value-based payment decision-making.

3. Challenges in real-world value assessment

3.1. Data-level issues: Insufficient quality, interoperability, and traceability

Although the infrastructure for RWD in China has begun to take shape, significant challenges persist regarding data quality, interoperability, and traceability, which constitute major bottlenecks undermining the scientific rigor of real-world value assessment ^[7]. Substantial variations in data collection standards, coding systems, and documentation practices among different healthcare institutions result in high data heterogeneity, complicating multi-source integration and cross-validation ^[8]. Healthcare information systems are not fully interconnected; limited integration exists between electronic medical records, insurance claims data, and drug utilization data, leading to widespread issues such as missing key variables and data fragmentation ^[9].

3.2 Methodological-level issues: Disconnect between assessment models and payment mechanisms

A significant methodological gap exists between real-world value assessment models and DRG payment systems ^[10]. Traditional pharmacoeconomic models, often based on static trial data, fail to capture real-world cost and effectiveness variations. While RWE is increasingly used, its integration into economic models lacks standardization ^[11]. Furthermore, most models assess single technologies, misaligning with DRG payment logic that focuses on overall cost control for a patient group. This disconnect is compounded by payers' limited use of RWE, preventing assessment results from translating into payment incentives ^[12].

4. Optimization strategies for real-world value assessment

In summary, the challenges identified across data, methodological, and policy dimensions highlight the structural gaps that hinder the effective application of Real-World Value Assessment under the DRG-based payment system. Specifically, the issues of insufficient data quality and interoperability underscore the need to prioritize the construction of a high-quality, standardized RWD infrastructure.

4.1. Building high-quality, interoperable RWD infrastructure

Building a high-quality, interoperable RWD infrastructure is fundamental ^[13]. This requires establishing national, unified standards to integrate multi-dimensional data, from electronic records and insurance claims to patient-reported outcomes, into a standardized framework. Accelerating interoperability between hospital, insurance, and research systems is crucial for secure, multi-source data sharing ^[14]. A full lifecycle quality control and traceability mechanism must ensure data authenticity and consistency. Leveraging technologies like blockchain can enhance security and provenance management, balancing accessibility with privacy. This robust data ecosystem forms the essential backbone for generating reliable real-world evidence and supporting value-based decisions for payment, reimbursement, and drug assessment ^[15].

Table 1. Action plan for building a high-quality, interoperable RWD infrastructure

Initiative/action	Description/key components	Primary stakeholders	Expected outcome/quantitative target
Establish national data standards	Develop and mandate unified standards for data collection, formatting, and coding (e.g., diagnoses, procedures, PROs)	NMPA, NHSA, standardization administration	≥ 90% of tertiary hospitals to adopt standardized medical coding systems by 2027; inter-institutional data consistency improved by 40%.
Promote system interoperability	Facilitate semantic and technical interoperability between HIS, regional health platforms, and national insurance databases	NHSA, healthcare institutions, IT vendors	By 2026, achieve ≥ 80% data exchange compatibility among core systems; reduce manual data transfer time by 50%.
Implement data governance & QC framework	Establish full-lifecycle quality control and traceability mechanisms with regular audits	Data custodians, regulatory bodies	Annual data audit compliance rate ≥ 95%; reproducibility of RWE studies improved by 30%.
Leverage advanced technologies	Pilot blockchain for auditability and privacy-preserving computation (e.g., federated learning) for secure analysis	Researchers, tech providers, regulators	Launch ≥ 5 national-level pilots; data breach incidents reduced to < 0.1% annually.
Develop a centralized metadata catalog	Create a national catalog documenting RWD sources, access protocols, and quality metrics	Researchers, NHSA	Comprehensive metadata coverage across ≥ 70% of public medical institutions by 2027; improve RWD discoverability and reuse efficiency by 50%.

4.2. Refining dynamic assessment models integrating RWE and health economics

Refining dynamic models that integrate RWE with health economics is essential for multi-dimensional value assessment. The focus should be on adopting a “Life-cycle Value Assessment” approach, extending drug evaluation from pre-market to post-market phases for continuous value re-assessment. Methodologically, dynamic cost-effectiveness models should be developed, centered on real-world outcomes like effectiveness and adherence. Advanced techniques are crucial: causal inference methods (e.g., PSM, DID) mitigate confounding bias, while machine learning algorithms (e.g., Random Forest) model complex, non-linear interactions and enable continuous parameter updates as new data arrives. These methods are selected for their robustness with high-dimensional data. Simultaneously, establishing model validation and re-calibration mechanisms ensures external validity across diseases and payment systems.

5. Conclusion

Real-World Value Assessment (RWVA) is pivotal for shifting China’s healthcare system from volume-based to quality-driven care. While international methodological advances and domestic DRG reform are promoting evidence-based decision-making, progress is hindered by uneven data quality, model inflexibility, and policy misalignment. Future priorities must be building a high-quality data infrastructure, creating dynamic models that integrate RWE with health economics, and fostering institutional innovation. This will establish an integrated “evidence-assessment-payment” cycle to optimize resource allocation. This study’s limitations include its focus on national/provincial data, potentially underrepresenting primary care, and its exploratory conclusions on policy linkage, which require validation through longitudinal, multi-center studies incorporating broader data sources.

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Analysis of the Application Value of the MEWS in Neurological Patients and Its Prognostic Influencing Factors

Shuting Tang, Zhe Zhou*, Mingming Wang, Peng Wang, Renmin Zhang, Yan Chen, Yajing Ling

Emergency Medicine Department, Jiangsu University Affiliated People's Hospital, Zhenjiang 212000, Jiangsu, China.

*Corresponding author: Zhe Zhou, 526260641@qq.com

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Abstract: *Objective:* To evaluate the predictive value of Modified Early Warning Score (MEWS) for neurological disease prognosis and identify prognostic factors. *Methods:* This retrospective study analyzed 768 neurological patients with MEWS ≥ 4 (June 2022–June 2024). Patients were stratified by outcomes (favorable/unfavorable). Multivariable logistic regression and ROC analysis were performed. *Results:* 108 cases (13.1%) had unfavorable outcomes. Significant prognostic factors included: age, TBI history, onset-to-admission time, PT, MEWS score, and MEWS ≥ 4 frequency (all $P < 0.05$). MEWS showed AUC = 0.749 (sensitivity 62.0%, specificity 77.4%). *Conclusion:* MEWS demonstrates moderate predictive value (AUC = 0.749) for neurological outcomes. Consciousness assessment limitations (56.5% impaired cases) may affect sensitivity. A specialized model incorporating pupillary reflexes and GCS is recommended for improved early warning.

Keywords: Modified early warning score; Neurological diseases; Predict prognosis; Risk factors; ROC

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1. Introduction

Neurological diseases encompass stroke, traumatic brain injury, intracranial infections, and others, characterized by high incidence, high prevalence, high disability rates, and high mortality rates^[1]. The 30-day mortality rate after intracerebral hemorrhage reaches as high as 35%–52%, with 80% of patients at risk of disability^[2]. In China, the annual incidence of traumatic brain injury ranges from 55 to 64 per 100,000 people, resulting in nearly 100,000 deaths annually and imposing a heavy burden on families and society^[3].

The Modified Early Warning Score (MEWS), proposed by Subbe et al. in 2001, is a scoring system used to monitor patients' vital signs^[4]. It is characterized by its convenience in clinical observation and simple operation^[5]. MEWS has shown favorable application effects in pre-hospital emergency care, emergency departments, ICUs, and other critical care settings. However, research on its application in neurological patients is relatively limited. An MEWS

score of ≥ 4 often serves as a threshold for poor prognosis, used for clinical risk stratification, indicating a worse prognosis for such patients. Therefore, this study will focus on neurological patients with a MEWS score of ≥ 4 , exploring the predictive efficacy of MEWS for the prognosis of neurological patients and screening for factors influencing their prognosis. The aim is to provide evidence-based support for establishing a neurology-specific early warning scoring system.

2. Materials and methods

2.1. General information

A retrospective study was conducted, selecting 768 patients from the neurology and neurosurgery wards of a tertiary hospital in Zhenjiang between June 2022 and June 2024 as the research subjects. The study was approved by the hospital's ethics committee (K-2025039-W).

The inclusion criteria are as follows:

- (1) Age ≥ 18 years old;
- (2) MEWS score ≥ 4 points.

The exclusion criteria are as follows:

- (1) Patients whose family members have abandoned treatment;
- (2) Patients with incomplete clinical data.

2.2. Research methods

The questionnaire is designed by the researchers themselves, it includes:

- (1) General patient information, including age, gender, smoking history, alcohol consumption history, NRS2002 nutritional score, pre-admission self-care ability score (Barthel score), BMI (based on the first measurement upon admission), thrombotic risk (clinical judgment method), and comorbidities (whether the patient has hypertension, diabetes, coronary heart disease, or hyperlipidemia);
- (2) Information related to neurological diseases, including GCS score (based on the first admission), clinical symptoms (dizziness, headache), cranial CT examination, MEWS score (based on the first admission), and frequency of MEWS scores ≥ 4 points;
- (3) Other laboratory tests (based on the first measurement within 24 hours of admission), including total bilirubin, blood glucose, prothrombin time (PT), etc.

2.3. Data collection methods

After obtaining approval from the hospital administration, data was collected using the hospital's medical record management information system.

2.4. Statistical methods

SPSS 27.0 software was used for analysis. MEWS scores, as continuous data that did not conform to a normal distribution, were represented by medians (quartiles). Intergroup comparisons were made using analysis of variance or t-tests. Count data were represented by frequencies and percentages (%), and intergroup comparisons were made using chi-square tests or rank-sum tests. The significance level was set at $\alpha = 0.05$. A statistically significant difference was considered when $P < 0.05$.

Based on the sample size estimation method for multivariate logistic regression models and adhering to the principle of requiring 5–10 patients per independent variable, this study ultimately included 11 variables in the model. The incidence of poor patient prognosis in this study was 14%, and a 20% sample attrition rate was considered. Therefore, the minimum required sample size for the study was calculated to be approximately 491 cases using the formula $5 \times 11 \div 14\% \div (1 - 20\%)$, and ultimately, 768 cases were included in the study.

3. Results

3.1. General information of patients

A total of 768 patients were included in this study, comprising 297 males (38.7%) and 471 females (61.3%). After treatment, 660 patients (85.9%) had favorable outcomes, while 108 patients (14.1%) had unfavorable outcomes. **Table 1** presents the demographic and general information of the 768 patients with neurological diseases, with specific data provided in the table.

3.2. Univariate analysis of patient prognosis

From **Table 1**, it can be observed that age, BMI, number of underlying diseases, diabetes, history of cranial trauma, time from onset to medical consultation, NRS2002 score, prothrombin time (PT), ICU admission, MEWS score, and the frequency of MEWS ≥ 4 all showed statistically significant differences ($P < 0.05$).

Table 1. Univariate analysis of patient prognosis

Item	Total cases	Favorable outcome (n=660)	Unfavorable outcome (n=108)	Statistic	P value
Gender [n, %]				$\chi^2 = 0.644$	0.422
Male	297	259 (39.2)	38 (35.2)		
Female	471	401 (60.8)	70 (64.8)		
Age [years, n, %]				$\chi^2 = 23.417$	< 0.001
18–59	224	206 (31.2)	18 (16.7)		
60–90	524	443 (67.1)	81 (75.0)		
> 90	20	11 (1.7)	9 (8.3)		
Consciousness [n, %]				$\chi^2 = 2.534$	0.282
Alert	335	281 (83.9)	54 (16.1)		
Stupor	220	195 (88.6)	25 (11.4)		
Coma	213	184 (86.4)	29 (13.6)		
GCS Score [n, %]				$\chi^2 = 0.703$	0.704
3–8	230	201 (30.5)	29 (26.9)		
9–12	138	119 (18.0)	19 (17.6)		
13–15	400	340 (51.5)	60 (55.6)		
BMI [kg/m ² , n, %]				$\chi^2 = 4.066$	0.001
≤ 25	557	470 (71.2)	87 (28.8)		
> 25	211	190 (28.8)	21 (19.4)		

Table 1 (Continued)

Item	Total cases	Favorable outcome (n=660)	Unfavorable outcome (n=108)	Statistic	P value
Number of comorbidities [n, %]				$\chi^2 = 7.124$	0.008
< 2	493	436 (66.1)	57 (52.8)		
≥ 2	275	224 (33.9)	51 (47.2)		
Diabetes [n, %]				$\chi^2 = 8.158$	0.004
Yes	168	133 (20.2)	35 (32.4)		
No	600	527 (79.8)	73 (67.6)		
Hypertension [n, %]				$\chi^2 = 1.132$	0.287
Yes	528	449 (68.1)	79 (73.1)		
No	240	211 (32)	29 (26.9)		
Hyperlipidemia [n, %]				$\chi^2 = 1.826$	0.177
Yes	11	11 (1.7)	0 (0.0)		
No	757	649 (98.3)	108 (100.0)		
History of head trauma [n, %]				$\chi^2 = 7.043$	0.008
Yes	609	513 (77.7)	96 (88.9)		
No	159	137 (22.3)	12 (11.1)		
Meningeal signs [n, %]				$\chi^2 = 1.056$	0.304
Negative	658	562 (85.2)	96 (88.9)		
Positive	110	98 (13.8)	12 (11.1)		
Onset to admission time [n, %]				$\chi^2 = 11.815$	< 0.001
< 24h	572	506 (76.7)	66 (61.1)		
$\geq 24h$	196	154 (23.3)	42 (38.9)		
Barthel index [n, %]				$\chi^2 = 0.690$	0.406
≤ 40	384	334 (50.6)	50 (46.3)		
> 40	384	326 (49.4)	58 (53.7)		
NRS2002 ccore [n, %]				$\chi^2 = 11.742$	0.008
Normal (0 points)	47	35 (5.3)	12 (11.1)		
Mild (1 point)	49	39 (5.9)	10 (9.3)		
Moderate (2 points)	126	117 (17.7)	9 (8.3)		
Severe (≥ 3 points)	546	469 (71.1)	77 (71.3)		
Total bilirubin [$\mu\text{mol/L}$, n, %]				$\chi^2 = 1.690$	0.194
≤ 21	619	527 (79.8)	92 (85.2)		
> 21	151	133 (20.2)	16 (13.8)		
Prothrombin time [s, M (P25–P75)]				Z = 0.182	< 0.001
	11.5 (10.9, 12.2)	11.6 (10.4, 12.4)			

