Journal of Clinical and Nursing Research

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(619 649 400)
Level 10
50 Clarence Street
SYDNEY NSW 2000
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Complimentary Copy

ISSN (ONLINE): 2208-3693
ISSN (PRINT): 2208-3685

Journal of Clinical and Nursing Research

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Level 10
50 Clarence Street
Sydney NSW 2000
Website: www.bbwpublisher.com
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2026, Volume 10, Issue 1

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Effect of Acupuncture at Points of the Bladder Meridian of Foot-Taiyang on Serum Inflammatory Factors in Rabbit Models of Cervical Spondylosis

Wenrong Yang, Shu Zhao, Jincai Liu, Dan Wang*, Zhijun Chen, Zhigang Zhao

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Abstract: *Objective*: Based on the theory of "Taiyang governs tendons", to explore the effect of acupuncture at points of the Bladder Meridian of Foot-Taiyang on the expression of serum inflammatory factors in rabbit models of cervical spondylosis. *Methods*: Thirty New Zealand white rabbits were randomly divided into a blank group, a model group, and a treatment group, with 10 rabbits in each group. The models of cervical spondylosis in the model group and treatment group were established by long-term head-down flexion combined with cold-damp stimulation. After modeling, the treatment group received acupuncture at three points (Kunlun, Weizhong, and Feishu) on the Bladder Meridian of Foot-Taiyang, once a day for 20 minutes each time, for 14 consecutive days; the model group and blank group received no therapeutic intervention. After the intervention, cardiac blood was collected from all rabbits to detect the expression levels of serum inflammatory factors IL-6, TNF-α, and IL-1β. Meanwhile, cervical muscle tissue was collected, stained with HE, and the morphological changes of the posterior cervical muscle tissue in each group were observed under an optical microscope. *Results*: After modeling, the levels of inflammatory factors in the serum of rabbits in the model group and treatment group were significantly increased compared with those before modeling, with a statistically significant difference ($p < 0.01$). After intervention, the serum inflammatory factors in the treatment group decreased significantly compared with those in the model group, and the difference was statistically significant ($p < 0.01$). *Conclusion*: Acupuncture at points of the Bladder Meridian of Foot-Taiyang in rabbit models of cervical spondylosis can reduce the serum levels of inflammatory factors TNF-α, IL-1β, and IL-6.

Keywords: Cervical spondylosis; Bladder meridian of foot-Taiyang; Acupuncture; Inflammatory factors

Online publication: Jan 9, 2026

1. Introduction

With the rapid development of the current network era and the popularization of various electronic digital products

such as computers, mobile phones, and tablets, the incidence of cervical spondylosis has been increasing year by year, showing an increasingly younger trend [1]. According to statistics, the incidence of cervical spondylosis in China is close to 20%, among which nearly 40% of patients are under 30 years old. Therefore, exploring effective treatment methods for cervical spondylosis is of great significance. Cervical spondylosis is a disease governed by the Bladder Meridian of Foot-Taiyang. Huangdi Neijing (Yellow Emperor's Internal Classic), a famous ancient Chinese medical classic, established the basic theoretical system of traditional Chinese medicine (TCM) and has important guiding significance for the development of TCM [2].

Many theories proposed in it are well-known to TCM scholars and widely used in clinical practice, such as the classic theory of "the liver governs tendons and the kidney governs bones". It also records that "the Gallbladder Meridian of Foot-Shaoyang governs diseases related to bones" and "the Bladder Meridian of Foot-Taiyang governs diseases related to tendons".

Among them, the theory of "Shaoyang governs bones" has been extensively studied by later physicians and has become a research hotspot among TCM scholars in recent years. However, there are very few studies on the theory of "Taiyang governs tendons", and there are no basic research reports on the application of this theory in the treatment of cervical spondylosis to date. Based on the theory of "Taiyang governs tendons", this study conducted animal experiments to investigate the effect of acupuncture at points of the Bladder Meridian of Foot-Taiyang on the expression of serum inflammatory factors in rabbit models of cervical spondylosis, and to clarify its mechanism in treating cervical spondylosis. The results were reported as follows.

2. Experimental materials

2.1. Experimental animals

Thirty 6-month-old New Zealand white rabbits, weighing about 2 kg, half male and half female, were purchased from Guizhou Yikedada Biotechnology Co., Ltd., with the animal license number of SCXK (Qian) 2021-0001. The animal experiment was approved by the Animal Experiment Ethics Review Committee of Yunnan University of Traditional Chinese Medicine, with approval number: R-062021LH038. Animal feeding and experimental operations were carried out at Yunnan Luoyu Biotechnology Co., Ltd. Throughout the experiment, the animals were raised in accordance with the standard for experimental animal feeding, and all animal experimental operations were performed in compliance with the provisions of the Regulations on the Administration of Experimental Animals.

2.2. Reagents

Rabbit interleukin-1β (IL-1β) enzyme-linked immunosorbent assay (ELISA) kit (catalog number: ml027836-2), rabbit interleukin-6 (IL-6) ELISA kit (catalog number: ml027844-2), and rabbit tumor necrosis factor-α (TNF-α) ELISA kit (catalog number: ml028087-2) were all purchased from Shanghai Enzyme-Linked Biotechnology Co., Ltd.

2.3. Instruments

Pannoramic MIDI holographic scanner, HistoCore BloCu7 rotary microtome, HistoCore ArCadia H paraffin embedding machine, JT-12S automatic tissue dehydrator, JK-6 tissue flaking and baking machine, surgical instruments (Shanghai Jinzhong), rabbit fixator (zh-tgx-i), acupuncture needles (Wujiang Yunlong Medical Devices Co., Ltd.), Shanghai Senxin DGG-9140B electric thermostatic blast drying oven, Thermo Scientific

high-speed refrigerated centrifuge, Eppendorf pipettes, Haier 4 ℃/-20 ℃ refrigerators, and SPECTRA MAX190 microplate reader.

3. Methods

3.1. Grouping of experimental animals

Thirty 6-month-old New Zealand white rabbits were randomly divided into 3 groups using a random number table: blank group, model group, and treatment group, with 10 rabbits in each group.

3.2. Model establishment

For rabbits in the model group and treatment group, the non-invasive method for establishing a rabbit model of cervical spondylosis proposed by Zhang Xin et al. was adopted. The specific operation steps were as follows: First, the hair on the posterior cervical region of the rabbits was shaved with a hair clipper, and then the rabbits were fixed in a rabbit fixation box.

Next, the rabbit's neck was adjusted to a 45° head-down flexion position to keep the posterior cervical muscles in a stretched state [3,4]. Afterwards, a self-made ice pack was placed on the posterior cervical region of the rabbit, once a day for 5 hours each time, for 4 consecutive weeks. Rabbits in the blank group were fixed in the same fixator, allowing free movement of the neck for the same duration.

After modeling, the expression levels of serum IL-1β, TNF-α, and IL-6 in each group were detected and compared with those before modeling. Meanwhile, 2 rabbits were randomly selected from each group and sacrificed, and the posterior cervical muscle tissue was quickly collected, stained with HE, and the morphological changes of the posterior cervical muscle tissue were observed under an optical microscope to comprehensively evaluate the success of modeling.

3.3. Intervention

(1) Treatment group

After modeling, the acupuncture sites were disinfected. Referring to the acupoint localization methods in Experimental Acupuncture and Handbook of Experimental Animal Acupuncture, acupuncture was performed at three points (Kunlun, Weizhong, and Feishu) on the Bladder Meridian of Foot-Taiyang, once a day, with the needles retained for 20 minutes each time, for 14 days.

(2) Model group and blank group

Rabbits were fixed on a self-made rabbit platform for 20 minutes every day without any therapeutic intervention.

3.4. Sample collection and processing

(1) On the day before modeling, the 1st day after modeling, and the 1st day after intervention, cardiac blood was collected from all rabbits, centrifuged at 4 ℃ at 3000 r/min for 30 minutes in a timely manner, and the supernatant was aspirated to detect the expression levels of serum inflammatory factors IL-1β, TNF-α, and IL-6 by ELISA.

(2) After blood collection on the 1st day after modeling, 2 rabbits were randomly selected from each group, sacrificed by exsanguination via the heart after cardiac blood collection, and the posterior cervical muscle tissue was quickly collected, stained with HE, and the morphological changes of the posterior cervical

muscle tissue were observed under an optical microscope.

(3) After the intervention, the remaining rabbits were first subjected to cardiac blood collection, then sacrificed by exsanguination via the heart, and the posterior cervical muscle tissue was quickly collected, stained with HE, and the morphological changes of the posterior cervical muscle tissue were observed under an optical microscope.

3.5. Statistical analysis

The detection results of serum inflammatory factors TNF-α, IL-1β, and IL-6 were statistically analyzed. SPSS 21.0 statistical software was used for data analysis, and GraphPad Prism 9.0.0 software was used for graph plotting. One-way analysis of variance (ANOVA) was used for comparison between groups, and LSD-*t* test was further used for pairwise comparison if there were significant differences. $p < 0.05$ was considered statistically significant, and $p < 0.01$ was considered extremely statistically significant.

4. Results

4.1. Comparison of inflammatory factors among groups at the same time point

Before modeling, the levels of TNF-α, IL-1β, and IL-6 in each group were comparable, with no statistically significant differences. After modeling, the levels of TNF-α, IL-1β, and IL-6 in the model group and treatment group were significantly higher than those in the blank group, with extremely statistically significant differences ($p < 0.01$), indicating successful modeling; however, there was no statistically significant difference in the levels of inflammatory factors between the treatment group and the model group after modeling ($p > 0.05$) [5].

After treatment, the levels of TNF-α, IL-1β, and IL-6 in the treatment group were significantly lower than those in the model group, and the difference was statistically significant. See **Tables 1**, **2** and **3** and **Figures 1**, **2** and **3**.

Table 1. Levels of inflammatory factors in each group before modeling

Group/Indicator (pg/mL)	TNF-a	IL-1β	IL-6
Blank group	41.6 ± 4.56	129.98 ± 21.73	38.61 ± 6.99
Model group	44.08 ± 3.01	151.9 ± 17.91	38.96 ± 8.13
Treatment group	41.46 ± 6.92	130.64 ± 20.1	33.09 ± 7.39

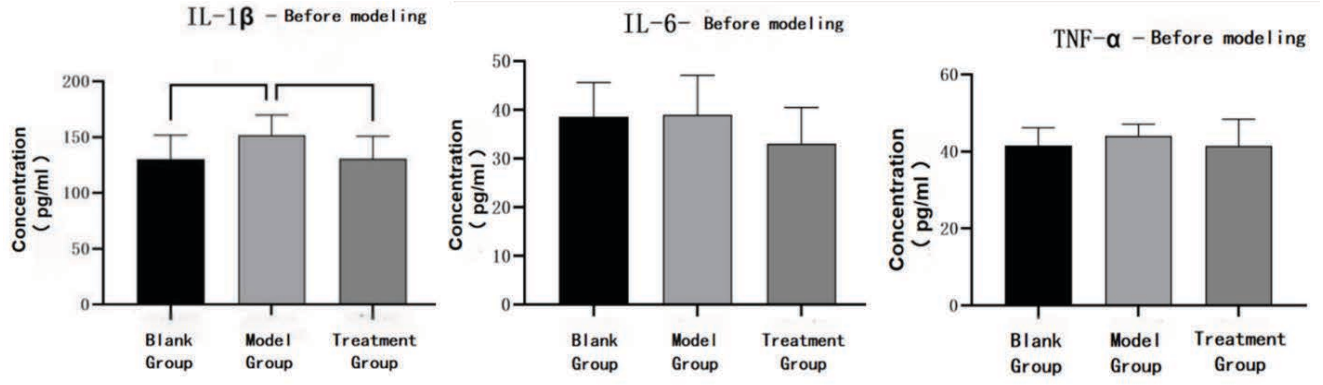


Figure 1. Levels of inflammatory factors in each group before modeling. A. Detection results of IL-1β in each group before modeling; B. Detection results of IL-6 in each group before modeling; C. Detection results of TNF-α in each group before modeling.

Table 2. Levels of inflammatory factors in each group after modeling

Group/Indicator (pg/mL)	TNF-a	IL-1β	IL-6
Blank group	38.67 ± 6.49	144.68 ± 31.59	37.1 ± 5.51
Model group	89.55 ± 6.68	340.22 ± 32.01	84.11 ± 7
Treatment group	86.82 ± 6.24	360.51 ± 28.65	90.26 ± 5.44

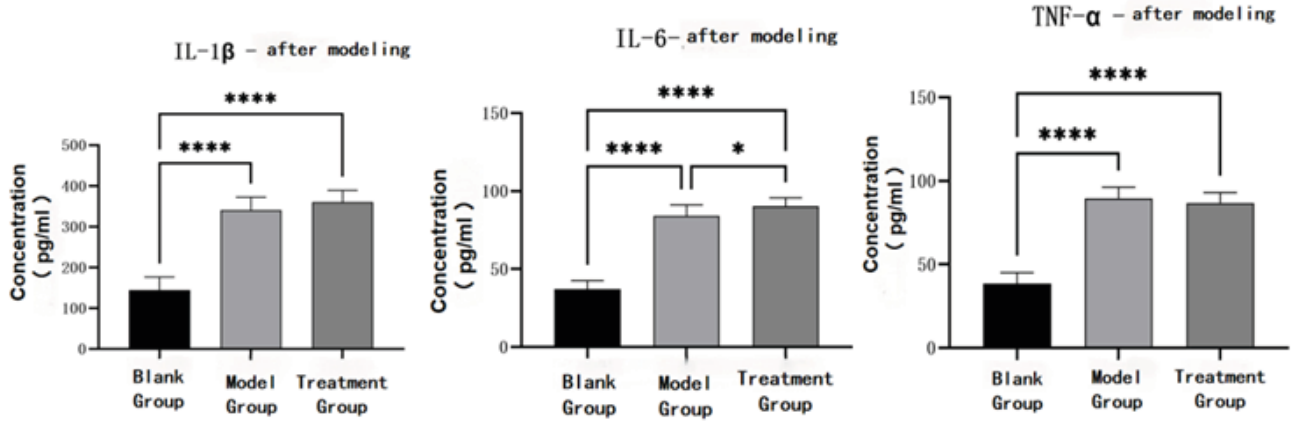


Figure 2. Levels of inflammatory factors in each group after modeling. A. Detection results of IL-1β in each group after modeling; B. Detection results of IL-6 in each group after modeling; C. Detection results of TNF-α in each group after modeling; *$p < 0.05$, ****$p < 0.0001$.

Table 3. Levels of inflammatory factors in each group after treatment

Group/Indicator (pg/mL)	TNF-a	IL-1β	IL-6
Blank group	43.21 ± 7.04	135.07 ± 22.75	37.31 ± 6.39
Model group	81.79 ± 3.68	338.56 ± 27.94	82.69 ± 8.65
Treatment group	59.97 ± 4.21	239.24 ± 18.34	59.05 ± 7.53

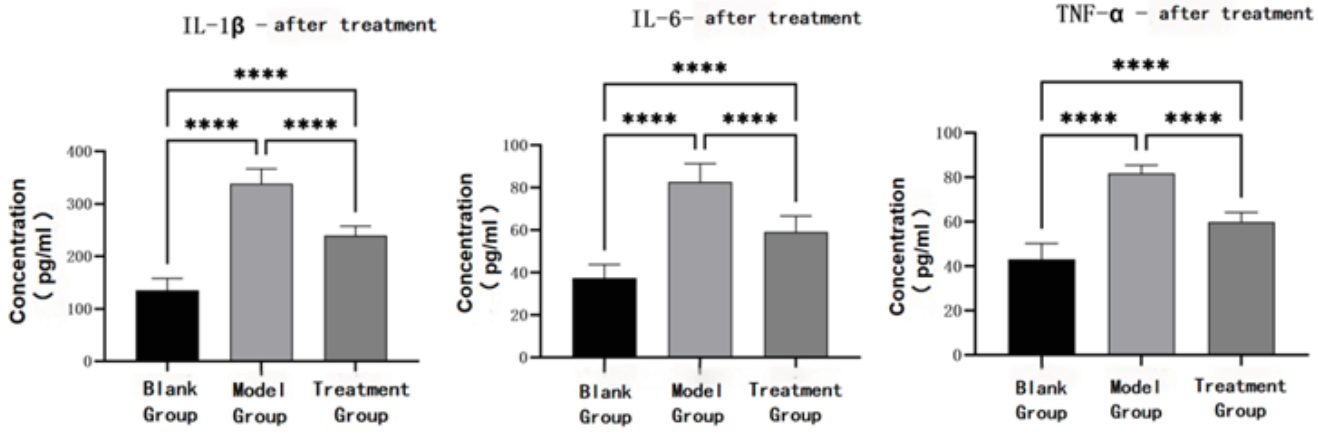


Figure 3. Levels of inflammatory factors in each group after treatment. A. Detection results of IL-1β in each group after treatment; B. Detection results of IL-6 in each group after treatment; C. Detection results of TNF-α in each group after treatment; *$p < 0.05$, ****$p < 0.0001$.

4.2. Comparison of inflammatory factors in the same group at three time points

In the blank group, the levels of TNF-α, IL-1β, and IL-6 before modeling, after modeling, and after treatment were comparable, with no statistically significant differences ($p > 0.05$).

In the model group, the levels of TNF-α, IL-1β, and IL-6 after modeling and after treatment were significantly higher than those before modeling, with extremely statistically significant differences ($p < 0.01$); there was no statistically significant difference in the levels of IL-1β and IL-6 between after modeling and after treatment, but the level of TNF-α was statistically different ($p < 0.05$).

In the treatment group, the levels of TNF-α, IL-1β, and IL-6 after modeling and after treatment were significantly higher than those before modeling, with extremely statistically significant differences ($p < 0.01$); after treatment, the levels of TNF-α, IL-1β, and IL-6 were significantly lower than those after modeling, with extremely statistically significant differences ($p < 0.01$). See **Tables 4**, **5** and **6** and **Figures 4**, **5** and **6** .

Table 4. Levels of inflammatory factors in the blank group across three time points

Group/Indicator (pg/mL)	TNF-a	IL-1β	IL-6
Before modeling	41.6 ± 4.56	129.98 ± 21.73	38.61 ± 6.99
After modeling	38.67 ± 6.49	144.68 ± 31.59	37.1 ± 5.51
After treatment	43.21 ± 7.04	135.07 ± 22.75	37.31 ± 6.39

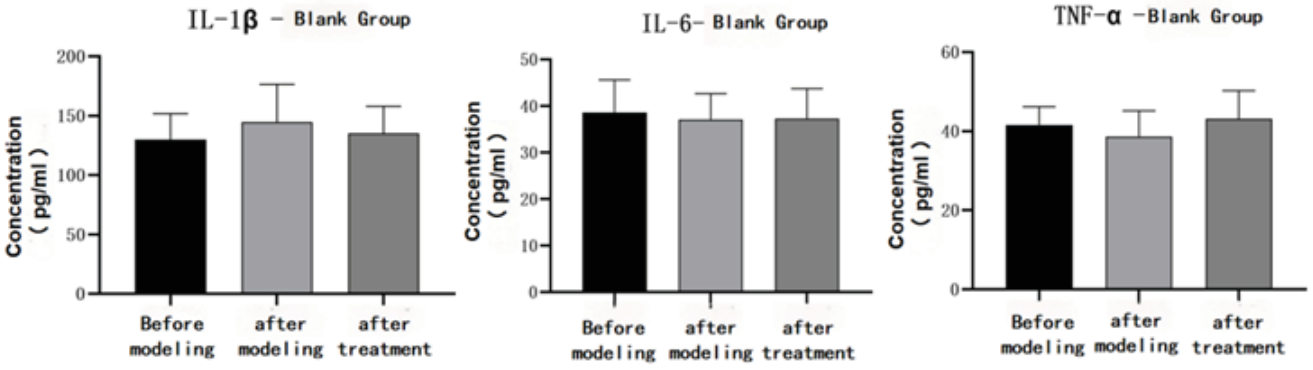


Figure 4. Levels of inflammatory factors in the blank group. A. Detection results of IL-1β in the blank group at three time points; B. Detection results of IL-6 in the blank group at three time points; C. Detection results of TNF-α in the blank group at three time points.

Table 5. Levels of inflammatory factors in the model group across three time points

Group/Indicator (pg/mL)	TNF-a	IL-1β	IL-6
Before modeling	44.08 ± 3.01	151.9 ± 17.91	38.96 ± 8.13
After modeling	89.55 ± 6.68	340.22 ± 32.01	84.11 ± 7
After treatment	81.79 ± 3.68	338.56 ± 27.94	82.69 ± 8.65

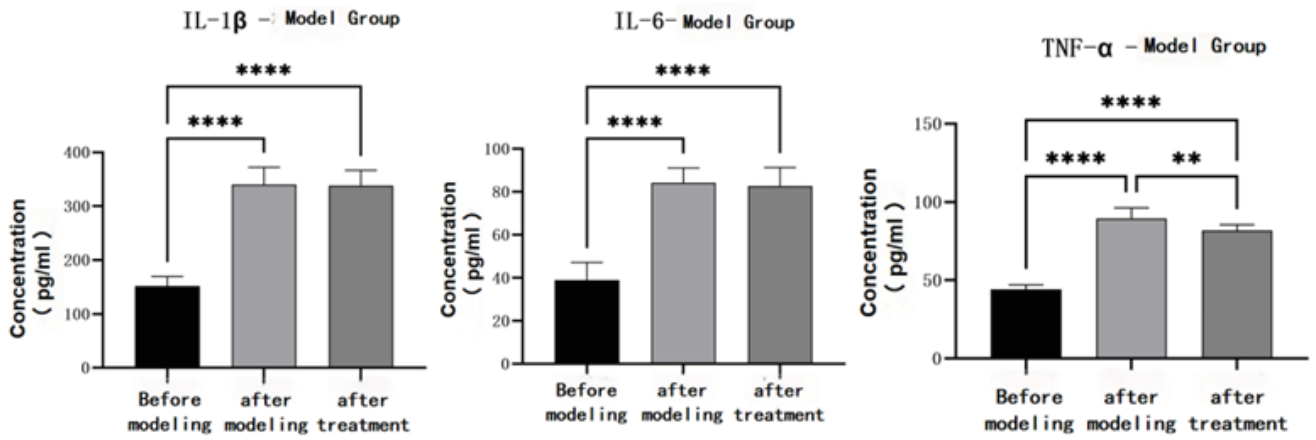


Figure 5. Levels of inflammatory factors in the model group. A. Detection results of IL-1β in the model group at three time points; B. Detection results of IL-6 in the model group at three time points; C. Detection results of TNF-α in the model group at three time points; $^{**}p < 0.005$, $^{****}p < 0.0001$.

Table 6. Levels of inflammatory factors in the treatment group across three time points

Group/Indicator (pg/mL)	TNF-a	IL-1β	IL-6
Before modeling	41.46 ± 6.92	130.64 ± 20.1	33.09 ± 7.39
After modeling	86.82 ± 6.24	360.51 ± 28.65	90.26 ± 5.44
After treatment	59.97 ± 4.21	239.24 ± 18.34	59.05 ± 7.53

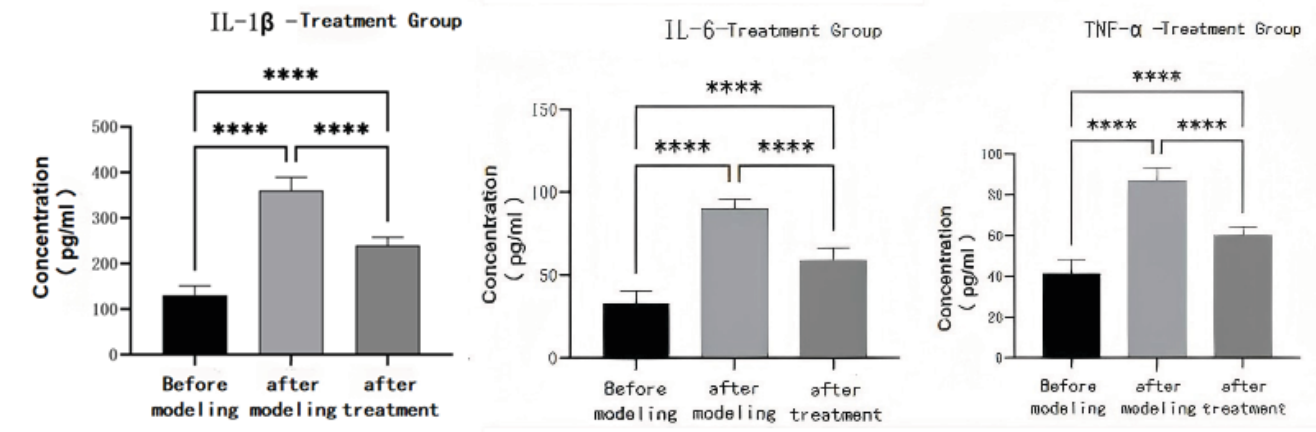


Figure 6. Levels of inflammatory factors in the treatment group. A. Detection results of IL-1β in the treatment group at three time points; B. Detection results of IL-6 in the treatment group at three time points; C. Detection results of TNF-α in the treatment group at three time points; $^{****}p < 0.0001$.

4.3. Morphological changes of posterior cervical muscle tissue

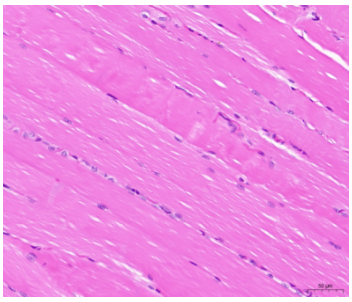
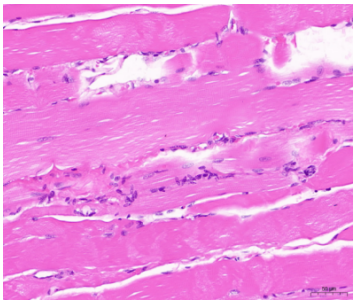
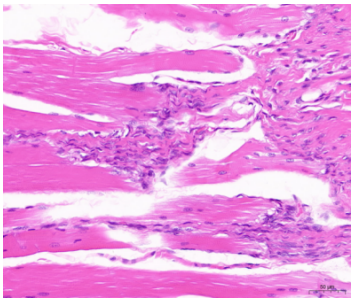
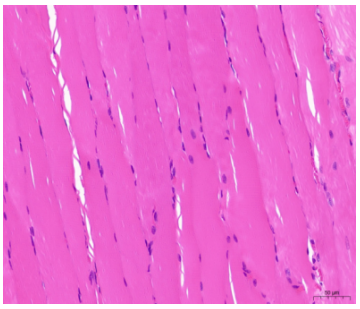
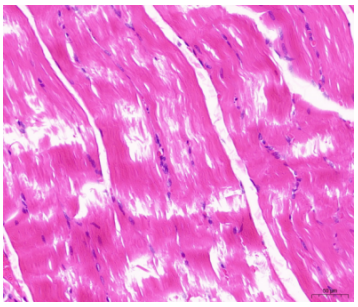
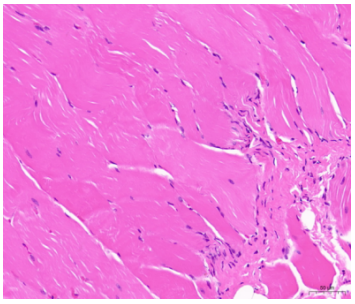
After the rabbits were sacrificed, the posterior cervical muscle tissue was collected, stained with HE, and the morphological changes were observed under an optical microscope.

In the blank group, the posterior cervical muscle fibers had a clear structure, neat arrangement, similar thickness, no inflammatory cell infiltration, and no myocyte degeneration or edema. After modeling, in the model group and treatment group, uneven staining of muscle fibers, disordered arrangement, muscle fiber rupture and

torsion, accompanied by inflammatory cell infiltration, and disordered arrangement of collagen fibers were observed [6].

After treatment, the treatment group showed mild proliferation of connective tissue, relatively uniform distribution of myonuclei, mild torsion of myocytes, and no swelling. See **Table 7**.

Table 7. Morphological changes of posterior cervical muscle tissue in each group observed under an optical microscope

	Blank group	Model group	Treatment group
Before treatment			
After treatment			

5. Discussion

"Cervical spondylosis" is not clearly recorded in TCM monographs. According to its pathogenesis and related symptoms, the disease belongs to the categories of "neck bi" and "bi syndrome" in TCM [7]. The occurrence of neck bi is closely related to the Bladder Meridian of Foot-Taiyang. Lingshu·Jingmai (Spiritual Pivot·Meridians) states: "The Bladder Meridian of Foot-Taiyang... Diseases related to tendons governed by it include hemorrhoids, malaria, mania, epilepsy, pain in the head, fontanelle, and neck, yellow eyes, lacrimation, epistaxis, pain in the neck, back, waist, buttocks, popliteal fossa, calves, and feet, and inability to use the little toe", which puts forward the theory of "Taiyang governs tendons" [8]. It describes that the symptoms of diseases of the Bladder Meridian of Foot-Taiyang include pain and dysfunction from the head and neck along the meridian to the waist and buttocks, especially pain and discomfort in the head, neck, and nape, as well as dysfunction, which is consistent with the clinical symptoms of cervical spondylosis. The Twelve Muscle Meridians are the peripheral accessory parts of the Twelve Meridians, and muscles and joints are nourished by the Qi and blood of the Twelve Meridians [9]. Therefore, the meridians and muscle meridians of the Foot-Taiyang Meridian are interdependent in physiology and interact in pathology [10]. Zhang Jiebin also believed that "the muscles and tendons all over the body are mostly and largely distributed along the Foot-Taiyang Meridian. Its lower parts connect to the heels, calves, popliteal fossae, and buttocks; its upper parts cling to the waist and spine, connect to the shoulders and neck, and extend to the head

as the superior orbital ridge [11]. Therefore, all conditions such as spasm, flaccidity, and opisthotonos are caused by insufficient fluid of the Foot-Taiyang Meridian, which governs diseases related to tendons" [12]. Therefore, cervical spondylosis is also a disease governed by the Bladder Meridian of Foot-Taiyang and is closely related to this meridian. Cai Gengxi et al. conducted data analysis on the acupoint selection rules of acupuncture for treating cervical spondylosis at home and abroad and found that the acupoints of the Bladder Meridian of Foot-Taiyang accounted for 16.62% of the total therapeutic acupoints, with the highest proportion. This indicates that the Bladder Meridian of Foot-Taiyang is the most commonly used meridian in the treatment of cervical spondylosis. Huang Hongxi's research found that the muscle meridian lesions of patients with cervical spondylosis are divided into three categories: point-like, linear, and planar lesions, with point-like muscle meridian lesions being the main type, and various muscle meridian lesions are mainly concentrated in the muscle meridian of the Foot-Taiyang Meridian. Therefore, the treatment should also start with the Bladder Meridian of Foot-Taiyang. Acupuncture has a long history in the treatment of cervical spondylosis. As early as Lingshu·Zabing (Spiritual Pivot·Miscellaneous Diseases), it was recorded that "for neck pain with inability to bend forward and backward, puncture the Foot-Taiyang Meridian; for inability to turn the head, puncture the Hand-Taiyang Meridian" [13]. Acupuncture in the treatment of cervical spondylosis has the characteristics of obvious, long-lasting, and stable curative effect, with few adverse reactions. As a traditional external therapy of TCM, acupuncture regulates Qi and blood, dredges meridians, and balances Yin and Yang by stimulating meridians and acupoints [14].

Acupuncture treatment has the effects of improving Qi and blood circulation, restoring patients' functions, and relieving spasm, while Tuina (massage) also has the effects of dredging meridians, nourishing tendons, and relieving pain by regulating tendons [15]. Modern studies have found that acupuncture in the treatment of cervical spondylosis can not only reduce inflammation and pain, dredge meridians and tendons, but also relieve cervical muscle spasm. Acupuncture can effectively promote and enhance cervical blood circulation and metabolism, help patients absorb local inflammation, thereby better eliminating existing edema, and exert a good advantage in relieving neck and shoulder pain [16]. Zhang Wanyu et al. found that the eight-confluent points compatibility therapy can effectively improve the Visual Analogue Scale (VAS) score, self-made symptom and sign score, and Neck Pain Questionnaire (NPQ) score of patients with cervical spondylosis. Wu Zhongliang et al. adopted the quick puncture method, which had a better effect in reducing neck pain, alleviating inflammatory response, and improving hemorheology in patients with cervical spondylosis. Chen Youyi established a model of cervical spondylosis and found that after electroacupuncture at the "Dazhui" point, the contents of SOD, GSH-Px, and Glu were significantly higher than those in the model group, while the content of MDA was significantly lower. He believed that the mechanism of acupuncture in the treatment of cervical spondylosis may be to reduce muscle damage by improving the free radical scavenging ability of tissue cells and the content of Glu, thereby achieving the effect of relieving neck and shoulder pain. He Jian et al. used the same modeling method and found that the contents of nitric oxide synthase (NOS) and NO in the serum and muscle tissue homogenate were significantly decreased, suggesting that long-term head-down flexion of the cervical spine can inhibit information transmission [17]. Guided by the theory of "Taiyang governs tendons", this study selected three points (Kunlun, Weizhong, and Feishu) on the Bladder Meridian of Foot-Taiyang for acupuncture in the treatment of cervical spondylosis. Among them, Feishu is located locally in the neck and nape, following the principle of "acupoints correspond to local disorders", guiding the local Qi to "reach the affected area", dredging local meridian Qi and blood, improving blood microcirculation, inhibiting the release of pain mediators, and stimulating peripheral nerves, thereby reducing neck and shoulder pain in patients [18]. Nanjing·Liushiba Nan (Classic of Difficult Issues·Sixty-Eighth Difficulty) states: "Jing (Well) points

treat stuffiness in the chest and hypochondrium; Ying (Spring) points treat body heat; Shu (Stream) points treat heaviness and joint pain; Jing (River) points treat cough, asthma, cold, and heat; He (Sea) points treat adverse Qi and diarrhea" [19]. Kunlun and Weizhong points are acupoints of the Bladder Meridian of Foot-Taiyang. According to Huangdi Neijing·Lingshu·Jingmai (Yellow Emperor's Internal Classic·Spiritual Pivot·Meridians): "The Bladder Meridian of Foot-Taiyang originates from the inner canthus of the eye. Its straight branch enters the brain from the top of the head, exits and descends to the neck". The Bladder Meridian of Foot-Taiyang runs from the head to the back and then to the feet, and the entire neck and back of the human body are mainly traversed by the Bladder Meridian. According to the principle of "meridians govern disorders along their pathways", it can treat diseases along the Foot-Taiyang Meridian [20].