Table 1 (Continued)

Item	Total cases	Favorable outcome (n=660)	Unfavorable outcome (n=108)	Statistic	P value
ICU Admission [n, %]				$\chi^2 = 5.104$	0.024
Yes	395	352 (53.3)	43 (39.8)		
No	373	308 (46.7)	65 (60.2)		
MEWS [points, M (P25, P75)]				Z = -9.013	< 0.001
	4 (4, 5)	6 (5, 10)			
Frequency of MEWS ≥ 4 [n, %]				$\chi^2 = 45.840$	< 0.001
< 5 times	572	520 (78.8)	52 (48.1)		
≥ 5 times	196	130 (21.2)	56 (51.9)		

3.3. Multivariate analysis of patient prognosis

Using the outcome status as the dependent variable (unfavorable = 0, favorable = 1), 11 statistically significant variables from the univariate analysis were included in the logistic regression model. **Table 2** presents the assignment of independent variables. With $\alpha_{\text{entering}} = 0.05$ and $\alpha_{\text{exiting}} = 0.1$, the forward conditional method was employed to identify risk factors. The Hosmer-Lemeshow test yielded $\chi^2 = 5.997$, $P = 0.540$.

Table 2. Description and coding of independent variables

Variable	Assignment
Age	18–59 years = 1, 60–90 years = 2, > 90 years = 3
BMI	$\leq 25 \text{ kg/m}^2 = 1$, $> 25 \text{ kg/m}^2 = 2$
Number of comorbidities	$\geq 2 = 1$, $< 2 = 2$
History of diabetes	No = 0, Yes = 1
Onset to admission time	$< 24 \text{ h} = 1$, $\geq 24 \text{ h} = 2$
NRS2002 score	0 points = 0, 1 point = 1, 2 points = 2, ≥ 3 points = 3
Prothrombin time	$< 13.3 \text{ s} = 1$, $\geq 13.3 \text{ s} = 2$
ICU admission	No = 0, Yes = 1
MEWS score	≤ 5 points = 1, > 5 points = 2
Frequency of MEWS ≥ 4	< 5 times = 1, ≥ 5 times = 2
History of head trauma	No = 0, Yes = 1

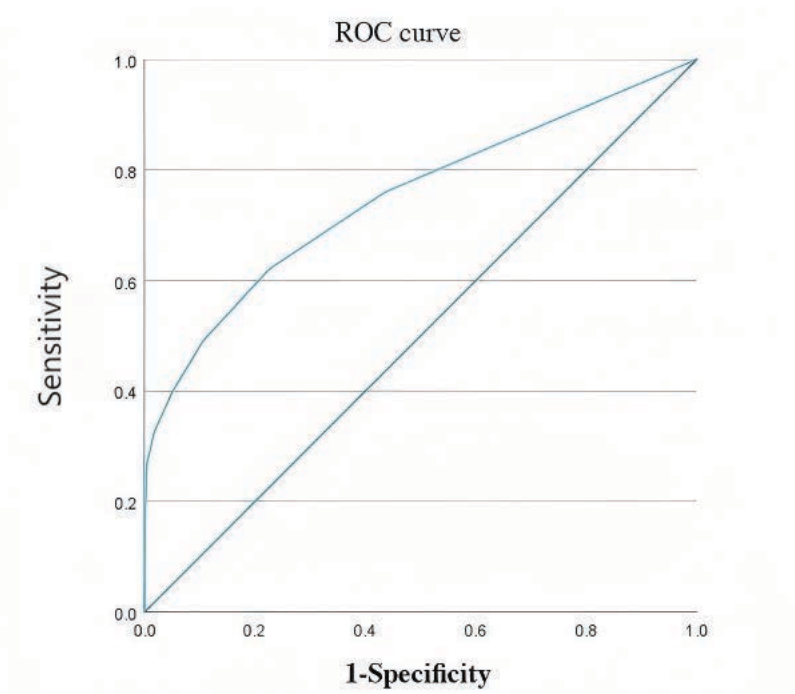
The Omnibus test of model coefficients showed $\chi^2 = 163.070$, $P < 0.001$, indicating a good fit. The data in **Table 3** reveal that age, history of cranial trauma, time from onset to medical consultation, prothrombin time, and the frequency of MEWS score ≥ 4 are independent risk factors for the prognosis of patients with neurological diseases.

Table 3. Multivariate analysis of prognostic factors in patients with neurological disorders

Variable	β	SE	Wald	P-value	OR	95% CI
Age	0.922	0.283	10.603	0.001	2.514	1.443–4.378
History of head trauma	-0.869	0.392	4.914	0.027	0.419	0.195–0.904
Onset to admission time	0.802	0.278	8.334	0.004	2.230	1.294 - 3.843
Prothrombin time	1.801	0.330	29.860	< 0.0001	6.057	3.175–11.558
MEWS score	1.981	0.255	60.165	< 0.0001	7.251	4.395–11.961
Frequency of MEWS ≥ 4	1.345	0.251	28.682	< 0.0001	3.839	2.346–6.280
Constant	-9.167	0.998	84.384	< 0.0001	< 0.0001	-9.167

3.4. Predictive effect of MEWS score on the prognosis of patients with neurological diseases

Figure 1 depicts the ROC curve drawn with the state variable value set to 1 (i.e., unfavorable outcome). The area under the ROC curve for the MEWS score was 0.749 [95% CI 0.692, 0.807], $P < 0.001$, with an optimal cutoff value of 6, a Youden index of 0.394, a sensitivity of 62.00%, and a specificity of 77.40%.

**Figure 1.** ROC curve of the modified early warning score (MEWS).

4. Discussion

4.1. Analysis of the effectiveness of MEWS scores in patients with neurological disorders

Figure 1 indicates that MEWS exhibits moderate predictive efficacy for the prognosis of patients with neurological disorders (AUC = 0.749, sensitivity 62.00%, specificity 77.40%), which is slightly lower than that reported in previous studies ^[6,7]. This discrepancy may be attributed to the relatively broad range of neurological diseases included in this study, suggesting limitations in the application of the MEWS system in specific populations.

Notably, 56.5% of cases exhibited impaired consciousness, leading to an imbalance in the weighting of the AVPU score and an elevated overall MEWS score. This resulted in insufficient sensitivity to pathological changes specific to neurological disorders.

Studies have shown that a MEWS score of ≥ 4 has predictive value for intensive care needs ^[8–11]. A foreign study indicated that the AVPU dimension does not fully reflect neurological specificity ^[12]. It is recommended to optimize the implementation of MEWS scoring system and incorporate specialized neurological indicators to construct a neurology-specific assessment model, aiming to enhance the accuracy of nursing teams in identifying neurological critical conditions.

4.2. Factors influencing the prognosis of neurological patients with MEWS scores ≥ 4

4.2.1. Age

The results in **Table 3** indicate that age is a significant factor influencing the prognosis of neurological patients ($P < 0.05$). As age increases, patient prognosis tends to worsen, consistent with findings from related studies ^[13–15]. The potential reasons for this are as follows:

- (1) With the progression of aging, the incidence of various comorbidities gradually rises, affecting patient prognosis ^[14];
- (2) Decline in physiological functions among elderly patients can lead to discrepancies between disease progression and clinical manifestations, making early disease changes easily overlooked and thereby delaying treatment and affecting prognosis.

In clinical practice, nursing staff should conduct comprehensive specialist nursing assessments for patients of different age groups and implement targeted measures based on the patient's condition. In the event of any changes in the patient's condition, a rapid response system should be immediately activated to improve patient prognosis.

4.2.2. History of cranial trauma

Table 3 reveals that a history of cranial trauma is a protective factor for the prognosis of neurological patients ($P < 0.05$), with patients having a lower risk of poor prognosis. The findings of this study differ from those of previous studies ^[16,17]. The reasons for these discrepancies may include:

- (1) Patients with cranial trauma, due to the severity of their condition, tend to receive greater attention from healthcare professionals, leading to earlier and more proactive interventions;
- (2) This study also included patients from the neurology department, which may introduce some bias into the results.

Future research could further expand the sample size, include a wider range of patient types, and analyze the impact of different interventions on prognosis to more comprehensively explore the relationship between a history of cranial trauma and patient prognosis.

4.2.3. Time from onset to hospital visit

The time from symptom onset to medical consultation is a risk factor affecting the prognosis of patients with neurological disorders ($P < 0.05$). Patients with symptom duration ≤ 24 hours exhibit better prognoses, with specific data presented in **Table 3**. Zheng's team confirmed that delayed medical consultation is a key factor influencing patient prognosis (OR = 1.050) through logistic regression analysis, although its effect size is slightly lower than that observed in this study ^[18]. Hu et al. argued that a time from symptom onset to medical consultation

exceeding 3.5 hours is an independent risk factor for poor prognosis in severe cerebral infarction (OR = 3.643), showing significant consistency with the findings of this study ^[19]. Delayed medical consultation may result in missing the golden window for treatment, leading to irreversible patient damage. It is recommended to conduct community health education during the pre-hospital phase to enhance the public's ability to recognize early symptoms and to conduct prospective, detailed analyses of the relationship between medical consultation time and patient prognosis.

4.2.4. Prothrombin time

Prolonged PT is a predictor of poor prognosis ($P < 0.001$). Patients with neurological disorders who have a PT < 13.3 seconds exhibit relatively better prognoses, consistent with the findings of related studies, with specific data presented in **Table 3** ^[20,21]. The results of a retrospective study conducted by scholars such as Li indicate that the use of antithrombotic drugs is a key risk factor affecting the prognosis of elderly patients with intracranial hemorrhage, a finding similar to that of this study ^[22]. PT is an important indicator for assessing a patient's coagulation function, primarily reflecting the status of the exogenous coagulation system. Abnormalities in the quantity or quality of coagulation factors, as well as the presence of anticoagulant substances in the blood, can lead to prolonged PT ^[23]. Prolonged PT may further trigger multiple organ failure, causing irreversible harm, and can lead to poor prognosis or even death in patients ^[24]. Therefore, monitoring PT is crucial for early identification of coagulation dysfunction and prevention of poor prognosis. It is recommended that nursing staff monitor and assess patients' coagulation function as early as possible, promptly identify coagulation abnormalities, and implement targeted interventions at an early stage to reduce the risk of poor patient prognosis.

4.2.5. MEWS score and frequency of MEWS ≥ 4

The study results indicated that the MEWS score was a significant influencing factor on patient prognosis ($P < 0.001$), with specific data presented in **Table 3**. A higher MEWS score was associated with a worse patient prognosis. MEWS demonstrated good efficacy in predicting in-hospital mortality among TBI patients and could also predict patient prognosis ^[6,14,25]. The MEWS score aids healthcare professionals in identifying potentially critically ill patients. Our study results revealed that the frequency of MEWS scores ≥ 4 was a risk factor affecting patient prognosis ($P < 0.001$), with a higher frequency of MEWS scores ≥ 4 correlating with an increased risk of poor patient prognosis. Currently, research on the frequency of MEWS scores and their association with prognosis is relatively scarce. We recommend conducting prospective studies in the future to explore the relationship between the frequency of MEWS scores ≥ 4 and prognosis.

5. Conclusion

The MEWS demonstrated moderate efficacy (AUC = 0.749) in predicting the prognosis of patients with neurological diseases. The high incidence of impaired consciousness (56.5%) led to an imbalance in the AVPU scale's weighting, with its sensitivity (62.00%) and specificity (72.40%) showing potential for improvement. Studies have shown that compared to other illness assessment systems, the MEWS score offers higher accuracy in predicting the risk of patient condition changes. By integrating factors such as age, time from onset to medical consultation, coagulation function, and pupillary reflex, MEWS could potentially construct a specialized early warning model that breaks through the bottleneck of traditional scoring systems in neurological applications.

The study's limitations include its single-center retrospective design, which may introduce selection bias, and the potential for errors in manual data entry. We recommend conducting multi-center prospective studies in the future, utilizing standardized electronic medical record systems for data collection, and developing specialized neurological scores to provide evidence-based support for establishing a localized early warning system.

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Disclosure statement

The authors declare no conflict of interest.