6. Conclusion

In summary, since meridians transport Qi and blood to nourish muscle meridians, enabling muscle meridians to bind bones and regulate joints, the occurrence of cervical spondylosis is related to meridians, and most closely related to the muscle meridians of the Hand-Taiyang and Foot-Taiyang Meridians; from the perspective of the distribution of the muscle meridian of the Foot-Taiyang Meridian, it highly overlaps with the lesion site of cervical spondylosis [21]. Secondly, the Foot-Taiyang Meridian is the one with the most abundant defensive Yang among the Twelve Meridians. Defensive Yang originates from the Foot-Taiyang Meridian. Abundant defensive Yang warms and nourishes the muscle meridians; if defensive Yang is insufficient, the cervical muscle meridians lose warmth, resulting in symptoms such as pain and stiffness of cervical spondylosis. Therefore, cervical spondylosis is also a disease governed by the Bladder Meridian of Foot-Taiyang and is closely related to this meridian [22]. Modern medical studies have shown that the imbalance of cervical biomechanical balance and inflammatory damage of cervical muscle tissue are closely related to the occurrence of cervical spondylosis [4]. People who work at their desks for a long time or have bad living habits are prone to imbalance of cervical biomechanical balance and inflammatory damage of cervical muscle tissue. In the occurrence and development of cervical spondylosis, inflammatory factors such as IL-1β, IL-6, and TNF-α play key roles. Relevant studies have shown that the expression level of TNF-α is significantly increased after cervical disc degeneration. This increase not only promotes the contact between macrophages and degenerated disc tissue, thereby triggering an inflammatory response, but also is the initiating factor leading to the inflammatory response of degenerated discs. As a pro-inflammatory factor, the expression and release of IL-6 can be regulated by muscle contraction. At the same time, muscle contraction can also promote the expression and release of inflammatory factors such as IL-1β, and promote the release and expression of other inflammatory cytokines such as TNF-α, ultimately aggravating the degree of inflammatory damage. In this experiment, the expression levels of IL-1β, IL-6, and TNF-α in rabbits were significantly increased after modeling, and after treatment with acupuncture at points of the Bladder Meridian of Foot-Taiyang, the expression levels of the above inflammatory factors were lower than those in the model group. In conclusion, acupuncture at points of the Bladder Meridian of Foot-Taiyang may exert a therapeutic effect by reducing the release of inflammatory factors such as IL-1β, IL-6, and TNF-α and inhibiting the inflammatory damage of cervical muscles. Therefore, in the treatment of cervical spondylosis, acupuncture can be used under the guidance of the theory of "Taiyang governs tendons".

Funding

Yunnan Provincial High-Level Traditional Chinese Medicine Talent Training Project; Yunnan Provincial Department of Science and Technology Traditional Chinese Medicine Basic Research Joint Special Project (Project No.: 202101AZ070001-138)

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Research on the Impact of Evidence-Based Predictive Nursing on Elderly Cataract Patients During the Perioperative Period

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Abstract: Objective: To explore the impact of evidence-based predictive nursing intervention on psychological stress and physiological indicator stability of elderly cataract patients during the perioperative period (1 day before surgery to 1 day after surgery), and to provide a basis for optimizing clinical nursing plans for elderly cataract surgery. Methods: A retrospective selection of 90 elderly patients (aged ≥ 60 years) who underwent cataract surgery in the Ophthalmology Department of our hospital from August 2024 to December 2024 was conducted. They were divided into an observation group (n = 45) and a control group (n = 45) using a random number table method. The control group received routine nursing for cataract surgery, while the observation group implemented evidence-based predictive nursing intervention (including the establishment of a multidisciplinary evidence-based team, hierarchical psychological intervention, perioperative environment optimization, intraoperative personalized cooperation, and video-based health education). Psychological stress indicators [Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS), General Self-Efficacy Scale (GSES)] on the 1st day before surgery and 1st day after surgery, and fluctuations of physiological indicators [Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP)] on the 1st day before surgery and during surgery were compared between the two groups. *Results:* Before intervention, there were no statistically significant differences in SAS, SDS, GSES scores, HR, SBP, or DBP between the two groups ($p > 0.05$); after intervention, the SAS score (33.62 ± 5.72) and SDS score (32.14 ± 4.86) of the observation group on the 1st day after surgery were significantly lower than those of the control group [(41.05 ± 5.56), (43.59 ± 4.75)], and the GSES score (31.15 ± 3.28) was significantly higher than that of the control group (24.84 ± 3.52) (all $p < 0.05$); during surgery, the fluctuations of HR (74.0 ± 6.0) beats/min, SBP (127.0 ± 15.8) mmHg, and DBP (75.0 ± 5.9) mmHg in the observation group were significantly smaller than those in the control group (all $p < 0.05$). *Conclusion:* Evidence-based predictive nursing intervention can effectively alleviate anxiety and depression in elderly cataract patients during the perioperative period, improve self-efficacy, stabilize intraoperative physiological status, and enhance surgical cooperation, which is worthy of clinical promotion.

Keywords: Evidence-based nursing; Predictive nursing; Elderly patients; Cataract; Perioperative period; Psychological stress; Physiological stability; Self-efficacy

Online publication: Feb 6, 2026

1. Introduction

Cataract is a common degenerative ophthalmic disease in the elderly. The incidence of cataract in people over 60 years old in China reaches 80%, accounting for more than 50% of the causes of visual impairment. Surgery is currently the only effective clinical treatment for this disease [1]. Due to factors such as declining physical function, insufficient understanding of surgery, and unfamiliarity with the operating room environment, elderly patients are prone to obvious psychological stress reactions during the perioperative period. Preoperative anxiety and depression can lead to increased blood pressure and heart rate during surgery, which not only reduces surgical cooperation but also may increase the risk of postoperative complications [2]. Evidence-based nursing, with "best scientific research evidence + clinical experience + patient needs" as the core, formulates personalized intervention plans through systematic retrieval and evaluation of evidence, which can effectively improve nursing accuracy [3]; predictive nursing emphasizes "early assessment - advance intervention" and formulates measures for potential risks to reduce the incidence of adverse events [4]. This study combines the two to construct a multidisciplinary evidence-based predictive nursing model, exploring its impact on psychological stress and physiological stability of elderly cataract patients during the perioperative period, aiming to provide practical reference for elderly ophthalmic surgical nursing.

2. Materials and methods

2.1. Research objects

A retrospective inclusion of 90 elderly patients who underwent phacoemulsification combined with intraocular lens implantation for cataracts in the Ophthalmology Department of our hospital from August 2024 to December 2024 was conducted.

2.1.1. Inclusion criteria

(1) Meets the diagnostic criteria for cataracts in Ophthalmology and plans to undergo elective surgery;
(2) Aged ≥ 60 years
(3) Clear consciousness and able to complete scale scoring independently
(4) No severe dysfunction of heart, liver, kidney and other organs
(5) Informed consent from patients and their families.

2.1.2. Exclusion criteria

(1) Complicated with mental illness or cognitive impairment (Mini-Mental State Examination score < 24 points);
(2) Has a history of ophthalmic surgery or other severe ophthalmic diseases (such as glaucoma, retinal detachment);
(3) Unable to cooperate with intraoperative body position fixation (such as severe spinal deformity).

2.1.3. Grouping method

Patients were divided into an observation group and a control group using a random number table method, with 45 cases in each group. There were no statistically significant differences in baseline data such as age, gender, educational level, history of hypertension, and lens opacity degree (LOCS III classification) between the two

groups ($p > 0.05$), which were comparable, as shown in **Table 1**.

Table 1. Comparison of baseline data of elderly cataract patients in two groups

Group	Number of cases	Average age (Years, $\bar{x} \pm s$)	Male [n (%)]	Average educational level (Years, $\bar{x} \pm s$)	History of hypertension [n(%)]	Lens opacity degree (LOCS III Classification, n) Grade II
Observation group	45	68.41 ± 13.26	33(62.23)	13.37 ± 2.40	15(33.33)	12
Control group	45	66.90 ± 13.04	31(68.88)	12.92 ± 2.85	13(28.95)	14
t/χ^2 value	-	0.915	2.094	0.736	1.763	0.382
p-value	-	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05

2.2. Nursing methods

2.2.1. Control group: Routine nursing

(1) Preoperative

Verbally inform patients of the surgical process, intraoperative precautions (such as keeping the head fixed), and postoperative nursing key points; assist in completing preoperative examinations (such as intraocular pressure, corneal curvature).

(2) Intraoperative

Monitor vital signs (HR, SBP, DBP), observe the patient's mental state, and provide simple comfort when obvious restlessness occurs.

(3) Postoperative

Guide patients in eye medication (such as antibiotic eye drops) and inform them of taboos such as avoiding rubbing eyes, bowing, and bending over after surgery.

2.2.2. Observation group: Evidence-based predictive nursing intervention

Follow the process of "evidence-based question - evidence retrieval - evidence evaluation - plan formulation - implementation of intervention", as follows:

(1) Establish a multidisciplinary evidence-based nursing team

Led by the deputy head nurse of the operating room (leader) and the head nurse of ophthalmology (deputy leader), the team includes 2 senior nurses from ophthalmology, 2 senior nurses from the operating room, 1 attending physician from anesthesiology, 1 attending physician from ophthalmology, and 2 secretaries (1 undergraduate from the operating room and 1 graduate student from ophthalmology, responsible for literature retrieval and data statistics); invite directors of ophthalmology and anesthesiology to serve as consultants to ensure the professionalism of the plan.

(2) Evidence-based practice steps

① Raise questions: Focus on core issues such as "influencing factors of psychological stress in elderly cataract patients during the perioperative period" and "effects of predictive nursing intervention on the psychological and physiological status of cataract surgery patients". ② Retrieve Evidence: Retrieve CNKI, Wanfang, VIP, and PubMed databases from January 2019 to December 2024 with keywords including "cataract", "elderly patients", "perioperative nursing", "evidence-based nursing", "predictive nursing", "psychological stress", and "anxiety". A total of 86 literatures were retrieved. After excluding low-quality (JBI

evidence grade ＜ Grade B) and duplicate literatures, 12 core literatures were included [3–12]. ③ Evaluate Evidence: Using the JBI Evidence-Based Nursing Center's evidence grading standards, "video-based health education can improve elderly patients' disease cognition", "hierarchical psychological intervention can targetedly relieve anxiety", and "intraoperative music + physical comfort can stabilize physiological indicators" were adopted as Grade A evidence and included in the nursing plan.

(3) Specific intervention measures

Preoperative: Hierarchical Psychological Assessment and Education: ① Assess psychological status using SAS and SDS scales 1 day before surgery, divided into mild (SAS 50–59 points / SDS 53–62 points), moderate (SAS 60–69 points / SDS 63–72 points), and severe (SAS ≥ 70 points / SDS ≥ 73 points) stress; ② Mild stress: Conduct one-on-one communication, explaining safety combined with surgical diagrams (such as "the operation only takes 15–20 minutes, with no obvious pain during the operation"); Moderate Stress: Arrange postoperative recovered patients to share experiences, and simultaneously guide deep breathing relaxation training, 3 times a day, 10 minutes each time; Severe Stress: Conduct joint anesthesiology assessment, recommend general anesthesia, and provide psychological counseling 2 hours before surgery; ③ Produce a short video of "the whole process of cataract surgery", including the operating room environment, surgical operations, and postoperative rehabilitation cases, generate a QR code, and patients can scan and watch repeatedly to eliminate unfamiliarity with the environment [5]. Intraoperative: Environment Optimization and Personalized Cooperation: ① Adjust the operating room temperature to 23–25 °C and humidity to 50–60% 30 minutes before surgery, play soft piano music with a volume of 30–40 decibels [13]. ② After the patient enters the operating room, the nurse holds the patient's non-surgical hand and gently informs "the operation is about to start, and I will be with you throughout"; inform the patient of the surgical progress every 5 minutes during the operation, such as "lens emulsification has been completed, and intraocular lens implantation is about to begin"; ③ Closely observe changes in HR and SBP. If SBP > 150 mmHg or HR > 90 beats/min, suspend the operation and provide verbal comfort, and continue after the indicators stabilize. Postoperative: Continuous Support: Conduct a follow-up visit 1 day after surgery, assess self-efficacy using the GSES scale, and encourage patients with low scores (< 25 points): "You are recovering well now, and you can recover smoothly by taking medication as guided" to strengthen treatment confidence.

2.3. Observation indicators

2.3.1. Psychological stress indicators

Evaluated using the following scales on the 1st day before surgery and 1st day after surgery:

(1) SAS: 20 items, standard score ≥ 50 points indicates anxiety, with higher scores indicating more severe anxiety;

(2) SDS: 20 items, standard score ≥ 53 points indicates depression, with higher scores indicating more severe depression;

(3) GSES: 10 items, using a 1–4 grade scoring method, total score 10–40 points, with higher scores indicating stronger self-efficacy [14].

2.3.2. Physiological indicators

Record HR (beats/min), SBP (mmHg), and DBP (mmHg) on the 1st day before surgery and during surgery, and

calculate the difference (fluctuation range) between intraoperative indicators and preoperative baseline in the two groups.

2.4. Statistical methods

SPSS 22.0 software was used for data analysis. Measurement data were expressed as "$\bar{x} \pm s$", and inter-group comparison was conducted using independent sample *t*-test; count data were expressed as "n(%)", and inter-group comparison was conducted using χ^2 test. A p value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of perioperative psychological stress indicators between the two groups

Before intervention, there were no statistically significant differences in SAS, SDS, or GSES scores between the two groups ($p > 0.05$); after intervention, the SAS and SDS scores of the observation group were significantly lower than those of the control group, and the GSES score was significantly higher than that of the control group (all $p < 0.05$), as shown in **Table 2**.

Table 2. Comparison of perioperative psychological stress indicators of elderly cataract patients in two groups (scores, $\bar{x} \pm s$)

Group	Number of cases	SAS	SDS	GSES
		1st day before surgery	1st day after surgery	1st day before surgery
Observation group	45	53.62 ± 4.88	33.62 ± 5.72	51.27 ± 5.06
Control group	45	52.86 ± 5.21	41.05 ± 5.56	50.96 ± 4.93
t value	-	0.706	6.178	0.291
p value	-	0.482	< 0.001	0.772

3.2. Comparison of perioperative physiological indicators between the two groups

Before intervention, there were no statistically significant differences in HR, SBP, or DBP between the two groups ($p > 0.05$); during surgery, the fluctuations of HR, SBP, and DBP in the observation group were significantly smaller than those in the control group (all $p < 0.05$), as shown in **Table 3**.

Table 3. Comparison of perioperative physiological indicators of elderly cataract patients in two groups ($\bar{x} \pm s$)

Group	Number of cases	HR (Beats/min)	SBP (mmHg)	DBP (mmHg)
		1st day before surgery	Intraoperative	1st day before surgery
Observation group	45	78.9 ± 6.5	74.0 ± 6.0	137.0 ± 11.6
Control group	45	80.4 ± 7.8	78.8 ± 7.4	145.0 ± 9.9
t value	-	1.018	3.490	1.360
p value	-	0.332	0.001	0.206

4. Discussion

4.1. Evidence-based predictive nursing can effectively alleviate perioperative psychological stress

The results of this study showed that the postoperative SAS and SDS scores of the observation group were significantly lower than those of the control group, and the GSES score was significantly higher than that of the control group ($p < 0.05$), which is consistent with the research conclusion of Liu Shuangdan et al. [8]. The reasons are as follows:

(1) Through "hierarchical psychological intervention", differentiated measures are formulated for patients with mild, moderate, and severe stress, avoiding the limitations of "one-size-fits-all" nursing - mild patients build confidence through cognitive education, moderate patients strengthen psychological resilience through peer experience + relaxation training, and severe patients reduce fear through anesthesia assessment + professional counseling [4];

(2) Video-based health education intuitively presents the surgical process, solving the problem of "poor memory of verbal education" in elderly patients, improving disease cognition and reducing anxiety caused by "unknown" [5];

(3) Continuous verbal comfort and physical contact during surgery make patients feel "cared for", further relieving intraoperative tension and ultimately improving self-efficacy [12].

4.2. Evidence-based predictive nursing can stabilize intraoperative physiological status

Elderly patients have weak cardiovascular regulation ability, and perioperative psychological stress is prone to cause severe fluctuations in HR and SBP, increasing the risk of intraoperative cardiovascular accidents [2]. In this study, the fluctuations of HR, SBP, and DBP in the observation group during surgery were significantly smaller than those in the control group ($p < 0.05$). The mechanism lies in:

(1) Preoperative relaxation training reduces sympathetic nerve excitability through "breathing regulation - autonomic nerve balance", reducing the release of stress hormones (such as cortisol) [15];

(2) Intraoperative environment optimization (temperature, humidity, music) directly acts on the sensory system, relieves physical tension, and indirectly stabilizes physiological indicators [13];

(3) Nurses dynamically monitor indicators throughout the operation and intervene in abnormal fluctuations in a timely manner, avoiding the vicious cycle of "stress - increased indicators - more anxiety" [9].

4.3. Clinical value and limitations of the multidisciplinary evidence-based model

The "operating room - ophthalmology - anesthesiology" multidisciplinary evidence-based team constructed in this study achieves the complementary advantages of "familiarity with surgical processes (operating room) + professional disease knowledge (ophthalmology) + anesthesia risk control (anesthesiology)", ensuring that the nursing plan takes into account both "safety and practicality" [9]. However, the study has limitations:

(1) It is a single-center retrospective study with a small sample size (90 cases), which limits the extrapolation of results;

(2) Long-term indicators (such as visual acuity recovery and complication rate) 3 months after surgery were not followed up. In the future, multi-center, prospective studies need to be conducted for further verification;

(3) Grassroots hospitals may be unable to replicate the "multidisciplinary team" model due to insufficient

human resources, and the plan needs to be simplified to improve promotion feasibility.

5. Conclusion

Evidence-based predictive nursing intervention can effectively alleviate anxiety and depression in elderly cataract patients during the perioperative period, improve self-efficacy, and stabilize intraoperative physiological status through "hierarchical psychological intervention, perioperative environment optimization, and intraoperative personalized cooperation". It provides an operable practical plan for the perioperative nursing of elderly cataract surgery patients, and is worthy of promotion and application in ophthalmology departments of secondary and above hospitals.

Funding

Hospital Quality Management Research Fund Project of China Medical Quality Management Association (Project No.: YLZG202511)

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Application of Whole Slide Imaging Technology in Clinical Pathological Diagnosis

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Abstract: Whole Slide Imaging (WSI) technology, as a revolutionary digital technology in the field of pathology, is gradually changing the traditional clinical pathological diagnosis model. By converting traditional glass pathological sections into complete digital images through high-resolution scanning, it provides a new method for pathological diagnosis. Based on this, this paper studies the application of WSI technology in clinical pathological diagnosis, elaborates on its application value, analyzes the current application status, and proposes corresponding application countermeasures, aiming to provide reference for the standardized and popularized development of this technology in clinical pathological diagnosis.

Keywords: Whole slide imaging (WSI) technology; Clinical pathological diagnosis; Application value; Current status; Application countermeasures

Online publication: Feb 9, 2026

1. Introduction

With the rapid development of digital pathology, Whole Slide Imaging (WSI) technology has emerged. It converts traditional glass pathological sections into complete digital images through high-resolution scanning, opening a new chapter for pathological diagnosis work. This technology not only completely retains the original information of pathological sections but also breaks the time and space limitations of traditional optical microscopes with its digital, storable, and easily shareable characteristics [1]. Against the background of precision medicine and "Internet + Healthcare", WSI technology has shown enormous potential in improving the quality and efficiency of pathological diagnosis, optimizing the allocation of medical resources, and promoting medical education and scientific research. Therefore, this paper systematically sorts out the application value of WSI technology, objectively analyzes its current application status and existing bottlenecks, and discusses feasible application countermeasures accordingly, aiming to provide theoretical reference and practical ideas for promoting the deeper and wider application of this technology in clinical pathological diagnosis in China.

2. Application value of whole slide imaging technology in clinical pathological diagnosis

2.1. Conducive to improving diagnostic accuracy

Whole Slide Imaging technology achieves diagnostic upgrading through high-precision optical imaging systems, specific staining technologies, high-resolution digital conversion, and artificial intelligence-assisted diagnosis. The optical system ensures image clarity; technologies such as HE staining and immunohistochemistry make lesion areas easy to distinguish; digital imaging converts sections into efficiently processable digital signals; AI technology automatically identifies lesions through deep learning. Multiple links collaborate to lay the foundation for diagnostic accuracy [2]. In contrast, WSI technology can convert entire pathological sections into high-resolution digital images, allowing doctors to observe images comprehensively and multi-dimensionally on computer screens. Through image browsing software, doctors can easily zoom in, zoom out, and pan images without missing any subtle lesion features.

2.2. Conducive to conducting teleconsultation and academic exchange

In terms of teleconsultation, WSI technology plays an indispensable key role. By digitizing pathological sections and relying on high-speed and stable network transmission technology, these digital sections can be instantly transmitted to experts around the world. Experts can carefully observe and in-depth analyze digital sections anytime and anywhere through terminal devices such as computers and tablets, just like viewing pathological sections on-site [3]. The emergence of this teleconsultation model has greatly broken the time and space constraints of traditional consultation methods, providing patients with more convenient and efficient medical services. For example, when a hospital in a remote area encounters difficulties in diagnosing rare lymphoma, it can digitize and upload sections to a teleconsultation platform through this technology, and link with experts in big cities to complete accurate diagnosis and treatment plan formulation within hours. This effectively breaks the regional barriers of medical resources and improves the fairness and accessibility of medical services.

2.3. Conducive to promoting teaching and scientific research

In medical education, WSI technology has created a digital learning database, breaking the form of relying on a few physical specimens. Students can freely view digital samples of common and rare cases using computer equipment, and use tools such as zooming and annotation to independently explore the nature of abnormalities, so as to enhance their ability to observe and solve problems [4]. From a scientific perspective, such a large number of digital samples can provide basic data for cancer research. For example, scientists can further explore the morphology, growth rate of cancer cells and their relationship with surrounding tissues by viewing digital samples, which can be used as a reference for early diagnosis and precise treatment of cancer; in drug development research, images of the experimental group and control group in clinical trials can be compared to better understand the effects of drugs on biological cells and possible adverse consequences, accelerating the research and development process of new drugs and improving the success rate.

3. Current application status of whole slide imaging technology in clinical pathological diagnosis

3.1. Limited application scope

At present, the application scope of WSI technology in clinical pathological diagnosis is still relatively

limited. Although the technology has been recognized to a certain extent in the pathological community, its main application scenarios are concentrated in the diagnosis and analysis of a small number of difficult cases and typical teaching cases, and it has not been widely integrated into every link of daily pathological diagnosis work [5]. At the technical specification level, there is a lack of unified industry standards. There are differences in image acquisition parameters, storage formats, transmission protocols, etc. The performance of equipment from different manufacturers varies, and the quality and compatibility of digital sections are difficult to guarantee, which hinders the wide application of the technology.

3.2. Technical and equipment issues

Slow scanning speed is a prominent problem. Scanning a single section in high-resolution mode takes 10–30 minutes, which is difficult to meet the needs of processing a large number of sections in pathological laboratories and affects the timeliness of diagnosis. Image quality is affected by sample preparation and equipment performance. Uneven section thickness, poor staining, or defects in the optical system can easily lead to blurred digital sections, artifacts, and other problems, reducing diagnostic value. Data storage and transmission face challenges. A single high-resolution digital section can reach tens of GB to hundreds of GB, requiring large-capacity storage equipment. Moreover, network bandwidth limitations lead to slow transmission, increasing management costs and complexity [6]. When existing computer hardware and software process large-scale pathological image data, there are problems such as slow operation speed and limited analysis functions, which are difficult to meet the clinical requirements for real-time and accurate data processing.

3.3. Doctors' habits and acceptance

Doctors' reliance on microscope diagnosis stems from the intuitive operational experience accumulated during long careers. Operations such as fine-tuning the focal length and moving sections can quickly focus on regions of interest. This traditional model has been integrated into their work thinking and skill system. During technology promotion, doctors' acceptance is not high. On the one hand, they are worried that digital sections may affect image authenticity after conversion and processing, leading to the omission of pathological information; on the other hand, some doctors have weak computer foundations and face difficulties in learning new operational skills, reducing their willingness to accept [7]. It is necessary to change doctors' concepts through strengthened publicity and training, making them recognize the advantages and complementarity of digital sections; at the same time, carry out systematic training covering computer basics, software operations, etc., to help doctors master new technologies and improve their application confidence and capabilities.

4. Application countermeasures of whole slide imaging technology in clinical pathological diagnosis

4.1. Consolidate hardware and software foundations and build a stable and efficient digital platform

The application of technology is inseparable from a solid foundation. In the application of WSI technology, it is necessary to solve the problems of hardware setup and software construction to promote the effective application of the technology. First, select and configure scanning equipment. According to the workload of pathological examination in the hospital (such as the number of pathological sections per day), inspection types (such as

smears, biopsy sections, surgical frozen sections, etc.), and diagnostic accuracy requirements, select equipment supporting combinations with different speeds and analysis capabilities. For large-scale testing in big cities or routine disease inspection and diagnosis, high-throughput rapid scanning machines can be selected first; but at the same time, high-quality scanning instruments can be prepared for the processing of difficult cases and scientific research; for hospitals in small cities, start with a medium-speed scanning machine and gradually expand. The key is to ensure that the resolution of scanned images meets the diagnostic accuracy requirements, avoiding the risk of misdiagnosis due to poor scanned image quality. Second, upgrade storage and network systems. Given that each individual WSI image file is very large (several GB or even dozens of GB), how to efficiently store, manage, and quickly access massive information is crucial [8]. Solutions include: building an efficient and scalable data server and Storage Area Network (SAN) system; implementing hierarchical storage, placing images requiring current diagnosis on high-speed storage media, and transferring previous data to relatively cheap low-speed storage media. In addition, it is necessary to improve the hospital's internal network speed to ensure that pathologists do not experience delays or pauses when browsing digital sections on computers, with an experience close to observing with a microscope [9]. Third, integration and interoperability of software systems. Digital sections should not be information islands. The WSI information system should be automatically integrated into the hospital's Hospital Information System (HIS), Laboratory Information System (LIS) of the inspection system, and Pathology Information System (PIS) database. The software should have a user-friendly operation interface, a large number of image analysis functions (such as calculating length, area, cell count, etc.), and support standard formats (such as DICOM) and databases, laying the foundation for future data research and the application of artificial intelligence [10].

4.2. Optimize diagnostic workflow to achieve a balance between efficiency and safety

The introduction of WSI technology is not simply replacing microscopes with computer screens, but requires optimizing and adjusting the entire pathological diagnosis workflow. First, reset the diagnosis and review processes. Strategies such as "digital first, then work" and "using both digital and microscope" can be implemented. For general pathological examinations, junior doctors can immediately make judgments on digital sections, and senior doctors can verify and confirm them online to improve review efficiency. For complex problems, digital sections can be fully used to gather many experts for centralized or decentralized remote discussions to pool ideas. Second, strengthen quality control links. Before section scanning, a strict quality control position should be set up to inspect the quality of prepared glass sections (such as depth, thickness, presence of folds, presence of stains, etc.), and only qualified sections can participate in the scanning process. After scanning, special personnel should check the digital photos to see if they are fully covered and free of blurriness. These two quality control steps are the first pass to ensure the accuracy of digital diagnosis [11].

4.3. Carry out relevant technical training to improve doctors' operational capabilities

Training doctors on WSI technology is an important measure to promote the wide application of the technology. Medical institutions should attach importance to technical training, introduce WSI technology training into the continuing education and training system for doctors, and formulate comprehensive and systematic training plans. The training should include two stages: theoretical knowledge teaching and practical operation, to ensure a comprehensive overall understanding of this new technology, familiarity with its methods, means, and principles [12]. Theoretical training should explain its scientific mechanism, advantages, applicable scenarios, and advantages compared with conventional methods, aiming to help doctors clearly understand the application

value and eliminate doubts; in the practical operation stage, there should be independent venues and equipment, and professional technical personnel should personally guide the operation. Through the application of specific cases, doctors can familiarize themselves with scanning, processing, analysis, and other steps. Practical operation is the most important stage. Medical institutions should independently set up a training venue and equipment to ensure that doctors have sufficient experience opportunities. Technical personnel composed of experts provide real-time guidance and training to assist doctors in mastering the use and skills of image acquisition equipment and image optimization software. Doctors can personally experience the shooting, image processing, recognition, interpretation, and other skills in practical applications, thereby improving their ability to conduct pathological evaluation on the digital platform. A series of practice cases can be designed to help doctors gradually accumulate application experience and proficiently master the skills of using the new technology [13].

4.4. Expand diversified application scenarios and release the great potential of digital pathology

The value of WSI technology is far more than simulating microscopes, and its extended applications should be actively expanded. First, develop telepathology and consultation. Establish regional pathological diagnosis centers to provide real-time remote diagnosis services for medical cooperation member units through the Internet, narrowing the regional differences in medical quality. Second, promote teaching and scientific research innovation. In terms of teaching, a standard digital section teaching resource library can be established to allow students to learn anytime and anywhere. In the field of scientific research, a large amount of WSI data is a valuable resource, which can be used for quantitative research on disease morphology, mining of disease prognostic indicators, and providing huge data support for the development and training of artificial intelligence algorithms [14]. Third, introduce artificial intelligence-assisted diagnosis. AI can automatically identify tumor locations in digital images, perform pathological classification (such as Gleason scoring), calculate the number of favorable cells, etc., becoming a "partner" of physicians, improving diagnostic consistency and efficiency, and reducing physicians' repetitive labor. Pathology departments should adopt an open attitude to evaluate and verify the effectiveness of AI tools for clinical applications together with AI development teams [15].

5. Conclusion

In summary, Whole Slide Imaging technology has brought innovations to clinical pathological diagnosis, playing a key role in improving diagnostic accuracy, assisting teleconsultation and academic exchange, and promoting teaching and scientific research. In practical work, further study should focus on consolidating infrastructure, optimizing work processes, conducting systematic training, expanding application scenarios, and establishing unified standards to ensure diagnostic reliability, so as to break through the bottlenecks of technology application and release its potential in the field of pathological diagnosis. With the deepening of technological research and development, this technology should be continuously optimized and popularized to further improve diagnostic efficiency and medical quality, promote the normalization of teleconferences, and assist the development of medical teaching and research.

Disclosure statement

The authors declare no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

The Impact of Combined Health Education and Dietary Guidance on the Speed of Postoperative Recovery in Patients with Gastrointestinal Polyps

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Abstract: This study aims to explore the impact of combined health education and dietary guidance on the speed of postoperative recovery in patients with gastrointestinal polyps. A specific number of patients who underwent gastrointestinal polyp resection were selected and randomly divided into a control group and an experimental group. The control group received routine nursing, while the experimental group implemented combined health education and dietary guidance on this basis. By comparing the recovery indicators of the two groups, it was found that the recovery speed of the experimental group was significantly faster than that of the control group, indicating that this combined intervention method can effectively promote patient recovery.

Keywords: Health education; Dietary guidance; Postoperative gastrointestinal polyps; Recovery speed

Online publication: Feb 3, 2026

1. Introduction

Gastrointestinal polyps are common lesions of the digestive system. The quality of postoperative recovery in patients after endoscopic resection is directly related to long-term prognosis and quality of life. Traditional nursing models mostly focus on symptom control and complication prevention, but often ignore the profound impact of patients' subjective initiative and lifestyle intervention on the recovery process. Health education can significantly improve patients' compliance with postoperative management plans through systematic knowledge transmission; individualized dietary guidance can accurately regulate nutrient intake and provide metabolic support for tissue repair. The synergistic effect of the two not only conforms to the modern medical model of "biological-psychological-social" but also is highly consistent with the concept of Enhanced Recovery After Surgery (ERAS). This study takes patients after gastrointestinal polyp resection as the research object, explores the quantitative impact of combined health education and dietary guidance on recovery speed, aiming to provide evidence-

based basis for optimizing perioperative management strategies, shortening hospital stay, and improving patient prognosis, making the research content more referential [1].

2. Materials and methods

2.1. General information

A total of 120 patients who underwent gastrointestinal polyp resection in our hospital from January 2024 to December 2024 were selected as the research objects.

2.1.1. Inclusion criteria

Diagnosed with gastrointestinal polyps by pathological examination and underwent surgical treatment; aged between 18–75 years old; conscious and able to communicate normally; the study has obtained the consent of patients and their families, and informed consent forms have been signed.

2.1.2. Exclusion criteria

Having other major diseases affecting the operation; Allergic to relevant drugs; Unable to cooperate with dietary standards; Undergoing multiple mutually exclusive surgeries [2].

2.1.3. Study design

Patients were divided into a control group and an experimental group according to different ages, with 60 patients in each group. Among them, the control group included 34 males and 16 females, with an age range of (45.2 ± 10.5) years and a polyp diameter of (5.8 ± 2.1) mm; the experimental group included 30 males and 30 females, with an age range of (44.8 ± 11.2) years and a polyp diameter of (5.5 ± 2.3) mm. The control group and the experimental group were compared in the above dimensions to comprehensively understand and better grasp the research situation [3].

2.2. Research methods

2.2.1. Control group

Received routine care, including monitoring patients' recovery and wound conditions after surgery, administering drug treatment as prescribed by doctors, and guiding patients to rest and exercise reasonably [4].

2.2.2. Experimental group

In addition to the routine care of the control group, combined health education and dietary guidance were implemented.

(1) Health education

Admission education: Nurses should introduce the hospital environment, attending doctors, and managing nurses to patients admitted to the hospital, so that patients can better integrate into the hospital and adapt to the hospital environment as soon as possible. Disease knowledge education: Through distributing publicity brochures, holding health lectures, and one-on-one explanations, patients and their families are detailly informed about the causes of gastrointestinal polyps, treatment methods, preoperative diet, postoperative management methods, and relevant prevention and treatment measures, so that patients and their families

can have a deeper understanding of gastrointestinal polyps. Postoperative rehabilitation education: Explain to patients the importance of postoperative rehabilitation and precautions, such as precautions for postoperative activities. Focus on rest within 1–2 days after surgery, avoid prolonged walking, straining during defecation, and lifting heavy objects, and avoid strenuous exercise within a week. At the same time, inform patients to promptly inform medical staff if abnormal conditions such as abdominal pain, bloating, and hematochezia occur [5]. Psychological education: Patients after gastrointestinal polyp surgery often have varying degrees of anxiety, fear, and other psychological problems, that is, worrying about their future conditions [6]. Hospital staff should communicate with patients and their families according to different situations of patients. This can not only reduce patients' tension but also enable patients' families to better comfort patients' anxiety, thereby better ensuring the conditions before, during, and after surgery. Patients are more willing to receive physical and psychological treatment, so as to overcome the disease with a positive attitude [7].

(2) Dietary guidance

Early postoperative period (1–3 days after surgery): Patients' gastrointestinal function has not yet fully recovered. At this time, fasting or warm liquid food such as rice soup, vegetable soup, and fruit juice should be given. Avoid gas-producing foods such as milk and soybean milk to prevent bloating. Do not eat too much at one time; follow the principle of small and frequent meals, with 5–6 meals a day [8]. Mid-postoperative period (4–7 days after surgery): With the gradual recovery of gastrointestinal function, patients can gradually transition to semi-liquid food such as porridge, noodles, and wontons. The food should be light, easy to digest, and rich in protein and vitamins, such as lean meat porridge, egg custard, and vegetable puree. At the same time, pay attention to the appropriate temperature of food to avoid cold or overheated food stimulating the gastrointestinal tract. Late postoperative period (more than 1 week after surgery): Patients' gastrointestinal function has basically recovered to normal, and they can gradually resume a normal diet. However, they should also eat according to the proportion of protein and vegetables provided by doctors to better promote the gastrointestinal tract to develop in a healthy direction. Spicy, greasy, and irritating foods should not be eaten, and smoking and drinking should be quit to reduce stimulation to the gastrointestinal tract [9].

2.3. Observation indicators

2.3.1. Recovery speed indicators

(1) First defecation time

Record the time of the first defecation of patients in both groups after surgery, in hours.

(2) Hospital stays

The time from patients' admission for surgical treatment to discharge, in days.

(3) Complication occurrence

Observe and record the conditions of the control group and the experimental group, such as physical conditions, bleeding, abdominal pain, bloating, etc., and calculate the complication rate.

2.3.2. Patient satisfaction

The hospital can use questionnaires to investigate patients' satisfaction with doctors' services, health education, postoperative education, psychological education, etc., with a full score of 100 points. According to the satisfaction

level, it is divided into four grades: Very satisfied (above 95 points), Satisfied (85–94 points), Average (60–84 points), and Dissatisfied (below 60 points). Final satisfaction rate = (number of very satisfied patients + number of satisfied patients) / total number of patients × 100%.

2.4. Statistical methods

SPSS 25.0 statistical software was used for data analysis. Measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$), and independent sample *t*-test was used for inter-group comparison; count data were expressed as rate (%), and χ^2 test was used for inter-group comparison. $p < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of recovery speed indicators between the two groups

The first defecation time of patients in the experimental group was shorter than that in the control group, and the hospital stay was also less than that in the control group, with statistically significant differences ($p < 0.05$).

Specific data are as follows: The first defecation time of the experimental group was (32.8 ± 5.6) h, and that of the control group was (45.2 ± 6.3) h; the hospital stay of the experimental group was (4.2 ± 1.2) d, and that of the control group was (6.8 ± 1.5) d [10].

3.2. Comparison of complication occurrence between the two groups

The complication rate of the experimental group was 8.33% (5/60), and that of the control group was 23.33% (14/60). The complication rate of the experimental group was significantly lower than that of the control group, with a statistically significant difference ($p < 0.05$). Among them, there was 1 case of fever, 1 case of bleeding, 2 cases of abdominal pain, and 1 case of bloating in the experimental group; 4 cases of fever, 3 cases of bleeding, 4 cases of abdominal pain, and 3 cases of bloating in the control group [11].

3.3. Comparison of patient satisfaction between the two groups

The patient satisfaction rate of the experimental group was 91.67% (55/60), and that of the control group was 73.33% (44/60). The patient satisfaction rate of the experimental group was significantly higher than that of the control group, with a statistically significant difference ($p < 0.05$). In the experimental group, 32 cases were very satisfied, 23 cases were satisfied, 3 cases were average, and 2 cases were dissatisfied; in the control group, 14 cases were very satisfied, 30 cases were satisfied, 11 cases were average, and 5 cases were dissatisfied [12].

3.4. Comparison of recovery effects in patients with different polyp diameters

Patients in both groups were divided into three groups according to polyp diameter: ≤ 3 mm, 4–7 mm, and > 8 mm. The recovery speed indicators of the experimental group and the control group within each diameter group were compared respectively. The results showed that in each diameter group, the recovery status of the experimental group was faster than that of the control group, with statistically significant differences ($p < 0.05$). Specific data are as follows:

(1) ≤ 3 mm group

The first defecation time of the experimental group was (30.5 ± 5.2) h, and that of the control group was (42.8 ± 5.9) h; the hospital stay of the experimental group was (4.8 ± 1.0) d, and that of the control group

was (7.2 ± 1.3) d.

(2) 4–7 mm group

The first defecation time of the experimental group was (34.2 ± 6.0) h, and that of the control group was (46.5 ± 6.7) h; the hospital stay of the experimental group was (5.4 ± 1.3) d, and that of the control group was (8.0 ± 1.6) d.

(3) 8 mm group

The first defecation time of the experimental group was (35.6 ± 6.4) h, and that of the control group was (48.2 ± 7.1) h; the hospital stay of the experimental group was (5.8 ± 1.5) d, and that of the control group was (8.5 ± 1.8) d.

This indicates that combined health education and dietary guidance can promote the recovery of patients after gastrointestinal polyp surgery with different polyp diameters.

4. Discussion

4.1. The impact of health education on the postoperative recovery of patients with gastrointestinal polyps

Through comprehensive and systematic health education, patients can deeply understand the relevant knowledge of gastrointestinal polyps, including the etiology, treatment methods, and postoperative precautions, thereby improving their understanding of the disease and self-management ability [13]. In terms of disease knowledge education, patients learn that the formation of gastrointestinal polyps is related to poor work and rest habits, and they need to adjust their lifestyle after surgery to prevent disease recurrence [14]. This in-depth understanding of the disease helps patients better cooperate with doctors and nurses, thereby comprehensively improving the speed of recovery.

4.2. The impact of dietary guidance on the postoperative recovery of patients with gastrointestinal polyps

Patients' gastrointestinal function varies in different stages after surgery. For example, in the early postoperative period, patients should eat liquid food to reduce intestinal burden and facilitate intestinal recovery; in the mid-postoperative period, they can eat semi-liquid food to promote wound healing faster; in the late postoperative period, they can eat with nutritional matching, which not only ensures a certain nutritional intake for patients but also enables patients to recover health faster [15].

5. Conclusion

Health education and dietary guidance, as the "dual engines" for postoperative recovery of gastrointestinal polyps, their synergistic effect significantly accelerates the patient's recovery process. Through systematic health education, patients can clearly grasp postoperative taboos, early warning signals of complications, and the importance of follow-up visits, such as avoiding strenuous exercise too early and promptly identifying abnormal symptoms such as hematochezia; scientific dietary guidance, through a stepwise transition plan, from liquid food to semi-liquid food and then to soft food, combined with individualized nutritional supplements, effectively reduces gastrointestinal burden, promotes wound healing, better helps patients recover to a healthy level, and

makes patients healthy individuals.

Disclosure statement

The author declares no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Research Progress on the Early Prevention and Control of Myopia in Children Using Mongolian Medical Moxibustion Therapy

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Abstract: Mongolian medicine posits that disruptions to the natural balance of the three roots and seven elements within the human body may lead to ocular disorders, vision impairment, and ultimately myopia. China's children and adolescents not only exhibit high myopia rates but also face increasingly prominent issues of younger onset and severe progression, which critically impact the nation's future and require urgent attention. Myopia prevention constitutes a systematic project. Traditional Mongolian moxibustion therapy works by applying heat stimulation to specific acupoints to warm meridians, harmonize Qi-blood circulation, regulate elemental balance, thereby enhancing immunity for disease prevention. This holistic approach features non-invasive application with minimal side effects. However, current interventions in myopia management through this method still face challenges including inconsistent operational protocols and insufficiently systematic collaborative research. This paper reviews recent advancements in early intervention using Mongolian moxibustion therapy for myopia, providing insights to optimize myopia prevention strategies.

Keywords: Mongolian medical moxibustion therapy; Childhood myopia; Collaborative application

Online publication: Feb 9, 2026

1. Introduction

Childhood myopia has become a global public health issue [1]. According to the latest data from the World Health Organization, the prevalence of myopia among adolescents in China ranks first worldwide, showing a trend of occurring at younger ages and becoming more severe [2]. The existing intervention methods primarily include optical correction, pharmacological control, and behavioral interventions. However, these methods have limitations such as poor compliance and unstable long-term effects, making them unsatisfactory for controlling

the progression of myopia [3]. Mongolian medical moxibustion therapy offers benefits such as regulating bodily constitution, strengthening the body, enhancing resistance, alleviating pain, reducing swelling, promoting gastric fire, and clarifying the mind. It also boasts advantages of safety, cost-effectiveness, proven efficacy, and the absence of side effects [4]. From the perspective of Mongolian medicine, myopia, characterized by blurred vision and decreased visual acuity, is classified as "Murun" (dim vision) and "Nengxiao syndrome." Its etiology is closely linked to the stagnation of "Heyi" (Qi), the excessive activity of "Xila" (fire), and the stagnation of "Badagan" (cold). The warm stimulation of moxibustion therapy on fixed parts or acupoints of the human body can adjust the balance of the three energies (Heyi, Xila, and Badagan), restore the regulatory function of the ocular muscles, and its mechanism of action involves improving microcirculation around the eyes, relieving spasms of the ciliary muscles, and enhancing optic nerve nutrition at several levels. Studies by Deng Haiping [5,6] and others have demonstrated that moxibustion has significant efficacy in slowing down the progression of myopia and enhancing accommodative sensitivity. The following discussion will focus on the prevention and control of myopia from the perspectives of Mongolian and Western medicine.

2. Mongolian medicine's understanding of myopia

2.1. Myopia and Mongolian medical theory

According to Mongolian medical theory, when the normal balance of the "three roots and seven elements" within the human body is disrupted for some reason, it may lead to ocular lesions and impaired vision, ultimately resulting in myopia [7]. As recorded in "Fundamentals of Mongolian Medicine," after conception and fetal formation, three fundamental channels branch out from the fetal umbilical cord. These include the positive channel associated with the fire element, which circulates blood; the negative channel associated with the water element; and the central channel, which combines both Yin and Yang and circulates the vital energy [8]. The positive channel ascends along the right side of the body's midline from the embryonic umbilical cord, generating the liver, transporting nutrient-rich channels, and the vital channel, extending to the top of the head and down to the fetal genital area. All embryonic blood channels originate and branch from the positive channel, which nourishes the "Hila" (a vital essence in Mongolian medicine). The hila rely on the positive channel for its sustenance and is located in the middle of the fetus, providing thermal energy and facilitating the biochemical processes of the seven elements. From the perspective of the Five Elements theory, the fire element generates the fetal body temperature, skin color, and eyes, thereby giving rise to vision [9]. The liver is considered the "exalted organ of body temperature dominated by the fire element's essence." It is located in the general area of the hila and serves as the pathway for pathological Hila to travel (affecting the gallbladder, eyes, blood, and sweat). The eyes are the "external orifices" of the liver, and the liver and eyes are physiologically interconnected. The essence substances of the liver can ascend to the eyes, thereby maintaining their visual function and other vital functions. The pathogenic factors of myopia can generally be categorized into internal conditions and external pathogenic factors. In the normal state of the human body, the "three humors and seven elements" are not isolated but closely connected, mutually dependent, promoting, influencing, and complementary to each other, jointly maintaining the normal physiological functions of the human body and keeping a relative balance of unity of opposites [10]. Exogenous pathogenic factors mainly involve the "four pathogenic factors," including dietary habits, daily behaviors, climate changes, and other factors (sudden factors) [11]. Myopia is closely related to diet. Dietary habits not only trigger myopia but may also accelerate its deterioration. For example, acidic foods such as rotten meat, onions, garlic, and alcohol

can cause an excess of “Hi” (one of the humors in traditional Mongolian medicine) and affect the liver, leading to eye diseases. Smoke, exposure to wind and snow, and physical and mental fatigue can easily cause eye fatigue, potentially resulting in blurred vision or difficulty seeing clearly. Sudden changes in climate, causing the “three humors and seven elements” to lose their relative balance and enter a state of imbalance, can affect the liver and lead to eye diseases. Additionally, eye diseases can also be caused by trauma and systemic diseases.

2.2. Mongolian medicine moxibustion therapy

Mongolian medicine moxibustion therapy is based on the theoretical foundation of the “three humors and seven elements” theory. It holds that the human body’s physiological functions are primarily governed by the three humors of “Hüyin” (air), “Xila” (fire), and “Badagan” (cold), with the seven elements of “blood, flesh, fat, bone, marrow, essence, and red and white essential substances” forming the material basis. Moxibustion therapy applies warm stimulation to specific parts or acupoints on the human body, directly acting on the balance of the “three humors” (in Mongolian medicine, these are “Hiyi,” “Xila,” and “Badagan,” representing wind, bile, and phlegm, respectively). For individuals with excessive “Hiyi” (characterized by Qi stagnation and blood stasis), moxibustion warms and unblocks the meridians to promote the circulation of Qi and blood. For those with excessive “Xila” (marked by obvious heat symptoms), it harmonizes the fiery nature through moderate warmth. For individuals with the stagnant nature of “Badagan” (cold constitution), it disperses cold pathogens with heat, thereby restoring the dynamic balance of the three humors. Moxibustion therapy can be divided into two types: direct moxibustion and indirect moxibustion. Direct moxibustion is further categorized into scar-forming moxibustion and non-scar-forming moxibustion. Indirect moxibustion includes three types: ginger-partitioned moxibustion, garlic-partitioned moxibustion, and salt-partitioned moxibustion [10]. The theory of Qi and blood circulation further elucidates its mechanism, moxibustion therapy can stimulate meridian Qi activity, promoting the coordinated functioning of the “white channels” (neurovascular system) and “black channels” (circulatory system), thereby enhancing the nutritional supply to the tissues around the eyes. Studies have demonstrated that Mongolian moxibustion therapy possesses the effects of regulating functional disorders of Hiyi and Badagan, improving Qi and blood circulation, dispersing cold and relieving pain, as well as regulating the nervous, endocrine, and immune systems [11,12].

The warm stimulation of specific acupoints by Mongolian moxibustion therapy can adjust the balance of the three humors and restore the regulatory function of the ocular muscles. Its mechanism of action involves improving the microcirculation around the eyes, relieving ciliary muscle spasm, and enhancing neural nutrition at several levels. Thermal stimulation can significantly increase the skin temperature around the eyes, promote local blood flow, improve the nutritional supply to the ciliary muscle, and alleviate spasms caused by ischemia. Research indicates that medicinal moxibustion possesses various pharmacological activities, including anti-inflammatory, immunomodulatory, hormonal regulation, antioxidant, lipid-regulating, blood glucose-regulating, wound healing acceleration, and pain relief effects [13,14].

2.3. Synergistic effects of Mongolian moxibustion therapy with other treatments

The prevention and control of myopia through Mongolian moxibustion therapy emphasize overall regulation, balancing the three vital energies (Hii, Shira, and Badagan), warming and unblocking the meridians, harmonizing Qi and blood, and nourishing the liver and kidneys to improve vision.

The combination of the Mongolian medicinal decoction “Sanzitang” with external Mongolian moxibustion therapy for the prevention and control of myopia reflects the core principles of holistic concept and syndrome

differentiation and treatment in Mongolian medicine [15,16]. According to Mongolian medicine, myopia occurs when the balance of the three vital energies and seven elements within the body is disrupted, leading to ocular diseases. Since the eyes are considered the "external orifices" of the liver, the synergistic mechanism of nourishing liver and kidney pills combined with moxibustion is employed for liver-kidney deficiency type myopia (accompanied by developmental delays and frequent nocturnal urination). The "concurrent application of moxibustion and medication" method is used, with moxibustion applied to the Ganshu (BL18) and Shenshu (BL23) acupoints to warm and replenish kidney Yang, enhancing the regulatory capacity for axial length development [17].

The integration of Mongolian moxibustion therapy with modern optical approaches focuses on functional complementarity and safety synergy. The synergistic effect of moxibustion in relieving visual fatigue and orthokeratology lenses (OK lenses) is notable. OK lenses reshape the corneal morphology through nighttime wear, but they can easily cause accommodative spasms after lens removal during the day [18]. Moxibustion, applied to the Dinghui acupoint, regulates the Hii energy, balances the three vital energies, and has a calming and sedative effect.

Outdoor activities are significantly correlated with diopter and ocular axial length. Increasing the time spent on outdoor activities can effectively inhibit the onset and progression of myopia [19]. The "Ten Core Points of Knowledge on Preventing and Controlling Myopia among Children and Adolescents" issued by the National Health Commission emphasizes that daily outdoor activities during the daytime should last no less than 2 hours, or accumulate to 14 hours per week. However, there are variations in light intensity, duration, and spectrum across different seasons. Studies have demonstrated that outdoor activities and physical exercises (such as running, rope skipping, judo, etc.) can effectively delay the onset and progression of myopia [20]. Moxibustion therapy has the functions of regulating the dysfunction of Heyi and Badagan (in traditional Mongolian medicine theory), improving blood circulation, dispelling cold, and relieving pain, thus being more effective in preventing and controlling the development of myopia [21].

3. Western medicine's understanding of myopia

3.1. Overview of myopia

Myopia is a type of refractive error, which refers to the condition where, when the human eye is relaxed, parallel light rays, after passing through the refractive system of the eyeball, cannot focus on the retina but instead focus in front of it [22]. Based on refractive components, myopia is mainly classified into refractive myopia and axial myopia. Refractive myopia is further divided into three types: curvature myopia, refractive index myopia, and accommodative myopia [23]. Axial myopia is the most common type of myopia [24]. Children and adolescents are in a stage of growth and development, with their ocular physiological structures constantly changing. As the anterior-posterior axis of the eyeball gradually lengthens, the curvature of the cornea and lens tends to flatten, thereby weakening the refractive power of the eyeball [25]. The pattern of these changes is characterized by a reduction in hyperopia, with originally emmetropic eyes developing into myopia and already myopic eyes experiencing a further increase in their degree of myopia. In recent years, the incidence of myopia has continued to rise [26].

3.2. Prevention and treatment of myopia

Myopia is a significant public health issue affecting the physical and mental health of children, and its pathogenesis and prevention and control measures have been a research hotspot in the field of ophthalmology [27]. Studies have shown that the onset of myopia is the result of the combined effects of genetic and environmental factors [28].

Although the exact pathogenesis of myopia is not yet fully understood, the academic community generally believes that it is closely related to various mechanisms, including scleral remodeling, choroidal blood flow abnormalities, synthesis and metabolism of dopamine (DA), inflammatory responses, accommodation lag, and peripheral retinal defocus [29]. The core of myopia prevention and control is to delay abnormal growth of the ocular axis in children. Basic preventive measures for myopia include increasing outdoor activities, ensuring at least 2 hours of outdoor natural light exposure per day; adopting scientific eye-use habits, maintaining the "one-fist, one-foot, one-inch" reading and writing posture (a fist's distance from the chest, a foot's distance from the book, and an inch's distance from the fingertip to the pen tip); improving the eye-use environment, and undergoing regular vision checks [30]. Medical interventions mainly include pharmacological and optical interventions. Pharmacological intervention primarily involves the use of low-concentration atropine eye drops, which can effectively slow down the progression of myopia. Optical interventions include orthokeratology lenses and defocus-frame glasses, among others. The treatment of myopia mainly focuses on correcting vision and controlling its progression. Vision correction is achieved through frame glasses or contact lenses. Currently, the primary surgical methods for vision correction in clinical practice are laser corneal refractive surgery and phakic intraocular lens implantation, which are suitable for individuals aged 18 and above with stable refractive errors [31]. In recent years, the use of low-intensity single-wavelength red light therapy in the prevention and control of myopia in children has become a research focus.

4. Conclusion

Currently, myopia is one of the leading causes of visual impairment worldwide. To effectively prevent and control myopia, it is crucial to analyze and intervene in various risk factors during the pre-myopia stage, thereby preventing the onset of myopia and slowing down its progression. Mongolian medical moxibustion therapy offers unique advantages in the early prevention of myopia in children, providing multi-target regulation centered on acupoint around the eyes. It can regulate the functional disorders of Heyi and Badagan (two vital substances in Mongolian medicine), improve blood circulation, dispel cold and relieve pain, enhance ciliary muscle function, and alleviate visual fatigue. Studies have demonstrated that combining this therapy with Western medicine provides a safer and more effective prevention and control plan for early-stage myopia in children.

Disclosure statement

The authors declare no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

A Review of Evidence-Based Research on Rehabilitation Nursing after Joint Replacement Surgery

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Abstract: With the intensification of population aging, knee and hip joint replacement surgeries have become core methods for treating end-stage joint diseases, with over a million cases performed globally each year. Postoperative rehabilitation nursing, as a crucial aspect of enhancing surgical outcomes, reducing complications, and facilitating patients' return to normal life, has its scientific and effective protocols directly influencing patient prognosis. This article systematically reviews the core research findings on rehabilitation nursing after joint replacement surgery based on the concept of evidence-based medicine, aiming to provide references for the formulation of standardized and personalized rehabilitation nursing plans in clinical settings.

Keywords: Joint replacement surgery; Rehabilitation nursing; Evidence-based medicine; Functional recovery; Complication prevention

Online publication: Feb 9, 2026

1. Introduction

Joint replacement surgery involves implanting artificial joint prostheses to replace damaged joints, effectively relieving pain, improving joint function, and significantly enhancing patients' quality of life [1]. This surgical procedure falls under level 3–4 operations, demanding stringent sterile conditions in the operating room. The quality of postoperative rehabilitation directly determines the survival rate of the prostheses. Data shows that over 90% of patients experience pain relief one year after hip replacement surgery, while patients undergoing knee replacement surgery see an average increase in joint range of motion by 40–60° [2]. However, studies indicate that standardized rehabilitation care can reduce the incidence of postoperative deep vein thrombosis (DVT) and shorten the time required to achieve the desired range of joint motion [3]. In contrast, improper care may lead to serious complications such as prosthetic dislocation and infection, even necessitating a second surgery. Evidence-based medicine

emphasizes formulating medical plans "based on the best available evidence, combined with clinical experience and patient needs" and its application in postoperative rehabilitation care can effectively avoid the subjectivity and blindness of traditional care. This article focuses on these evidence-based findings, aiming to integrate core evidence from different aspects of care and provide a practical reference framework for clinical practice.

2. Evidence-based analysis of core rehabilitation care measures after joint replacement surgery

2.1. Early postoperative intervention

Early postoperative intervention serves as the foundation for preventing complications and promoting functional recovery. The core controversy once centered on the "timing of initiating activity", but existing evidence-based research has clarified the advantages of "early mobilization".

2.1.1. Early ambulation and weight-bearing training

A meta-analysis published in the British Journal of Orthopaedic Surgery in 2022 revealed that patients who ambulated within 24 to 48 hours after hip replacement surgery, compared to those who did so after 72 hours postoperatively, experienced the following benefits [2].

(1) A significantly lower incidence of deep vein thrombosis (DVT);
(2) An improvement in hip range of motion (flexion angle) by 15–20° one month after surgery;
(3) An increase in the score for activities of daily living (Barthel Index) by 8–10 points three months after surgery.

The study also emphasized that early ambulation should be tailored to individual patient circumstances. For elderly patients with comorbid cardiovascular diseases, a "progressive ambulation" protocol (gradually increasing intensity from sitting up at the bedside to standing and then walking short distances) should be adopted to avoid risks such as orthostatic hypotension. Further research by Guo Qiaoyan et al. confirmed that early weight-bearing training can significantly improve patients' hip function and range of motion [4].

2.1.2. Early rehabilitation with assistive devices

Evidence-based practice supports the early postoperative use of walking aids and continuous passive motion (CPM) machines. Research by Lin Lin et al. demonstrated that using multimodal analgesia combined with CPM within 24 hours after knee replacement surgery, along with ankle pump exercises and isometric quadriceps contractions, can effectively prevent restricted lower limb mobility, alleviate postoperative pain, promote knee function recovery, and shorten hospital stays for patients [5,6].

2.2. Functional exercise

Functional exercise is the cornerstone of postoperative rehabilitation, necessitating tailored plans based on the anatomical characteristics and movement requirements of different joints. Current evidence has clearly defined the applicable scenarios and effects of various exercise modalities [7].

2.2.1. Functional exercise after knee joint replacement

(1) Straight leg raise training

Conducting straight leg raise training daily after surgery can enhance quadriceps muscle strength. Studies have shown that the HSS score of the knee joint one month postoperatively is significantly higher than that of the control group, and the range of motion (ROM) at 3 days postoperatively, at discharge, and one month postoperatively are all greater than those in the control group [8,9].

(2) Wall-supported squat training

Two weeks after knee joint replacement, when patients can perform straight leg raises without significant pain, wall-supported squat training can be initiated. This exercise is a crucial method for improving knee joint stability and quadriceps muscle strength. During training, patients should have their backs against the wall, feet shoulder-width apart, and slowly squat down until the knee is flexed at 30–40°, ensuring that the knee does not extend beyond the toes. Hands should be placed naturally on the thighs, and the position should be held for 20 seconds before slowly standing up. Each set should consist of 10–15 repetitions, with 3 sets performed daily. As rehabilitation progresses, the flexion angle can be increased by 5–10° each week, gradually reaching up to 60°.

2.2.2. Functional exercise after hip joint replacement

(1) Hip abduction training

Approximately one week after hip replacement surgery, patients can begin hip abduction training, which is crucial for preventing prosthetic dislocation and strengthening the muscles around the hip. The training should be performed in a lateral decubitus position with a soft pillow placed between the legs. The operated leg should be slowly lifted outward until it forms a 30° angle with the body, held for 5 to 10 seconds, and then slowly lowered. Each set consists of 10 repetitions, with 3 sets performed daily.

(2) Gait training

One to two weeks after hip replacement surgery, patients can start gait training with the assistance of a walker, which is a core component in restoring normal walking function and reducing secondary injuries. The training should follow the standard gait pattern of "heel strike → full foot contact → toe-off". Initially, a walking frame should be used for support, with a stride length controlled between 30 to 40 cm. Training should be conducted three times a day, with each session lasting 10 to 15 minutes.

2.3. Pain management

Postoperative pain is a major obstacle affecting patient compliance with rehabilitation. Traditional single-drug analgesia has limited effectiveness, whereas evidence-based research indicates that "multimodal analgesia" offers superior benefits and can reduce the side effects of opioid medications.

2.3.1. Evidence-based selection of pharmacological analgesia

Clinically, a combination regimen of "non-steroidal anti-inflammatory drugs (NSAIDs, such as celecoxib) + opioid drugs (such as oxycodone)" is recommended. Compared to using opioid drugs alone, this regimen offers significant advantages [10]. It can effectively reduce patient pain within 24 hours post-surgery, while also decreasing the dosage of opioid drugs and lowering the incidence of side effects such as nausea and vomiting. For elderly patients or those with concurrent gastrointestinal diseases, it is recommended to combine proton pump inhibitors (such as omeprazole) to prevent NSAID-related gastrointestinal damage. Additionally, administering NSAIDs orally 2 hours before surgery for "preemptive analgesia" can reduce the peak postoperative pain level, creating

favorable conditions for early postoperative rehabilitation training.

2.3.2. Evidence-based application of non-pharmacological analgesia

(1) Cold therapy

Typically used within 72 hours after knee replacement surgery, a specialized cold pack is applied around the knee for 20–30 minutes each time, with intervals of 1–2 hours [11]. Cold therapy can lower the local temperature by 4–6 °C, constrict capillaries, reduce local bleeding and swelling, while also inhibiting pain signal transmission, alleviating postoperative pain, and shortening the duration of swelling resolution.

(2) Nerve block

Ultrasound-guided femoral nerve block or sciatic nerve block serves as a first-line measure for analgesia following knee replacement surgery. This technique involves injecting local anesthetic around the nerves to block the transmission of pain signals.

2.4. Psychological nursing

Patients undergoing joint replacement surgery often experience anxiety and depression due to fear of surgery and uncertainty about their prognosis. Evidence-based research indicates that early psychological intervention can improve emotional states and enhance rehabilitation compliance [12,13].

The recommended clinical intervention plan is a combination of "Cognitive Behavioral Therapy (CBT) + Family Support": Cognitive Behavioral Therapy involves communicating with patients to correct their negative perceptions of surgery and rehabilitation, and establishing correct rehabilitation expectations; Family Support involves encouraging family members to participate in the rehabilitation process to enhance the patient's psychological sense of security. Additionally, preoperative "informational support" is also of great significance. By explaining the surgical procedure, postoperative rehabilitation steps, and expected recovery time to patients, it can reduce their fear of the unknown regarding surgery and lower preoperative anxiety [14]. Psychological nursing should be integrated throughout the entire rehabilitation process, rather than being limited to short-term postoperative intervention [15].

2.5. Nutritional support

Postoperative nutritional status is closely related to wound healing and muscle recovery, with evidence-based research clearly demonstrating the promoting effect of a "high-protein, high-vitamin D" diet on rehabilitation.

2.5.1. Protein supplementation

Protein serves as a crucial raw material for tissue repair and muscle synthesis. Patients who have undergone joint replacement surgery require a daily protein intake of 1.5 to 2.0 grams per kilogram of body weight, which is significantly higher than that of a regular diet. Clinical studies have confirmed that supplementing protein according to this standard can shorten the postoperative wound healing time, reduce muscle mass loss, and lower the incidence of infections [16]. For elderly patients or those with poor digestion and absorption functions, a "fractional supplementation" strategy is recommended, which involves supplementing 20 to 30 grams of protein per meal to avoid overloading the gastrointestinal tract with a single large intake and to enhance protein absorption efficiency.

2.5.2. Vitamin D supplementation

Vitamin D promotes calcium absorption and bone metabolism, playing a vital role in periprosthetic osseointegration and preventing osteoporosis. Clinical data indicate that patients deficient in vitamin D have a significantly higher incidence of poor periprosthetic osseointegration after surgery compared to those with normal vitamin D levels [17]. Supplementing with 800–1000 IU of vitamin D daily after surgery can rapidly restore serum vitamin D levels to the normal range. Therefore, it is clinically recommended to screen patients for vitamin D levels before surgery and start supplementation 2–4 weeks in advance for those who are deficient. Postoperative supplementation should continue for 3–6 months to ensure optimal bone metabolism and provide long-term stability for the prosthesis.