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Aromatherapy Combined with Emotional Freedom Techniques on Fear of Recurrence and Sleep Quality in Lung Cancer Survivors

Haiying Xu¹, Wei Xiao^{2*}

¹Yichang Central People's Hospital, Yichang 443003, Hubei, China

²Zhijiang People's Hospital, Zhijiang 443200, Hubei, China

**Author to whom correspondence should be addressed.*

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Abstract: *Objective:* This study aimed to explore the effect of aromatherapy combined with emotional release technology on recurrence fear and sleep quality of lung cancer survivors. *Methods:* 114 cases of lung cancer survivors were divided into routine nursing group, emotional release technology group and aromatherapy combined with emotional release technology group. Routine nursing group received routine nursing; Emotional release technology group implemented emotional release technology for one month on the basis of routine nursing group; Aromatherapy combined with emotional release technology group used lavender aromatherapy on the basis of emotional release technology group. *Results:* After one month of intervention, there were statistically significant differences in the scores of fear of disease progression and sleep quality among the three groups. *Conclusion:* Aromatherapy combined with emotional release technology can improve the sleep quality of lung cancer survivors and reduce the economic toxicity of cancer to some extent.

Keywords: Emotional freedom technology; Lavender; Lung cancer; Fear of relapse; Sleep

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1. Introduction

With the development of medical conditions, the update of targeted drugs and treatment methods, the survival period of lung cancer survivors has been prolonged ^[1]. However, the negative emotions brought by cancer to survivors have not disappeared, and they still suffer from severe psychological burden during treatment, including fear of cancer recurrence ^[2,3]. Studies have shown that the higher the level of fear of recurrence among cancer survivors, the worse their sleep quality ^[4]. If not intervened in a timely manner, it may lead to a prolonged recovery period for survivors.

Lavender is known as the “king of herbs” with a fresh and elegant aroma. It is mild in nature and has the effects of sedation, hypnosis and anti-anxiety. Moreover, its fragrance can enter the spleen to invigorate spleen Qi.

Emotional Freedom Techniques (EFT), developed by American scholar Gary Craig, is a psychological intervention method based on traditional Chinese medicine meridian theory and Western psychology. It mainly relieves negative emotions by tapping specific acupoints to dredge meridians while reciting cues ^[5]. Foreign scholars have used EFT to alleviate anxiety and depression in medical staff and women ^[6]. Domestic and foreign studies have confirmed that aromatherapy combined with EFT has a significant effect on different groups of people with insomnia.

This study applied aromatherapy combined with EFT to lung cancer survivors to explore its impact on their fear of recurrence and sleep quality, in order to provide a reference for traditional Chinese medicine nursing. The report is as follows:

2. Objects and methods

2.1. Objects

Based on Wang's intervention study, this paper adopted the formula $n = (Z\alpha + Z\beta)^2 \cdot 2\sigma^2 / \delta^2$ ^[11]. Here, σ represents the standard deviation, and δ represents the difference between the means of the two groups. In this study, $\sigma = 4.24$, $\delta = 3.45$, with $\alpha = 0.05$ and $\beta = 0.10$. A two-tailed test was used. By looking up the table, $u_{0.05/2} = 1.96$ and $u_{0.10} = 1.282$. Substituting these values into the formula, the sample size of the intervention group in this study was calculated to be 32.

The sample size of each of the three groups was 38, totaling 114 cases. Using convenient sampling, 114 lung cancer survivors from the Oncology Department of a Grade A tertiary hospital in Yichang City were selected. A non-concurrent controlled experimental design was adopted: those admitted from September to December 2023 were set as the routine nursing group, those admitted from January to March 2024 as the EFT group, and those admitted from April to June 2024 as the aromatherapy combined with EFT group.

2.2. Intervention methods

2.2.1. Routine nursing group

The control group received routine nursing. Responsible nurses provided face-to-face guidance on diet, medication, and health education to survivors during morning nursing and treatment.

2.2.2. EFT group

On the basis of routine nursing, this group received operational procedure intervention from postgraduate nurses with professional EFT knowledge. The intervention cycle was 1 month, once a day, 8–10 minutes each time.

(a) Preparation stage

An EFT intervention team composed of 1 postgraduate nurse with professional EFT knowledge, 1 oncology head nurse, and 1 oncology specialist nurse was established, where all three of them had systematically studied EFT theory and received training. A comfortable and quiet room was arranged, and the Chinese version of the Fear of Progression Questionnaire-Short Form, Pittsburgh Sleep Quality Index and a general information questionnaire was filled out by the cancer survivors to establish personal files.

(b) Operation stage

Before the operation, survivors were instructed to trim their nails, practice hand hygiene, take a comfortable position, relax, and take relevant protective measures. Survivors were asked to feel and

identify their fear emotion, and the intensity of fear was evaluated with reference to the negative psychological index. They were then informed of the specific locations of the following acupoints and the corresponding cues: Houxi (SI3), Neiguan (PC6, preferably the left side), Cuanzhu (BL2), Tongziliao (GB1), Chengqi (ST1), Shuigou (GV26), Chengjiang (CV24), Shencang (KI25), Dabao (SP21), and Baihui (GV20). Survivors were guided to put their index, middle, and ring fingers together, and tap the above acupoints in sequence with their fingertips, with the intensity being slightly sore and distended. They have recited the cues while tapping the acupoints. After tapping the 10 acupoints in sequence, 3 deep breaths were taken and turbid Qi was exhaled to complete a round of psychological regulation. After evaluating the effect of the first round of emotional regulation, the cues were adjusted and the second round of emotional regulation was adjusted. After adjusting the cues according to the effect, the third and fourth rounds of emotional regulation were conducted. The intervention was terminated when the emotional intensity score was ≤ 2 points and the survivor's fear emotion was relieved.

2.3. Evaluation methods

2.3.1. Evaluation indicators

(a) Negative psychological index

A 0–10 scale was used, where 0 points indicate no discomfort at all, and 10 points indicate extreme inner pain that is unbearable. It was used for survivors to subjectively and quickly assess emotional intensity before and after performing EFT, and the score indicates whether the emotional release operation can be terminated.

(b) Chinese version of the fear of progression questionnaire-short form (FoP-Q-SF)

Localized by Wu in 2015, it includes 12 items divided into two dimensions: physical health dimension and family-social dimension, which is used to evaluate the level of fear of recurrence in cancer survivors. The scale adopts a 5-point Likert scoring system and is a self-assessment scale for survivors, with “1” representing “never” and “5” representing “always”. The total score ranges from 12 to 60, and a higher score indicates a higher level of fear in cancer survivors.

(c) Pittsburgh sleep quality index (PSQI)

Developed by Buysse in 1989, it is used to evaluate the sleep quality of the subjects. The total score ranges from 0 to 21 points: a total score ≤ 7 points indicates normal sleep quality, while a total score ≥ 8 points indicates poor sleep quality.

2.3.2. Data collection methods

When the subjects were enrolled, a postgraduate student conducted a general information assessment and FoP-Q-SF scale evaluation, and a second evaluation was performed one month later. If a cancer survivor was discharged from the hospital during the study period, the intervention group was supervised by another researcher to check in via WeChat group after completing the daily operation, and the second data collection was completed by scheduling a time through WeChat or phone call at the end of the study.

2.4. Statistical methods

SPSS 23.0 software was used for t-test, Wilcoxon rank-sum test, χ^2 test and Fisher's exact probability test. The test level was set at $\alpha = 0.05$.

3. Results

3.1 Comparison of scores of the Chinese version of FoP-Q-SF before and after intervention between the EFT group and the routine nursing group

The EFT group demonstrated a significantly greater reduction in fear of progression (as measured by the Chinese version of the FoP-Q-SF) compared to the routine nursing group following the intervention. The detailed scores are presented in **Table 1**.

Table 1 Comparison of scores of the Chinese version of FoP-Q-SF before and after intervention between the EFT group and the routine nursing group

Groups	n	Physical health dimension	Family-social dimension	Total scale score
EFT group				
Before intervention	38	19.34 ± 2.643	22.58 ± 2.596	41.92 ± 3.744
After intervention	38	11.13 ± 1.989	13.03 ± 2.795	24.16 ± 4.156
Routine nursing group				
Before intervention	38	19.79 ± 2.256	21.66 ± 2.374	41.45 ± 2.938
After intervention	38	20.95 ± 1.874	22.42 ± 2.262	43.37 ± 3.174
Inter-group comparison	-			
Before intervention (<i>t/P</i>)	-	-0.794/0.430	1.614/0.111	0.614/0.541
After intervention (<i>t/P</i>)	-	-22.145/< 0.001	-16.109/< 0.001	-22.645/< 0.001
Intra-group comparison of EFT group (before vs after intervention) (<i>t/P</i>)	-	15.300/< 0.001	15.439/0.012	19.575/0.002
Intra-group comparison of routine nursing group (before vs after intervention) (<i>t/P</i>)	-	-2.434/0.17	-1.435/0.156	-2.738/0.08

3.2. Comparison of scores of the Chinese version of FoP-Q-SF before and after intervention between the aromatherapy combined with EFT group and the routine nursing group

A significant difference was observed in the reduction of FoP-Q-SF scores when comparing the aromatherapy combined with EFT group to the routine nursing group, as detailed in **Table 2**.

2.3 Comparison of scores of the Chinese version of FoP-Q-SF before and after intervention between the aromatherapy combined with EFT group and the EFT group

A comparison of the Chinese Version of the FoP-Q-SF scores before and after the intervention was conducted between the two groups. As presented in **Table 3**, the aromatherapy combined with EFT group demonstrated a significantly greater reduction in scores compared to the EFT-only group.

Table 2 Comparison of scores of the Chinese version of FoP-Q-SF before and after intervention between the two groups

Groups	n	Physical health dimension	Family-social dimension	Total scale score
Aromatherapy combined with EFT group				
Before intervention	38	20.37 ± 2.211	21.87 ± 2.133	42.24 ± 3.300
After intervention	38	9.84 ± 1.717	10.71 ± 2.588	20.55 ± 3.818
Routine nursing group				
Before intervention	38	19.79 ± 2.256	21.66 ± 2.374	41.45 ± 2.938
After intervention	38	20.95 ± 1.874	22.42 ± 2.262	43.37 ± 3.174
Inter-group comparison	-			
Before intervention (t/P)	-	-1.130/0.262	-0.407/0.685	-1.101/0.274
After intervention (t/P)	-	26.938/< 0.001	21.003/< 0.001	28.325/< 0.001
Intra-group comparison of aromatherapy combined with EFT group (before vs after intervention) (t/P)	-	23.183/< 0.001	20.509/< 0.001	26.488/< 0.001
Intra-group comparison of routine nursing group (before vs after intervention) (t/P)	-	-2.434/0.17	-1.435/0.156	-2.738/0.08

Table 3 Comparison of scores of the Chinese version of EoP-Q-SF before and after intervention between the two groups

Groups	n	Total score of physical health dimension	Total score of family-social dimension	Total scale score
Aromatherapy combined with EFT group				
Before intervention	38	20.37 ± 2.211	21.87 ± 2.133	42.24 ± 3.300
After intervention	38	9.84 ± 1.717	10.71 ± 2.588	20.55 ± 3.818
EFT group				
Before intervention	38	19.34 ± 2.643	22.58 ± 2.596	41.92 ± 3.744
After intervention	38	11.13 ± 1.989	13.03 ± 2.795	24.16 ± 4.156
Inter-group comparison				
Before intervention (t/P)	-	-1.836/0.07	1.304/0.196	-0.390/0.698
After intervention (t/P)	-	0.334/0.003	0.149/< 0.001	0.329/< 0.001
Intra-group comparison of aromatherapy combined with EFT group (before vs after intervention) (t/P)	-	23.183/< 0.001	20.509/< 0.001	26.488/< 0.001
Intra-group comparison of EFT group (before vs after intervention) (t/P)	-	15.300/0.001	15.439/0.012	19.575/0.002

4. Discussion

4.1 Both EFT and aromatherapy combined with EFT can effectively reduce survivors' fear of recurrence and improve their sleep quality

After one month of intervention with EFT and aromatherapy combined with EFT, the scores of FoP-Q-SF and PSQI in the aromatherapy combined with EFT group were significantly lower than those in the routine nursing group, with statistically significant intra-group differences ($P < 0.05$, $P < 0.01$). This indicates that EFT and aromatherapy combined with EFT can effectively reduce the fear of recurrence and improve the sleep quality of lung cancer survivors, thereby enhancing their quality of life, which is consistent with the research by Chen et al. [7]. Meanwhile, the above data showed that aromatherapy combined with EFT has a more positive effect on relieving survivors' fear than EFT alone, making survivors more mentally calm and improving their sleep quality ($P < 0.05$, $P < 0.01$).

4.2. Mechanisms of action of EFT and aromatherapy

EFT is based on the theories of traditional Chinese medicine meridian theory and Western psychology. It relieves the negative emotions caused by the fear of cancer recurrence in cancer survivors at different disease stages by tapping acupoints to dredge meridians and reciting cues [8]. Lonnberg used computational models to test the mechanistic relationship between amygdala function and circuit adaptation during fear regulation, which affects fear behavior through changes in neural circuits, providing a framework model of the amygdala in the process of neural adaptation [9]. The amygdala is the fear center of the brain and is responsible for fear memory. The body's endocrine activities regulate emotions through the "amygdala-hypothalamus-pituitary" signal axis [10–12].

At the same time, a study by Stapleton et al. have shown that tapping acupoints can reduce the size of the amygdala and the secretion of cortisol [13]. By tapping specific acupoints, lung cancer survivors can reduce cortisol secretion, dredge meridians, and alleviate negative emotions. Tapping specific acupoints has different effects; for example, tapping Cuanzhu (BL2) can regulate Qi and calm the mind, and tapping Baihui (GV20) can eliminate fear [14].