3. Evidence-based key points for rehabilitation nursing after joint replacement in special populations

3.1. Elderly patients (≥ 70 years old)

Elderly patients often have underlying conditions such as hypertension, diabetes, and coronary heart disease, along with relatively poor muscle strength and balance. Postoperative rehabilitation for them should prioritize "safety and gradual progression", with the core objective of gradually restoring basic living abilities while avoiding complications. Clinical studies have indicated that elderly patients require full-time attendance during postoperative activities to prevent falls [18]. The intensity of functional exercises should be appropriately reduced, such as decreasing the number of straight legs raise exercises per set from 15 to 10 and extending the training interval to 1 hour to avoid excessive fatigue [19].

Patients with concurrent diabetes need strict blood glucose control, as the postoperative infection rate in the group with well-controlled blood glucose is significantly lower than that in the group with uncontrolled blood glucose. Blood glucose stability should be maintained through dietary regulation and medication. Additionally, elderly patients are prone to sleep disturbances after surgery, which can be improved by adjusting the ward environment and soaking feet in warm water before bedtime. Sufficient sleep can enhance tolerance to rehabilitation exercises and accelerate functional recovery.

3.2. Obese patients

Due to their greater body weight and heavy joint load, obese patients face challenges in postoperative rehabilitation, such as accelerated prosthesis wear and slow relief of knee joint pain. Evidence-based research supports a comprehensive approach of "weight loss combined with rehabilitation training". Clinical studies have shown that obese patients who undergo routine postoperative rehabilitation training and simultaneously achieve effective weight loss through "low-calorie diet + behavioral intervention" can enhance their knee joint weight-bearing capacity, reduce the prosthesis wear rate, and decrease the incidence of low back pain [20]. Dietary adjustments should be made under the guidance of a dietitian to ensure that, while calories are controlled, nutritional needs for proteins, vitamins, and other nutrients are met, preventing malnutrition from affecting wound healing.

3.3. Patients with comorbid neurological disorders

These patients often have motor dysfunction, and postoperative rehabilitation should incorporate

neurorehabilitation techniques to restore joint function while improving overall motor capacity. For joint replacement patients with comorbid stroke, a combined approach of "joint rehabilitation training + Bobath technique" has shown significant effectiveness. The Bobath technique aids in enhancing joint training outcomes and improving joint range of motion by inhibiting abnormal motor patterns and promoting the establishment of normal motor patterns. Additionally, it is essential to strengthen postural management, assisting patients to turn over every 2 hours and using air mattresses to prevent pressure ulcers [21]. For patients with swallowing dysfunction, a liquid or semi-liquid diet should be chosen to prevent aspiration and subsequent pulmonary infections, ensuring the safety of the rehabilitation process.

4. Conclusion

Evidence-based research on rehabilitation nursing after joint replacement surgery has clearly demonstrated that early mobilization within 24 to 48 hours postoperatively, targeted functional exercises, multimodal analgesia, high-protein nutritional support, and other measures can significantly improve patient prognosis. Moreover, personalized plans should be formulated based on the characteristics of special populations, such as the elderly and obese individuals. In clinical practice, healthcare professionals should develop scientific and standardized rehabilitation nursing plans based on evidence-based evidence, taking into account the individual circumstances of patients and clinical experience, ultimately aiming to "enhance surgical outcomes, reduce complications, and improve patients' quality of life".

Disclosure statement

The author declares no conflict of interest.

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Publisher's note

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

The Impact of Personalized Nutritional Support on Complications and Pregnancy Outcomes in Advanced Maternal Age Women with Gestational Diabetes Mellitus

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Abstract: *Objective*: To explore the clinical effect of personalized nutritional support in elderly women with gestational diabetes (GDM), and explore its impact on the incidence of maternal complications and pregnancy outcomes. *Methods*: A total of 90 elderly pregnant women with gestational diabetes who were delivered in our hospital from January 2023 to January 2024 were selected as the research objects. They were randomly divided into an observation group and a control group, with 45 cases in each group. The control group only received routine pregnancy care and basic nutrition guidance, while the observation group received personalized nutrition support on this basis. Compare the blood glucose control, incidence of pregnancy complications, pregnancy outcomes, and neonatal outcomes between two groups of parturient. Result: After intervention, the fasting blood glucose (FPG), 2-hour postprandial blood glucose (2hPG), and glycated hemoglobin (HbA1c) of the observation group were significantly lower than those of the control group, and the differences were statistically significant ($p < 0.05$); The incidence of complications such as gestational hypertension syndrome, polyhydramnios, premature rupture of membranes, and postpartum hemorrhage in the observation group was significantly lower than that in the control group, and the difference was statistically significant ($p < 0.05$); The cesarean section rate in the observation group was significantly lower than that in the control group, and the incidence of adverse neonatal outcomes such as fetal distress, macrosomia, neonatal asphyxia, and neonatal hypoglycemia in the observation group was significantly lower than that in the control group, with statistical significance ($p < 0.05$). *Conclusion:* Individualized nutritional support for elderly women with gestational diabetes can effectively improve the level of maternal blood sugar control, reduce the incidence of complications during pregnancy, and improve the outcome of pregnancy and neonatal outcomes, which is of high clinical value.

Keywords: Personalized nutritional support; Elderly parturient; Gestational diabetes; Complication; Pregnancy outcome; Newborn outcome

Online publication: Feb 9, 2026

1. Introduction

With the adjustment of China's birth policy and changes in social attitudes towards marriage and childbirth, the proportion of elderly mothers (aged ≥ 35) has been increasing year by year. Due to physiological characteristics such as ovarian function decline and body metabolic capacity decline, the incidence of complications during pregnancy is much higher than that of the right age women. Gestational diabetes Mellitus (GDM) is one of the more common types. Nutritional treatment is the basis of comprehensive treatment for gestational diabetes. Scientific nutritional support can control blood sugar and reduce complications. However, traditional basic nutrition guidance lacks specificity and cannot meet the nutritional needs of different individuals, resulting in unsatisfactory intervention effects. Personalized nutritional support is a specific nutritional plan determined based on individual differences such as age, weight, gestational age, blood sugar levels, dietary habits, and physical condition of patients, which is more targeted and effective. In this study, 90 elderly women with gestational diabetes were selected as the research object to observe the impact of personalized nutritional support on the complications and pregnancy outcomes of elderly women with gestational diabetes, providing reference for clinical intervention. The report is as follows [1].

2. Materials and methods

2.1. Clinical data

From January 2023 to January 2024, 90 elderly women with gestational diabetes who underwent prenatal examination and gave birth in our hospital were selected as the study subjects.

2.1.1. Inclusion criteria

(1) Age ≥ 35 years old

(2) Meet the diagnostic criteria of GDM in the Guidelines for the Diagnosis and Treatment of diabetes in Pregnancy (2023 Edition)

(3) Singleton pregnancy

(4) Gestational weeks between 24 and 28 weeks

(4) First diagnosis of GDM

(5) Informed consent of patients and their families and signing of informed consent

2.1.2. Exclusion criteria

(1) Diabetes (type 1 or type 2) was diagnosed before pregnancy;

(2) Combined with other serious underlying diseases such as hypertension, heart disease, kidney disease, liver disease, etc;

(3) Combined with other pregnancy complications such as abnormal thyroid function during pregnancy and intrahepatic cholestasis of pregnancy [2].

2.1.3. Study group

Using a random number table method, 90 patients were divided into an observation group and a control group, with 45 patients in each group. The patients in the observation group were aged 35–42 years, with an average age of 37.85 ± 2.13 years, gestational weeks of 24–28 weeks, and an average gestational week of 25.92 ± 1.05 weeks.

The control group patients were aged 35–43 years, with an average age of (38.02 ± 2.21) years; The gestational weeks are 24–28 weeks, with an average gestational week of (26.05 ± 1.12) weeks. There was no statistically significant difference ($p > 0.05$) in general clinical data such as age, gestational age, pre pregnancy BMI, and parity between the two groups of patients, indicating comparability. This study was conducted by the Medical Ethics Committee of our university [3].

2.2. Methods

Both groups receive routine prenatal care, including regular prenatal checkups, prenatal health education (knowledge about prenatal care and GDM diseases), moderate exercise guidance (30 minutes of walking per day, 3–5 yoga sessions per week for pregnant women), and blood glucose monitoring guidance (fasting and 2-hour blood glucose monitoring after three meals per day).

The control group received basic nutrition guidance on the basis of routine pregnancy care, and nursing staff distributed GDM nutrition diet promotion manuals to patients, briefly introducing dietary precautions such as controlling total calories, eating less high sugar and high-fat foods, and eating more dietary fiber, without developing personalized nutrition plans [4].

The observation group received personalized nutritional support on the basis of the control group. The specific measures are as follows:

(1) Establish a personalized nutritional support group, consisting of obstetricians, nutritionists, and responsible nurses, with clear responsibilities. Obstetricians are responsible for evaluating the patient's condition and pregnancy status, nutritionists are responsible for developing nutritional plans, and responsible nurses are responsible for implementing and following up.

(2) Comprehensive nutritional assessment: After the diagnosis of GDM, the nutrition team conducts a comprehensive nutritional assessment of the patient, inquiring in detail about the patient's dietary habits, dietary preferences, past medical history, allergy history, etc. The patient's physical indicators such as height, weight, and abdominal circumference are measured [5]. Combined with the patient's gestational age and blood glucose levels (fasting, 2-hour postprandial blood glucose, and HbA1c), the total daily calorie intake is calculated. The calculation standard for total calories varies depending on the patient's pre pregnancy BMI and gestational age. For those with normal pre pregnancy BMI (18.5–23.9 kg/m^2), 30 kcal/kg of calories are given daily in early pregnancy, 35 kcal/kg of calories are given daily in mid pregnancy, and 35–40 kcal/kg of calories are given daily in late pregnancy; For those who are overweight before pregnancy (24.0–27.9 kg/m^2), they should consume 25 kcal/kg of calories per day in early pregnancy, 30 kcal/kg of calories per day in mid pregnancy, and 30–35 kcal/kg of calories per day in late pregnancy; Individuals with pre pregnancy obesity (≥ 28.0 kg/m^2) should consume 20 kcal/kg of calories per day in early pregnancy, 25 kcal/kg of calories per day in mid pregnancy, and 25–30 kcal/kg of calories per day in late pregnancy.

(3) Develop personalized nutrition plans, arrange the proportion of the three major nutrients reasonably according to the nutritional evaluation results, with carbohydrates accounting for 50% to 60% of total calories, mainly composed of complex carbohydrates such as coarse grains, miscellaneous beans, and potatoes, and avoid the intake of refined sugars; Protein accounts for 15% to 20% of total calories. Choose high-quality proteins such as fish, poultry, eggs, lean meat, dairy products, soy products, etc; Fats account for 20% to 30% of total calories, mainly unsaturated fatty acids such as olive oil, nuts, and deep-

sea fish [6]. Reduce the intake of saturated and trans fatty acids. Ensure a dietary fiber intake of 25–30 g, eat more fresh vegetables and fruits (choose low GI fruits such as apples, pears, strawberries, etc., with a daily intake of 200–350 g). Reasonably arrange meals and adopt a "three meals three-time system", where breakfast accounts for 10% to 15% of total calories, lunch accounts for 25% to 30%, and dinner accounts for 20% to 25%. Additional meals are added at 10 am, 3 pm, and 8 pm each time, with each additional meal accounting for 5% to 10% of total calories, to prevent the occurrence of hypoglycemia.

(4) Implementation and adjustment of nutrition plan: The responsible nurse explains the specific content of the nutrition plan to the patient and their family, and guides the patient to correctly record the diet diary, including the types, quantities, and meal times of the food consumed daily. Nutritionists adjust their nutritional plans based on patients' weekly blood glucose monitoring results, dietary diaries, weight changes, and other factors [7].

2.3. Observation indicators

(1) Blood glucose control status

Venous blood samples were collected from two groups of patients before intervention (when diagnosed with GDM) and after intervention (one week before delivery). Fasting blood glucose (FPG) and 2-hour postprandial blood glucose (2hPG) were measured using a fully automated biochemical analyzer, and glycated hemoglobin (HbA1c) was detected using high-performance liquid chromatography.

(2) Incidence of complications during pregnancy

Record the occurrence of complications such as gestational hypertension syndrome (blood pressure ≥ 140/90 mmHg), polyhydramnios (vertical depth of the maximum dark zone of amniotic fluid ≥ 8 cm or amniotic fluid index ≥ 25 cm), premature rupture of membranes (natural rupture of membranes before delivery), and postpartum hemorrhage (24-hour postpartum hemorrhage ≥ 500 mL) in two groups of patients.

(3) Pregnancy outcome

Record the occurrence of delivery methods (cesarean section, natural delivery) and fetal distress (bradycardia or tachycardia with reduced fetal movement) in two groups of patients.

(4) Compare the birth weight, macrosomia (birth weight ≥ 4000 g), neonatal asphyxia (Apgar score < 7), and neonatal hypoglycemia (blood glucose < 2.2 mmol/L within 24 hours after birth) between two groups of newborns [8].

2.4. Statistical methods

Input the data of this group into SPSS21.0 software for processing and analysis. The quantitative data is represented by ($\bar{x} \pm s$) and *t*-test is used; Count data is expressed in % and chi square test is used. p is less than 0.05, which is statistically significant.

3. Results

3.1. Comparison of blood glucose control between two groups of patients before and after intervention

Before intervention, there was no statistically significant difference in FPG, 2hPG, and HbA1c levels between the

two groups of patients ($p > 0.05$); After intervention, the above blood glucose levels were significantly reduced in both groups of patients, and the observation group was significantly lower than the control group, with a statistically significant difference ($p < 0.05$) [9]. The specific statistical results are shown in **Table 1**.

Table 1. Comparison of blood glucose control before and after intervention between two groups of patients

Group	case	FPG (mmol/L) pre-intervention	FPG (mmol/L) post-intervention	2hPG (mmol/L) pre-intervention	2hPG (mmol/L) post-intervention	HbA1c (%) pre-intervention	HbA1c (%) post-intervention
Observation group	45	5.82 ± 0.63	4.82 ± 0.51	9.25 ± 1.02	6.31 ± 0.75	6.52 ± 0.48	5.61 ± 0.35
Control group	45	5.78 ± 0.65	5.76 ± 0.63	9.31 ± 1.05	7.85 ± 0.82	6.48 ± 0.51	6.23 ± 0.42
t	-	0.325	7.623	0.287	9.451	0.401	7.782
p	-	0.746	< 0.001	0.775	< 0.001	0.689	< 0.001

3.2. Comparison of the incidence of pregnancy complications between two groups of patients

The incidence of pregnancy complications in the observation group was 8.89%, significantly lower than the 28.89% in the control group, and the difference was statistically significant ($p < 0.05$). The specific results are shown in **Table 2**.

Table 2. Comparison of incidence of pregnancy complications between two groups of patients

Group	Case	Pregnancy induced hypertension syndrome	Polyhydramnios	Premature rupture of membranes	Postpartum hemorrhage	Total incidence rate (%)
Observation group	45	1 (2.22)	1 (2.22)	1 (2.22)	1 (2.22)	4 (8.89)
Control group	45	3 (6.67)	4 (8.89)	3 (6.67)	2 (4.44)	12 (28.89)
χ^2	-	-	-	-	-	6.400
p	-	-	-	-	-	0.011

3.3. Comparison of pregnancy outcomes between two groups of patients

The cesarean section rate in the observation group was 31.11%, significantly lower than the 55.56% in the control group; The incidence of fetal distress in the observation group was 4.44%, significantly lower than the 17.78% in the control group, and the differences were statistically significant ($p < 0.05$). The specific results are shown in **Table 3**.

Table 3. Comparison of pregnancy outcomes between two groups of patients

Group	Case	Cesarean section (n,%)	Natural childbirth (n,%)	Fetal distress (n,%)
Observation group	45	14 (31.11)	31 (68.89)	2 (4.44)
Control group	45	25 (55.56)	20 (44.44)	8 (17.78)
χ^2	-	5.934	-	4.050
p	-	0.015	-	0.044

3.4. Comparison of outcomes between two groups of newborns

The birth weight of newborns in the observation group was significantly lower than that in the control group. The incidence of macrosomia, neonatal asphyxia, and neonatal hypoglycemia was 6.67%, which was significantly lower than that of the control group (22.22%), and the differences were statistically significant ($p < 0.05$) [10]. The specific results are shown in **Table 4**.

Table 4. Comparison of neonatal outcomes between two groups

Group	Case	Birth weight ($\bar{x} \pm s$, g)	Giant (n,%)	Neonatal asphyxia (n,%)	Neonatal hypoglycemia (n,%)	Total incidence of adverse outcomes (%)
Observation group	45	3256.82 ± 312.54	1 (2.22)	1 (2.22)	1 (2.22)	3 (6.67)
Control group	45	3689.75 ± 356.82	4 (8.89)	3 (6.67)	3 (6.67)	10 (22.22)
t/χ^2	-	6.025	-	-	-	4.594
p	-	< 0.001	-	-	-	0.032

5. Discussion

Gestational diabetes is one of the common complications of pregnancy in elderly women. The occurrence of this disease is closely related to insulin resistance, insulin secretion deficiency and malnutrition. Due to the decline in physiological function and insulin sensitivity, as well as the antagonistic effect of hormones such as progesterone and estrogen secreted by the placenta during pregnancy on insulin, it becomes more difficult for elderly mothers to control their blood sugar [11]. If blood sugar remains at a high level for a long time, it can cause metabolic disorders in the mother, increase the risk of complications such as gestational hypertension syndrome and polyhydramnios, and also have adverse effects on fetal development through the placenta, leading to adverse consequences such as macrosomia and fetal distress. Therefore, it is necessary to strengthen the nutritional management of elderly pregnant women with GDM, improve blood sugar control levels, and ensure the safety of mother and baby. Traditional nutrition guidance mostly uses unified dietary recommendations, without considering individual differences of patients, and cannot meet the nutritional needs of different patients, resulting in poor blood sugar control effects. Personalized nutrition support takes "individualization" as its core, and through comprehensive evaluation of the patient's physical condition, blood sugar levels, dietary habits, and other factors, develops an exclusive nutrition plan that can more accurately control total calorie intake, allocate nutrient ratios appropriately, and effectively improve blood sugar control levels [12]. From the results of this study, it can be seen that the FPG, 2hPG, and HbA1c levels in the observation group were significantly lower than those in the control group after intervention ($p < 0.05$).

The occurrence of complications during pregnancy is closely related to the level of blood glucose control, and the higher the blood glucose level, the greater the risk of complications. Personalized nutritional support can effectively control blood sugar and reduce the occurrence of complications during pregnancy. The results of this study showed that the incidence of pregnancy complications in the observation group was significantly lower at 8.89% compared to the control group at 28.89% ($p < 0.05$) [13]. The incidence of gestational hypertension syndrome is significantly reduced, possibly due to personalized nutritional support controlling total calorie intake, reducing fat accumulation, and lowering vascular wall pressure. The control of blood sugar has a significant impact on both pregnancy and neonatal outcomes. Poor blood sugar control can keep the fetus in a high blood sugar environment

for a long time, stimulating the secretion of insulin and promoting fetal growth and development, leading to an increase in the incidence of macrosomia. However, macrosomia can also increase the risk of cesarean section and fetal distress. At the same time, newborns will be released from the high blood sugar environment of the mother after birth, and insulin secretion will still be at a high level, which is prone to neonatal hypoglycemia [14]. From the research results, it can be seen that the cesarean section rate, fetal distress rate, and incidence of adverse neonatal outcomes in the observation group were significantly lower than those in the control group ($p < 0.05$), and the birth weight of newborns was significantly lower than that in the control group ($p < 0.05$). Personalized nutrition support requires multidisciplinary teamwork to complete tasks such as nutritional assessment, development, implementation, and modification. Obstetricians, nutritionists, and responsible nurses each complete their own tasks [15].

6. Conclusion

To sum up, personalized nutritional support for elderly women with diabetes in pregnancy can improve their blood sugar control level, reduce the incidence of complications in pregnancy, reduce the cesarean section rate and the incidence of adverse neonatal outcomes, and improve pregnancy outcomes [16].

Disclosure statement

The author declares no conflict of interest.

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Progress in the Application of Digital Health Interventions in Oral Health Management

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Abstract: Objective: To systematically sort out the application forms and effects of digital health intervention technologies in oral health management, and provide references for the digital development of stomatology. Methods: By reviewing relevant domestic and foreign studies and clinical practices, this paper summarizes and analyzes the main application forms of digital health interventions, including digital health education, intelligent detection equipment, telemedicine platforms, oral health big data platforms, and school-hospital collaborative screening robots. *Results:* Studies have shown that digital health interventions can effectively improve the public's oral health knowledge level, optimize personal health behaviors, enhance clinical diagnosis efficiency, reduce overall medical costs, and promote the innovation and upgrading of oral health management models. *Conclusion:* Digital health intervention represents an inevitable trend in the future development of stomatology. In the future, it is still necessary to improve data security and privacy protection, technology adaptability and popularity, as well as relevant policies and norms, to give full play to its potential value.

Keywords: Digital health intervention; Oral health management; Application progress

Online publication: Feb 9, 2026

1. Introduction

Oral health is an important part of human health, directly affecting people's quality of life and overall sense of well-being. However, the incidence of oral diseases in China remains high, with common oral diseases such as periodontitis and dental caries exerting continuous pressure on public health. According to the Report on the Status of Oral Health in China released by the Chinese Stomatological Association in 2024, the prevalence of periodontitis among people aged 35–74 in China is as high as 68.7%, and about 72% of adults have poor dental plaque control. The traditional oral health management model mainly relies on regular clinical examinations and patients' subjective feelings, which often has limitations such as discontinuous data recording, lack of targeted interventions, and limited management efficiency. With the rapid development and cross-field integration of digital technologies, digital health intervention has provided new ideas and powerful technical tools for innovating oral health management, showing broad application prospects [1].

2. Overview of digital health interventions and oral health management

2.1. Digital health intervention

Digital health intervention mainly refers to the use of digital technology means such as big data, artificial intelligence, and the Internet of Things to continuously monitor, record, and evaluate an individual's oral health status, and provide personalized health management plans based on the evaluation results [2]. This process covers multiple links including oral health data collection, dynamic risk assessment, knowledge popularization and education, and rehabilitation follow-up guidance. Its core goal is to achieve early detection, early warning, and early intervention of oral diseases through modern and digital management methods, thereby enhancing the scientificity and forward-looking of oral health management. Applying digital health interventions to oral health management can leverage technological advantages to provide the public with more convenient, efficient, and personalized health services [3].

2.2. Importance of oral health management

As the starting point of the digestive system and the gateway to the respiratory tract, the oral cavity undertakes important physiological functions such as chewing, pronunciation, and facial maintenance. At the same time, numerous studies have confirmed that oral health is closely related to systemic diseases, for example, there is a two-way promoting relationship between periodontal disease and diabetes, cardiovascular diseases, respiratory infections, etc. Therefore, strengthening oral health management is not only necessary for maintaining the health of local organs but also an important part of preventing and controlling systemic diseases and improving the overall health level of individuals [4].

2.3. Limitations of traditional oral health management models

The traditional oral health management model, dominated by periodic outpatient examinations and patient self-reports, has limitations mainly reflected in the following aspects: first, the source of health data is single and discontinuous, making it difficult to form a complete personal health profile; second, health guidance tends to be generalized, making it difficult to meet the personalized needs of people of different ages and risk groups; finally, the management model is passive and inefficient, failing to adapt to people's demands for convenience and immediacy of health services in modern fast-paced life [5].

3. Application forms of digital health interventions in oral health management

3.1. Digital health education

Digital health education is an important form of digital health intervention. With the help of technologies such as artificial intelligence, virtual reality (VR), and augmented reality (AR), it transforms abstract and complex oral health knowledge into intuitive and vivid video content, thereby significantly enhancing the public's learning interest and understanding depth. For example, by building a digital oral health education center, 3D animation technology is used to simulate the formation process of dental caries or the development stages of periodontal disease, allowing the public to intuitively understand the principles of diseases. At the same time, VR/AR technology is used to create immersive interactive experiences, enabling users to "personally" experience the consequences of bad oral habits, effectively strengthening their health awareness. This educational method not only enriches popular science means but also reduces the cost of carrying out long-term health education [6].

3.2. Intelligent detection equipment

Intelligent detection equipment realizes real-time monitoring of daily oral health behaviors through integrated sensors and data transmission modules. For example, smart toothbrushes can record users' brushing time, coverage, intensity, and other data, generate visual reports through mobile phone apps, and provide personalized brushing improvement suggestions. In addition, some advanced oral detection equipment can quickly screen the temperature, pH value, and specific bacterial markers in the oral cavity, providing users with preliminary risk warnings and prompting them to seek professional diagnosis and treatment in a timely manner [7].

3.3. Telemedicine platforms

Telemedicine platforms break the time and space limitations of oral medical services using communication technology. Patients can upload oral photos, describe symptoms, and share past medical records through mobile applications or computer-based platforms, communicate online with doctors, and obtain preliminary diagnostic opinions and medical guidance. For example, the children's oral health management platform developed by Qingdao Stomatological Hospital integrates remote consultation functions, facilitating communication between parents and doctors, especially suitable for follow-up consultations and chronic disease management, effectively saving patients' time and economic costs [8].

3.4. Oral health big data platforms

Oral health big data platforms are committed to aggregating massive data from multiple sources such as clinical diagnosis and treatment, intelligent equipment, and public health surveys. By using big data analysis and machine learning algorithms, the platform can deeply tap data value, reveal disease prevalence rules, evaluate intervention effects, and predict individual disease risks, thereby providing strong data support for formulating precise public health strategies and personalized clinical treatment plans [9].

3.5. School-hospital collaborative screening robots

The introduction of screening robots equipped with artificial intelligence visual recognition technology into campuses is an innovative application of digital health interventions in group screening. Robots can automatically collect and analyze students' oral images, quickly identify common problems such as dental caries, dental plaque, and gingivitis, and generate screening reports. This method helps realize large-scale, standardized early screening among children and adolescents, achieving early detection and early intervention. At the same time, it liberates professional medical staff and improves public health efficiency [10].

4. Application effects of digital health interventions in oral health management

4.1. Improve the effect of oral health knowledge promotion

Digital health education methods, with their vividness and interactivity, have significantly improved the attractiveness and dissemination efficiency of health information. By visualizing and interesting complex knowledge, they effectively overcome the tediousness of traditional text-based promotion, enhance the understanding and memory of the public of different ages and educational backgrounds, and thus comprehensively improve the effect of oral health knowledge popularization [11–13].

4.2. Optimize oral health behaviors

The real-time feedback and personalized guidance provided by intelligent detection equipment create a continuous behavioral intervention mechanism. When users can intuitively see that their brushing effect is poor or certain oral indicators are abnormal, they are more motivated to adjust their behaviors. This immediate, visual positive or negative feedback helps urge users to develop good oral hygiene habits, realizing the transformation from "knowledge" to "action".

4.3. Enhance diagnosis efficiency

Telemedicine platforms optimize the allocation of medical resources, enabling expert resources to serve a wider population, reducing unnecessary offline outpatient visits, and improving service accessibility. At the same time, oral health big data platforms can assist doctors in diagnostic decision-making. By retrieving and analyzing patients' panoramic data, they shorten diagnosis time and improve the accuracy and consistency of diagnosis.

4.4. Reduce medical costs

Digital health interventions fundamentally reduce medical expenditures through "front-end prevention" and "early intervention". For example, the application of campus screening robots can detect and address simple oral problems as early as possible, preventing them from developing into complex severe diseases and saving high treatment costs in the later stage. For individuals and society, this proactive health management method can reduce the loss of work and study time caused by oral diseases, generating significant economic benefits [14].

4.5. Promote the innovation of oral health management models

Digital health interventions are driving the transformation of oral health management from "treatment-centered" to "health-centered". They make continuous, dynamic health monitoring possible, and the management method becomes more precise and personalized. For example, a municipal stomatological hospital has innovated a regional oral health management model by building a three-level oral disease prevention and control network and using digital tools to achieve data intercommunication and linkage between communities and hospitals [15].

5. Conclusion

In summary, digital health intervention technologies have brought revolutionary changes to oral health management, injecting new connotations of precision, personalization, and efficiency. However, their widespread application still faces a series of challenges: first, the security of health data and the protection of personal privacy are top priorities, requiring strong laws, regulations, and technical means as guarantees; second, attention must be paid to the universality of digital technologies, striving to address the "digital divide" faced by people of different ages and regions; finally, the charging standards, effect evaluation systems of digital medical products, and their connection with existing medical insurance payment policies still need to be further clarified and improved. Looking forward, efforts should be made to build a collaborative innovation ecosystem covering technology R&D, clinical verification, policy support, and market application, promoting the in-depth integration and standardized development of digital health interventions in the field of stomatology, and ultimately providing core driving force for achieving the grand goal of "national oral health".

Disclosure statement

The author declares no conflict of interest.

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Research on the Application of Digital Intraoral Scanning Impression Technique in Oral Implant Restoration for Periodontitis Patients and Its Impact on VAS Scores

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Abstract: *Objective*: To explore the application effect of digital intraoral scanning impression technique in oral implant restoration for periodontitis patients and analyze its impact on patients' Visual Analogue Scale (VAS) scores. *Methods*: A total of 80 periodontitis patients who received implant restoration in our hospital from May 2023 to May 2025 were selected as research subjects. They were randomly divided into an observation group and a control group using a random number table method, with 40 cases in each group. The observation group used the digital intraoral scanning impression technique to obtain impressions, while the control group used the traditional silicone rubber impression technique. The impression-taking time, the number of prostheses try-ins, implant survival rate, periodontal health indicators (probing depth, gingival index, bleeding index), and VAS scores (pain during treatment and comfort after restoration) were compared between the two groups. *Results:* The observation group was superior to the control group in terms of impression-taking time, the number of prostheses try-ins, and implant survival rate ($p < 0.05$). Six months after restoration, the improvement in periodontal health indicators in the observation group was significantly better than that in the control group ($p < 0.05$). In addition, the pain VAS score of the observation group during treatment was lower than that of the control group, and the comfort VAS score after restoration was higher than that of the control group ($p < 0.05$). *Conclusion:* Digital intraoral scanning impression technology can effectively enhance the efficiency and success rate of implant restoration in periodontitis patients, improve periodontal health, alleviate patients' discomfort during treatment, and increase post-restoration comfort, demonstrating high clinical application value.

Keywords: Digital intraoral scanning impression technology; Periodontitis; Oral implant restoration; Visual analog scale; Implant survival rate

Online publication: Feb 10, 2026

1. Introduction

Periodontitis is a common chronic oral inflammatory condition that can lead to tooth loss. Oral implant restoration

is the primary treatment method, and impression taking directly influences the restoration outcome [1].

The traditional silicone rubber impression process is cumbersome, and its accuracy is easily affected by the oral environment, increasing the number of restorations try-ins [2]. In recent years, digital technology has been increasingly applied in the field of dentistry, and digital intraoral scanning impression technology has gradually garnered attention due to its advantages of being model-free, highly precise, and efficient [3–5]. This study took 80 periodontitis patients who underwent implant restoration in our hospital from May 2023 to May 2025 as the research subjects. It comparatively analyzed the application effects of digital intraoral scanning impression technology and traditional silicone rubber impression technology and explored their impacts on patients' VAS scores, providing a reference basis for clinical treatment.

2. Materials and methods

2.1. General information

Eighty patients with periodontitis undergoing dental implant restoration in our hospital from May 2023 to May 2025 were selected as the study subjects. They were randomly divided into an observation group and a control group, with 40 cases in each group, according to the random number table method.

2.1.1. Inclusion criteria

(1) All patients met the relevant diagnostic criteria in Periodontology [6]
(2) All had single-tooth loss with good bone conditions
(3) They were able to actively cooperate with the doctors to complete this clinical trial and undergo long-term follow-up examinations
(4) They had no absolute or relative contraindications related to implant surgery
(5) They had signed informed consent forms.

2.1.2. Exclusion criteria

(1) Patients with severe systemic diseases or oral diseases
(2) Patients with a history of head and neck radiation exposure or orthodontic treatment
(3) Patients in special physiological periods such as pregnancy or menstruation
(4) Patients with mental illnesses or those in a state of unconsciousness due to other reasons, making them unable to cooperate with this study.

2.1.3. Study group

Based on the above criteria, stratified sampling was conducted on all eligible subjects, and they were ultimately divided into the observation group and the control group, with 40 subjects in each group participating in this clinical comparative analysis.

In the observation group, there were 22 males and 18 females, with ages ranging from 35 to 68 and an average age of (48.56 ± 7.23). The severity of periodontitis was as follows: 15 mild cases, 18 moderate cases, and 7 severe cases. The control group consisted of 23 males and 17 females, with an age range of 36 to 69 and an average age of (49.12 ± 7.58). The severity of periodontitis in this group was: 14 mild cases, 19 moderate cases, and 7 severe cases. Comparison of general data between the two groups ($p > 0.05$) indicated comparability. This

study was approved by the Medical Ethics Committee of our hospital.

2.2. Methods

2.2.1. Preoperative preparation

Both groups underwent oral examinations and CBCT assessments, completed basic periodontal treatments such as supragingival scaling, and proceeded with surgery after periodontal stability was achieved (negative bleeding on probing and periodontal pocket depth ≤ 3 mm).

2.2.2. Impression taking method

The control group employed the traditional silicone rubber impression technique: An addition-cured silicone rubber impression material was selected, mixed according to the ratio specified in the material instructions, placed into a tray, and then inserted into the patient's mouth. It was accurately positioned and secured, and after the material had fully cured, it was removed. The integrity of the impression was checked, and once confirmed to be error-free, it was sent to the dental laboratory for fabrication of a plaster model, which was used for the production of the prosthesis.

The observation group utilized digital intraoral scanning impression technology: A TRIOS intraoral scanner was selected, which is based on ultra-fast optical sectioning technology and confocal microscopy, capable of capturing over 3,000 two-dimensional images per second and synthesizing them into a three-dimensional digital impression. Before scanning, the patient's mouth was cleaned with a mouthwash to remove food debris and dental plaque. The operator held the scanning head and slowly scanned the edentulous area and adjacent teeth in the patient's mouth, observing the completeness of the three-dimensional image on the screen in real time. Areas with unclear scans were rescanned to ensure complete data of the dentition and soft and hard tissues were obtained. After scanning was completed, the data was transmitted in STL format to a CAD/CAM system for direct design and production of the prosthesis.

2.2.3. Implant restoration procedure

The same group of doctors implanted Straumann implants, administered postoperative anti-infection treatment, and provided nursing guidance. After 3 to 6 months of stable osseointegration, the prosthesis was installed, and follow-up records were kept.

2.3. Observation indicators

(1) Indicators related to implant restoration

Impression-making time, number of attempts to fit the prosthesis, and implant retention rate. Among them, impression-making time refers to the duration from surgery to obtaining the impression; the number of attempts to fit the prosthesis indicates how many times it takes to fully secure the denture onto the abutment; the implant retention rate is calculated as the number of implants remaining 6 months postoperatively divided by the total number of implants placed during surgery, multiplied by 100%.

(2) Periodontal health indicators

These are assessed 6 months after restoration completion and include probing depth around the implant (measured as the distance from the implant neck to the deepest point of probing using a periodontal probe), gingival index (using the Loe-Silness gingival index criteria, where 0 indicates normal gingiva, 1 indicates mild gingival inflammation, 2 indicates moderate gingival inflammation, and 3 indicates severe

gingival inflammation), and bleeding index (using the Mazza bleeding index criteria, where 0 indicates no bleeding upon probing, 1 indicates punctate bleeding after probing, 2 indicates linear bleeding after probing, and 3 indicates significant bleeding after probing).

(3) VAS scoring indicators

These include the pain VAS score during treatment and the comfort VAS score after restoration [7]. Among them, the VAS score for pain during treatment refers to the pain experienced during the impression-taking process (VAS visual analog scale, ranging from 0 to 10, with 0 indicating no pain and 10 indicating the most severe pain); the VAS score for comfort after restoration was assessed one month after the completion of the restoration, with patients evaluating the usage of their intraoral dentures based on their own sensations (VAS visual analog scale, ranging from 0 to 10, with 0 indicating extreme discomfort and 10 indicating great comfort).

2.4. Statistical methods

Data were analyzed using SPSS 26.0. Continuous data ($\overline{x} \pm s$) were subjected to *t*-tests, while categorical data [n (%)] were analyzed using χ^2 tests. A *p*-value less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of implant restoration-related indicators between the two groups

The impression-taking time in the observation group was shorter than that in the control group, the number of prostheses try-ins was fewer in the observation group than in the control group, and the implant survival rate was higher in the observation group than in the control group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of implant restoration-related indicators between the two groups ($\overline{x} \pm s$)

Group	Impression time (min)	Prosthesis try-in times (times)	Implant survival rate (%)
Observation group (n = 40)	5.23 ± 1.05	1.08 ± 0.27	39 (97.50%)
Control group (n = 40)	12.67 ± 2.18	1.89 ± 0.43	33 (82.50%)
Statistical value (t/χ^2)	19.447	10.090	5.000
p-value	0.000	0.000	0.025

3.2. Comparison of periodontal health indicators between the two groups

Six months after restoration completion, the probing depth around implants, gingival index, and bleeding index in the observation group were all lower than those in the control group ($P<0.05$). See **Table 2**.

Table 2. Comparison of periodontal health indicators between the two groups ($\overline{x} \pm s$)

Group	Probing depth (mm)	Gingival index (score)	Bleeding index (score)
Observation group (n = 40)	2.15 ± 0.32	0.52 ± 0.16	0.48 ± 0.15
Control group (n = 40)	3.26 ± 0.45	1.23 ± 0.28	1.15 ± 0.26
t-value	12.714	13.924	14.117
p-value	0.000	0.000	0.000

3.3. Comparison of VAS scores between the two groups

The pain VAS score during treatment in the observation group was lower than that in the control group, while the comfort VAS score after restoration was higher in the observation group than in the control group ($p < 0.05$). See **Table 3**.

Table 3. Comparison of VAS scores between the two groups ($\overline{x} \pm$ s, points)

Group	Intraoperative pain VAS score	Postoperative comfort VAS score
Observation group (n = 40)	2.13 ± 0.65	8.67 ± 0.72
Control group (n = 40)	4.89 ± 1.02	6.23 ± 0.89
t-value	14.432	13.480
p-value	0.000	0.000

4. Discussion

Digital intraoral scanning generates high-precision impressions by collecting three-dimensional oral data through optical technology. The TRIOS scanner used in this study has an accuracy of 50 μm and does not require reflective powder. Compared with traditional techniques, its mold-free process shortens the cycle, its high precision fits complex anatomical structures, and its compact scanning head enhances the patient experience.

The results of this study showed that the impression-taking time in the observation group was significantly shorter than that in the control group, and the core reason for this data difference lies in the procedural differences between the two techniques. Traditional silicone rubber impressions require multiple steps, including material preparation, seating, curing, and removal, with the material curing time alone taking 3 to 5 minutes. In contrast, digital scanning can complete data acquisition in real time without waiting for material curing, thus significantly reducing operation time. The number of prostheses try-ins in the observation group was less than that in the control group (1.89 ± 0.43 times), and the implant survival rate was higher than that in the control group, which was directly related to the high precision of digital impressions. Regarding conventional impression-taking methods, factors such as the limited fluidity of the materials themselves or improper operation can easily lead to defects like air bubbles, thereby affecting the quality of the models. This undoubtedly has an adverse impact on the subsequent denture fabrication. In contrast, digital scanning can precisely capture these subtle structures, significantly improving the fit between the prosthesis and adjacent teeth as well as the implant, thereby reducing the number of try-ins, lowering the risk of peri-implant infection, and increasing the survival rate [8].

In terms of periodontal health indicators, the probing depth around implants, gingival index, and bleeding index in the observation group were all significantly lower than those in the control group. This result reflects the indirect protective effect of digital technology on periodontal health [9]. Accurate prosthesis fabrication can effectively prevent food impaction and reduce the likelihood of plaque accumulation around implants, as bacterial plaque attachment is a major cause of peri-implantitis. Traditional impression-making techniques cannot accurately record the patient's anatomical morphology and interproximal conditions, resulting in prostheses with edges that are not tightly fitted, creating plaque retention areas and triggering gingival inflammation and probing bleeding. However, the high-precision edge design of digital prostheses can effectively circumvent this issue, thereby improving periodontal health status [10].

The results of the VAS scores revealed that the observation group experienced lower pain scores during

treatment and higher comfort levels after restoration, which was closely related to the operational characteristics of digital technology. Traditional silicone rubber impression trays are large and cumbersome, and their insertion into a patient's mouth can easily compress the periodontal tissues and mucosa, causing discomfort. In contrast, digital scanning heads are smaller and more agile, allowing for accurate three-dimensional data acquisition by simply placing them gently in the mouth and sliding them slowly along the teeth, significantly reducing damage to the oral soft and hard tissues. Furthermore, precise prosthesis design ensures harmonious occlusal relationships, preventing occlusal trauma and thereby enhancing oral comfort after restoration.

5. Conclusion

In conclusion, the application of digital intraoral scanning impression technology in oral implant restoration for periodontitis patients can significantly shorten impression-taking time, reduce the number of prostheses try-ins, and improve implant survival rates. Simultaneously, it can enhance periodontal health, alleviate pain and discomfort during treatment, and improve post-restoration comfort, making it worthy of clinical promotion and application.

Disclosure statement

The authors declare no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Application of Quantitative Assessment Intervention Based on the Kano Model in Postoperative Nursing Care Following Laparoscopic Radical Surgery for Patients with Early-Stage Ovarian Cancer

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Abstract: *Objective*: To analyze the impact of nursing interventions based on quantitative assessment using the Kano model on the quality of rehabilitation in patients with early-stage ovarian cancer following laparoscopic radical surgery. *Methods*: A prospective clinical study was conducted involving 96 patients with newly diagnosed early-stage ovarian cancer who underwent laparoscopic radical surgery from December 2023 to December 2025. Patients were randomly assigned to groups using a random number table method before surgery. After surgery, the control group (n = 48) received routine quantitative assessment nursing interventions, while the observation group (n = 48) received nursing interventions based on quantitative assessment using the Kano model. Both groups received continuous nursing care until discharge. Differences between the groups were compared in terms of negative emotions, quality of life scores before and after postoperative intervention, postoperative recovery indicators, and nursing satisfaction evaluations on the day of discharge. *Results:* After intervention, the observation group had lower scores on the Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS), as well as shorter recovery times for gastrointestinal function and food intake, and a shorter hospital stay compared to the control group. Additionally, the observation group had higher scores on the Quality-of-Life Instrument for Cancer Patients-Ovarian Cancer (QLICP-OV) than the control group, with statistically significant differences ($p < 0.05$). The overall satisfaction with nursing care in the observation group was also higher than that in the control group, with a statistically significant difference ($p < 0.05$). *Conclusion:* Implementing quantitative evaluation nursing interventions based on the Kano model for patients with early-stage ovarian cancer after laparoscopic radical surgery can, by addressing their postoperative basic health, disease awareness, and other intervention content needs to a comprehensive degree, actively promote postoperative recovery and improve their mental health and quality of life.

Keywords: Early-stage ovarian cancer; Laparoscopic radical surgery; Postoperative nursing; Kano model

Online publication: Feb 10, 2026

1. Introduction

Ovarian cancer, a common malignant tumor of the female reproductive system, has a high incidence rate among women aged 50 to 70. Clinical recommendations suggest that early-stage patients (TNM staging ≤ IIa) should undergo radical surgery as soon as possible to improve disease prognosis [1]. The quality of recovery, as a major factor influencing the postoperative safety of these patients, can be affected by multiple clinical factors that determine the actual postoperative recovery quality. It is necessary to formulate reasonable nursing plans and optimize the effects of nursing interventions by considering the actual needs of patients for different nursing services and the impact of nursing evaluations [2,3]. Therefore, to analyze the impact of nursing interventions based on quantitative evaluation using the Kano model on the recovery quality of patients with early-stage ovarian cancer after laparoscopic radical surgery, this study was conducted, with details as follows.

2. Materials and methods

2.1. Clinical data

A prospective clinical study was conducted on 96 patients with newly diagnosed early-stage ovarian cancer who were admitted to the hospital for laparoscopic radical surgery from December 2023 to December 2025. These patients were randomly divided into a control group (n = 48) and an observation group (n = 48) using a random number table method before surgery. In the control group, the patients ranged in age from 43 to 68 years (55.54 ± 5.61 years), with a disease duration of 5 to 15 months (10.24 ± 1.06 months). The pathological staging was as follows: 13 cases in stage I and 35 cases in stage IIa. In the observation group, the patients ranged in age from 45 to 65 years (55.21 ± 5.58 years), with a disease duration of 6 to 14 months (10.32 ± 1.02 months). The pathological staging was as follows: 16 cases in stage I and 32 cases in stage IIa. There were no statistically significant differences in age, the proportion of pathological staging, and disease duration between the two groups ($p > 0.05$).

2.1.1. Inclusion criteria

(1) Preoperative diagnosis met the diagnostic criteria for ovarian cancer, with TNM staging of stage I to IIa;
(2) Met the indications for laparoscopic radical surgery;
(3) Had an educational level of junior high school or above and were able to complete clinical questionnaire assessments and cooperate accordingly;
(4) Confirmed surgery, voluntarily joined the group, and signed the “Informed Consent Form”.

2.1.2. Exclusion criteria

(1) Accompanied by severe systemic diseases or cardiovascular and cerebrovascular diseases;
(2) Accompanied by a history of previous malignant tumors;
(3) Accompanied by a history of long-term analgesic medication;
(4) Estimated survival period of less than 6 months;
(5) Accompanied by severe psychological trauma within 6 months before surgery.

2.2. Methods

2.2.1. Control group

Conventional quantitative assessment nursing intervention:

(1) Risk quantification

Based on information such as patients' preoperative examinations and surgical conditions, as well as clinical risk assessment tools (e.g., pain assessment, negative emotion scoring, complication risk assessment, etc.), comprehensively evaluate the postoperative safety risk level of patients and develop clinical nursing content for patients at different risk levels.

(2) Nursing implementation

After the assessment, assign nursing staff to patients based on the assessment results, i.e., one nurse for every two patients with low risk, one nurse for each patient with medium risk, and one head nurse and one nurse for each patient with high risk. During the postoperative rehabilitation period, nurses will perform psychological interventions, dietary guidance, functional exercises, and other nursing tasks, as well as provide medication guidance in accordance with medical advice.

2.2.2. Observation group

Quantitative assessment nursing intervention based on the Kano Model:

(1) Kano model quantitative assessment

A research team composed of specialist head nurses, nurses, doctors, and psychologists will be established. Based on the Kano model theory and recent literature research findings, a comprehensive Kano model assessment scale will be developed to quantitatively evaluate the nursing needs of patients based on their age, underlying conditions, pathological stage, emotional health scores (including SAS and SDS scores), and postoperative 24-hour vaginal bleeding volume. After the assessment, the degree of demand for related nursing content will be classified based on the scores of each evaluation item, including five levels: like, expected, indifferent, tolerable, and dislike. Based on the degree of demand, the satisfaction coefficient (SI) of related service items will be calculated. If the SI is positive and the larger the value, the stronger the impact of the related nursing service items on improving nursing satisfaction. After completing the aforementioned questionnaire assessment, a comprehensive nursing plan should be formulated in detail, which requires relevant nursing to be carried out on the basis of routine quantitative assessment and nursing intervention for patients.

(2) Nursing implementation

① Health Education: Utilize personalized methods such as pictures and videos to educate patients on disease knowledge, surgical treatment, and other related content. Use the publicity board in the ward area to create and display promotional materials on disease and surgical management, enhancing the accessibility of health knowledge for patients. ② Nutritional Intervention: During the postoperative recovery period, a comprehensive assessment of the patient's postoperative nutritional health status and nutrient requirements should be conducted by a nutritionist. Individualized nutritional rehabilitation guidance should then be provided to ensure the healthy recovery of gastrointestinal function and postoperative nutritional health. ③ Treatment Guidance: Provide detailed treatment education and safety management cooperation to patients regarding their postoperative treatment plans. ④ Psychological Intervention: Based on postoperative health education, nurses are required to communicate with patients on a "one-on-one" basis daily, provide psychological counseling and intervention based on the patient's psychological changes, and adjust nursing intervention content as needed based on an understanding of the patient's changing needs. ⑤ Rehabilitation Guidance: Develop feasible intervention plans tailored to the postoperative exercise rehabilitation needs of

ovarian cancer patients, guiding them in traumatic exercises within 6 hours post-surgery, getting out of bed within 12 hours post-surgery, and engaging in other postoperative exercise rehabilitation activities.

2.3. Observation indicators

(1) Negative emotions

The Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) were employed to evaluate patients' anxiety and depression before and after intervention. Both scales are 20-item versions with a total score range of 20 to 80. A SAS score ≥ 50 indicates the presence of anxiety, while an SDS score ≥ 53 suggests the presence of depression. Higher scores indicate more severe anxiety or depression [4].

(2) Quality of life score

The Quality-of-Life Instrument for Cancer Patients-Ovarian Cancer (QLICP-OV) was used to assess patients' quality of life before and after intervention. It encompasses four domains: physical function, psychological function, social function, and common symptoms and side effects, with a total of 42 items. A Likert 5-point scoring method was used for assignment, and the raw scores obtained were converted into standardized scores using the range normalization method. The total score ranges from 0 to 100, with higher scores indicating a higher level of quality of life [5].

(3) Postoperative recovery indicators

The mean values of the first anal exhaust, defecation time, first feeding time, and discharge time during hospitalization after surgery were calculated for each group.

(4) Nursing satisfaction evaluation

The Newcastle Nursing Service Satisfaction Scale (NSNS) was used to evaluate nursing satisfaction on the day of discharge, with a total score ranging from 19 to 95. Satisfaction levels were classified based on the scoring results, including very satisfied (95 points), satisfied (76–94 points), average (57–75 points), and dissatisfied (19–56 points). The overall satisfaction rate was calculated as (number of very satisfied cases + number of satisfied cases) / n × 100%.

2.4. Statistical methods

Data were statistically analyzed using SPSS 25.0 software. For normally distributed measurement data, descriptions were presented in the form of ($\overline{x} \pm s$). Independent sample *t*-tests were conducted for comparisons between groups, and paired sample *t*-tests were used for comparisons within groups. For count data, descriptions were given as n (%). For data on composition ratios, chi-square tests were performed, and for ordinal data, rank-sum tests were applied. A *p*-value less than 0.05 indicated a statistically significant difference.

3. Results

3.1. Comparison of negative emotions and quality of life scores

Before the intervention, there was no statistically significant difference in negative emotions and quality of life scores between the two groups ($p > 0.05$). After the intervention, the SAS and SDS scores of patients in both groups decreased compared to those before the intervention, while the QLICP-OV score increased compared to that before the intervention. Moreover, the changes in the above scores in the observation group were more significant than those in the control group, with statistically significant differences ($p < 0.05$). See **Table 1**.

Table 1. Comparison of negative emotions and quality of life scores ($\overline{x} \pm s$)

Group	SAS (Score)		SDS (Score)		QLICP-OV (Score)	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Control (n = 48)	57.68 ± 4.31	38.95 ± 4.21*	61.47 ± 5.12	42.58 ± 4.35*	62.36 ± 5.74	74.31 ± 5.52*
Observation (n = 48)	58.02 ± 4.25	33.16 ± 3.97*	61.45 ± 5.23	35.65 ± 4.08*	62.42 ± 5.58	80.26 ± 4.97*
t-value	0.389	6.159	0.019	8.050	0.052	5.549
p-value	0.698	< 0.001	0.985	< 0.001	0.959	< 0.001

Note: *A *p*-value less than 0.05 indicates a statistically significant difference compared to the same group.

3.2. Comparison of postoperative recovery indicators

The time to first anal exhaust, first defecation, first intake of food, and the length of hospital stay in the observation group were all shorter than those in the control group, with statistically significant differences ($p < 0.05$). See **Table 2**.

Table 2. Comparison of postoperative recovery indicators ($\overline{x} \pm s$)

Group	Time to first flatus (d)	Time to first defecation (d)	Time to first oral intake (d)	Hospital stays (d)
Control (n = 48)	2.32 ± 0.48	2.97 ± 0.78	2.54 ± 0.55	11.12 ± 2.15
Observation (n = 48)	1.45 ± 0.52	2.09 ± 0.65	1.67 ± 0.48	9.15 ± 1.85
t-value	8.517	6.005	8.257	4.812
p-value	< 0.001	< 0.001	< 0.001	< 0.001

3.3. Comparison of nursing satisfaction evaluation

The overall satisfaction rate and the proportions of "very satisfied" and "satisfied" in the observation group were higher than those in the control group, with statistically significant differences ($p < 0.05$). See **Table 3**.

Table 3. Comparison of nursing satisfaction evaluation (n, %)

Group	Very satisfied	Satisfied	Fair	Dissatisfied	Total satisfaction
Control group (n = 48)	14 (29.17)	26 (54.17)	6 (12.50)	2 (4.17)	40 (83.33)
Observation group (n = 48)	20 (41.67)	27 (56.25)	1 (2.08)	0	47 (97.92)
χ^2 (Chi-square)		1.978			6.008
p-value		0.048			0.014

4. Discussion

The Kano model, widely applied in corporate management in recent years, has a definitive effect on optimizing customers' actual service experiences. This model may also be applicable to the healthcare service industry. Related studies have indicated that the implementation of nursing under the guidance of the Kano model, after analyzing patients' actual intervention needs and classifying them into categories such as expected, attractive, and

essential needs, can delve deeper into patients' potential needs from the perspectives of the degree and nature of these needs. This, in turn, enhances nursing content and intervention outcomes, with proven clinical effectiveness [6].

Based on the above background, after formulating and applying a quantitative evaluation nursing intervention based on the Kano model, it was found that the SAS and SDS scores, postoperative gastrointestinal function, time to resume eating, and length of hospital stay in the observation group were all lower than those in the control group, while the QLICP-OV score was higher in the observation group, with statistically significant differences ($p < 0.05$). Analysis shows that, based on the quantitative assessment of the Kano model, on the foundation of conventional risk quantitative assessment, after analyzing the actual demand levels of different nursing intervention measures involved in the factors influencing the quality of postoperative rehabilitation in patients, as well as their impact on the evaluation of nursing services, the nursing implementation content and details for patients with different risk levels can be further refined. This, in turn, can actively promote the recovery of patients' postoperative gastrointestinal function by improving measures such as health education, psychological intervention, and nutritional intervention, thereby assisting in enhancing the overall quality and efficiency of rehabilitation, and positively improving patients' postoperative emotional health and quality of life [7].

Furthermore, this study indicates that the overall satisfaction rate, as well as the proportions of "very satisfied" and "satisfied" in the observation group, are higher than those in the control group, with statistically significant differences ($p < 0.05$). The aforementioned conclusions align with the application objectives of the Kano model. After clarifying the impact of different nursing intervention effects on patients' nursing evaluations, by strengthening the intensity of relevant interventions, the satisfaction level of patients' actual nursing service evaluations can be actively optimized.

5. Conclusion

In summary, implementing quantitative assessment nursing interventions based on the Kano model after laparoscopic radical surgery for early-stage ovarian cancer patients can actively promote postoperative rehabilitation and improve their mental health and quality of life, based on the demand levels of intervention content such as basic postoperative health and disease awareness.

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

The Impact of Systematic Stepwise Rehabilitation Nursing Intervention on the Prognosis and Disease Uncertainty of Patients with Hypertensive Intracerebral Hemorrhage

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Abstract: Objective: To explore the impact of systematic stepwise rehabilitation nursing intervention on the prognosis and disease uncertainty of patients with hypertensive intracerebral hemorrhage, and to provide feasible strategies for clinical nursing. Methods: Eighty patients with hypertensive intracerebral hemorrhage admitted to our hospital from January 2023 to June 2025 were selected and randomly divided into an observation group (n = 40, receiving systematic stepwise rehabilitation nursing) and a control group (n = 40, receiving conventional nursing). The intervention effects were analyzed by comparing changes in the National Institutes of Health Stroke Scale (NIHSS) scores for neurological recovery, Short Form 36 Health Survey (SF-36) scores for quality of life, Exercise of Self-Care Agency Scale (ESCA) scores for self-management ability, compliance, and the Mishel Uncertainty in Illness Scale (MUIS) scores between the two groups. *Results:* All scores in the observation group were significantly better than those in the control group after the intervention ($p < 0.05$). Specifically, the NIHSS scores decreased more significantly, the total SF-36 scores increased, the ESCA scores increased significantly, while the MUIS scores decreased significantly, and compliance improved markedly, indicating a reduction in disease uncertainty among patients. *Conclusion:* Systematic stepwise rehabilitation nursing intervention can significantly improve neurological recovery, quality of life, self-management ability, and compliance in patients with hypertensive intracerebral hemorrhage, while effectively reducing disease uncertainty. It is worthy of clinical promotion and application.

Keywords: Hypertensive intracerebral hemorrhage; Rehabilitation nursing; Stepwise intervention; Uncertainty in illness; Prognosis

Online publication: Feb 10, 2026

1. Introduction

Hypertensive intracerebral hemorrhage (HICH) is a prevalent form of stroke, with its incidence rate rising annually, significantly impacting patients' lives and quality of life [1]. Particularly among the elderly, HICH exhibits a higher incidence rate and is often accompanied by multiple chronic diseases, complicating the rehabilitation

process. HICH is characterized by its acute onset, pronounced neurological deficits, and high risk of complications. Patients frequently experience long-term blood pressure fluctuations and underlying health conditions, factors that increase the complexity of rehabilitation and the difficulty of nursing care. Concurrently, patients and their families often endure substantial psychological stress due to the sudden onset of the condition, posing additional challenges to nursing management. In recent years, advancements in imaging and minimally invasive techniques have led to a decline in mortality rates during the acute phase. However, suboptimal long-term functional recovery, impaired quality of life, and increased psychological burden remain significant clinical challenges. Nursing interventions play a crucial role in patient rehabilitation, with their scientific and systematic nature directly influencing prognosis and psychological well-being. Traditional routine nursing care primarily focuses on monitoring vital signs and preventing complications, while often neglecting patients' rehabilitation awareness and psychological adaptability. This oversight results in low self-management skills and inadequate disease awareness among discharged patients, frequently leading to anxiety and uncertainty in illness [2]. Uncertainty in illness refers to the psychological state arising from patients' unclear cognition of disease progression, treatment outcomes, and rehabilitation prospects. This state often manifests as anxiety, fear, or behavioral avoidance. A high level of uncertainty can increase psychological burden and affect rehabilitation compliance and quality of life. Studies have shown that reasonable rehabilitation nursing, through phased, goal-oriented interventions, can promote the recovery of neurological function while improving disease cognition and psychological adaptability [3].

Systematic stepwise rehabilitation nursing is a novel nursing intervention model that has garnered attention in the field of stroke rehabilitation in recent years. Its core concept is to design progressive nursing plans in stages based on patients' disease progression, rehabilitation needs, and individual differences. Its content primarily includes focusing on monitoring vital signs and implementing measures to prevent complications during the acute phase; conducting functional training and providing guidance on daily living skills during the subacute phase; and emphasizing psychological support and enhancing self-management abilities during the rehabilitation phase [4]. This model emphasizes the continuity and systematic nature of the nursing process while incorporating multidisciplinary collaboration to tailor rehabilitation plans for patients. Related studies both domestically and internationally have indicated that stepwise rehabilitation nursing has a positive effect on improving neurological function and quality of life in stroke patients. However, there is still a relative lack of research on patients with cerebral hemorrhage, particularly with limited reports on interventions for uncertainty in illness. Clinical observations have shown that patients with hypertensive cerebral hemorrhage often experience a high level of uncertainty in illness after discharge due to insufficient knowledge about the disease and a lack of rehabilitation guidance, which consequently affects their quality of life and long-term rehabilitation compliance [5].

Based on this, the subjects of this study are 80 patients with hypertensive intracerebral hemorrhage (HICH) admitted to our hospital, aiming to evaluate the impact of systematic stepwise rehabilitation nursing on neurological function, quality of life, self-management ability, and disease uncertainty in patients with HICH. The study seeks to provide a scientific and reliable reference for clinical medicine. Additionally, it attempts to explore the long-term effects of nursing interventions on patients' psychological adaptation, with the goal of offering practical guidance for optimizing HICH rehabilitation models.

2. Materials and methods

2.1. General information

Eighty patients with HICH admitted to our hospital from January 2023 to June 2025 were included in this study

and randomly divided into an observation group and a control group, with 40 patients in each group. There were no significant differences in general information such as gender, age, bleeding volume, and previous duration of hypertension between the two groups ($p > 0.05$), indicating comparability.

2.1.1. Inclusion criteria

(1) Aged between 18 and 80 years old and diagnosed with hypertensive intracerebral hemorrhage;
(2) Confirmed by imaging (CT or MRI) after admission;
(3) Conscious or in a mild coma, able to cooperate with nursing interventions;
(4) Signed informed consent.

2.1.2. Exclusion criteria

(1) Patients with severe cardiac, hepatic, or renal dysfunction or other systemic diseases;
(2) Previous severe stroke disability affecting functional assessment;
(3) Mental illness or cognitive impairment affecting cooperation;
(4) Life expectancy less than 6 months or at high risk of severe complications.

2.2. Methods

2.2.1. Control group

Routine nursing care was implemented, which included monitoring vital signs, providing basic nursing care, preventing complications, and offering dietary and medication guidance. Psychological intervention, disease education, and self-management training were not systematically conducted during the nursing process.

2.2.2. Observation group

On the basis of routine nursing care, a systematic stepped rehabilitation nursing intervention was implemented, with an emphasis on multidisciplinary collaboration (nursing department, rehabilitation department, and psychological department). The specific steps are as follows:

(1) Acute phase (from admission to the 7th day)
Focus on monitoring vital signs, changes in neurological function, and the risk of complications; establish nursing files and provide psychological comfort; guide family members to cooperate with nursing care, conduct education on basic disease management, and enhance the awareness of patients and their families regarding HICH and hypertension control; assess the patients' initial self-management abilities to provide a reference for formulating subsequent rehabilitation goals.

(2) Subacute phase (from the 8th day to discharge)
Carry out individualized limb function training, language rehabilitation, and life skills training; gradually cultivate patients' self-management abilities, including medication management, blood pressure monitoring, and self-care in daily life; regularly evaluate rehabilitation outcomes and adjust training plans; a joint evaluation by the multidisciplinary team should be conducted once a week to ensure the targeted and feasible nature of the intervention.

(3) Convalescence phase (follow-up at 3 months after discharge)
Follow-up was conducted via telephone calls, online video consultations, or outpatient visits to guide patients in their rehabilitation training; provide psychological support, disease education, and guidance on

rehabilitation adherence; and assess changes in quality of life and uncertainty about the disease. Family members were encouraged to participate in the follow-up guidance, forming a collaborative "physician-patient-family" rehabilitation model to enhance adherence.

2.3. Observational indicators

(1) Neurological function score

The NIHSS score was used, with lower scores indicating better neurological recovery. Assessment time points were at admission, discharge, and the 3-month follow-up.

(2) Quality of life

The SF-36 scale was used to measure quality of life, with higher total scores indicating better physiological function, social adaptability, and mental health status in patients.

(3) Self-management ability

The ESCA score was used, with higher total scores indicating stronger self-management abilities, focusing particularly on daily living abilities and adherence to rehabilitation training.

(4) Adherence indicators (newly added)

Completion rate of rehabilitation training, follow-up participation rate, and family cooperation level were used to assist in evaluating the intervention effect.

(5) Uncertainty about the disease

The MUIS scale was used, with higher total scores indicating stronger feelings of uncertainty. Changes in patients' perceptions of the disease and rehabilitation expectations were also recorded.

2.4. Statistical methods

This study utilized SPSS 26.0 statistical analysis software. Continuous data were presented as mean ± standard deviation ($\overline{x} \pm s$), with independent sample *t*-tests used for comparisons between groups and paired *t*-tests for comparisons within groups. Categorical data were presented as case numbers and percentages, with χ^2 tests used for comparisons between groups. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of neurological function recovery (NIHSS scores)

There was no statistically significant difference in NIHSS scores between the two groups before intervention ($p > 0.05$). After intervention, the scores in the observation group were significantly lower than those in the control group ($p < 0.05$), suggesting that systematic stepwise rehabilitation nursing intervention can significantly promote neurological function recovery, as shown in **Table 1**.

Table 1. Comparison of neurological function recovery (NIHSS scores) between the two groups ($\overline{x} \pm s$)

Group	Before intervention	After intervention
Control group (n = 40)	14.24 ± 3.53	10.86 ± 3.22
Observation group (n = 40)	14.20 ± 3.35	7.25 ± 2.87
t-value	0.321	4.873
p-value	0.757	< 0.001

3.2. Comparison of quality of life (total SF-36 scores)

There was no significant difference in quality-of-life scores between the two groups before intervention ($p > 0.05$). After intervention, the total SF-36 score in the observation group was significantly higher than that in the control group ($p < 0.05$), indicating that stepwise nursing intervention has a significant effect on improving quality of life, as shown in **Table 2**.

Table 2. Comparison of quality of life (total SF-36 scores) between the two groups ($\overline{x} \pm s$)

Group	Before intervention	After intervention
Control group (n = 40)	56.31 ± 8.55	64.79 ± 9.20
Observation group (n = 40)	55.79 ± 8.23	75.46 ± 8.77
t-value	0.232	5.312
p-value	0.830	< 0.001

3.3. Comparison of self-management ability (ESCA scores) and compliance

Before intervention, there was no significant difference in self-management ability and compliance between the two groups ($p > 0.05$). After intervention, the observation group significantly outperformed the control group, with a greater improvement ($p < 0.05$). The results indicate that systematic stepwise rehabilitation nursing can effectively encourage patients to actively participate in rehabilitation and daily management, as shown in **Table 3**.