"Compendium of Materia Medica" records that lavender is sweet, mild, and non-toxic, with the effects of nourishing meridians, calming the mind, and inducing sleep. Thirteen components of lavender, including linalool, may be related to increasing the content of 5-HT and decreasing the content of dopamine in brain tissue, thereby exerting sedative and soothing effects [15].

5. Conclusion

Aromatherapy combined with EFT can effectively alleviate the fear of recurrence and improve the sleep quality of lung cancer survivors, better enhance their compliance with anti-cancer treatment, reduce the economic toxicity of cancer, avoid the vicious cycle between poor sleep and negative emotions, and thus improve their quality of life. As a method integrating traditional Chinese medicine meridian theory and Western psychology, EFT is helpful for relieving the fear of recurrence in lung cancer survivors. Lavender, as an easily accessible Chinese herbal medicine, has the advantages of being cost-free, painless, free of side effects, non-invasive, easy to learn and operate. The combination of the two can further exert the effect of traditional Chinese medicine.

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Comprehensive Review and Response Strategies for Nipple Confusion

Chong Yang¹, Jie Cui¹, Yongtao Kang², Longhai Song^{3*}

¹ Department of Obstetrics, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

² Department of Neurology, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

³ Department of Urology, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

**Author to whom correspondence should be addressed.*

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Abstract: The term “nipple confusion” accurately describes the confusion newborns experience between their mother’s nipple and an artificial nipple during feeding. Specifically, it refers to the feeding habits infants develop based on their initial feeding experiences after birth. Infants accustomed to the maternal nipple often resist bottle-feeding; conversely, those accustomed to bottle-feeding may reject the maternal nipple. This confusion is particularly common among infants receiving mixed feeding.

Keywords: Nipple confusion; Newborn; Breastfeeding; Breast milk and bottle

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1. Introduction

Nipple confusion is a common issue in newborn feeding, referring to an infant’s confusion between the mother’s nipple and an artificial nipple due to early exposure to different feeding methods (breastfeeding and bottle-feeding). This confusion leads to a strong preference for or resistance to one method. This phenomenon is especially pronounced among mixed-fed infants, with approximately 30–50% of globally experiencing varying degrees of nipple confusion. Data from the Chinese Center for Disease Control and Prevention in 2021 indicates that mixed-feeding rates reach 42% in urban areas and 35% in rural areas, with about 60% of mixed-fed infants exhibiting breast milk refusal behavior. Breastfeeding is not only the optimal source of nutrition for infants but also a core pathway for emotional bonding between mother and child. However, nipple confusion may lead to breastfeeding discontinuation, impacting infant health and the mother-infant relationship. This paper systematically reviews research progress on nipple confusion from multiple perspectives, including physiological mechanisms, influencing factors, sociocultural contexts, and intervention strategies, aiming to provide scientific evidence for clinical practice and home care.

2. Advantages of breastfeeding

Nutritionally, breast milk is rich in multiple nutrients. Its balanced ratio of proteins, fats, and carbohydrates, along with essential vitamins, minerals, and immune-active substances, perfectly meets the nutritional needs of infants aged 0–6 months, supporting healthy growth ^[1]. In terms of enhancing infant immunity, components like immunoglobulins and lactoferrin in breast milk not only support growth and development during the first 4–6 months but also effectively defend against bacterial and viral infections, reducing the risk of respiratory infections, diarrhea, gastrointestinal infections, and otitis media ^[2].

For the infant's digestive system, breast milk is naturally gentle and easier to digest and absorb, reducing the occurrence of gastrointestinal discomfort. Emotionally, breastfeeding involves close mother-infant contact; eye contact and skin-to-skin interaction significantly enhance parent-child bonding, providing infants with ample security and benefiting their psychological development. From the mother's perspective, breastfeeding promotes postpartum uterine contraction and accelerates physical recovery, while also lowering her risk of developing diseases like breast cancer and ovarian cancer. Economically and environmentally, breastfeeding eliminates the need to purchase expensive formula and related products, saving household expenses. It also avoids the resource consumption and environmental pollution associated with formula production and packaging, making it both cost-effective and eco-friendly.

3. Physiological mechanisms and causes of nipple confusion

3.1. Data on infant “path dependency”

Research indicates that infants develop “path dependence” in their sucking patterns within the first 2–4 weeks after birth. Early exposure to either the mother's nipple or a bottle can solidify oral muscle memory. Babies accustomed to the mother's nipple may resist bottle feeding, while those accustomed to bottle feeding may reject the mother's nipple ^[3].

A 2022 study by the U.S. National Institutes of Health (NIH) found that 65% of infants introduced to bottles within the first week of life exhibited breast refusal after one month, significantly higher than the delayed introduction group (22%). A 2020 cohort study in Chinese cities like Beijing and Shanghai also showed that infants using bottles within three days postpartum had a nipple confusion rate as high as 58%. It is noteworthy that in countries like Norway and Sweden, where breastfeeding rates exceed 80%, nipple confusion occurs in less than 15% of cases. Conversely, in the Philippines and Mexico, where formula feeding is more prevalent, this rate exceeds 40%. China's situation is more complex: mixed feeding rates in first-tier cities are comparable to developed countries, but inadequate breastfeeding support in primary healthcare facilities means correction rates for nipple confusion in rural areas are only half those in urban areas.

3.2. Differences in sucking patterns

Clinically, the primary concern involves infants who first encounter and become accustomed to bottle-feeding during the neonatal period. Due to premature exposure to bottle-feeding or frequent bottle use for various reasons, these infants may exhibit weak or uncoordinated sucking and swallowing, disrupted sucking rhythms, and abnormal sucking responses when transitioning to breastfeeding ^[4]. This phenomenon arises from significant differences in the mechanical mechanisms between breastfeeding and bottle feeding.

3.2.1. Breastfeeding

The infant must envelop the areola with the tongue, using peristaltic waves to compress milk ducts and stimulate the let-down reflex. This process requires coordinated breathing, swallowing, and jaw movements, with an average suckling frequency of 40–60 times per minute, consuming considerable energy. Breast milk flow depends on let-down (average flow rate 5–10 mL/min) and is intermittent; bottle flow is constant and can be artificially adjusted by tilting the bottle, leading infants to develop a dependency on “instant gratification.”

3.2.2. Bottle feeding

The fixed shape of the nipple and gravitational force create a fast, steady milk flow (approximately 20–30 mL/min). Infants only need to swallow passively, reducing sucking frequency to 10–20 times per minute without exerting force.

The sensations of a bottle and a nipple in the baby’s mouth differ significantly. This encompasses multiple aspects including length, firmness, milk flow rate, and the effort required for sucking. For instance, when suckling the mother’s nipple, the baby must engage muscle strength, balance breathing, and trigger the let-down reflex through sucking to achieve a substantial milk flow. In bottle feeding, however, the nipple creates a completely sealed space, allowing the baby to obtain milk effortlessly through simple swallowing without exerting significant force. Therefore, after becoming accustomed to bottle-feeding, babies may react differently when encountering nipples of varying textures and lengths, or when faced with milk flow that fluctuates in volume and speed. Some babies may show patience and persist until the milk let-down occurs, while others may resist strongly, crying incessantly after just a few sucks. While others may start crying the moment they are brought to their mother. These reactions all reflect how nipple confusion impacts a baby’s feeding habits. When faced with their mother, the child may exhibit a more sensitive and reluctant attitude, which is actually not surprising. The child needs time to adapt and transition. When encountering such resistance, the mother should be fully patient and understanding.

3.2.3. Neurological reflexes and behavioral learning

While the sucking reflex is controlled by the brainstem, feeding method selection involves higher-level cortical learning mechanisms. Frequent switching between feeding tools may lead infants to develop an “operant conditioning response”, associating bottles with effortless feeding and breastfeeding with strenuous sucking, resulting in behavioral avoidance.

4. Multidimensional impacts of nipple confusion

4.1. Direct impact on breastfeeding

The direct impact on breastfeeding would be a reduction in milk production. As the most natural lactation stimulator, the infant’s suckling action significantly promotes milk secretion. When nipple confusion occurs, the lack of direct breastfeeding stimulation may gradually decrease a mother’s milk production. Data indicates that mothers experiencing nipple confusion produce 30–40% less milk daily compared to those exclusively breastfeeding. A 2022 report by the Chinese Maternal and Child Health Association indicates that insufficient milk supply due to nipple confusion accounts for 47% of weaning cases within the first six months postpartum. Although breast pumps can partially serve a similar function, and some mothers successfully increase milk production through pumping, prolonged pump use may lead to poor milk removal, recurrent milk stasis, and even

irreversible breast damage, further reducing milk supply. It also increases risks to breast health. Improper pump use can cause duct blockages or damage, raising the risk of mastitis (by 2–3 times). A 2021 multicenter study in China found that 35% of mothers experiencing nipple confusion had experienced mastitis episodes, significantly higher than the 12% rate in the exclusive breastfeeding group.

4.2. Infant health and development

4.2.1. Nutritional intake differences

Immunoglobulins (e.g., sIgA), oligosaccharides, and active enzymes in breast milk cannot be fully preserved in bottles. Mixed-fed infants have an 18% higher risk of respiratory infections compared to exclusively breastfed infants. Chinese CDC data shows mixed-fed infants have a significantly higher diarrhea incidence (21.3%) than exclusively breastfed infants (9.8%) ^[5].

4.2.2. Oral development abnormalities

Prolonged bottle feeding may affect mandibular development, increasing the likelihood of dental caries and malocclusion. A 2023 study by Peking University School of Stomatology indicated that 45% of children who used bottles extensively before age 3 exhibited anterior crossbite issues.

4.3. Psychological and social consequences

Skin-to-skin contact during breastfeeding stimulates oxytocin release, which enhances the emotional bond between mother and child. However, weakened mother–infant bonding may occur when nipple confusion disrupts these interactions, potentially leading to greater infant separation anxiety. A 2022 survey by the Chinese Academy of Social Sciences found that parent–child interaction scores among infants with nipple confusion were 23% lower than those of exclusively breastfed infants. Moreover, maternal psychological stress tends to rise around 70% of affected mothers reported feelings of anxiety or self-blame, and 15% discontinued breastfeeding prematurely. According to a 2023 study by the Chinese Association of Maternal and Child Health Psychology, nipple confusion is also a major contributor to postpartum depression, accounting for approximately 31% of outpatient cases.

5. Regional variations and impacts of nipple confusion

In high-income countries, medicalized childbirth practices such as increasing cesarean section rates are often accompanied by early bottle feeding. Data indicate that in the United States, the mixed feeding rate reaches 58%, with a nipple confusion rate of 38%. In contrast, European countries benefit from strong policy support; for instance, Sweden’s 18-month paid parental leave helps maintain breastfeeding rates above 80%, while nipple confusion occurs in only 12–18% of cases. In low-income countries, a strong traditional breastfeeding culture has historically kept nipple confusion below 10%, though aggressive formula marketing is beginning to challenge this trend ^[6].

According to the China Child Development Report (2022), the Chinese exclusive breastfeeding rate within the first six months is 29.2%, far below the WHO’s recommended target of 50%. In first-tier cities such as Beijing and Shanghai, mixed feeding exceeds 40%, with nipple confusion occurring in 52% of cases. Rural areas retain more traditional breastfeeding practices, showing a mixed feeding rate of 35%. However, scarce medical resources for correcting nipple confusion mean only 28% of mothers receive professional guidance. China’s infant formula

market grew at an average annual rate of 12%, reaching RMB 50 billion in 2022. Excessive advertising led 30% of mothers to mistakenly believe “formula is nutritionally equivalent to breast milk,” indirectly exacerbating nipple confusion. Some medical staff prematurely recommended formula supplementation due to concerns about neonatal hypoglycemia, indirectly contributing to nipple confusion.

6. Comprehensive intervention strategies for nipple confusion

6.1. Golden window period management

Implementing immediate postpartum interventions is crucial to promote successful breastfeeding. One effective approach is biological nurturing, which encourages mothers to breastfeed in a semi-reclined position while allowing infants to use their innate crawling reflex to self-attach ^[7]. In Norway, the introduction of a “no bottle policy” in hospitals, which prohibits the use of artificial nipples within the first 72 hours after birth has increased breastfeeding rates to 90%. China can draw from this experience by strengthening the enforcement of its Breastfeeding Promotion Regulations to provide stronger institutional support for early breastfeeding practices.

6.2. Breastfeeding recommendations

To address nipple confusion, mothers should adopt proactive and effective measures.

(1) Increase skin-to-skin contact with the infant

During daily interactions, try gentle face-to-face conversations with the baby, accompanied by soft touch massage, or natural skin-to-skin contact during bath time ^[8]. As these interactions increase, breastfeeding can naturally progress to the intimate chest-to-chest position. This gradual approach provides the baby with a sense of security while helping mothers adapt to close parenting, ultimately achieving seamless intimacy during feeding.

(2) Experiment with feeding positions

During bottle-feeding, infants typically lie flat with the bottle held upright. Milk flows rapidly due to gravity, prompting fast swallowing and quicker feeding completion. However, when transitioning to breastfeeding, milk flow is relatively slower. Infants may not receive sufficient milk within the same timeframe, leading to frustration and restlessness. Therefore, during bottle-feeding, try positioning the baby in a seated posture with adequate back support, keeping the bottle nearly parallel to the ground. This slows the milk flow rate, mimicking breastfeeding conditions ^[9]. During bottle-feeding, incorporate brief pauses between sucking and swallowing to allow the baby to rest. Gradually, the baby will learn this is the normal feeding rhythm.