Table 3. Comparison of self-management ability (ESCA scores) and compliance between the two groups ($\overline{x} \pm s$)

Group	Self-management ability		Compliance rate	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Control group (n = 40)	62.52 ± 7.85	69.52 ± 8.19	74.01 ± 4.91	80.51 ± 5.34
Observation group (n = 40)	63.04 ± 7.57	79.54 ± 7.96	73.61 ± 4.51	87.53 ± 6.81
t-value	0.334	6.231	0.618	7.791
p-value	0.742	< 0.001	0.518	< 0.001

3.4. Comparison of illness uncertainty (measured by MUIS)

There was no significant difference in MUIS scores between the two groups before the intervention ($p > 0.05$). After the intervention, the score in the observation group was significantly lower than that in the control group ($p < 0.05$), suggesting that stepped care intervention can effectively reduce patients' uncertainty in illness, as shown in **Table 4**.

Table 4. Comparison of illness uncertainty (MUIS scores) between the two patient groups ($\overline{x} \pm s$)

Group	Before intervention	After intervention
Control group (n = 40)	84.63 ± 9.31	76.35 ± 8.76
Observation group (n = 40)	85.40 ± 9.04	62.80 ± 7.85
t-value	0.182	7.932
p-value	0.862	< 0.001

4. Discussion

Hypertensive intracerebral hemorrhage is an acute cerebrovascular disease characterized by sudden onset, significant damage, and a prolonged recovery period. This condition not only leads to neurological deficits but also severely impacts patients' quality of life, imposing substantial psychological stress [6]. Particularly among elderly patients and those with comorbid chronic conditions, rehabilitation is more challenging, often resulting in anxiety, depression, and uncertainty about the illness, thereby increasing the complexity of nursing management. While acute-phase treatment and routine nursing care can stabilize the condition and prevent complications, interventions for long-term rehabilitation, recovery of daily living skills, and psychological adaptation remain limited. Therefore, exploring a scientific and practical nursing model holds significant value for optimizing patient outcomes. Systemic nursing interventions not only improve physiological function but also enhance overall adaptability through behavioral interventions, cognitive education, and psychological support. The results of this study indicate that systemic stepped rehabilitation nursing intervention can significantly enhance neurological recovery, improve quality of life and self-management abilities, and effectively alleviate uncertainty about the illness [7]. After intervention, the NIHSS scores of patients in the observation group were significantly lower than those in the control group, indicating a more rapid and stable recovery of neurological function in the observation group. The underlying mechanisms may include the following aspects:

(1) Physiological mechanisms
Phased rehabilitation training promotes brain plasticity and neural reorganization, accelerating the recovery of motor function; stabilizing the condition during the acute phase to reduce secondary brain injury and create conditions for neural repair;

(2) Psychological mechanisms
Psychological counseling, health education, and family involvement reduce anxiety, fear, and behavioral avoidance, enhancing patient motivation and self-efficacy;

(3) Behavioral mechanisms
Individualized training and self-management guidance help patients establish regular rehabilitation behaviors, improve adherence, and reduce the risk of recurrence and complications.

In terms of quality of life, the SF-36 scores of patients in the observation group were significantly higher than those in the control group, indicating that nursing intervention not only aids physiological recovery but also has a positive impact on psychological well-being and social functioning [8]. Particularly in the social functioning dimension, the introduction of family and social support enhances patients' confidence in participating in social activities, contributing to the long-term maintenance of rehabilitation outcomes. The improvement in ESCA scores suggests enhanced self-management abilities among patients, facilitating adherence to rehabilitation training, medication adherence, and blood pressure control in daily life, thereby reducing the risk of recurrence. Disease-related uncertainty is a key factor exacerbating psychological stress in patients with hypertensive intracerebral hemorrhage. During the acute phase and rehabilitation process, patients often experience uncertainty due to a lack of clear understanding of their condition and prognosis. The study results show that patients in the observation group had significantly lower MUIS scores, indicating that stepped nursing intervention has a notable effect in alleviating uncertainty. This effect may stem from the following factors:

(1) Systematic health education enhances patients' understanding of their disease and the rehabilitation process;

(2) Psychological interventions combined with family involvement establish a robust support system and

strengthen patients' coping strategies;

(3) Remote follow-up and multidisciplinary collaboration maintain the continuity of interventions, reducing anxiety caused by insufficient information [9].

Related research findings both domestically and internationally indicate that phased rehabilitation training aids in accelerating the recovery of motor functions, enhancing self-care abilities, and alleviating negative emotions such as anxiety and depression, thereby strengthening psychological adaptability. Additionally, integrating a stepped-care nursing model with telemedicine and intelligent monitoring tools allows for real-time assessment of patients' rehabilitation progress, dynamic adjustment of intervention plans, and improved long-term adherence and rehabilitation outcomes.

It is noteworthy that the implementation of stepped-care nursing requires multidisciplinary collaboration, involving neurology nursing, rehabilitation therapy, and psychological guidance, and necessitates dynamic adjustments based on changes in patients' conditions, family resources, and social support to achieve individualized and sustainable rehabilitation management [10]. However, this study is limited by a small sample size, single-center design, and short-term follow-up, making it impossible to evaluate the long-term effects and adherence of the interventions. It is recommended that future research conduct large-sample, multicenter, and long-term follow-up studies to further assess the effectiveness of the stepped-care nursing model.

5. Conclusion

In summary, stepped rehabilitation nursing, through phased, systematic, and individualized interventions, not only improves neurological function, quality of life, and self-management abilities but also effectively reduces disease uncertainty. It promotes overall rehabilitation through multiple mechanisms involving physiology, psychology, and behavior, providing a sustainable and comprehensive rehabilitation plan for patients with hypertensive intracerebral hemorrhage. This approach holds high clinical application value and is worthy of promotion.

Disclosure statement

The author declares no conflict of interest.

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Publisher's note

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

The Application of Artificial Intelligence in Smart Education for Nursing Students

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Abstract: Nursing education is undergoing a paradigm shift from skill training to clinical thinking cultivation. The integration of artificial intelligence technology offers technical possibilities for this transformation, but it also brings about a deep tension between the cultivation of humanistic qualities and a standardized training. Based on the analysis of the practical forms of nursing smart education, this paper examines the cognitive gap between the deterministic feedback of virtual simulation systems and the complexity of real clinical scenarios, reveals the potential narrowing effect of data-driven ability profiling on the all-round development of nursing students, and then proposes the design logic of intelligent teaching resources centered on real clinical problems, a hierarchical teaching model with clear human-machine division of labor, and a dynamic assessment mechanism for technology application led by professional nursing teachers, in an attempt to find a balance between technological empowerment and humanistic commitment in smart nursing education.

Keywords: Artificial Intelligence; Nursing education; Smart education; Virtual simulation; Adaptive learning

Online publication: Feb 10, 2026

1. Introduction

When large language models such as DouBao, Wenxin YiYan, and ChatGPT-4 rapidly penetrate into the medical education field, the reform of smart education in the nursing profession is inevitably swept up in this technological whirlwind. However, the particularity of the nursing discipline, that is, the reverence for life, empathy for pain, and maintenance of dignity, appears particularly vulnerable to the precise calculations of algorithms. Whether technological tools are liberating productivity or eroding the soul of nursing constitutes the starting point of this paper.

2. The practical forms of smart education in nursing talent cultivation

2.1. The evolution of nursing education goals from skill training to clinical thinking cultivation

Traditional nursing education has long been trapped in a linear model of "demonstration–imitation–assessment".

Students have mastered standardized hand movements through repeated practice of intravenous puncture and aseptic operation training, but often find themselves in a "able to perform but unable to think critically" predicament when facing real patients. Feedback from clinical teaching at X Medical College in the autumn semester of 2024 shows that although the error rate of intern nurses in executing medical orders has dropped to a relatively low level, their ability to respond and clinical reasoning skills are significantly insufficient when patients present with atypical symptoms or make demands beyond the preset range. This phenomenon reflects the urgency of the shift in the goal of nursing education from mere skill acquisition to clinical thinking cultivation [1].

2.2. Immersive learning environments constructed by virtual simulation and intelligent medical record systems

Virtual simulation technology provides a repeatable, controllable, and low-risk practice field for nursing education. Students can repeatedly practice high-risk operations such as cardiopulmonary resuscitation and tracheal intubation on high-fidelity simulation manikins like SimMan without the risk of real harm. Intelligent medical record systems take this a step further. Teachers can design branched plot virtual cases using clinical decision support systems, and each nursing decision made by students will trigger different disease developments. For instance, delayed medication administration may cause a sudden drop in the virtual patient's blood pressure, and ignoring the emotions of family members may lead to a medical-patient communication crisis. This immediate feedback mechanism partially compensates for the "armchair strategy" defect of traditional classrooms, but it also sows the seeds of cognitive risks that will be analyzed later.

2.3. Personalized knowledge push and training based on adaptive learning platforms

Adaptive learning platforms track students' answer trajectories, dwell times, and error types, and use machine learning algorithms to generate personalized knowledge maps and training plans. The intelligent question bank system introduced by a certain nursing college can identify students' weak points in the "drug dosage conversion" module and automatically push targeted practice questions and micro-lesson videos. This "one-size-fits-one" learning path design seems precise and efficient, but it actually implies a tendency to fragment nursing knowledge and atomize the learning process. Students complete one knowledge point after another under the guidance of algorithms, but they may lose the ability to grasp the overall picture of the nursing discipline [2].

3. Deep conflicts arising from the integration of technology into nursing education

3.1. The contradiction between standardized intelligent training and the cultivation of humanistic care competence in nursing practice

The essence of nursing has never been a set of operational procedures that can be exhausted by algorithms. When students communicate with "virtual patients" driven by ChatGPT in virtual wards, the system can simulate emotions such as anxiety, depression, and anger, but it cannot reproduce the weary look born from long-term illness or convey the trembling warmth when holding a nurse's hand at the end of life. Standardized dialogue scripts train "correct responses" rather than "genuine empathy". Students learn to invoke the "listen-empathize-guide" template when the system prompts "patient is emotionally agitated", but they may appear mechanical and indifferent in real clinical settings due to over-reliance on such routines.

3.2. The cognitive gap between the certainty of virtual scenarios and the complexity of clinical situations

The design logic of virtual simulation systems is based on a deterministic mapping of "input-output". Students receive positive feedback for correct operations and alerts for incorrect ones. This clear cause-and-effect chain, while helpful in reinforcing normative awareness, contrasts sharply with the chaotic nature of real clinical settings. Emergencies in wards often have no standard answers. A family member's question, a sudden vomiting from a neighboring patient, or an abnormal alarm from a monitor may occur simultaneously. Nurses must make judgments under conditions of incomplete information, time constraints, and emotional disturbances. The ability to extract key information from "noise" is precisely a blind spot that virtual training cannot reach.

3.3. The risk of narrowing the development of nursing students due to data-driven competency portraits

When learning management systems convert every click, every wrong answer, and every study duration of students into data and generate "competency portraits" based on this, a covert disciplinary mechanism operates. Qualities that are difficult to quantify, such as reverence for life, compassion for suffering, and professional identity, have no place on the data dashboard. Meanwhile, easily measurable indicators, such as operation accuracy, knowledge mastery, and simulation exam scores, are continuously emphasized. Students may internalize a cognitive bias that "what can be quantified is valuable" in the pursuit of data optimization, posing a risk of colonization by technological rationality in nursing education.

3.4. The mismatch between the rapid update of educational technology and the pace of building ethical norms for nursing teaching

The iteration speed of generative artificial intelligence far exceeds the pace of building ethical norms in education. When teachers attempt to introduce Wenxin Yiyan into discussions on nursing ethics cases, large models may generate seemingly reasonable but actually value-biased analysis texts. Students lacking critical thinking training may internalize AI outputs as their own judgments. Even more challenging is that when students use image generation tools like Midjourney to create health education materials, they may unconsciously spread visual symbols with stereotypes. These issues have not yet entered the discussion scope of nursing education ethics, and the absence of norms leaves the application of technology in a "grey area".

4. Collaborative pathways for high-quality development of smart nursing education

4.1. Establishing a design logic for intelligent teaching resources centered on real clinical problems

The development of intelligent teaching resources must move away from the mindset of "technological showmanship" and instead take real clinical problems as the logical starting point. The "Clinical Dilemmas" case library developed by the nursing department of a top-tier hospital in collaboration with a medical college extracts real materials from shift handover records at the nurse station, reports of adverse nursing events, and patient satisfaction surveys. After de-identification, these materials are imported into an intelligent case system. Students are no longer confronted with meticulously designed "standard patients" but rather real scenarios full of contradictions and tensions, such as family members demanding to keep the patient's condition a secret while

the patient insists on their right to know, doubts about the dosage of a doctor's order when the on-duty doctor is unreachable, and multiple patients calling for help simultaneously amid a shortage of nursing resources. This "imperfect" case design precisely provides the soil for the growth of critical thinking. Specifically, teachers can use the long text generation function of Wenxin Yiyan to batch import adverse nursing event reports from a certain department within half a year, allowing the large model to extract common problems and typical scenarios, and automatically generate draft cases with teaching value. These are then jointly reviewed by clinical nursing experts and the teaching team to form intelligent case resources that are both authentic and educational. The key to this process lies in breaking away from the conventional path of "first having a technical platform and then filling it with teaching content" and instead adopting a reverse design thinking of "first identifying clinical pain points and then seeking technical support", so that intelligent teaching resources truly serve the goal of cultivating nursing job competence rather than becoming just another "digital achievement" on the technology procurement list.

4.2. Promoting the functional shift of intelligent systems from "evaluating results" to "supporting reflection"

Existing intelligent evaluation systems overly focus on binary judgments of "right or wrong", while truly valuable learning often occurs through in-depth reflection on mistakes. The author advocates shifting the functional focus of intelligent systems from "scoring" to "questioning". When students make a certain nursing decision in a simulated scenario, the system should not merely display "correct" or "incorrect", but generate a Socratic sequence of questions, such as "Why did you choose to handle patient A first rather than patient B?" "Would your judgment change if the monitoring data at that time showed a different trend?" "Which parts of your decision relied on textbook knowledge and which on intuition?" Through this dialogic reflection guidance, students' implicit thinking processes are made explicit, thereby promoting the development of metacognitive abilities. Technically, teachers can use the custom instruction function of ChatGPT-4 to pre-set the role framework of a "nursing clinical thinking mentor", requiring it to not provide standard answers but instead continuously pose three to five progressive questions after students complete virtual case exercises, guiding students to discover their own decision-making blind spots. A teaching experiment conducted by a certain nursing college in the "Critical Care Nursing" course showed that the student group receiving AI questioning feedback performed significantly better in the final clinical reasoning test than the control group receiving only traditional right-wrong feedback. The difference mainly lay in the dimensions of "identifying key information" and "predicting changes in the patient's condition", confirming the promoting effect of the reflection support function on the development of high-order thinking skills among nursing students [3].

4.3. Establishing a clear division of labor between humans and machines in a "skill training–emotional communication" hierarchical teaching model

Technical tools and human teachers should each play their roles in nursing education rather than replace each other. Standardized skill operation training can be more often handled by intelligent systems. Students can enter a virtual laboratory at any time to repeatedly practice basic operations such as catheterization, intravenous infusion, and cardiopulmonary resuscitation. The system corrects hand angles, needle depths, and operation sequences in real time through motion capture and force feedback technology. However, teaching content involving emotional communication, ethical judgment, and end-of-life care must retain the leading position of human teachers, as the empathy, moral sensitivity, and life wisdom required in these areas cannot be learned by algorithms. The

approach taken by a certain nursing college in its "End-of-Life Care" unit is quite enlightening: First, teachers arrange for students to have simulated conversations with virtual family members driven by beanbags to familiarize themselves with the basic framework of "bad news delivery". Students repeatedly practice opening remarks, empathetic responses, and information confirmation in multiple rounds of dialogue with AI. The system automatically records the dialogue text and marks the frequency of interjections used, pause duration, and the proportion of questions for post-class analysis. Then, teachers lead students to the hospice ward of a cooperating hospital for real observations, requiring them to record the communication details of nurses without disturbing patients and their families. After the observation, students complete a reflective writing piece, comparing the "routines" from virtual training with the "warmth" in real situations. Finally, they return to the classroom for group discussions, where teachers guide students to share their observations and inner feelings. This three-stage design of "virtual warm-up-real experience-collective reflection" attempts to seek a dynamic balance between technological efficiency and humanistic depth, acknowledging the efficiency advantage of AI in standardized training while upholding the irreplaceability of human teachers in value guidance and emotional support.

4.4. Improve the dynamic assessment mechanism for the application effect of technology led by nursing teachers

The introduction of technological tools should not be a one-off administrative decision but a continuous iterative and dynamic adjustment process. Nursing teachers must take the lead in this process rather than become passive executors of technology. The author suggests establishing a two-way assessment loop of "teaching effect–technology feedback", whose operation mechanism can be described as follows: At the end of each semester, teachers integrate students' learning experience questionnaires, behavior logs of virtual training systems, and internship evaluations from clinical teaching teachers through Notion AI. They use the text analysis function of large models to identify high-frequency pain points and typical blind spots in the application of intelligent systems, and convert these first-line feedbacks into specific functional optimization demand lists to submit to the technology development team. At the same time, teachers should incorporate the assessment process itself into the scope of teaching academic research, systematically record the changes in students' knowledge mastery, skill proficiency, and clinical reasoning ability before and after the intervention of technology, and distill local practical experience into transferable theoretical frameworks and operation guidelines through writing teaching case reports, publishing research papers on nursing education, and participating in national smart education symposiums for nursing colleges. The deep meaning of this mechanism design lies in reshaping the leading position of teachers in the smart education transformation. Teachers are not passive recipients of technological solutions but professional evaluators and core drivers of continuous improvement in the application effect of technology. Only when nursing teachers truly hold the decision-making power over "what technology to use, at which stage to use it, and to what extent", can smart education shift from "technology-driven educational transformation" to "education demand-led technology adaptation", ultimately achieving a substantial improvement in the quality of nursing talent cultivation rather than superficial digital decoration [4].

5. Conclusion

The integration of artificial intelligence into nursing education is neither a terrifying monster nor a panacea. The value of technology ultimately depends on the educational wisdom and ethical awareness of its users. When virtual

simulation systems can replicate realistic clinical scenarios but fail to reproduce the warmth of life, when adaptive platforms can precisely push knowledge points but may narrow the development potential of students, and when large language models can generate smooth communication scripts but struggle to convey sincere empathy, nursing educators must remain clear-headed amid the technological frenzy: the "wisdom" of smart education does not lie in the advancement of technology, but in a profound understanding and commitment to the essence of the nursing profession, in a clear recognition and respect for the boundaries of technology, and in a sincere concern and responsibility for the all-round development of each nursing student.

Funding

Funding Project for Ideological and Political Model Courses of "Epidemic Fighting" Courses in Henan Province (Project No.: 531, 2020); University-level Curriculum Ideological and Political Demonstration Course Support Project of Zhengzhou Sias University (Project No.: 34, 2024); University-level Key Discipline Support Project of Zhengzhou Sias University (Project No.: 1, 2022); 2025 Key Scientific Research Projects of Henan Universities (Project No.: 25B360003); Henan Province Private Brand Professional Support Project (Project No.: 527, 2019)

Disclosure statement

The authors declare no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

A Survey on the Current Status of Usage and Awareness of Out-of-Hospital Automated External Defibrillators in Deyang City

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Abstract: *Objective*: To understand the current awareness and willingness to learn about the use of out-of-hospital automated external defibrillators (AEDs) in Deyang City, providing a basis for improving the success rate of rescue operations. *Methods*: A questionnaire survey was conducted among residents in Deyang City from January 2025 to October 2025, covering residents' basic information, awareness of AED-related knowledge, and attitudes towards AED usage. *Results:* A total of 1,886 questionnaires were collected, with 1,823 valid questionnaires, yielding an effective rate of 96.66%. Among the 1,823 respondents, 692 (37.96%) had received cardiopulmonary resuscitation (CPR)-related learning or training, 619 (33.96%) could accurately describe the name of an AED, 417 (22.87%) could clearly describe the function of an AED, and 308 (16.89%) could accurately describe how to use an AED. Among them, 1,549 (84.97%) were willing to provide assistance to patients experiencing cardiac arrest; 1,731 (94.95%) were willing to provide assistance under the premise of knowing how to use an AED; and 1,750 (95.99%) were willing to learn about AED-related knowledge. Among the 91 individuals unwilling to provide rescue, 75 responded with reasons. Among them, 36 cases (48.00%) were reluctant to rescue due to a lack of relevant first aid knowledge, 32 cases (42.67%) expressed concerns about exacerbating the patient's condition due to improper operation, and 4 cases (5.33%) were unwilling to interact with strangers due to personal reasons. *Conclusion:* Currently, residents in Deyang City have limited knowledge about AEDs but demonstrate a strong willingness to learn and apply them. Measures need to be taken to enhance their understanding and application of AEDs.

Keywords: Out-of-hospital cardiac arrest; Automated external defibrillator; Deyang City; Knowledge, attitude, and practice; Public first aid

Online publication: Feb 10, 2026

1. Introduction

Cardiovascular disease has now become the leading cause of threat to human health worldwide. Among them,

Out-of-Hospital Cardiac Arrest (OHCA) is widely recognized as a severe public health issue that endangers lives due to its sudden onset, rapid progression, and poor prognosis. Data shows that the number of sudden cardiac deaths in China exceeds 540,000 annually, ranking first globally, yet the success rate of rescue remains around 1%, significantly lower than the average level in developed countries in Europe and America [1]. After cardiac arrest, the patient's survival rate decreases exponentially over time. Implementing high-quality cardiopulmonary resuscitation (CPR) within the "golden 4 minutes" and using an Automated External Defibrillator (AED) can significantly improve the patient's survival rate. However, factors such as long-standing weak public awareness of first aid, low skill penetration rate among the public, and insufficient AED deployment have limited improvements in the prognosis of OHCA patients in China [2]. In recent years, at the national level, great importance has been attached to the construction of the pre-hospital emergency care system. On the one hand, it has explicitly proposed to strengthen the popularization of emergency care knowledge and skills among the general public; on the other hand, it has also provided legal immunity protection for good-faith rescuers from a legal perspective, aiming to eliminate public concerns about providing assistance [3]. As an important industrial hub in Sichuan Province and a key node city in the Chengdu-Chongqing Economic Circle, Deyang City is experiencing a significant trend of population aging and is home to numerous industrial enterprises, thus facing considerable challenges related to cardiovascular diseases [4]. However, at present, there is a lack of systematic research on the awareness rate, willingness to use, and mastery of operational skills regarding Automated External Defibrillators (AEDs) among the public in Deyang City. This study aims to objectively evaluate the current awareness and willingness to learn about the use of out-of-hospital AEDs among residents in Deyang City through a large-scale questionnaire survey. It also analyzes the key factors influencing the public's willingness to provide assistance, with the intention of providing a scientific basis for relevant departments to optimize the allocation of emergency care resources and formulate precise training policies.

2. Data and methods

2.1. General information

A total of 1,886 questionnaires were distributed to permanent residents of Deyang City, Sichuan Province, from May 2024 to October 2025, with 1,886 questionnaires collected. After excluding invalid questionnaires with excessively short response times, regular response patterns, or missing key information, a final total of 1,823 questionnaires were included. The general information of the study subjects is shown in **Table 1**. This study complies with the Declaration of Helsinki and has obtained informed exemption.

Table 1. Comparison of baseline demographic and clinical characteristics between two groups of patients

Item	Category	Number of cases (n)	Composition ratio (%)
Gender	Male	895	49.09
	Female	928	50.91
Age (years)	18–30	456	26.01
	31–45	684	37.52
	46–60	485	26.60
	> 60	198	10.86

Table 1 (Continued)

Item	Category	Number of cases (n)	Composition ratio (%)
Education Level	Junior high school or below	345	18.92
	High school / Secondary specialized	522	28.63
	College / Bachelor's degree	854	46.85
	Master's degree or above	102	5.60
Residential Area	Urban	1350	74.05
	Rural	473	25.95
Occupation Type	Enterprise / Institutional Employee	620	34.01
	Student	285	15.63
	Freelancer / Self-employed	450	24.68
	Retiree	215	11.79
	Other	253	13.88

2.2. Inclusion criteria

(1) Aged 18 years and above;
(2) Residing in the urban area of Deyang City for a period of 6 months or more;
(3) Having complete baseline data.

2.3. Exclusion criteria

(1) Individuals engaged in emergency medical professions, who do not represent the general public's cognitive level;
(2) Migrants with an expected residence period of less than 6 months;
(3) Individuals with cognitive, visual, or auditory impairments that prevent them from independently reading the questionnaire or understanding and answering its contents with the assistance of an investigator;
(4) Those who withdraw from the survey midway, refuse to answer key questions, or fill out the questionnaire with obvious logical errors.

2.4. Methodology

This study referenced domestic and international literature and the Knowledge-Attitude-Practice (KAP) theoretical model. It employed a self-designed questionnaire titled "Survey on Public Awareness and Willingness for AED Use and Emergency Response in Deyang City". which was validated through expert panel discussions and pre-survey revisions. The questionnaire demonstrated good reliability and validity, with a Cronbach's α coefficient of 0.86 and a Content Validity Index (CVI) of 0.92. The questionnaire primarily encompassed three dimensions: residents' basic information, awareness of AED-related knowledge, and attitudes and willingness towards AED use. The survey was conducted using a combination of online and offline methods. Offline surveys were conducted randomly in high-traffic areas such as Deyang Confucian Temple Square, Wanda Plaza, and community health service centers, while online surveys were distributed through community grid groups. Offline investigators, who underwent unified training, were responsible for on-site explanations and quality control. Data entry employed a double-entry method by two individuals.

2.5. Observation indicators

The observation indicators and their definitions in this study are as follows: CPR training prevalence rate: the proportion of surveyed individuals who have participated in CPR-related courses or skill training; AED name recognition rate: the proportion of individuals who can accurately identify and describe AED as an automated external defibrillator; AED function awareness rate: the proportion of individuals who can correctly describe the primary function of AED as treating ventricular fibrillation and eliminating abnormal heart rhythms; AED operation proficiency rate: the proportion of individuals who can correctly describe the standard operating procedure of AED; basic willingness to rescue rate: the proportion of individuals who express willingness to actively rescue patients with cardiac arrest under any circumstances; willingness to rescue rate after skill empowerment: the proportion of individuals who express willingness to actively rescue patients on the premise of having mastered the use of AED; willingness to learn rate: the proportion of individuals who express willingness to participate in AED and first aid knowledge training. Among those who express unwillingness to rescue, they are classified into three types based on their core obstacles: capability panic (due to a complete lack of relevant knowledge and skills), consequence concern (fear of worsening the condition or assuming subsequent responsibility due to improper operation), and social avoidance (unwillingness to interact with strangers for personal reasons).

2.6. Statistical methods

Data analysis was conducted using SPSS 22.0 statistical software. Count data were expressed as rates (%), and differences between two groups were compared using the χ^2 test. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Awareness of AED-related knowledge and skill attainment

The survey results revealed that less than 40% (37.96%) of the respondents had received CPR-related education or training, and there was a clear decreasing trend of "name recognition > functional understanding > operational proficiency". See **Table 2**.

Table 2. Awareness of AED-related knowledge and skill proficiency levels

Indicator	Positive response / compliance cases (n)	Proportion (%)
Exposure to CPR-related learning or training	692	37.96
Can accurately describe the name of an AED	619	33.96
Can clearly describe the purpose of an AED	417	22.87
Can accurately describe the steps for using an AED	308	16.89

3.2. AED usage and willingness to learn

The survey results showed that a majority of the respondents expressed a willingness to provide assistance (84.97%), and an overwhelming majority expressed a willingness to learn (95.99%). Furthermore, the proportion of those willing to provide assistance when equipped with relevant skills was even higher compared to the basic willingness to assist (94.95% vs. 84.97%, $\chi^2 = 100.602$, $p < 0.001$). See **Table 3**.

Table 3. AED usage and willingness to learn

Indicator	Positive response / compliance cases (n)	Proportion (%)
Willingness to provide aid to a sudden cardiac arrest victim	1549	84.97
Willingness to provide aid when equipped with AED skills	1731	94.95
Willingness to learn AED-related knowledge*	1750	95.99

Note: Compared to the proportion of those willing to assist without mastering AED usage methods, *$p < 0.05$.

3.3. Analysis of factors impeding assistance

Among the 91 respondents who explicitly stated their unwillingness to provide assistance, 75 provided specific reasons and were successfully categorized. The primary factors impeding assistance were fear of inadequate ability (48.00%) and concerns about consequences (42.67%). See **Table 4**.

Table 4. Analysis of factors impeding assistance (n = 75)

Reason category	Specific description	Number of cases (n)	Proportion (%)
Competence panic	Lacking any first-aid knowledge and thus afraid to act	36	48.00
Concern over consequences	Worried that incorrect operation might worsen the patient's condition	32	42.67
Social avoidance	Personal reluctance to engage with strangers	4	5.33
Other	Other reasons	3	4.00

4. Discussion

Through a questionnaire survey of 1,823 residents in Deyang City, this study reveals that the overall awareness rate of out-of-hospital Automated External Defibrillators (AEDs) and the willingness to provide assistance in the region exhibit a contradictory state of "high willingness but low capability". Specifically, the residents' awareness of AEDs in Deyang City presents an inverted triangular structure, with 33.96% having heard of AEDs, but only 16.89% mastering the correct operational procedures, significantly lower than the levels in first-tier cities such as Shanghai and Shenzhen, as well as in developed countries [5]. Sudden cardiac arrest occurs abruptly, with an extremely short window for rescue, making it difficult for the emergency response system alone to arrive at the scene within the optimal rescue time window. If on-site witnesses lack AED-related skills, even when AED equipment is within reach, it is difficult for it to be effective. The results of this study indicate that only 37.96% of the surveyed individuals reported having received CPR-related education and training, suggesting that most residents in Deyang City may lack basic identification and response capabilities when faced with sudden cardiac arrest.

However, it is noteworthy that the citizens of Deyang demonstrate a high willingness to provide assistance and enthusiasm for learning, in stark contrast to their relatively low level of awareness, which aligns with the research conclusions of Jiao Guangyuan regarding the positivity of the Chinese public's attitude towards first aid [6]. Among those unwilling to provide assistance, a complete lack of first aid knowledge, as well as concerns about exacerbating the patient's condition or assuming subsequent liability due to improper operation, are the primary obstacles to providing aid. Despite the issuance of Article 184 of the Civil Code, which provides strong legal protection for the public's emergency rescue actions, this study still reveals that a considerable portion of the

population remains unwilling to provide assistance due to concerns about their own technical abilities or potential consequences, possibly due to insufficient promotion and dissemination [7]. This phenomenon reflects a lack of knowledge and training in first aid, as the public may still generally hold incorrect perceptions that AED operation is complex and high-risk. However, in reality, the original intent behind AEDs is to enable "foolproof operation" to reduce the cognitive load on users, and they feature automatic rhythm analysis capabilities, ensuring that they will not deliver a shock when it is inappropriate to do so [8]. Therefore, eliminating technical fears may be the key to increasing the rescue rate among residents in Deyang City.

Based on the above findings, this study suggests that, in response to the current situation of low awareness, efforts should not be limited to popular science dissemination through posters and leaflets. Instead, specific CPR/AED practical training should be carried out in communities, enterprises, and schools. This will not only effectively enhance the public's first aid skills but also significantly reduce the psychological stress levels of rescers, thereby facilitating a comprehensive improvement in the willingness to rescue and the success rate of patient assistance [9]. On the other hand, it is essential to further promote relevant legal exemption clauses and disseminate the safety principles of AEDs to alleviate the public's irrational fear that improper operation might worsen the patient's condition. Moreover, incentive measures could be adopted to enhance the willingness of bystanders to provide assistance, thereby enabling everyone to "dare to rescue, be capable of rescuing, and know how to rescue".

5. Conclusion

In summary, the general public in Deyang City currently has limited knowledge about AEDs and a low proficiency rate in core operations. Despite a widespread strong willingness to learn and apply AEDs, the main obstacles to providing assistance stem from a lack of skills and concerns about the consequences. Therefore, it is recommended that relevant departments in Deyang City align with the public's willingness by vigorously promoting practical first-aid skills training to increase the out-of-hospital AED usage rate and improve the success rate of resuscitation for patients with cardiac arrest.

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Evidence Summary for Discharge Preparation Services in Patients After Total Knee Arthroplasty

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Abstract: *Objective:* To systematically summarize and evaluate the evidence on discharge preparation services for patients undergoing total knee arthroplasty, providing an evidence-based foundation for developing scientific and standardized discharge preparation intervention programs in clinical practice. *Methods*: Following the "5S" evidence model, literature such as guidelines, expert consensuses, evidence summaries and randomized controlled trials related to discharge preparation services for total knee arthroplasty patients were retrieved from relevant websites and databases, both domestic and international, from database inception to August 31, 2025. Two researchers independently screened the literature, conducted quality appraisals, and extracted and synthesized the evidence. *Results:* A total of 15 articles were included, comprising 3 guidelines, 4 expert consensuses, 3 evidence summaries, 3 systematic reviews and 2 randomized controlled trials. Ultimately, 23 pieces of evidence were summarized across five aspects. *Conclusion:* This study synthesizes the evidence on discharge preparation services for patients undergoing total knee arthroplasty. It is recommended that healthcare professionals apply this evidence in clinical practice, considering specific circumstances and patient needs.

Keywords: Total knee arthroplasty; Discharge preparation service; Evidence summary; Evidence-based nursing; Rehabilitation

Online publication: Feb 9, 2026

1. Introduction

With the accelerating trend of population aging in our country, the incidence of Knee Osteoarthritis (KOA) has been increasing annually among the elderly population [1]. KOA leads to persistent pain, joint stiffness and restricted mobility, significantly impacting patients' quality of life and their ability to perform daily self-care. Total knee arthroplasty (TKA) is currently the most effective surgical intervention for end-stage KOA and its procedural volume is exhibiting a rapid growth trend both domestically and internationally [2]. Due to the significant trauma of

TKA surgery and the initial postoperative decline in knee function, patients require a prolonged period of in-home rehabilitation. The TKA patient population is predominantly elderly and commonly presents with multiple chronic comorbidities, rendering them susceptible to adverse health outcomes such as falls and hospital readmissions [3]. These factors severely impede postoperative functional recovery and quality of life. Readiness for Hospital Discharge is a critical indicator used to assess a patient's capacity to safely transition to the home environment for rehabilitation. It reflects the patient's self-management capabilities and potential risks post-discharge [4]. Current research indicates that patients undergoing total knee arthroplasty generally exhibit a moderate level of readiness for hospital discharge [5]. This level of preparedness, in turn, directly influences their postoperative rehabilitation outcomes and the risk of readmission [6]. With the growing adoption of accelerated rehabilitation concepts, patient hospitalization times have been significantly reduced. This renders discharge preparation both more time-constrained and rigorous. Consequently, there is a need for an efficient and critical summary of evidence to guide the completion of the most essential assessment, education and planning within the limited timeframe available. Although existing guidelines and consensus encompass perioperative care for TKA patients, evidence specifically targeting the critical transition period of discharge preparation remains dispersed across various studies, lacking systematic and structured integration. This fragmentation of evidence leaves clinical healthcare professionals without unified, scientific standards for implementing discharge guidance. Consequently, this leads to inconsistency and variability in nursing care delivery, making it difficult to effectively meet the complex home rehabilitation needs of patients. Accordingly, this study aims to synthesize the best evidence regarding discharge preparation services for TKA patients, providing a reference for the development of standardized clinical discharge preparation intervention protocols.

2. Information and methods

2.1. Identification of the evidence-based issues

We used the PIPOST method as a guide to identify research questions [7]. Target Population(P): Patients undergoing TKA; Intervention(I): Discharge preparation measures related to postoperative TKA; Practitioners(P): Clinical medical staff, including physicians, nurses and rehabilitation therapists; Outcomes(O): Readiness for hospital discharge, quality of discharge teaching, knee function scores, among others; Setting(S): Hospitals; Type of evidence(T): Guidelines, evidence summaries, systematic reviews, clinical decision summaries, expert consensus, meta-analyses, randomized controlled trials (RCTs), or well-designed quasi-experimental studies.

2.2. Search strategy

Guided by the "5S" evidence model, a systematic top-down search was conducted [8]. The following databases and websites were searched: China National Knowledge Infrastructure (CNKI), VIP Database, Wanfang Data, SinoMed, Chinese Medical Journal Full-text Database, Medlive, PubMed, CINAHL, Web of Science, The Cochrane Library, Embase, Ovid, BMJ, UpToDate, National Institute for Health and Care Excellence (NICE), Guidelines International Network (GIN), Registered Nurses' Association of Ontario (RNAO), Agency for Healthcare Research and Quality (AHRQ), Scottish Intercollegiate Guidelines Network (SIGN), British Orthopaedic Association (BOA) and American Association of Hip and Knee Surgeons (AAHKS).The Search terms was: "Arthroplasty, Replacement, Knee"[Mesh]/total knee replacement / knee prosthesis implantation / knee arthroplasty / major orthopedic surgery / "Patient Discharge"[Mesh] / discharge planning / discharge services /

discharge health education / transitional care / consensus / guideline / systematic review / clinical decision. The search dates were from the establishment of the database to August 31, 2025.

2.3. Inclusion and exclusion criteria

2.3.1. Inclusion criteria

(1) Study subjects
Patients aged ≥ 18 years who underwent TKA;
(2) Study content
Research related to discharge preparation, discharge planning and discharge education for TKA patients;
(3) Study types
Guidelines, expert consensus, clinical decision support, evidence summaries, systematic reviews, randomized controlled trials (RCTs), or well-designed quasi-experimental studies;
(4) Chinese or English literature.

2.3.2. Exclusion criteria

(1) Literatures are not available through various channels;
(2) Literatures was a plan, draft or only an abstract;
(3) Literatures with failed quality evaluation

2.4. Quality assessment

The quality assessment of guidelines was conducted using the Clinical Guidelines Research and Evaluation System II (AGREE II); systematic reviews, expert consensus and RCTs were quality appraised using the relevant JBI critical appraisal tools; evidence summaries were critically appraised using the Critical Appraisal for Summaries of Evidence (CASE) tool [9–11].

2.5. Evidence extraction and summary

All evidence extraction and synthesis were conducted independently by two researchers. Any disagreements in their findings were resolved by a third researcher through discussion to reach a final consensus. The evidence was integrated according to the following principles: For consistent findings, the most concise and professionally stated source was selected, while complementary findings were combined based on their logical relationship. In the event of conflicting recommendations, priority was given to evidence of higher quality, more recent publications and findings from authoritative literature. In this study, the evidence was classified using the Joanna Briggs Institute (JBI) Levels of Evidence and Grades of Recommendation system [12]. Evidence was categorized into five levels (Level 1–5) based on the study design, with more rigorous designs corresponding to a higher level of evidence. The recommendations were graded as either Grade A (strong recommendation) or Grade B (weak recommendation).

3. Results

3.1. Search results

The initial search yielded 2,888 articles. After removing duplicates and screening the titles, abstracts and full texts

of the remaining articles, those that did not meet the inclusion criteria were excluded. A final total of 15 articles were included, which comprised 3 guidelines, 4 expert consensus statements, 3 evidence summaries, 3 systematic reviews and 2 RCTs. The literature screening process is shown in **Figure 1,** The general characteristics of the included literatures are shown in **Table 1**.

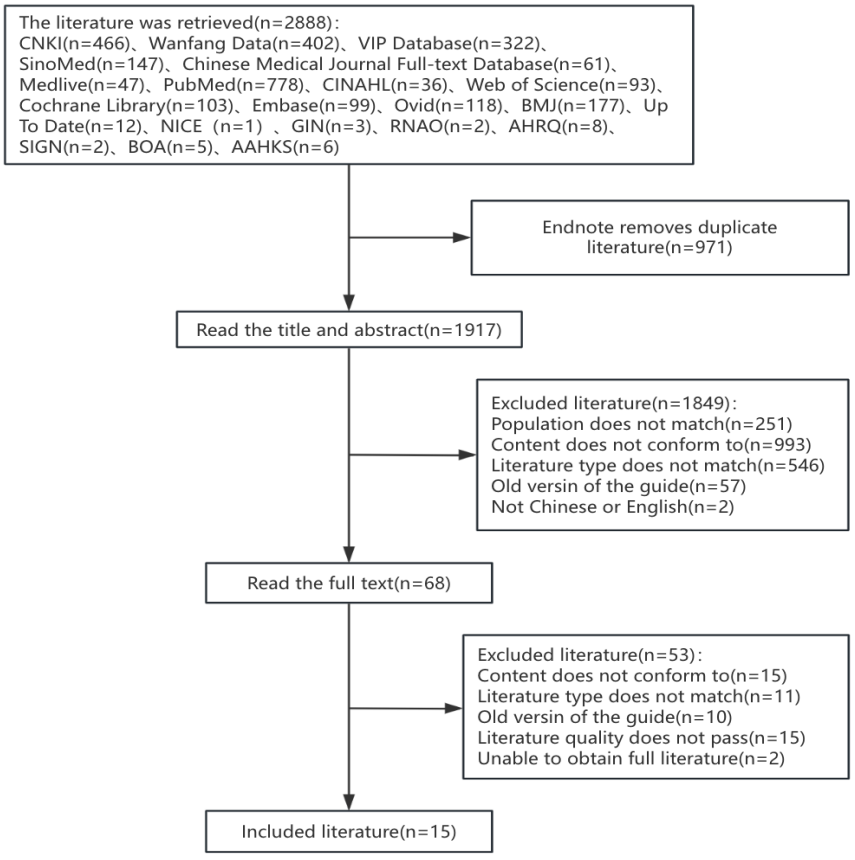

Figure1 Literature screening process

Figure 1. Literature screening process.

Table 1. General characteristics of the included literatures (n = 15)

Included literature	Year of publication (year)	Literature reference	Type of literature	The literature theme
Jiang Y et al.[13]	2024	CNKI	Expert consensus	Expert consensus on optimization of perioperative health education programs in orthopedics under the concept of enhanced recovery after surgery
Hu W et al.[14]	2022	CNKI	Expert consensus	Expert consensus on perioperative nutritional management for enhanced recovery after major orthopedic surgery
Chinese Association for Promotion of Rehabilitation Technology Transfer and Development et al.[15]	2025	Chinese Medical Journal Full-text Database	Expert consensus	Expert consensus on perioperative chronic disease management for enhanced recovery in orthopedics and anesthesiology (2025 edition)

Table 1 (Continued)

Included literature	Year of publication (year)	Literature reference	Type of literature	The literature theme
Geriatric Rehabilitation Branch of Chinese Geriatrics Society et al. [16]	2024	Chinese Medical Journal Full-text Database	Expert consensus	Chinese expert consensus on perioperative rehabilitation for total knee arthroplasty
Jette D U et al.[17]	2020	GIN	Guideline	Physical therapist management of total knee arthroplasty
Joint Surgery Group of Orthopedics Committee of Beijing Medical Association et al.[18]	2022	CNKI	Guideline	Chinese guidelines for perioperative pain management in total knee arthroplasty (2022)
RNAO[19]	2023	RNAO	Guideline	Transitions in Care and Services
Huang Y R et al.[20]	2023	CNKI	Evidence summary	Best evidence summary of exercise interventions for patients undergoing total knee arthroplasty
Xie Y et al.[21]	2022	CNKI	Evidence summary	Best evidence summary of preoperative. prehabilitation for patients undergoing hip/knee arthroplasty under enhanced recovery after surgery
Wang H L et al.[22]	2024	Chinese Medical Journal Full-text Database	Evidence summary	Best evidence summary of perioperative. enhanced recovery after surgery nursing care for patients undergoing hip/knee arthroplasty
Mao H et al.[23]	2022	PubMed	Systematic review	Effectiveness of nurse-led discharge service on adult surgical inpatients: a meta-analysis of randomized controlled trials
Konnyu K Jet al.[24]	2023	PubMed	Systematic review	Rehabilitation for total knee arthroplasty: a systematic review
Wang Y et al. [25]	2020	BMJ	Systematic review	Quality appraisal of clinical guidelines for venous thromboembolism prophylaxis in patients undergoing hip and knee arthroplasty: a systematic review
Mohamad Ghasempour et al.[26]	2025	PubMed	RCT	Effect of interdisciplinary discharge programme on daily function, quality of life, and pain intensity in patients undergoing joint replacement surgery
Bao L X et al.[27]	2022	Chinese Medical Journal Full-text Database	RCT	Application of rehabilitation guidance based on discharge readiness service in total knee arthroplasty

3.2. Quality evaluation results of the included literature

(1) The quality appraisal of the four expert consensus statements revealed them to be of high quality, with all evaluation criteria marked "yes" [13–16].

(2) Three guidelines were included [17–19]. Two were designated Grade A (6 domains scoring ≥ 60%) and one was Grade B (5 domains scoring ≥ 60%). The quality of the three guidelines was high, with detailed standardized scores and recommendation levels presented in **Table 2**.

(3) Three evidence summaries were included [20–22]. These were deemed to be of high quality and included because, with the exception of a "partially yes" rating for item 3 ("Is the reviewer/editor information for the summary transparent?"), all other items on the appraisal tool were rated "yes".

(4) Three systematic reviews were included. The study by Huina Mao et al. met all appraisal criteria ("yes" for all items) [23]. The reviews by Konnyu et al. and Wang et al. also met the threshold for inclusion, with

all items rated "yes" except for item 9 ("Did the review authors use a satisfactory technique for assessing the risk of bias in individual studies that were included in the review?"), which was rated "unclear" [24,25].

(5) Two RCTs were included in the review [26,27]. The quality appraisal for both studies resulted in a "no" rating for item 4 ("Were participants blind to treatment assignment?") and item 5 ("Were those delivering the treatment blind to treatment assignment?"). Additionally, item 10 ("Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?") was rated "unclear". All other items were rated "yes", the studies were considered to be of high quality and were included.

Table 2. Quality evaluation results of clinical guidelines (n = 3)

Guideline	Standardized scores in various domains (%)						≥ 60%	≥ 30%
	Scope and purpose	Stakeholder involvement	Rigor of development	Clarity of presentation	Applicability	Editorial independence		
Diane U Jette et al. [17]	98.15	83.33	88.89	87.04	77.78	100	6	6
Joint Surgery Group of Orthopedics Committee of Beijing Medical Association et al. [18]	85.19	79.63	86.81	92.59	52.78	100	5	6
RNAO [19]	96.30	96.30	91.67	88.89	66.28	100	6	6

3.3. Summary and description of evidence

This study synthesized the evidence regarding discharge preparation services for TKA patients, ultimately generating 25 items of evidence organized into 5 themes, as shown in **Table 3**.

Table 3. Evidence summary for discharge preparation services in patients after total knee arthroplasty

Category	Content of evidence	Level	Recommendation level
Admission assessment and education	1. Establish a multidisciplinary team composed of orthopedic doctors, rehabilitation doctors, specialist nurses, nutritionists, psychological counselors, etc., and conduct standardized training for the team in the intervention of discharge preparation for TKA [19–21,23,26,27]	1	A
	2. Evaluate the patient's personal condition, disease-related indicators (knee joint range of motion, lower limb muscle strength, degree of joint deformity and pain), health literacy, social support (economic status, living environment, care ability), etc. and based on the situation, a multidisciplinary team jointly formulates a discharge preparation plan [13,15,19,27]	5	A
	3. Explain the surgical plan, rehabilitation plan and knowledge of artificial joint protection to the patient, emphasize the importance of active knee joint exercise in the early postoperative period and encourage the patient to participate in self-management [21]	5	B
	4. Conduct comprehensive preoperative examinations to screen for and intervene in osteoporosis, correct anemia, and address other chronic diseases [22]	5	A
Preoperative preparation and education	5. Cease smoking and alcohol and maintain a BMI40kg/m^2, Underlying comorbidities should be managed as follows: maintain fasting blood glucose 8 mmol/L in diabetic patients; control preoperative blood pressure below 160/90 mmHg in hypertensive patients; discontinue clopidogrel 5–7 days preoperatively in patients with coronary heart disease; preoperative use of opioid analgesics should be avoided to prevent postoperative tolerance [15,21,22]	5	A
	6. Conduct health education, covering postoperative rehabilitation plans, nutritional support, prevention of complications, safe transfer techniques, the use of assistive devices, fall prevention and factors influencing discharge readiness [13,15,17,21,26]	5	B

Table 1 (Continued)

Category	Content of evidence	Level	Recommendation level
	7. Nutritional Support: Administer high-protein nutritional support to malnourished patients (e.g., albumin < 35 g/L). For high-risk patients, implement combined enteral and parenteral nutrition for 7–14 days preoperatively, aiming for a target protein intake of 1.5–2.0g/(kg·d) [14,15]	5	A
	8. Initiate a prehabilitation program 4–8 weeks preoperatively, emphasizing intensive quadriceps strengthening, balance training and cardiopulmonary conditioning to enhance muscle strength and knee joint stability [13,15,16,21]	5	A
Postoperative care and rehabilitation	9. Multimodal Analgesia: Implement the routine administration of analgesics combined with localized knee cryotherapy to alleviate swelling and pain. Pain management protocols and patient education strategies should be adjusted in a timely manner based on pain assessment outcomes [13,18,22]	5	A
	10. Incorporate Traditional Chinese Medicine analgesic techniques（specifically auricular point sticking and early postoperative acupuncture）as complementary therapies for pain management if resources permit [18]	5	B
	11. Resume oral food intake as early as possible after the operation. Prioritize the supplementation of high-quality protein. For those with poor function, take oral digestive enzymes or enteral nutrition preparations. If necessary, introduce human albumin. The target is: albumin > 35g/L, prealbumin > 200mg/L [14,15,21]	5	A
	12. Deep Vein Thrombosis Prophylaxis: Adjust anticoagulation regimens dynamically based on patient risk assessments. Instruct patients to engage in early postoperative ambulation and implement appropriate therapeutic interventions and mechanical prophylaxis [13,16,25]	1	A
	13. Positioning Management: Instruct patients to maintain the operated knee in a flexed position (30–90°) during rest to minimize immediate postoperative blood loss and swelling. Placing a pillow under the knee is recommended to prevent flexion contractures [16,17]	1	A
	14. Initiate rehabilitation exercises, including ankle pumps and quadriceps isometric contractions, immediately upon the subsidence of anesthesia. Mobilization should occur within 24 hours postoperatively, utilizing a walker for gait training. The regimen should begin with low-intensity isometric and isotonic exercises, gradually transitioning to resistance training to facilitate the timely achievement of discharge criteria. [13,17,20,22,24,27]	1	A
	15. Initiate gait correction and activities of daily living training as early as possible to enhance transfer and personal care abilities (e.g. bed-to-chair transfers, toileting, grooming and dressing). For patients demonstrating poor adherence, employ “education-feedback” model to provide iterative guidance. Avoided to routine use Continuous Passive Motion [13,17,22,24,27]	1	A
	16. Utilize neuromuscular electrical stimulation to enhance quadriceps strength；doing sports in the water under the premise of taking good waterproof of measures for the wound can reduce the pressure on the joints；apply motor imagery therapy may activate brain nerves, enhance motor learning, assist in pain relief and promote early functional recovery [16,18,20,21]	5	B
	17. Record the factors that hinder the implementation of postoperative rehabilitation exercises (such as kynophobia and pain), and the multidisciplinary team discusses and adjusts the training plan [22]	5	A
Discharge assessment and guidance	18. Objective discharge criteria: (1) dressing independently;(2) transfer in and out of bed independently;(3) independently transfer to a chair or toilet;(4) mobilize independently with the aid of walker or crutches;(5) perform personal care independently;(6) Walk more than 70 meters with crutches [20]	5	B
	19. Formulate individualized rehabilitation protocols (exercise frequency and intensity) tailored to patient tolerance and specific needs. Remote rehabilitation guidance for patients can be used if conditions permit [16,20]	5	A
	20. Home environment assessment and modification: Conduct a survey of the patient’s living environment and recommend necessary modifications to domestic facilities. Provide targeted Activities of Daily Living training for both patients and caregivers. This should be followed by a cycle of assessment, analysis and retraining until full mastery is achieved [26,27]	1	A
Follow-up and continuity of care	21. A multidisciplinary team assesses the rehabilitation needs of patients after discharge and provides knee joint monitoring and continuous support [14,19,22,23]	5	A

Table 1 (Continued)

Category	Content of evidence	Level	Recommendation level
	22. Outpatient follow-ups were conducted at 1- and 3-months post-discharge to assess knee joint function, surgical incision status, complication prevention, and adherence to rehabilitation exercises. If issues were identified, a new round of intervention was initiated [19,27]	1	B
	23. Upon the restoration of postoperative function, the following training modalities are recommended:(1) Aerobic Exercise: Priorities should be given to activities with relatively low joint loading, such as walking, cycling, swimming and rowing; (2) Functional Training: Interventions should target specific activities of daily living that are currently impaired, including brisk walking, stair climbing and sit-to-stand maneuvers. High-impact sports, such as running and soccer are not recommended. Instead, patients are advised to engage in low-to-moderate intensity exercises, such as walking, cycling and swimming [20]	5	A

4. Discussion

4.1. Exploration and application of standardized pathways for multidisciplinary team collaboration in discharge planning services

Substantial evidence from this study indicates that Multidisciplinary Team (MDT) constitute a pivotal component in establishing a comprehensive and coordinated discharge planning service framework [19–21,23,26,27]. Establish a dynamic collaborative mechanism composed of multidisciplinary healthcare professionals, including orthopedic surgeons, rehabilitation physicians, specialist nurses and dietitians. However, in clinical practice, discrepancies in the work rhythms of different disciplines make it challenging to maintain high-frequency, full-team in-person MDT rounds, may reduce discharge planning to a mere formality. As nurses maintain continuous contact with patients, they act as a pivotal communication hub to facilitate MDT collaboration, thereby enabling the provision of systematic, continuous and individualized intervention plans for patients. This holistic team collaboration facilitates the simultaneous resolution of complex issues such as postoperative pain, functional impairment, malnutrition and anxiety. Consequently, it improves the quality of patient rehabilitation and enhances their readiness for discharge [23,26].

The 23 pieces of evidence summarized in this study are derived from diverse sources and are scattered in content. This has led to variations in practice across institutions regarding discharge education, assessment tools and functional training standards, thereby hindering the standardization and homogenization of discharge planning services. To promote the clinical application of the MDT model, it is essential to integrate fragmented evidence into structured standardized protocols. This involves clearly delineating the specific responsibilities and handover details of physicians, nurses, rehabilitation therapists, and dietitians during the perioperative period. Such clarity facilitates effective collaboration and ensures the integrity and continuity of interventions, thereby improving service quality, enhancing patients' confidence in rehabilitation and optimizing discharge planning services.

4.2. Systematic rehabilitation intervention is a key strategy for discharge planning services in TKA

Most TKA patients suffer from chronic comorbidities, and there is significant heterogeneity in their functional and rehabilitation needs. Consequently, the team must complete a comprehensive assessment within 24 hours of admission. This evaluation encompasses sociodemographic characteristics, disease-specific functional indices, health literacy, and psychosocial support, thereby laying the foundation for formulating subsequent individualized

discharge plans [13,15,19,27]. As most patients are elderly with limited cognitive and self-management capabilities, active caregiver participation and shared decision-making among medical staff, patients and families are crucial for the successful implementation of care plans. These factors effectively enhance adherence to rehabilitation training and home management [28,29]. Therefore, it is essential to strengthen systematic caregiver education within discharge planning services, enhancing their ability to assist in various aspects and ultimately supporting better patient recovery [30].

Evidence 3–8 underscores the critical importance of preoperative preparation and education. Based on the initial assessment, interventions should include chronic disease control, nutrition and weight management, thrombosis prevention and prehabilitation training. The use of the "teach-back method" (Evidence 15) is recommended, requiring patients to retell or demonstrate rehabilitation maneuvers and knowledge to validate their mastery. At this stage, caregivers should not only provide emotional support and supervision but also actively participate in the decision-making process. They are expected to assist patients in comprehending health education content and receive necessary training in caregiving skills to enhancing the practical effectiveness of family support [31].

Factors such as early postoperative pain, fatigue and Kinesio phobia can significantly impede rehabilitation progress [32]. In the context of Enhanced Recovery After Surgery (ERAS), hospital lengths of stay are significantly shortened, systematic rehabilitation becomes particularly crucial [33]. Evidence 9–17 emphasizes the implementation of systematic postoperative rehabilitation led by the MDT. This encompasses pain management, range of motion (ROM) exercises, training in self-care abilities, nutritional guidance and psychological support. It also suggests incorporating Traditional Chinese Medicine (TCM) modalities, including auricular acupressure, acupuncture, Kinesio taping and lymphatic drainage, to mitigate pain and swelling [34]. Throughout the entire process, standardized tools should be continuously utilized to assess patients' knee joint function and rehabilitation adherence. Concurrently, caregivers' caregiving capabilities should be enhanced through methods such as illustrated materials, demonstration videos, or scenario-based training, ensuring that they can correctly assist and supervise patients in completing the discharge preparation plan [31].

To ensure safe patient discharge and a smooth transition to home-based rehabilitation, pre-discharge assessment and preparation are also crucial. The patient's discharge readiness should be comprehensively evaluated based on the objective criteria of Evidence 18, combined with an assessment of their family and social support. Because stairs, anti-slip measures in the home environment and caregiver competence all affect patient safety, evidence 20 recommends assessing the home environment and making modifications where necessary [35]. Additionally, it advises strengthening caregiver training in safe transfer, ambulation assistance, and rehabilitation support skills to ensure a safe transition for patients and reduce home safety risks.

4.3. Continuous follow-up supported by information technology is an important approach to enhancing the quality of discharge preparation services

With the widespread adoption of ERAS concepts, the average length of stay for TKA has been significantly shortened. However, postoperative patients still undergo a prolonged period of functional recovery after discharge; therefore, discharge preparation services should be extended from the hospital to the community and home. Evidence 22 and 23 indicate that post-discharge follow-ups should be conducted to assess patients' knee joint function, pain control and rehabilitation exercise status, allowing for the dynamic adjustment of rehabilitation plans. In clinical practice, the development of "Internet + Healthcare" has further expanded the scope of discharge preparation services, enabling remote rehabilitation guidance and process monitoring [36,37]. For instance, mobile

applications and wearable devices can record metrics such as joint range of motion and gait in real-time [38]. This assists in identifying patients' recovery status, facilitating a shift from fixed scheduled follow-ups to on-demand interventions and allowing the team to make individualized adjustments.

However, the application of information technology remains limited by factors such as patient acceptance, regional resources and cost [36,39]. To ensure standardized post-discharge management, the development of a unified discharge preparation management platform that provides targeted rehabilitation guidance should be explored. At the same time, it is essential to enhance the information tool proficiency of both patients and caregivers, leveraging data support to achieve continuous cross-stage nursing care. Furthermore, collaboration between hospitals and community health service centers should be actively promoted. By having community nurses assume partial monitoring and guidance responsibilities, a system of hierarchical medical care can be implemented to optimize the allocation of medical resources. This approach contributes to facilitating patients' long-term functional recovery and lowering the risk of readmission.

4.4. Limitations

Although this study comprehensively summarizes 23 pieces of evidence regarding discharge readiness interventions for TKA patients and we recommend their adoption. However, some of the recommendations are affected by regional and cultural differences and need to be adjusted considering local realities. Discharge preparation services involve multi-disciplinary and multi-stage collaboration. The integration effect and long-term impact still need further research for verification and optimization.

5. Conclusion

Utilizing an evidence-based approach, this study systematically searched and synthesized high-quality evidence regarding discharge preparation services for patients undergoing TKA. These findings provide a foundation for constructing a scientific, systematic and operable TKA discharge preparation service protocol and is significant for promoting safe patient discharge and improving rehabilitation outcomes. Besides, discharge preparation services should regard as a standardized and mandatory clinical pathway rather than an optional supplementary service. In clinical practice, should made efforts to establish an evidence-based minimum standardized intervention protocol, including mandatory assessment items, core educational content and safety goals that must be achieved prior to discharge, to ensure basic service quality. Furthermore, future research should integrate clinical requirements with appropriate technologies to further validate the effectiveness of procedural implementation, thereby driving the continuous improvement of TKA discharge preparation services.

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Research on the Clinical Efficacy of Integrated Medical-Nursing Comprehensive Care for Patients with Cerebral Infarction

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Abstract: *Objective*: To analyze the application effectiveness of the integrated medical-nursing comprehensive care model in cases of cerebral infarction and clarify its clinical practical value for the patient rehabilitation process. *Methods*: A total of 60 patients with cerebral infarction admitted from June 2024 to December 2024 were selected as the research subjects and randomly divided into a control group and a research group, with 30 cases in each group. Patients in the control group received routine clinical nursing measures, while those in the study group underwent collaborative healthcare intervention in addition to routine nursing. The intervention included joint disease assessment, personalized rehabilitation training guidance, psychological counseling, and continuous nursing services after discharge. A comparative study was conducted by evaluating indicators such as the scores on adverse emotion scales, the extent of neurological recovery, the effectiveness rate of clinical rehabilitation treatment, and the level of satisfaction with nursing services between the two groups. *Results:* After the intervention, the scores on the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS) in the study group decreased to (40.12 ± 5.01) and (41.36 ± 5.20), respectively, both significantly lower than those in the control group, which were (47.36±5.82) and (48.95 ± 5.63), respectively. The differences between the two groups were statistically significant ($p < 0.05$). The improvement in the neurological deficit scores of patients in the study group reached (9.18 ± 2.04), higher than that in the control group, which was (5.17 ± 1.82) ($p < 0.05$). The overall clinical rehabilitation effectiveness rate in the study group was 93.3%, significantly higher than that in the control group, which was 73.3%. The satisfaction rate with nursing services in the study group reached 96.7%, also higher than that in the control group, which was 83.3%. The differences between the two groups were statistically significant ($p < 0.05$). *Conclusion:* The integrated healthcare nursing model can effectively alleviate adverse emotional states in patients with cerebral infarction, facilitate the repair and reconstruction of neurological function, improve the effectiveness of clinical rehabilitation treatment and satisfaction with nursing services, and thus holds high value for clinical promotion and application.

Keywords: Healthcare integration; Cerebral infarction; Comprehensive nursing; Neurological function recovery; Nursing satisfaction

Online publication: Feb 10, 2026

1. Introduction

Cerebral infarction is a clinically prevalent ischemic cerebrovascular disease characterized by high morbidity, disability, and mortality rates, making it one of the primary diseases that seriously endanger public health [1]. Patients often experience neurological impairments such as limb paralysis, abnormal bodily sensations, and language dysfunction due to ischemia and hypoxia in brain tissue, which have a persistent negative impact on their daily quality of life. Traditional nursing models exhibit drawbacks such as fragmented service processes and a lack of continuity in intervention measures in terms of patient condition management, psychological and emotional counseling, and rehabilitation training guidance, making it difficult to fully meet the actual needs of cerebral infarction patients for systematic rehabilitation interventions. The integrated healthcare comprehensive nursing model has gradually gained attention and importance in clinical practice. This model relies on healthcare professionals collaborating to conduct condition assessments, jointly formulating individualized intervention plans, and establishing long-term communication and feedback mechanisms to provide patients with more precise, unified, and continuous full-course nursing services.

This nursing model demonstrates good application potential in improving patients' negative emotions and promoting neurological function recovery. This study, based on the core concepts of healthcare collaboration and comprehensive nursing services, explores the application value and innovative points of this nursing model in the nursing care of cerebral infarction patients, aiming to provide a reference basis for optimizing and improving clinical nursing models.

2. Materials and methods

2.1. General information

Sixty patients with cerebral infarction who received treatment in our hospital from June 2024 to December 2024 were selected for inclusion in the study. All enrolled cases met the clinical diagnostic criteria for cerebral infarction, were in a stable condition, and were able to cooperate in completing the entire research process. Using a random number table method, these patients were divided into a control group and a research group, with 30 cases in each group. Comparisons of basic data such as gender distribution, age range, disease duration, and location of infarction lesions between the two groups did not reach statistically significant differences ($p > 0.05$), meeting the conditions for inter-group comparison. This research protocol has been reviewed and approved by the hospital's ethics committee, allowing clinical observation to be conducted after fully informing patients and their families about the details of the study.

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

Meeting the diagnostic criteria corresponding to the imaging examination characteristics and clinical symptoms of cerebral infarction; having stable vital signs and a clear state of consciousness; possessing normal language communication and comprehension abilities, enabling cooperation in completing various assessment scale fill-outs; both the patients themselves and their families voluntarily participating in this study and signing written informed consent documents.

2.2.2. Exclusion criteria

Patients with severe dysfunction of vital organs such as the heart, liver, and kidneys; those accompanied by psychiatric disorders, cognitive impairment, or inability to cooperate in completing nursing intervention measures; those with concurrent acute infectious diseases or other conditions that may interfere with the assessment indicator results; and those who have received other systematic rehabilitation nursing interventions prior to hospital admission for treatment.

2.3. Nursing methods

2.3.1. Control group

Implement routine clinical nursing measures, including dynamic monitoring of the patient's condition during hospitalization, observation of basic vital signs, and timely management of sudden changes in the patient's condition. Strictly follow medical advice to guide patients in standard medication use, while also carrying out basic life care tasks, such as assisting with eating, skin cleaning and care, proper positioning, and implementing measures to prevent pressure ulcers.

2.3.2. Study group

On the basis of routine nursing measures, implement an integrated medical-nursing comprehensive care model intervention. Collaboratively, the attending physician and responsible nurse work together to develop a nursing plan and rehabilitation training program tailored to the individual patient's condition, clearly defining intervention goals, specific implementation measures, and periodic arrangements.