(3) Stimulate the let-down reflex before feeding

Since bottle-feeding requires less effort, some babies may resist breastfeeding, which demands more vigorous sucking. To prevent nipple confusion, the key is to help the baby re-experience the ease of breastfeeding. Mothers can stimulate the let-down reflex before nursing to ensure the baby receives sufficient milk immediately upon latching. For the technique, choose a quiet, comfortable environment and relax through deep breathing. Before feeding, apply a warm towel to the breasts for a moment. Then gently roll the nipples with fingertips, mimicking the rhythm of a baby’s suckling. Simultaneously, visualize milk flowing or recall the sound of your baby swallowing contentedly. This mental imagery can stimulate oxytocin release ^[10]. When you feel slight breast engorgement, notice nipple leakage, or observe

milk ejecting in a spray-like pattern, this indicates the let-down reflex has been successfully triggered. Immediately position your baby to latch at this moment to more easily establish a successful feeding experience.

(4) Try feeding with the bottle tucked under your arm

First, position the baby close to your body. Then place the bottle under your arm, adjusting its height and angle to mimic the natural breast position. It is recommended to attempt this during periods when the baby is not fully awake, such as just before sleep or upon waking. Initially, allow the baby to suckle a small amount of milk from the bottle. Family members can then discreetly remove the bottle from behind and swiftly replace it with the breast. Note that this method requires multiple attempts and consistent patience; rushing the process is counterproductive.

7. Conclusion

In summary, nipple confusion is a complex issue intertwining biological behavior, sociocultural factors, and medical practices. While its challenges are significant, multidisciplinary collaboration between pediatricians and families, coupled with social support, can drive policy innovation and foster a breastfeeding-friendly society. As breastfeeding advocate Jack Newman stated: “Babies are not machines, and feeding is not a task, it is a two-way conversation requiring patience and wisdom.”

Disclosure statement

The authors declare no conflict of interest.

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The Impact of IKAP-Based Nursing Interventions on the Caregiving Capacity of Family Carers for Individuals with Dementia

Shuhui Zhao¹, Yao Li²

¹Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

²Department of Neurosurgery, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

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Abstract: *Objective:* To investigate the effect of an information-knowledge-attitude-practice (IKAP) nursing intervention on the caregiving capacity of family caregivers of elderly dementia patients. *Methods:* Sixty-nine family caregivers of elderly dementia patients attending the neurology outpatient clinic of a hospital between October 2024 and March 2025 were selected. They were randomly divided into a control group ($n = 35$) and an observation group ($n = 34$). The control group received routine health education, while the observation group additionally underwent a systematic Information-Knowledge-Attitude-Practice (IKAP) nursing intervention. Care competence and self-efficacy scores were compared between groups before intervention and after 12 weeks. *Results:* Pre-intervention, no statistically significant difference existed in care competence or self-efficacy scores between groups ($p > 0.05$). Following the 12-week intervention, all scores significantly increased in both groups, with the observation group demonstrating superior outcomes compared to the control group ($p < 0.001$). *Conclusion:* The care intervention program based on the IKAP model effectively enhances caregivers' care competence and self-efficacy, thereby positively promoting the quality of life for patients with dementia.

Keywords: Alzheimer's disease; Information-Knowledge-Attitude-Practice model; Family caregivers; Caregiving competence; Self-efficacy

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1. Introduction

With the acceleration of China's population ageing process, the prevalence of dementia (Alzheimer's disease) has been rising annually, and the challenges of its care have become a major public health challenge^[1].

Due to the scarcity of professional care resources for dementia patients, individuals primarily rely on family carers for long-term, high-intensity support. However, family carers commonly face issues such as insufficient care knowledge, inadequate skills, and overwhelming negative emotions. These factors severely impact their caregiving capacity and physical and mental health, ultimately leading to diminished care quality and increased patient readmission rates^[2]. Traditional health education models predominantly focus on one-way knowledge dissemination, struggling to effectively translate into caregivers' beliefs and sustained behaviors.

The IKAP (Information–Knowledge–Attitude–Practice) theoretical framework, adhering to cognitive principles, employs systematic, stepwise interventions to internalize information into knowledge, thereby reinforcing positive attitudes and ultimately guiding the adoption and maintenance of healthy behaviors. This approach demonstrates significant efficacy in chronic disease management ^[3]. This study aims to investigate whether an IKAP-based nursing intervention model can systematically enhance the caregiving capacity and self-efficacy of family carers for individuals with dementia, thereby providing evidence-based support for developing effective family care support programs.

2. Materials and methods

2.1. General data

Sixty-nine family caregivers of elderly dementia patients attending the neurology outpatient clinic of a certain hospital between October 2024 and March 2025 were selected. They were randomly divided into a control group (n = 35) and an observation group (n = 34). Comparisons of baseline characteristics including age, gender, and educational attainment between groups revealed no statistically significant differences ($p > 0.05$), indicating comparability. Details are presented in **Table 1**.

Table 1. Comparison of general characteristics between caregiver groups

Item	Category	Control group (n = 35)	Observation Group (n = 34)	t/χ^2	p
Age ($\bar{x} \pm s$), years)		58.06 \pm 8.98	57.82 \pm 8.73	0.113	0.911
Gender [n (%)]	Male	10 (28.57)	11 (32.35)	0.117	0.733
	Female	25 (71.42)	23 (67.65)		
Educational attainment [Example (%)]	Primary education and below	9 (25.71)	7 (20.59)	0.513	0.774
	Junior secondary	19 (54.29)	18 (52.94)		
	Senior secondary and above	7 (20.00)	9 (26.47)		
Occupation [Example (%)]	Farmer	11 (31.43)	10 (29.41)	0.120	0.942
	Clerical	14 (40.00)	15 (44.12)		
	Retired	10 (28.57)	9 (26.47)		
Relationship with patient [cases (%)]	Spouse	16 (45.71)	17 (50.00)	1.770	0.413
	Children	12 (34.29)	14 (41.18)		
	Daughters-in-law/Sons-in-law	7 (20.00)	3 (8.82)		
Daily care time [examples (%)]	Under 6 hours	5 (14.30)	7 (20.59)	0.529	0.768
	6–12 hours	18 (51.42)	17 (50.00)		
	12–18 hours	12 (34.28)	10 (29.41)		
Health status [cases (%)]	Average	16 (45.71)	18 (52.94)	0.360	0.548
	Good	19 (54.29)	16 (47.06)		
Level of understanding of the disease [Example (%)]	No knowledge	5 (14.29)	7 (20.59)	0.374	0.829
	Partially aware	21 (60.00)	20 (58.82)		
	Fully aware	9 (25.71)	7 (20.59)		
Monthly household income [Example (%)]	Below ¥2,000	5 (14.29)	6 (17.65)	0.159	0.923
	2000–4000 yuan	21 (60.00)	20 (58.82)		
	4000–6000	9 (25.71)	8 (23.53)		

2.1.1. Inclusion criteria

- (1) The care recipient meets the diagnostic criteria for dementia in middle-aged and elderly individuals as outlined in the Chinese Guidelines for the Diagnosis and Treatment of Dementia and Cognitive Impairment^[4]
- (2) Age \geq 18 years
- (3) Serves as the primary caregiver for the patient, providing \geq 4 hours of daily care for \geq 3 consecutive months
- (4) Possesses basic communication, reading, and comprehension abilities
- (5) Voluntarily participates in this study.

2.1.2. Exclusion criteria

- (1) Presence of severe cognitive impairment or psychiatric disorders
- (2) Concurrent participation in other similar intervention studies
- (3) Severe visual or auditory impairments preventing normal communication
- (4) Inability to complete the full intervention and follow-up

2.2. Methods

2.2.1. The control group received conventional health education over 12 weeks

Initially, caregivers were provided with the hospital's "Guidebook for Home Care of Dementia Patients", covering disease fundamentals, daily care techniques (dietary nutrition, personal hygiene, safety precautions), identification of common behavioral and psychological symptoms with basic management strategies, and self-psychological adjustment methods for caregivers.

Secondly, centralized health education lectures were organized, delivered by attending physicians or higher-grade neurologists and senior nurses. These sessions emphasized disease progression, medication adherence, and complication prevention.

During the intervention period, monthly telephone follow-ups (15–20 minutes each) addressed carers' queries and provided routine advice.

2.2.2. The observation group received a systematic 12-week Information–Knowledge–Attitude Practice (IKAP) nursing intervention

A multidisciplinary team comprising neurologists, head nurses, psychotherapists, and rehabilitation specialists developed and implemented a progressive intervention plan divided into four stages.

(1) Stage one (Information)

Establish individual profiles through in-depth interviews and assessments to comprehensively gather personal details of caregivers, including knowledge gaps, skill deficiencies, negative emotions (and specific caregiving challenges), thereby tailoring intervention plans.

(2) Stage two (Knowledge)

Deliver personalized, systematic knowledge education based on assessment findings. Employ diverse formats, including one-to-one guidance, group workshops, scenario simulations, and video tutorials to translate specialized knowledge such as disease management, communication techniques, emergency response and rehabilitation training into practical skills that caregivers can comprehend and implement,

ensuring genuine mastery of caregiving competencies.

(3) Stage three (Attitude)

Organize peer support groups featuring experienced, positive caregivers sharing insights. Psychotherapists facilitate cognitive behavioral therapy sessions to guide emotional regulation, challenge irrational beliefs such as “caregiving failure”, foster proactive coping frameworks, and enhance self-efficacy in caregiving.

(4) Stage four (Practice)

Establish a weekly behavioral check-in via a WeChat support group. Conduct regular home visits or video calls to observe and guide caregiving practices in real-time, promptly correcting erroneous behaviors while reinforcing positive actions. This ultimately facilitates the internalization of caregiving knowledge into stable, efficient behavioral competencies.

2.3. Observation indicators

Mastery of disease-related knowledge, caregiving skills and implementation capacity, coping and problem-solving abilities, self-regulation and physical/mental health management capabilities, caregiving beliefs and positive attitude scores.

2.3.1. Care competence

- (1) Disease-related knowledge mastery was assessed using the Alzheimer’s Disease Knowledge Scale, comprising 30 true/false statements with a maximum score of 30 points. Participants answered “true” or “false”; each correct response scored 1 point, incorrect responses scored 0 points.
- (2) Care skills and implementation capacity were assessed using a hospital-developed Care Skills Questionnaire. This 20-item scale, each worth 1 point, asked about specific care competencies. Participants indicated whether they could or could not perform each task. The sum of “could perform” scores constituted the total.
- (3) Coping and problem-solving abilities were evaluated using the Brief Coping Style Questionnaire, measuring participants’ strategic tendencies when facing stressful events. The maximum score is 36 points. Higher scores indicate stronger coping and problem-solving abilities.
- (4) Self-regulation and physical/mental health management abilities were assessed using the Health Promotion Lifestyle Scale. This scale comprises 22 items scored from 0 to 4 points each, yielding a maximum total score of 88 points. Higher scores indicate stronger self-regulation and physical/mental health management abilities.
- (5) Caregiving Beliefs and Positive Attitudes were assessed using the Caregiver Positive Feelings Scale. This scale comprises 9 items, each scored on a 5-point Likert scale (ranging from “Strongly Disagree” to “Strongly Agree”), yielding a total score range of 9–45 points. Higher scores indicate greater positive feelings experienced by caregivers and more positive caregiving beliefs.

2.3.2. Self-efficacy

Assessed using the Chinese version of the General Self-Efficacy Scale (GSES). The scale comprises 10 items scored on a 4-point scale, yielding a total score range of 10–40 points. Higher scores indicate greater confidence in coping with challenges. Cronbach’s α coefficient in this study was 0.819.

2.4. Statistical analysis

Statistical analysis was performed using SPSS 26.0 software. Normally distributed quantitative data were expressed as mean \pm standard deviation ($\bar{x} \pm s$), with intergroup comparisons conducted using *t*-tests. Qualitative data were presented as frequencies and percentages (%), with intergroup comparisons using χ^2 tests. Differences were considered statistically significant at $p < 0.05$.

3. Results

3.1. Comparison of caregiver competency scores between groups before and after intervention

Prior to intervention, no significant differences were observed between groups in disease-related knowledge, care skills and implementation, coping and problem-solving abilities, self-regulation and physical/mental health management, or care beliefs and positive attitudes ($p > 0.05$).

Following the intervention, scores across all dimensions of caregiving competence significantly increased in both groups, with the observation group demonstrating superior outcomes compared to the control group ($p < 0.001$). See **Table 2**.

Table 2. Comparison of caregiver competency scores between groups ($\bar{x} \pm s$, points)

Group	Mastery of Disease-Related Knowledge		Care Skills and Implementation Ability		Coping and problem-solving abilities		Self-regulation and physical/mental health management		Care Beliefs and Positive Attitude	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	After intervention	Before intervention	After intervention	Before intervention	Post-intervention
Control group (n = 35)	20.02 \pm 1.02	23.42 \pm 2.27*	12.33 \pm 0.86	16.25 \pm 0.92	25.40 \pm 1.08	30.15 \pm 1.17	60.45 \pm 2.27	79.15 \pm 3.57	30.06 \pm 2.51	40.19 \pm 1.31
Observation group (n = 34)	19.61 \pm 1.08	26.35 \pm 2.41*	12.17 \pm 0.69	18.06 \pm 0.87	24.97 \pm 1.13	33.59 \pm 1.14	60.52 \pm 2.38	81.42 \pm 3.09	29.89 \pm 2.67	42.24 \pm 1.28
<i>t</i>	1.622	5.20	0.851	8.392	1.616	12.370	0.126	2.821	0.274	6.573
<i>p</i>	0.109	< 0.001	0.398	< 0.001	0.110	< 0.001	0.900	0.006	0.785	< 0.001

3.2. Comparison of self-efficacy scores among caregivers in both groups before and after intervention

Prior to intervention, the difference in self-efficacy scores between the two groups of family caregivers was not statistically significant ($p > 0.05$). Following the 12-week intervention, self-efficacy scores significantly increased in both groups, with the observation group demonstrating higher scores than the control group. This difference was statistically significant ($p < 0.001$), as shown in **Table 3**.

Table 3. Comparison of self-efficacy scores between caregiver groups ($\bar{x} \pm s$, points)

Group	Pre-intervention	After intervention	<i>t</i>	<i>p</i>
Control group (n = 35)	23.58 \pm 5.72	26.29 \pm 2.60	2.552	0.013
Observation group (n = 34)	23.61 \pm 4.79	33.88 \pm 1.87	11.646	< 0.001
<i>t</i>	0.024	13.886		
<i>p</i>	0.981	< 0.001		

4. Discussion

The findings indicate that prior to intervention, no statistically significant differences existed between the two groups of family carers in terms of disease-related knowledge acquisition, caregiving skills and implementation capabilities, coping and problem-solving abilities, self-regulation and physical/mental health management competencies, caregiving beliefs and positive attitude scores, or self-efficacy ratings ($p > 0.05$).

Following the 12-week intervention, scores for all indicators among family carers in the observation group were significantly higher than those in the control group ($p < 0.05$). This indicates that nursing interventions grounded in the IKAP theory can effectively enhance family carers' caregiving capabilities and elevate their self-efficacy. Analysis attributes this outcome primarily to the distinct advantages of the nursing intervention model based on the Information-Knowledge-Attitudes-Practice (IKAP) framework

- (1) Unlike traditional health education's generalized knowledge dissemination, the IKAP model employs initial systematic assessment to precisely identify individual differences in each caregiver's knowledge structure, skill gaps, and psychological state. This enables tailored intervention plans that effectively address specific challenges in caregiving practice, significantly enhancing the precision and practicality of interventions ^[5].
- (2) The nursing intervention model grounded in IKAP theory transcends mere knowledge transmission. Through systematic training, scenario simulations, peer demonstrations and other methods, it constructs a complete pathway from cognitive internalization to behavioral transformation ^[6]. Crucially, it enhances carers' self-efficacy and caregiving beliefs through belief-level interventions, such as cognitive restructuring and psychological support, providing intrinsic motivation for sustained caregiving practice ^[7].
- (3) The IKAP model positions psychological support as a pivotal component. By organizing support groups and delivering emotional management training, it effectively alleviates carers' anxiety and helplessness while fortifying their psychological resilience to stress. This not only improves carers' subjective experience but also establishes the psychological foundation for sustaining consistent care practices ^[8-9].
- (4) The care intervention model grounded in IKAP theory establishes a multidimensional support system encompassing remote guidance, home visits, and peer mutual aid. This provides carers with continuous behavioral feedback and consolidation mechanisms, enabling timely resolution of emerging challenges in care practice while fostering robust behavioral maintenance. Consequently, it ensures sustained enhancement and long-term improvement in caregiving capacity ^[10].

5. Conclusion

In summary, this study confirms that the care intervention program grounded in IKAP theory effectively enhances the caregiving capacity and self-efficacy of family carers for patients with dementia, indirectly promoting improved patient quality of life. It warrants wider adoption in clinical practice.

Disclosure statement

The author declares no conflict of interest.

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Test and Application Prospect of Tracheal Stent *in Vitro* and *in Vivo*

Longhu Hu, Anning Li*

Shenzhen Xianjian Respiratory Technology Co., Ltd, Shenzhen 518000, Guangdong, China

*Author to whom correspondence should be addressed.

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Abstract: The development and improvement of tracheal stents, as an effective treatment for respiratory diseases such as tracheal stenosis and tracheal collapse, has been a hot topic in the field of medical engineering. *In vitro* testing and animal experiments are key steps in evaluating the performance and safety of tracheal stents. This paper reviews the *in vitro* testing methods, animal experimental models, current research status, and future directions of tracheal stents, aiming to provide research directions for the development and *in vitro* and *in vivo* testing of tracheal stents.

Keywords: Tracheal stent; *In vitro* testing; Animal experimental model

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1. Introduction

Tracheal stenosis and tracheal fistula are serious respiratory diseases that seriously affect the quality of life and survival rate of patients. Tracheal stents, as an effective treatment method, have become a common approach for treating these diseases by providing mechanical support, restoring airway patency, and improving respiratory function. However, the safety, effectiveness, and long-term stability of tracheal stents are key factors determining the success of their clinical application.

In order to ensure that tracheal stents can achieve the expected therapeutic effects in practical applications while minimizing potential side effects on patients, strict *in vitro* testing and animal experiments must be conducted to validate them. *In vitro* testing can evaluate the mechanical properties, biocompatibility, and degradability of stents, while animal experiments can simulate the human environment to assess the clinical efficacy and safety of stents.

In recent years, with the interdisciplinary integration of biomaterials science, biomedical engineering, and computer science, significant progress has been made in the research of tracheal stents. The development of new biocompatible materials, optimization of stent design, improvement of *in vitro* testing methods, and innovation of animal experimental models have all provided new ideas and methods for the research of tracheal stents. The

in vitro testing methods, animal experimental models, and research status of tracheal stents was reviewed in this article, which aim to provide research directions for the development and *in vivo* and *in vitro* testing of tracheal stents.

2. In vitro testing of tracheal stents

In vitro testing is the preliminary stage of tracheal stent research, aimed at evaluating the performance and safety of the stent before practical application. The following are some commonly used *in vitro* testing methods.

2.1. Mechanical performance testing

The primary performance requirement for tracheal stents is to have sufficient radial support force to open the airway and ensure smooth gas flow. Radial compression testing can determine the radial compressive strength of the stent.

Zeng Jun et al. used the LLY-06D human biological pipeline compressibility tester to test the radial support force of tracheal stents. The radial compression test of the stent is used to determine its radial compressive strength^[1]. The stent must be able to exert sufficient radial force to ensure that it stays in the narrow trachea while adapting to tracheal contraction. Secondly, tracheal stents need to undergo tensile strength and fracture strain testing. Currently, there is no specialized instrument or evaluation standard for measuring the displacement resistance of tracheal stents. Yang Xinyue et al. used a multifunctional tensile tester, silicone hose, and thin wire to build a simple pull-out force testing device to measure the displacement resistance of tracheal stents, providing a new method for measuring the tensile strength of tracheal stents^[2]. Again, the good anti migration and anti-fatigue properties of tracheal stents under forced vibration are important indicators to ensure long-term treatment effectiveness. Qu Shengqian simulated the effect of tracheal stents under cyclic stress loads of respiratory movement and radial displacement loads of tracheal circulation under random stimulation during service, and observed the fatigue damage of tracheal stents under two working conditions^[3].

The research results showed that the better the support performance of tracheal stents under the same deformation, the worse their anti-fatigue performance. The above research provides valuable experience for the mechanical performance testing of tracheal stents, and in the future, standardized and systematic testing instruments and evaluation indicators should be established for the support force testing, tensile strength, and fatigue resistance of tracheal stents.

2.2. Biocompatibility testing

In tissue engineering trachea, the ideal tracheal stent should have good biocompatibility, biodegradability, sufficient mechanical strength, biological flexibility, and three-dimensional porous structure, which is conducive to cell adhesion. The biocompatibility testing of tracheal stent is an important link to ensure its safe use in the human body. The ISO 18562 series of standards provide a detailed evaluation framework and testing methods for the biocompatibility testing of tracheal stents by evaluating their compatibility with biological tissues through contact with cells or tissues, including cytotoxicity testing, tissue compatibility testing, and immune response testing, to ensure that the stent material does not cause excessive immune reactions or tissue damage. Li Yahua designed a biocompatible drug-eluting tracheal stent in a mouse model with laryngeal and tracheal stenosis^[4].

The study found that the 70% poly (L-lactide) and 30% poly (caprolactone) constructs had the best

biomechanical strength and biocompatibility, and could elute drugs and provide drug delivery systems for various immunomodulators. Scholars have found that materials such as polylactic acid and polycaprolactone have good biocompatibility and degradability. In the future, *in vivo* and *ex vivo* animal experiments should be conducted to evaluate the biocompatibility of different materials, and standardized qualitative and quantitative biocompatibility evaluation indicators should be continuously explored and established.

2.3. Degradation testing

The appropriate degradation time for biodegradable stents has guiding significance for the clinical use of absorbable stents. If the degradation time of the stent is shorter than the tissue repair time, the stent will lose its support and slip due to degradation, which can easily cause further damage to the wound; If the degradation time is too long, the duration of the stent's presence in the body will be prolonged, which may not only cause discomfort to the patient, but also increase the risk of inflammation and infection^[1]. Chen Shaosen et al. evaluated the degradation rate and degradation products of degradable tracheal stents, which can help predict the lifespan of the stent *in vivo* and the potential impact of degradation products on the body^[5]. By monitoring the degradation process of the stent in a simulated *in vivo* environment, the design and material selection of the stent can be optimized. At present, the degradation methods of degradable stents are divided into non enzymatic hydrolysis and enzymatic degradation. Different degradation rates of degradable tracheal stents can be developed for different degradation methods to cope with airway lesions of different degrees of stenosis, providing reference for the refined development of degradable tracheal stents.

3. Animal experimental model of tracheal stent

Animal experiments are a direct method for evaluating the safety and effectiveness of tracheal stents. Choosing the appropriate animal model is crucial for the success of the experiment. Here are some commonly used animal models.

3.1. Rabbit model

The rabbit trachea is relatively long and suitable for evaluating the long-term stability and biocompatibility of the stent. The rabbit model has advantages in evaluating the long-term effectiveness and tissue response of scaffolds. Compared to rats and pigs, the rabbit model has a moderate cost and is suitable for medium scale experiments. The rabbit model was used for long-term stability testing and tissue response evaluation to assess the ability of the stent to maintain its shape and function *in vivo* for a long time. The long-term effects of stent implantation on surrounding tissues, such as granulation tissue formation and inflammatory response, were observed. Liu Geng tested the degradation and biocompatibility of magnesium alloy tracheal stents in New Zealand white rabbits under the conditions of mechanical performance testing and *in vitro* testing^[6]. The stent was implanted using balloon dilation, and the dilation rate was 85.78%, which was close to the rebound rate of the radial compression test *in vitro*, indicating good dilation of the magnesium alloy tracheal stent. And mild inflammatory damage was found in the early stage of implantation, which gradually recovered, indicating that the tissue compatibility of magnesium alloy tracheal stent is good. The above animal experiments provide reference for compatibility testing and fatigue resistance testing of tracheal stents.

3.2. Pig model

The anatomical structure and physiological characteristics of pig trachea are closest to those of humans, making it an ideal model for simulating the complexity of human trachea and evaluating the clinical effectiveness of stents. Compared to rats and rabbits, the cost of pig models is higher, and they provide experimental results that resemble to humans. The pig model is used for clinical efficacy evaluation and complex case simulation of tracheal stents. By implanting and evaluating the function of tracheal stents in the pig model, the application effect of stents in humans is predicted. Junhyoung Ha et al. conducted a 28 days spiral tracheal stent implantation experiment in a 20 kg Yorkshire pig. The study found that the animals had good tolerance to the spiral stent and did not observe coughing and respiratory distress. Weekly and retrograde bronchoscopy and chest X-ray examinations proved that the spiral tracheal stent was safe, providing reference for the development of tracheal stents and animal experiments.

4. Application and research status of tracheal stents

4.1. Clinical application of tracheal stent

Tracheal stents play an important role in the treatment of diseases such as tracheal stenosis and bronchial fistula. With the advancement of biomaterials science and minimally invasive surgical techniques, tracheal stents are gradually developing towards better biocompatibility, degradability, and personalized customization. Modern stent design focuses more on reducing tissue stimulation and promoting endometrial growth, while utilizing 3D printing technology to achieve precise matching of complex airway shapes, improving treatment effectiveness and patient comfort.

4.2. Material innovation of tracheal stent

Nickel titanium memory alloy is widely used in the manufacturing of tracheal stents due to its shape memory effect and super-elasticity. This material can restore its original shape *in vivo* and provide stable support. Domestic tracheal stents are mostly made of nickel titanium memory alloy as raw material, which has advantages such as safety, reliability, and strong biocompatibility. The application of biodegradable materials such as polylactic acid and polycaprolactone in tracheal stents is becoming increasingly widespread. These materials not only have good mechanical properties, but also gradually degrade in the body, reducing the occurrence of long-term complications^[7].

The application of natural polymer materials such as chitosan and alginate in tracheal stents has also made progress. These materials have good biocompatibility and biodegradability, but further improvement of their mechanical properties is needed. The application of artificially synthesized materials such as polylactic acid hydroxyacetic acid copolymers in tracheal stents is also constantly developing. These materials have easy to regulate properties and good biocompatibility. The polylactic acid hydroxyacetic acid copolymer stent has good mechanical properties and biocompatibility, and has a good implantation effect on the tracheal wall.

4.3. Design optimization of tracheal stent

Through computer-aided design and 3D printing technology, personalized and optimized stent design can be achieved, which can better adapt to the anatomical structures and needs of different patients, improve treatment effectiveness and patient comfort. The covered tracheal stent uses biocompatible materials such as silicone and

polyurethane, with a design focus on reducing irritation, preventing excessive tissue growth, and providing stable support. It also integrates drug release function to promote healing or inhibit inflammatory reactions ^[8]. Future tracheal stent designs are more inclined towards personalized customized products, which can be optimized for specific conditions and improved and innovated on the basis of traditional tracheal stents.

4.4. Functional evaluation of tracheal stent

Evaluating the correct position and stability of the stent without displacement through imaging examinations (X-rays, CT scans) can help to more accurately understand the actual manifestation of the stent *in vivo*. The functional evaluation of tracheal stents includes improvement of patient symptoms, restoration of airway patency, and enhancement of quality of life. By using the European Cancer Collaboration Scale to evaluate the functional status of patients before and after tracheal and bronchial stent implantation, it can be found that there is a significant improvement in postoperative symptoms. The degree of airway opening after stent implantation is evaluated to determine whether it effectively alleviates airway stenosis and improves the patient's respiratory function. Pulmonary function testing can evaluate the improvement of respiratory function after stent implantation, ensuring the effectiveness and safety of the stent.

5. Development trends and application prospects of tracheal stents

5.1. Development of new materials

The material selection of tracheal stent is the key to its design and application. The ideal tracheal stent material should have good biocompatibility, strong mechanical properties, and biodegradability. Polymer materials such as polycaprolactone, poly (L-lactide caprolactone), polypropylene, polylactic acid, etc. are widely used in tracheal stents. These materials have different mechanical strength, porosity, and biodegradation characteristics. The development of 3D printing technology makes it possible to construct personalized tissue-engineered tracheas. Simultaneously utilizing 3D printing technology to achieve precise matching of complex airway shapes has improved treatment efficacy and patient comfort. The application of biodegradable materials such as polylactic acid and polycaprolactone in tracheal stents not only has good mechanical properties, but also gradually degrades in the body, reducing long-term complications ^[9]. Bioactive materials include collagen, hyaluronic acid, alginate, etc. Their common feature is that they are highly similar to the composition and microstructure of the extracellular matrix of the body. The advantages of such materials are low immunogenicity, good tissue compatibility, and less likely to cause host immune reactions, making them widely applicable. The materials for future tracheal stents tend to be organic polymer materials such as polylactic acid and polycaprolactone, which can meet the performance requirements of biodegradability and 3D printing technology, and help develop personalized and functional tracheal stent products.

5.2. Personalization and intelligence

Future tracheal stent technology will focus more on intelligence and functionality. In recent years, 3D printing technology has played an important role in the personalized manufacturing of tracheal stents. Through 3D printing technology, the shape and size of the stent can be customized according to the specific situation of the patient, improving the fit and treatment effect, and better adapting to the anatomical structure and needs of different patients. This includes stents that can automatically adjust their shape according to changes in tracheal pressure.

The integration of implantable sensors can monitor airway pressure, inflammatory response, etc. in real time, providing treatment feedback for doctors. The intelligent drug release system can automatically adjust the drug release amount according to changes in the condition, achieving precise treatment^[10]. The development of future tracheal stents tends towards intelligent and personalized development. The design and production of tracheal stents can be customized for various types of airway diseases, providing development ideas for tracheal stent research and development enterprises.

5.3. Application prospects of tracheal stent

Tracheal stents play an important role in the treatment of diseases such as tracheal stenosis and bronchial fistula. Tracheal stent implantation is suitable for various malignant and benign diseases, with the most common indications including minimizing external pressure from tumors or lymph node enlargement, maintaining tracheal patency in cases of tracheal obstruction after tumor resection under bronchoscopy, and treating screened patients with benign tracheal diseases. Tracheal stents are also used to seal fistulas between the respiratory and digestive tracts. When surgical correction is contraindicated, stents are used to treat tracheoesophageal fistula or broncho-esophageal fistula. Simultaneous stent implantation in the trachea and esophagus is superior to single stent implantation in either channel. Tracheal stents can prevent tumors from extending into the trachea, aid in the healing and management of tracheal fistulas, and support the tracheal wall to prevent collapse or external compression. It can be seen that tracheal stents have a wide range of clinical applications and can meet the treatment needs of different airway diseases.

6. Summary and prospect

As an effective means of treating respiratory diseases such as tracheal stenosis and collapse, the development and improvement of tracheal stents have always been a hot topic in the field of medical engineering. *In vitro* testing and animal experiments are important steps in evaluating the safety and effectiveness of tracheal stents. By simulating physiological environments and mechanical loads, *in vitro* testing can evaluate the mechanical properties of tracheal stents, such as strength, elasticity, and durability. Biocompatibility testing ensures the compatibility of scaffold materials with human cells and tissues, while degradability testing is particularly important for biodegradable scaffolds. Animal models provide key data for the functional evaluation and safety research of tracheal stents. The selection of different animal models based on their anatomical and physiological similarities with the human trachea can help predict the performance of stents in the human body.

Future research will continue to explore new biocompatible materials to improve the safety and biodegradability of tracheal stents and reduce long-term complications. By combining advanced technologies such as 3D printing, intelligent sensing, and biodegradable materials, tracheal stents will develop towards personalization and intelligence, better adapting to the physiological needs of patients. Through continuous technological innovation and in-depth research, tracheal stents are expected to provide more effective and safer treatment options for more patients in the future, improve their quality of life, and promote the development of the entire medical engineering field.

Disclosure statement

The authors declare no conflict of interest.

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The Mediating Effect of Pain on the Relationship between Sleep Quality and Health-Related Quality of Life among Elderly Patients with Chronic Diseases: An Empirical Analysis Based on CHARLS Data

Ziyu Gui^{1,2}, Zimeng Liu^{1,2}, Meijie Zheng², Wenxiu Liu², Ran Hao^{1,2}, Xinping Zhang², Xian Li^{2*}

¹Nursing and Rehabilitation College of North China University of Technology, Tangshan 063210, Hebei, China

²Hebei General Hospital, Shijiazhuang 050051, Hebei, China

*Corresponding author: Li Xian, Lixian1966@126.com

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Abstract: *Objective:* Investigating the Mediating Role of Pain in the Relationship Between Sleep Quality and Health-Related Quality of Life Among Elderly Patients with Chronic Diseases. *Methods:* Using data from the 2018 China Health and Retirement Longitudinal Study (CHARLS), this study included 3,284 participants aged 60 years or older with chronic diseases. The sleep quality, pain status, health-related quality of life, and demographic-related data of these elderly patients were obtained. Pearson correlation analysis was conducted to assess the bivariate relationships among the variables. The mediating role of pain in the sleep quality-HRQoL relationship was tested using linear regression models, complemented by bootstrap sampling to verify the indirect effect. *Results:* Sleep quality was positively associated with health-related quality of life ($r = 0.218, p < 0.001$). Conversely, pain demonstrated significant negative correlations with both sleep quality ($r = -0.496, p < 0.001$) and health-related quality of life ($r = -0.067, p < 0.001$). The mediating effect results showed that pain played a partial mediating role between sleep quality and health-related quality of life in elderly patients with chronic diseases (effect value = 0.049), and the mediating effect accounted for 23.33%. *Conclusion:* Pain is a mediating variable between sleep quality and health-related quality of life in elderly patients with chronic diseases. This suggests that clinical practice should incorporate pain assessment into standard clinical care of elderly patients with sleep disorders and chronic diseases. By alleviating pain, sleep quality can be improved, and subsequently, their health-related quality of life can be enhanced.

Keywords: Elderly chronic diseases; Sleep quality; Health-related quality of life; Pain; Mediating effect

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1. Introduction

Health-related quality of life (HRQoL), also known as “quality of life”, is a subjective evaluation made by individuals based on their own conditions and feelings. It encompasses physical functions, emotional states, social functions, roles and responsibilities, and health awareness, reflecting the overall health level of individuals^[1,2]. Its improvement has profound significance for optimizing health resources and promoting national health development strategies^[3]. The “Healthy China 2030” planning blueprint indicates that strengthening health management for the elderly can effectively promote healthy aging, and improving the HRQoL of the elderly is the core link to achieve this goal^[4]. With the development of aging in China, the proportion of the elderly population has reached 22%, and the number of people with chronic diseases has reached nearly 180 million^[5,6]. Chronic diseases cause functional decline through multiple pathological mechanisms, and sleep disorders are particularly prominent. The prevalence of sleep disorders among the elderly in China is 46%, and the prevalence of chronic disease combined with sleep disorders is 50.8%^[7,8]. Studies demonstrate a significant correlation between pain symptoms and sleep quality among elderly patients with chronic diseases, and the two factors interact with each other, severely weakening the overall health of patients^[9,10]. Pain, as an intervention risk factor, is a breakthrough point for improving health. Currently, many studies independently explore the impact of sleep quality or pain on the HRQoL of elderly patients with chronic diseases, but the mediating mechanism of pain between sleep quality and HRQoL has not been clarified, and there is a lack of empirical analysis with nationally representative samples. Therefore, this study utilized data from the China Health and Retirement Longitudinal Study (CHARLS) to examine the mediating role of pain in the relationship between sleep quality and health-related quality of life (HRQoL) among elderly patients with chronic diseases. The findings thereby aim to inform strategies for improving HRQoL in this population.

2. Object and method

2.1. Data source

This study utilized the 2018 Chinese Health and Retirement Longitudinal Study (CHARLS) database, employing a multi-stage stratified sampling method. It is an authoritative survey on health issues among the elderly^[11]. The study was approved by the Medical Ethics Committee of Peking University (IRB00001052-11015). All participants in the study have provided informed consent. The data were rigorously screened, and finally 3284 valid samples were included, with the variable data extracted from the CHARLS database.

2.2. Study subjects

2.2.1. Inclusion criteria

- (1) Age ≥ 60 years old
- (2) Suffering from at least 1 chronic disease
- (3) Completed measurements of health-related quality of life, sleep quality and pain

2.2.2. Exclusion criteria

- (1) Data with missing key variables

2.3. Research tools

2.3.1. General information

Based on the health determinants model, the health influencing factors of elderly patients with chronic diseases were extracted from CHARLS, including biological and genetic factors (gender, age), personal health behavior factors (smoking, drinking), socioeconomic status factors (education level), and geographical distribution factors (place of residence) and more.

2.3.2. Health-related quality of life

This study employed the European Five-Dimensional Health Scale (EQ-5D), which consists of five dimensions: mobility, self-care ability, daily activity ability, pain or discomfort, and anxiety or depression.

Each dimension has three levels: no difficulty, some difficulty, and inability to complete/ extreme difficulty, and is assigned values of 1, 2, and 3 respectively. The questions in the questionnaire were extracted as follows: “Is there any difficulty in bending, bending knees, or squatting?” to assess mobility; “Is there any difficulty in cooking?” to assess self-care ability; “Is there any difficulty in doing household chores?” to assess daily activity ability; “Does the body feel pain?” to assess pain or discomfort; and “Do you feel depressed?” to assess anxiety or depression. The health utility value was calculated to reflect the health-related quality of life, and the closer the health utility value is to 1, the better the HRQoL^[11,12]. The health utility value = 1 - the sum of the corresponding coefficient of each dimension^[13].

2.3.3. Sleep quality

This study was based on the statement “My sleep is poor”^[14]. The sleep duration was defined as 4 points for “rarely or never (< 1 day)”, 3 points for “not too much (1–2 days)”, 2 points for “sometimes or half of the time (3–4 days)”, and 1 point for “most of the time (5–7 days)”. The higher the score, the better the sleep quality.

2.3.4. Pain

This study was based on the question “Which parts of the body feel pain? Please list all the parts.” The pain locations were counted, totaling 16 types including the head, shoulders, and any other locations. Each location was scored as 1 point, with a total score of 16 points. The higher the score, the more pain locations there were^[15].

2.4. Statistical methods

Data cleaning and analysis were conducted using RStudio 4.5.0 and SPSS 27.0 software. Normally distributed data are presented as mean \pm standard deviation ($\bar{x} \pm s$) and were compared using analysis of variance. For non-normally distributed data, which are expressed as median (P_{25} , P_{75}), non-parametric tests were employed for group comparisons, and comparisons between groups were conducted using non-parametric rank sum test.

Pearson correlation analysis was used to explore the correlations among pain, sleep quality, and health-related quality of life. The SPSS macro program Process v4.0 model (Model 4) was used for mediating effect test, with the significance level set at 0.05^[16].

3. Results

3.1. General information

Comparison of Health-Related Quality of Life by Demographic Characteristics among Elderly Patients with Chronic Diseases: Age, gender, place of residence, educational level, marital status, and history of alcohol consumption all showed statistical significance ($p < 0.001$). These variables were included as covariates in the study, as shown in **Table 1**.

Table 1. Comparison of Health-related Quality of Life (HRQoL) among elderly patients with chronic diseases based on different demographic characteristics (n = 3284)

Variable	Number of Subjects (n)	HRQoL [$\bar{x} \pm s/M (P_{25}, P_{75})$]	Test Statistic	p-value
Age (years)				
60–69	2180	0.81 ± 0.17	$F = 21.65$	< 0.001
70–79	1061	0.79 ± 0.19		
≥ 80	43	0.69 ± 0.64		
gender				
Male	915	(0.72, 0.94)	$Z = -6.68$	< 0.001
Female	2369	(0.68, 0.94)		
Place of residence				
Urban	703	(0.72, 0.94)	$Z = -4.44$	< 0.001
Rural	2581	(0.69, 0.94)		
Education				
High school and below	2053	(0.70, 0.94)	$Z = -8.21$	< 0.001
High school education or above	1231	(0.72, 0.94)		
marital status				
Married	2514	(0.71, 0.94)	$Z = -6.99$	< 0.001
Unmarried	770	(0.66, 0.92)		
Alcohol Use				
Yes	708	(0.78, 0.94)	$Z = -7.66$	< 0.001
No	2576	(0.70, 0.94)		
Smoking history				
Yes	619	(0.71, 0.96)	$Z = -1.41$	0.16
No	3165	(0.69, 0.94)		

3.2. Correlation analysis of sleep quality, pain and Health-related Quality of Life (HRQoL)

Pearson correlation analysis was conducted on the covariates such as gender, age, place of residence, educational level, marital status, and alcohol consumption history. The categorical variables were assigned values, as shown in **Table 2**.

Table 2. Assignment of values for categorical variables

Variable	Variable assignment
Gender	Male = 1, Female = 2
Age (years)	60–69 = 1, 70–79 = 2, $\geq 80 = 3$
Place of residence	Urban = 1, Rural = 2
Education	High school or less = 1, Education beyond high school = 2
marital status	Married = 1, Unmarried = 2
Alcohol Use	Yes = 1, No = 2

The results indicated that HRQoL was positively correlated with sleep quality ($r = 0.218$, $p < 0.001$), and negatively correlated with pain ($r = -0.067$, $p < 0.001$); sleep quality was negatively correlated with pain ($r = -0.496$, $p < 0.001$), as shown in **Table 3**.

Table 3. Correlation between sleep quality, pain and health-related quality of life in elderly patients with chronic diseases (r)

Variable	Sleep quality	Pain	Health-related quality of life (HRQoL)
Sleep quality	1	-0.067 *	0.218*
Pain		1	-0.496*
Health-related quality of life (HRQoL)			1

Note: * indicates $p < 0.001$

3.3. Linear regression of sleep quality, pain, and Health-related Quality of Life (HRQoL)

This study treated sleep quality as the independent variable. After adjusting for covariates, Model 1 and Model 2 examined pain and health-related quality of life (HRQoL) as the dependent variables, respectively, the results showed that sleep quality had an impact on pain ($\beta = -0.039$, $t = -2.574$) and HRQoL ($\beta = -0.205$, $t = 12.115$), and the differences reached statistical significance ($p < 0.05$). In Model 3, pain was the mediating variable and HRQoL was the dependent variable. The results showed that both sleep quality and pain had an impact on HRQoL ($\beta = -0.475$, $t = 32.196$), and the differences reached statistical significance ($p < 0.001$). At the same time, R^2 increased from 0.088 to 0.307, indicating that the introduction of the pain mediating variable enhanced the explanatory power of the model (**Table 4**).

Table 4. Regression analysis

Variable	Model 1 (Pain)		Mode2 (HRQoL)		Mode3 (HRQoL)	
	β	t	β	t	β	t
Gender	0.093*	5.521	0.020	0.135	0.058*	3.511
Age (years)	0.014	0.946	-0.096*	-5.224	-0.088*	-5.964
Place of residence	0.030	1.946	-0.029	-1.665	-0.022	-1.466
Education	-0.069*	-4.203	0.076*	4.130	0.041*	2.539
Marital status	0.053*	3.431	-0.079*	-4.592	-0.053*	-3.512

Table 4 (Continued)

Variable	Model 1 (Pain)		Mode2 (HRQoL)		Mode3 (HRQoL)	
	β	t	β	t	β	t
Alcohol Use	-0.010	-0.633	0.102*	5.695	0.089*	5.676
Sleep quality	-0.039**	-2.574	0.205*	12.115	0.191*	12.959
Pain					-0.475*	-32.196
R ²	0.028		0.088		0.307	
F	19.362*		46.067*		182.620*	

Note: * indicates $p < 0.001$, ** indicates $p < 0.05$.

3.4. Mediating effect analysis of pain on sleep quality and Health-related Quality of Life (HRQoL)

After adjusting for confounding variables, we assessed the mediating role of pain in the relationship between sleep quality and HRQoL. The coding schemes for all categorical variables are detailed in **Table 2**. Analysis of Model 4 confirmed that sleep quality directly improved HRQoL ($\beta = 0.161$, $p < 0.001$) while also reducing it indirectly through its negative association with pain ($\beta = -0.250$, $p < 0.001$), which itself lowered HRQoL ($\beta = -0.196$, $p < 0.001$), as shown in **Figure 1**.

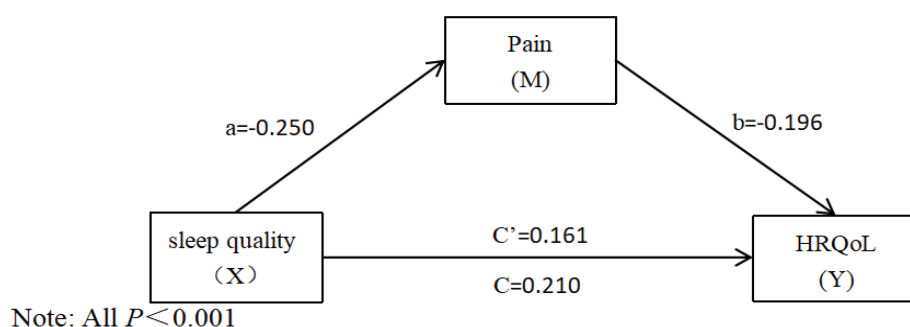


Figure 1. Path analysis of the mediating effect of pain between sleep Quality and Health-related Quality of Life (HRQoL).

The Bootstrap method (N = 5000 iterations) test results indicated that the effect value of pain as a mediating variable was 0.049 [95% CI (0.034, 0.056)], and the 95% CI excluded zero, thus confirming a significant mediating effect. Sleep quality could indirectly affect HRQoL through pain, with the total effect being 0.210, the direct effect being 0.161, and the mediating effect being 0.049, accounting for 23.33% of the total effect, as shown in **Table 5**.

Table 5. Decomposition of the mediating role of pain in sleep quality and Health-related Quality of Life (HRQoL)

Item	Effect Size	Boot SE	95% CI	Proportion Mediated
Sleep quality → HRQoL (Total effect)	0.210	0.002	(0.206,0.214)	-
Sleep quality → HRQoL (Direct effect)	0.161	0.002	(0.156,0.164)	76.67%
Sleep quality → pain → HRQoL (Indirect Effect)	0.049	0.005	(0.034, 0.056)	23.33%

Note: - indicates that no such data is available.

4. Discussion

4.1. Health-related Quality of Life (HRQoL) is influenced by demographic factors

The results of this study show that age, gender, marital status, place of residence, educational level, and alcohol consumption history are all related to HRQoL, which is consistent with previous findings^[17].

This may be attributed to the elevated risk of age-related chronic conditions, which can cause progressive functional limitations and more frequent pain. Especially for the elderly female group, they are more susceptible to hormonal influences and have a higher incidence of chronic diseases, making HRQoL more likely to be damaged.

Moreover, unmarried elderly patients with chronic diseases exhibit significantly lower HRQoL than their married counterparts, a difference that may be exacerbated by feelings of loneliness and a relative lack of social support^[18].

At the same time, there is an imbalance in medical resources between rural and urban areas, with urban residents enjoying better medical resources, which provides favorable conditions for improving HRQoL. People with higher educational levels have higher health literacy, which promotes their self-health management and has a positive impact on HRQoL. These aspects are highly consistent with the key points of the “Healthy China 2030 Plan Outline”, focusing on elderly, solitary, rural, and low-education-level patients with chronic diseases. This suggests that in nursing practice, regular screenings for elderly patients with chronic diseases who have these characteristics should be conducted to provide them with precise health interventions. At the same time, to “reduce the gap in health levels”, services such as remote guidance should be provided to rural elderly people for pain management and sleep intervention, thereby improving HRQoL.

4.2. Correlation between sleep quality, pain and Health-related Quality of Life (HRQoL) in elderly patients with chronic diseases

The results of this study show that pain is inversely associated with sleep quality and HRQoL ($r = -0.496, -0.067, p < 0.001$), which is in line with the outcomes of Huang Yingchun et al.^[19,20]. The possible reason is that HRQoL is a multi-dimensional indicator for assessing health status. Long-term pain not only multi-dimensionally damages the health condition but also interferes with the sleep structure, forming a vicious cycle of “poor sleep—severe pain—even worse sleep”, ultimately reducing HRQoL. Sleep quality is positively associated with HRQoL ($r = 0.218, p < 0.001$), which is consistent with the findings of Sun Xiuna et al.^[21].

The possible reason is that factors such as physiological decline in the elderly, reduced psychological ability, and chronic diseases causing physical discomfort affect sleep quality, thereby reducing HRQoL^[22].

These are in line with the strategic orientation of “combination of prevention and treatment” in the “Healthy China 2030 Planning Outline”, and it is recommended to incorporate pain and sleep management as important components of the chronic disease prevention and control system. In nursing practice, it is necessary to enhance patients’ cognitive education on the correlation among sleep quality, pain, and HRQoL.

4.3. Pain plays a partial mediating role between the sleep quality and Health-related Quality of Life (HRQoL) of older adults with chronic conditions

Mediation analysis confirmed that pain exerts a significant partial mediating effect on the sleep quality-HRQoL association in older adults with chronic conditions. The mediating effect value is 23.33%, suggesting that sleep quality exerts both direct and indirect effects on HRQoL, with the latter being mediated by pain. The possible reason is that as people age and suffer from chronic diseases, elderly individuals are more prone to sleep disorders^[23].

Poor sleep quality directly reduces HRQoL through causing physical decline, decreased daily activity ability, and triggering psychological stress and negative emotions ^[24]. Pain is a key mediating variable between sleep quality and HRQoL. Firstly, pain is negatively correlated with sleep quality and long-term chronic pain can disrupt sleep rhythms ^[25]. Secondly, pain is not only a body protection mechanism, but also directly affects the core dimensions of physical discomfort and functional limitations in HRQoL due to its being a crucial clinical indicator for predicting sleep disorders ^[26,27]. Therefore, poor sleep quality can exacerbate or maintain patients' pain, thereby negatively affecting HRQoL. These findings align with the strategy of "Fully Leveraging the Unique Advantages of Traditional Chinese Medicine" in the "Healthy China 2030 Planning blueprint", and a combination of Western medicine and analgesic treatment is recommended. It is suggested that pain assessment be included as a routine examination for elderly patients with chronic diseases who have sleep complaints, and digital health technologies should be utilized for long-term monitoring. Targeting the mediating pathway of pain may disrupt the adverse interplay between poor sleep and compromised HRQoL, ultimately leading to improved overall health in this patient population.

5. Conclusion

By elucidating the partial mediating role of pain, this study positions it as a key indicator for developing targeted strategies to enhance sleep quality in elderly patients with chronic conditions. It is suggested to incorporate the assessment of pain and sleep into the routine examinations of older adults with chronic conditions and to construct a multi-dimensional integrated intervention model centered on pain and sleep.

This study has certain limitations. Firstly, pain plays a partial mediating role. Besides pain, sleep quality can also affect HRQoL through other pathways. Further, more covariates need to be included to examine the relationship of key variables; Secondly, CHARLS did not distinguish between acute and chronic pain, which introduces the risk of information bias; Finally, the present study adopted a cross-sectional study of CHARLS, and could not infer the causal relationship between variables. In the future, longitudinal tracking data of CHARLS can be used for causal inference.

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The *Journal of Architectural Research and Development* is an international peer-reviewed and open access journal which is devoted to establish a bridge between theory and practice in the fields of architectural and design research, urban planning and built environment research.

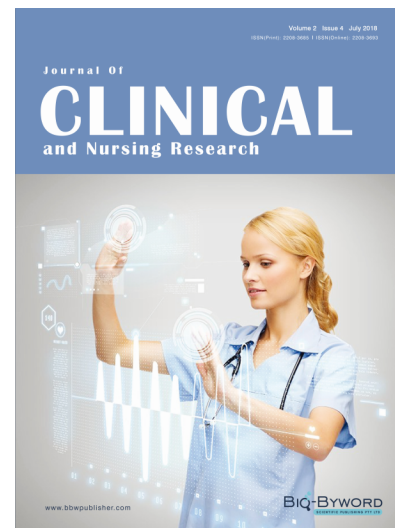
Topics covered but not limited to:

- Architectural design
- Architectural technology, including new technologies and energy saving technologies
- Architectural practice
- Urban planning
- Impacts of architecture on environment

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



Journal of Electronic Research and Application is an international, peer-reviewed and open access journal which publishes original articles, reviews, short communications, case studies and letters in the field of electronic research and application.

Topics covered but not limited to:

- Automation
- Circuit Analysis and Application
- Electric and Electronic Measurement Systems
- Electrical Engineering
- Electronic Materials
- Electronics and Communications Engineering
- Power Systems and Power Electronics
- Signal Processing
- Telecommunications Engineering
- Wireless and Mobile Communication