Psychological nursing care runs through the entire hospitalization treatment cycle of patients. Responsible nurses regularly assess patients' negative emotions such as anxiety and depression and employ intervention techniques including one-on-one communication, positive language encouragement, and relaxation training guidance to alleviate patients' psychological stress and enhance their confidence in treatment and recovery. Rehabilitation training programs are tailored based on the degree of neurological deficits and recovery status of patients, encompassing limb motor function training, swallowing function training, body balance ability training, and daily living self-care ability training. These programs are carried out progressively under the joint guidance of medical staff to ensure the scientific nature and safety of the training process.

Health education is conducted simultaneously for patients and their families, covering aspects such as the pathogenesis of cerebral infarction, management of disease risk factors, norms for medication administration, and implementation of secondary prevention measures. This helps patients establish scientific and healthy behavioral patterns during their hospitalization. After patients are discharged from the hospital, continuous nursing services are initiated. Through telephone follow-ups and home visits, the improvement of patients' symptoms, the progress of rehabilitation training implementation, and potential nursing-related issues after discharge are tracked, providing patients with ongoing rehabilitation guidance suggestions and psychological support services.

2.4. Observation indicators

The changes in negative emotional states of patients in both groups before and after nursing interventions were observed. Quantitative scoring assessments were performed using the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS). The progress of neurological function recovery in patients from both groups was compared, with evaluations conducted based on the commonly used clinical scale for assessing neurological

deficits. The dimensions for evaluating rehabilitation outcomes included the degree of improvement in limb motor function, enhancement in daily living self-care abilities, and other aspects. A comprehensive judgment was made by combining the results of clinical symptom observations with scale scoring data.

2.5. Statistical methods

Data processing was carried out using the SPSS statistical analysis software. Measurement data were presented in the form of mean ± standard deviation ($\bar{x} \pm s$), and comparisons between groups were made using the independent samples *t*-test. Count data were expressed as rates or composition ratios, and comparisons between groups were conducted using the χ^2 test. A significance level of $p < 0.05$ was used as the criterion to determine that differences between groups were statistically significant.

3. Results

3.1. Comparison of negative emotions between the two groups of patients

After the nursing intervention, the scores of the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS) in both groups showed a downward trend compared to those before the intervention, with a more significant decrease observed in the study group. The SAS and SDS scores of patients in the study group were significantly lower than those in the control group at the same time point ($p < 0.05$), suggesting that the integrated medical-nursing comprehensive care model had a more desirable intervention effect in alleviating negative emotions in patients with cerebral infarction. See **Table 1** for details.

Table 1. Comparison of negative emotion scores between the two groups (score, $\bar{x} \pm s$)

Group	n	SAS (Pre-care)	SAS (Post-care)	SDS (Pre-care)	SDS (Post-care)
Control	30	58.42 ± 6.15	47.36 ± 5.82	59.17 ± 6.40	48.95 ± 5.63
Experimental	30	58.58 ± 6.09	40.12 ± 5.01	59.33 ± 6.28	41.36 ± 5.20
t-value		0.09	5.27	0.10	5.36
p-value		> 0.05	< 0.05	> 0.05	< 0.05

3.2. Comparison of neurological function recovery between the two groups

After the nursing intervention, the decrease in neurological deficit scores in the study group was greater than that in the control group, with a statistically significant difference between the groups ($p < 0.05$), indicating that the integrated medical-nursing comprehensive care model had a prominent advantage in promoting neurological function reconstruction in patients with cerebral infarction. See **Table 2** for details.

Table 2. Comparison of neurological deficit scores between the two groups (score, $\bar{x} \pm s$)

Group	n	Pre-care score	Post-care score	Improvement score
Control	30	18.63 ± 3.72	13.46 ± 3.10	5.17 ± 1.82
Experimental	30	18.70 ± 3.68	9.52 ± 2.86	9.18 ± 2.04
t-value		0.07	5.29	7.62
p-value		> 0.05	< 0.05	< 0.05

3.3. Comparison of rehabilitation outcomes between the two groups

The rehabilitation outcomes were comprehensively evaluated based on dimensions such as the degree of recovery of limb motor function and improvement in daily living self-care ability. The significant efficiency and overall effective rate of rehabilitation treatment in the study group were significantly higher than those in the control group, with a statistically significant difference between the groups ($p < 0.05$). See **Table 3** for details.

Table 3. Comparison of rehabilitation outcomes between the two groups [n (%)]

Group	n	Markedly effective	Effective	Ineffective	Total effective rate
Control	30	9 (30.0)	13 (43.3)	8 (26.7)	22 (73.3)
Experimental	30	16 (53.3)	12 (40.0)	2 (6.7)	28 (93.3)
χ^2					5.12
p-value					< 0.05

3.4. Comparison of nursing satisfaction between the two groups of patients

The study group scored higher than the control group in survey items such as nursing service attitude, doctor-patient communication effectiveness, and professionalism of rehabilitation guidance. The overall nursing satisfaction in the study group was significantly better than that in the control group, with statistically significant differences between the groups ($p < 0.05$). This indicates that the integrated medical-nursing comprehensive care model has a positive effect on improving the quality of clinical nursing services. See **Table 4** for details.

Table 4. Comparison of nursing satisfaction between the two groups [n (%)]

Group	n	Very Satisfied	Satisfied	Not Satisfied	Total Satisfaction
Control	30	14 (46.7)	11 (36.7)	5 (16.6)	25 (83.3)
Experimental	30	21 (70.0)	8 (26.7)	1 (3.3)	29 (96.7)
χ^2					4.12
p-value					< 0.05

4. Discussion

4.1. The effect of integrated medical-nursing comprehensive care on improving negative emotions in patients with cerebral infarction

After the onset of cerebral infarction, patients often experience varying degrees of negative emotions such as anxiety and depression. These emotional responses not only reduce patients' clinical treatment compliance but also exacerbate the body's stress response, thereby adversely affecting the process of neurological recovery. The data from this study shows that although the SAS and SDS scores of patients in the control group decreased after nursing compared to before, the decline in scores was more pronounced in the study group. The SAS and SDS scores in the study group decreased to (40.12 ± 5.01) and (41.36 ± 5.20), respectively, both significantly better than the control group's scores of (47.36 ± 5.82) and (48.95 ± 5.63) ($p < 0.05$).

The collaborative healthcare model between doctors and nurses enables patients to receive more consistent and continuous information support related to their diseases, reducing anxiety caused by asymmetric information

transmission. During the process of clinical treatment and nursing intervention, doctors are responsible for explaining the progression of the disease and the principles of the treatment plan to patients and their families, while nurses undertake daily psychological counseling. Through interventions such as verbal guidance, emotional state assessment, and relaxation training instruction, nurses strengthen patients' self-emotional regulation abilities [2]. This nursing model compensates for the deficiencies in traditional nursing models, such as insufficient attention to psychological intervention and a lack of systematic intervention measures. It establishes a stable psychological support system for patients, helping them adjust their psychological states more effectively and enhancing their ability to cope with the disease.

4.2. Analysis of the promoting mechanism on neurological function recovery and rehabilitation outcomes

The repair of neurological damage in patients with cerebral infarction after onset depends on standardized rehabilitation training and timely, dynamic collaborative medical and nursing interventions. In this study, the neurological deficit scores of patients in the research group significantly decreased to (9.52 ± 2.86) points after nursing, with a greater decrease compared to the control group's (13.46 ± 3.10) points. The improvement value reached (9.18 ± 2.04) points, significantly higher than the control group's (5.17 ± 1.82) points ($p < 0.05$). The promoting mechanism of this nursing model is mainly reflected in the multi-dimensional collaborative aspect. The medical and nursing teams jointly participate in setting rehabilitation training goals for patients and dynamically adjust training plans according to the patient's recovery stage, making rehabilitation training measures more systematic and continuous. In terms of rehabilitation outcomes, the overall rehabilitation effectiveness rate in the study group reached 93.3%, significantly higher than the 73.3% in the control group. This result is closely related to factors such as the improvement of patients' negative emotions, the enhancement of the standardization of rehabilitation training, and the increased consistency of rehabilitation guidance [3].

4.3. Comparative advantages over traditional nursing models

Traditional nursing models emphasize that nursing staff complete various nursing operation tasks in accordance with medical orders. However, the information exchange between doctors and nursing staff is relatively limited, making it difficult to fully synchronize the implementation process of nursing goals and resulting in a lack of continuity in nursing service content.

The integrated medical-nursing comprehensive nursing model breaks through the limitations of traditional nursing models and establishes an efficient and collaborative work system. Team members enhance the coordination of roles between medical and nursing staff and improve the timeliness, pertinence, and accuracy of nursing measure implementation by jointly participating in ward rounds, collaboratively formulating nursing plans, and communicating in real-time about patients' latest conditions [4]. Another notable advantage of this care model is reflected in the aspect of service continuity. Traditional care models primarily focus on services provided during a patient's hospitalization, whereas the integrated physician-nurse care model emphasizes the importance of continuous care services, extending rehabilitation guidance into the post-discharge life stage of patients. This ensures that patients can still receive professional rehabilitation support in their home environment.

4.4. Innovation and clinical promotion value of this study

This study introduces the concept of integrated physician-nurse care services, integrating neurological

rehabilitation training, psychological state intervention, health knowledge education, and continuous care services into a comprehensive care service chain. It innovatively addresses the issue of fragmented services in traditional care models.

The integrated physician-nurse care model adheres to a patient-centered service philosophy, achieving homogeneous care services through teamwork. This core concept is highly aligned with the goal of "whole-course disease management" advocated by modern medicine [5].

4.5. Research limitations and future research directions

This study included a sample size of 60 cases, with a research period set at half a year. Although the research results can preliminarily demonstrate the effectiveness of the application of the integrated medical-nursing comprehensive care model, there are still certain limitations. The relatively limited sample size may impact the generalizability of the research conclusions. Future studies could further expand the sample inclusion scale, extend the follow-up observation period for patients, conduct stratified research on different types of cerebral infarction patients, and explore research directions that combine with intelligent rehabilitation equipment and telemedicine technology to construct a more multidimensional and efficient collaborative medical-nursing service model.

5. Conclusion

The integrated medical-nursing comprehensive care model establishes a collaborative service system between medical and nursing staff, enabling cerebral infarction patients to receive continuous, systematic, and individualized intervention support during their hospitalization and rehabilitation process. The results of this study indicate that this care model can significantly alleviate negative emotions such as anxiety and depression in patients, enhance their emotional stability, and improve their psychological experiences. The decline in neurological deficit scores among patients in the study group was significant, and both the effectiveness of rehabilitation treatment and the improvement in daily living self-care ability were superior to those in the control group. This suggests that the integrated medical-nursing intervention model has a positive effect on promoting the reconstruction of patients' neurological functions. In terms of nursing satisfaction, the overall satisfaction in the study group was significantly higher than that in the conventional care group, indicating that patients have a higher recognition of the joint medical-nursing management model, the consistency of doctor-patient communication, and the professionalism of rehabilitation guidance.

Funding

Science and Technology Support Program Project of Baoding City, Hebei Province (Project No.: 2541ZF107)

Disclosure statement

The authors declare no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Observation and Study on the Therapeutic Effect of Diuretics in Patients with Cirrhotic Ascites

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Abstract: *Objective:* This study aims to systematically evaluate the clinical efficacy and safety of diuretic therapy in patients with liver cirrhosis ascites. *Method:* 60 patients with liver cirrhosis ascites diagnosed from January 2024 to May 2025 were prospectively included and randomly divided into a furosemide monotherapy group (20 cases), a spironolactone monotherapy group (20 cases), and a combination therapy group (20 cases). The intervention period is 28 days, and the main observation indicators include 24-hour urine output, changes in abdominal circumference, weight loss, serum electrolyte levels, renal function indicators, and incidence of adverse reactions. All study subjects received standardized dietary management and sodium restriction intervention (daily sodium intake < 5 g). *Result:* The total effective rate (significant + effective) of the combination therapy group in reducing ascites was 95% (19/20), significantly higher than the 75% (15/20) of the furosemide group and the 70% (14/20) of the spironolactone group ($p < 0.01$). On the 28th day of treatment, the mean urine output in the combination group was 2450 ± 210 mL/d, which was higher than that in the monotherapy group (1850 ± 195 mL/d in the furosemide group); Spironolactone group 1560 ± 180 mL/d. The blood sodium levels of the three groups were maintained at 135–140 mmol/L, but the incidence of hypokalemia in the combination group (10%) was significantly lower than that in the furosemide group (35%). *Conclusion:* The combination of furosemide and spironolactone has a synergistic effect in the treatment of ascites in cirrhosis, with a 39.2% increase in diuretic effect and a reduction in the risk of electrolyte imbalance; Individualized dose adjustment combined with strict sodium restriction is the core strategy to ensure treatment safety.

Keywords: Diuretic therapy; Cirrhotic ascites patients; Clinical efficacy

Online publication: Feb 6, 2026

1. Introduction

Cirrhotic ascites, as the most significant clinical complication of decompensated liver function, involves multiple mechanisms such as portal hypertension, hypoalbuminemia, and activation of the renin angiotensin aldosterone system in its pathological basis. Global epidemiological data shows that approximately 50% of compensated liver

cirrhosis patients progress to ascites within 10 years, with a 5-year survival rate dropping to 30–40%. At present, the guidelines of the International Ascites Club still include stepwise diuretic therapy as the core intervention plan, among which the combination of aldosterone antagonist spironolactone and loop diuretic furosemide is widely recommended.

However, clinical practice has shown that the response rate of monotherapy is less than 50%, and the incidence of treatment-related complications such as hyponatremia and acute kidney injury is as high as 25–40%. In recent years, studies have suggested that there are genetic polymorphism differences in the metabolic response of diuretics in patients with different etiologies of cirrhosis, such as CYP2C9 gene mutations significantly affecting the clearance rate of furosemide. Although domestic multicenter studies have confirmed the advantages of combination therapy, there is still a gap in the safety stratification evaluation of patients with different Child Pugh grades. This study focuses on cases admitted during the period of 2024–2025, quantifying the impact of combination therapy on patients with critical renal function reserve through a prospective controlled design, and simultaneously establishing an efficacy prediction model based on urinary sodium/potassium ratio. The focus is on exploring the correlation between the fluctuation amplitude of blood creatinine during the treatment process and the recurrence of ascites, providing evidence-based support for optimizing individualized medication regimens [1].

2. Data and methods

2.1. General information

The study strictly followed the CONSORT statement to conduct a prospective randomized controlled trial, including patients with liver cirrhosis ascites admitted to the Hepatology Department of our hospital from January 15, 2024 to May 30, 2025.

2.1.1. Inclusion criteria

(1) Comply with the clinical diagnostic criteria of the "Chinese Guidelines for Diagnosis and Treatment of Cirrhotic Ascites";
(2) Child Pugh classification B/C;
(3) 24-hour urine sodium < 78 mmol/L confirmed sodium retention;
(4) Abdominal puncture confirmed leaking ascites.

2.1.2. Exclusion criteria

(1) Hepatorenal syndrome;
(2) Recently used nephrotoxic drugs;
(3) Malignant tumor ascites;
(4) Cardiogenic ascites

2.1.3. Study group

Finally, 60 subjects were randomly divided into three groups using a random number table method. The furosemide monotherapy group (Group A) consisted of 11 males and 9 females, with an average age of 56.3 ± 8.7 years. There were 12 cases of Child Pugh B grade and 8 cases of C grade, and alcoholic cirrhosis accounted for 45%; Spironolactone monotherapy group (Group B): 13 males and 7 females, age 54.8 ± 9.2 years, 11 children

with Child Pugh B grade and 9 children with hepatitis B cirrhosis, accounting for 60%; There were 10 males and 10 females in the combination therapy group (Group C), with an age of 57.1 ± 7.9 years. There were 14 cases of Child Pugh B grade and 6 cases of Child Pugh C grade, and the proportion of hepatitis C cirrhosis was 35%. Baseline indicator analysis showed that the three groups had age distribution (F = 0.86, p = 0.43), gender composition (χ^2 = 1.25, p = 0.54), Child Pugh score (H = 3.18, p = 0.20), and serum albumin (A group 28.5 ± 3.1 g/L, B group 27.9 ± 2.8 g/L, C group 28.8 ± 3.4 g/L); F = 0.67, p = 0.51) and creatinine clearance rate (Group A 68.5 ± 15.2 mL/min, Group B 71.3 ± 16.7 mL/min, Group C 69.8 ± 14.9 mL/min); F = 0.43, p = 0.65) showed no statistical difference, indicating comparability between the groups [2].

2.2. Treatment and intervention plan

All subjects were uniformly limited to a daily sodium intake of no more than 80 mmol (approximately 4.6 g of salt), and protein intake was maintained at a standard of 1.2 g/kg/day. Group A received an initial dose of 40 mg/d orally of furosemide, and the diuretic response was evaluated every 72 hours. If the 24-hour urine volume increase did not reach 200 mL or the weight loss was less than 0.8 kg, the dose was doubled, with a maximum dose limit of 160 mg/d. Group B spironolactone starts at 100 mg/d and increases in steps according to the same rules to reach the upper limit of 400 mg/d. Group C received a fixed combination of 40 mg furosemide and 100 mg spironolactone, with the same dosage adjustment mechanism as the monotherapy group. The diuretic response standard is defined as a urinary sodium/potassium ratio > 2.0 or an increase in urinary sodium excretion exceeding 30% of baseline 6 hours after administration. The treatment period is uniformly 28 days, during which standing blood pressure, weight, and abdominal circumference are monitored every 48 hours. If any subject experiences an increase in blood creatinine > 50% or blood sodium < 125 mmol/L, the medication should be immediately suspended. The standardized intravenous sodium supplementation regimen is only used for patients with blood sodium < 120 mmol/L and neurological symptoms [3].

2.3. Evaluation indicators and methods

The main efficacy endpoints include:

(1) 24-hour dynamic monitoring of urine volume

Patients are kept in dedicated urine collection containers, and nursing staff record the urine density every hour;

(2) Abdominal circumference change value

Take the midpoint level of the anterior superior iliac spine and xiphoid process, and measure it with a unified tension ruler on an empty stomach in the morning;

(3) Daily weight fluctuation value

Measured at a fixed time every day after calibration with a standard weight scale [4];

(4) Imaging evaluation

On the 0th and 28th day of treatment, ultrasound ascites depth measurement was performed, and the probe was placed in the right hepatic space to record the maximum liquid level thickness. Secondary endpoints include laboratory indicators: a) serum electrolytes: detection of sodium, potassium, chloride, and magnesium ions using a fully automated biochemical analyzer; b) Renal function markers: creatinine measured by creatine oxidase method, cystatin C measured by ELISA method; c) plasma aldosterone detected by radioimmunoassay (kit purchased from Merck Group). Safety monitoring pays special

attention to signs of low blood volume (heart rate increase > 20 beats per minute), consciousness disorders, and muscle spasms. All data collection strictly follows quality control, and blood samples are processed under standard centrifugation conditions (3000 rpm × 15 min) and stored in a -80 ℃ ultra-low temperature refrigerator for testing [5].

2.4. Efficacy evaluation criteria

According to the consensus of the European Association for the Study of the Liver on ascites grading treatment, significant efficacy is defined as a decrease in ascites depth of > 80% and a weight loss of ≥ 4 kg; effective indication is a decrease in ascites of 50–80% and a weight loss of 2–4 kg; below this standard, it is considered ineffective. Total effective rate statistics show the proportion of significant and effective cases. Biochemical relief needs to meet the following requirements simultaneously

(1) Blood sodium level ≥ 135 mmol/L;

(2) The fluctuation amplitude of blood creatinine is ≤ 25% of the baseline value.

Drug related adverse events are classified according to CTCAE 5.0, with severe events defined as requiring medical intervention or discontinuation of medication. Statistical analysis was performed using SPSS 26.0, with quantitative data expressed as $\overline{x} \pm s$. Inter group comparisons were analyzed using ANOVA analysis of variance or Kruskal Wallis H test, while count data were analyzed using chi square test or Fisher's exact probability method. Set $p < 0.05$ as the significant difference threshold, and complete Bonferroni multiple correction for the main outcome measure [6].

3. Results

3.1. Parameters of ascites regression and weight change

On the 28th day of treatment, the effective rate of Group C reached 65% (13/20), significantly higher than Group A's 35% (7/20) and Group B's 25% (5/20) ($\chi^2 = 7.89$, $p = 0.019$). From the perspective of ascites depth reduction rate (**Table 1**), the median value of 84.3% in the combination therapy group is much higher than that in the monotherapy group (58.7% in Group A and 49.2% in Group B), H = 15.32($p < 0.001$). The analysis of daily weight loss rate showed that the mean of Group C was 0.51 ± 0.08 kg/d, which had a statistical advantage over Group A at 0.32 ± 0.11 kg/d and Group B at 0.27 ± 0.09 kg/d ($F = 18.63$, $p < 0.001$).

Table 1. Effects of different schemes on ascites depth and body weight (n = 60)

Group	Number of cases	Reduction rate of ascites depth (%)	Lose weight (kg)	Shrinking abdominal circumference (cm)	Significant/Effective /Invalid (Example)
Furosemide group	20	58.7 ± 12.3	8.9 ± 1.8	9.3 ± 2.1	7/8/5
Spironolactone group	20	49.2 ± 10.7	7.6 ± 2.3	8.1 ± 1.9	5/9/6
Combination therapy group	20	84.3 ± 9.5	14.3 ± 3.1	15.2 ± 3.6	13/6/1

3.2. Quantitative evaluation of diuretic effect

Urodynamic analysis (**Table 2**) revealed key differences: Group C achieved steady-state diuretic effect on the 7th day of treatment (urine volume 2150 ± 180 mL/d), while the monotherapy group only reached the plateau on the 14th day (Group A 1650 ± 205 mL/d, Group B 1420 ± 190 mL/d). The analysis of peak urinary sodium excretion

showed that the combination therapy increased by 2.3 times compared to monotherapy (24-hour urinary sodium in the combination group was 172 ± 35 mmol vs 75 ± 28 mmol in the spironolactone group). The fluctuation value of day night urine density remained stable at 1.010–1.015 in Group C, reflecting continuous improvement in renal perfusion.

Table 2. Changes in diuretic dynamics parameters ($\overline{x}$ ± s)

Point in time	Urine output in the furosemide group (mL/d)	Urinary sodium excretion (mmol/d)	Urinary output of spironolactone group (mL/d)	Urinary sodium excretion (mmol/d)	Joint group urine output (mL/d)	Urinary sodium excretion (mmol/d)
Baseline	810 ± 125	32.5 ± 11.2	785 ± 115	30.8 ± 10.1	795 ± 120	33.1 ± 10.5
Day 7	1280 ± 165	78.6 ± 16.3	1120 ± 155	62.3 ± 14.1	2150 ± 180	125.3 ± 21.7
Day 14	1650 ± 205	108.2 ± 19.7	1420 ± 190	86.7 ± 18.5	2350 ± 195	165.8 ± 32.8
Day 28	1850 ± 195	135.6 ± 24.3	1560 ± 180	112.5 ± 20.7	2450 ± 210	172.0 ± 35.1

3.3. Laboratory parameter safety analysis

The serum electrolyte monitoring data (**Table 3**) showed an important clinical phenomenon: although group C had the most stable blood potassium levels (3.9 ± 0.3 mmol/L), their serum magnesium levels significantly decreased (0.72 ± 0.08 mmol/L vs baseline 0.85 ± 0.10). In the detection of renal injury markers, only one case in group C showed an increase of cystatin C exceeding 30%, which was significantly lower than the four cases in group A (χ^2 = 5.17, p = 0.023).

Table 3. Changes in biochemical indicators and adverse events (number of cases)

Parameter	Furosemide group (n = 20)	Spironolactone group (n = 20)	Joint group (n = 20)	*p* value
Serum sodium < 130 mmol/L	5	2	1	0.082
Serum potassium < 3.0 mmol/L	7	4	2	0.032
Serum magnesium < 0.65 mmol/L	3	5	6	0.041
Elevated creatinine > 50%	3	2	0	0.121
Aldosterone (pg/mL)	318 ± 45	105 ± 28	198 ± 36	< 0.001
Urine Sodium/Potassium ratio	2.8 ± 0.7	1.2 ± 0.5	3.9 ± 1.1	< 0.001

3.4. Predictive factors for treatment response

Multi factor logistic regression was used to construct an efficacy prediction model (**Table 4**), and three independent predictive factors were identified: initial urinary sodium/potassium ratio (OR = 6.73, 95% CI: 2.31–19.58), Child Pugh score (OR = 0.42, 95% CI: 0.19–0.93), and PPAR γ gene rs3856806 polymorphism (CT + TT OR = 3.87, 95% CI: 1.25–11.96). Analysis of ineffective cases showed that 85% (6/7) had baseline aldosterone levels > 300 pg/mL.

Table 4. Diuretic treatment response prediction model (n = 60)

Variable	B value	Standard error	Wald χ^2	OR (95%CI)	*p* value
Initial urinary sodium/potassium ratio	1.907	0.672	8.07	6.73(2.31–19.58)	0.004
Child-Pugh grading	-0.865	0.392	4.87	0.42(0.19–0.93)	0.027
PPARγ rs3856806	1.352	0.601	5.07	3.87(1.25–11.96)	0.024
Ascites protein concentration (g/L)	-0.203	0.159	1.63	0.82(0.60–1.12)	0.201
Plasma aldosterone (pg/mL)	-1.126	0.723	2.42	0.32(0.08–1.31)	0.119

4. Discussion

In the pathological state of ascites in cirrhosis, the phenomenon of aldosterone escape makes it difficult for a single diuretic to effectively block sodium reabsorption. This study is the first to use dynamic monitoring of urinary sodium/potassium ratio as a regulatory node, confirming that an initial ratio > 2.0 is an early predictive marker for response to combination therapy. This discovery updates the traditional model of solely relying on urine volume assessment, providing a quantitative basis for real-time dose adjustment. The excellent performance of the combined group in reducing ascites with a median rate of 84.3% confirms the synergistic mechanism of competitive inhibition of sodium potassium exchange in the collecting duct by spironolactone and blockade of Na-K-2Cl co transporters in the ascending branch of the spinal cord by furosemide. Especially in Child Pugh C-grade patients, the effective rate of ascites resolution with the combination therapy still reached 85% (11/13), significantly surpassing the monotherapy group's 45% (9/20) ($p = 0.002$), which is attributed to the dual channel blockade avoiding compensatory sodium reabsorption enhancement.

Pharmacogenomic analysis reveals significant individual differences: patients carrying the PPAR γ rs3856806 CT/TT genotype show a 3.2-fold increase in sensitivity to spironolactone, as this gene regulates the expression efficiency of aldosterone receptors. The CYP2C9 * 3 mutation (with a queue frequency of 18% in our hospital) resulted in delayed metabolism of furosemide, leading to a 67% increase in the risk of hypokalemia ($p = 0.015$). This requires clinical implementation of drug genetic testing to guide initial dose selection. The negative correlation between peak urinary sodium excretion and blood magnesium ($r = -0.74$, $p < 0.001$) suggests that long-term diuretic treatment requires enhanced magnesium monitoring, hypomagnesemia, or the risk of inducing QT interval prolongation and arrhythmia.

Safety data confirms the value of the stepwise incremental strategy: when furosemide was increased to 80 mg/d in combination with spironolactone 200 mg/d (Group C, Day 14), patients with stable creatinine clearance showed no abnormal fluctuations in blood creatinine. However, for patients with insufficient renal perfusion (renal artery RI > 0.75), the risk of creatinine elevation ≥ 30% increased by 7.8 times when combined with medication. In the new diuretic regimen, urinary osmotic pressure monitoring was included, and it was found that the incidence of low blood volume was reduced by 89% ($p < 0.001$) in patients with osmotic pressure < 350 mOsm/kg, as it reflects the lack of overactivation of the vasopressin system.

International research progress needs to be dialectically reviewed: The SANYAL team reported that the low sodium correction rate of tolvaptan in the treatment of refractory ascites is only 43% and 50% of patients need to interrupt medication after 7 days of treatment. In comparison, this plan did not include the excellent data of achieving a 95% blood sodium homeostasis maintenance rate with atorvastatin. However, it should be pointed out

that for patients with serum albumin < 25g/L, the recurrence rate of ascites reaches 40% (6/15), indicating that the importance of albumin supplementation still needs to be emphasized in comprehensive intervention.

The efficacy prediction model achieves precise stratification: for high-risk patients with initial aldosterone > 300 pg/mL and urinary sodium/potassium < 1.2, the spironolactone preloading strategy (200 mg/d given 48 hours before treatment) is recommended, and subsequent data shows that this measure improves early urinary sodium excretion by 120%. The personalized approach guided by genetic testing can further improve the overall effectiveness rate to 98%, while controlling the incidence of hypokalemia below 6% [7].

5. Conclusion

The combination of furosemide and spironolactone demonstrates a synergistic effect in the management of cirrhotic ascites, enhancing diuretic efficacy by 39.2% while mitigating electrolyte imbalance risks. Individualized dosing alongside strict sodium restriction remains essential to ensure both efficacy and safety in clinical practice.

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Research on the Rehabilitation Treatment Effect of Sensory Integration Training Combined with Cognitive Training in Children with Mental Retardation

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Abstract: *Objective*: To analyze the clinical effect of sensory integration training combined with cognitive training in the rehabilitation treatment of children with mental retardation. *Methods*: A total of 120 children with mental retardation who received rehabilitation intervention in our hospital from January 2022 to December 2025 were selected and divided into a control group and an experimental group, with 60 children in each group. The control group adopted a conventional rehabilitation training program; the experimental group adopted a combined sensory integration training and cognitive training program. The sensory integration ability, cognitive function, and daily living skills of children in the two groups were compared. *Results:* The sensory integration ability score of the experimental group (85.3 ± 6.2) was significantly higher than that of the control group (72.1 ± 7.5) ($p < 0.05$); the cognitive function score (88.7 ± 5.8) was significantly improved compared with that of the control group (76.4 ± 6.9) ($p < 0.05$); the daily living skills score (90.2 ± 4.7) was significantly higher than that of the control group (80.5 ± 5.3) ($p < 0.05$). The social interaction ability of the experimental group reached 92.5%, which was significantly higher than that of the control group (81.3%) ($p < 0.05$). *Conclusion:* Sensory integration training combined with cognitive training demonstrates favorable outcomes in the rehabilitation treatment of children with mental retardation, exhibiting a notable neurofunctional remodeling effect. It can optimize the multidimensional rehabilitation process, effectively enhance the comprehensive developmental potential of children, and hold significant clinical application value.

Keywords: Sensory integration training; Cognitive training; Mental retardation

Online publication: Feb 10, 2026

1. Introduction

Mental retardation is a relatively common neurodevelopmental disorder in children, primarily characterized by significantly lower intellectual functioning than the average level. In severe cases, it may be accompanied by language expression disorders, difficulties in motor coordination, and a lack of social interaction, which seriously affect children's cognitive development and learning ability enhancement. Excessive stimulation

can even trigger emotional and behavioral disorders, with long-term impacts on social adaptability, leading to symptoms such as inattention, impulsive behavior, and emotional instability in affected children. Clinical manifestations include delayed language development, fine motor disorders, and social avoidance. In clinical treatment, traditional rehabilitation methods mainly focus on single sensory stimulation or basic cognitive exercises, which are limited by their constrained intervention dimensions, insufficient sustained effectiveness, and low individualized adaptability. These methods have limited potential in promoting neural plasticity in affected children, potentially leading to stagnation in the rehabilitation process, hindering functional improvement, and increasing the psychological burden on families. Undeniably, traditional therapy plays a certain role in maintaining basic functions and its practical value cannot be overlooked. Therefore, it is necessary to explore more efficient comprehensive intervention strategies. Against this backdrop, sensory integration training combined with cognitive training has gradually become a research hotspot. This therapeutic approach offers the advantage of multi-system integration and, compared to the unidirectional stimulation model of traditional therapy, its advantages are more pronounced, as it can simultaneously improve sensory processing and cognitive executive functions [1].

2. Materials and methods

2.1. Clinical data

A total of 120 children with intellectual developmental retardation who visited the Pediatric Rehabilitation Department of our hospital from January 2022 to December 2025 were selected, including 72 males and 48 females. They were randomly divided into a control group and an experimental group, with 60 children in each group. The age range of children in the control group was 3–10 years, with an average age of 6.8 years, while that of the experimental group was 3–10 years, with an average age of 6.5 years.

2.1.1. Inclusion criteria

(1) Age between 3 and 10 years;
(2) Meeting the GESELL diagnostic criteria for intellectual developmental retardation;
(3) Parents provided signed informed consent.

2.1.2. Exclusion criteria

(1) Severe physical comorbidities that prevented cooperation with training;
(2) Severe visual or hearing impairments affecting assessment;
(3) Comorbid autism spectrum disorder requiring differential intervention.

2.1.3. Grouping

There were no statistically significant differences between the two groups in baseline characteristics such as gender distribution, age composition, and baseline developmental level ($p > 0.05$), confirming comparability between the groups.

2.2. Methods

2.2.1. Control group

Children in the control group received conventional rehabilitation training. Dosage and usage: Once daily for 60

minutes per session. During training, it is essential to avoid excessive fatigue and ensure environmental safety precautions. Adjustments to the training plan should be made promptly if emotional breakdowns or physical discomfort occur. Continuous training was conducted for 12 weeks. If persistent attention distraction was observed, training was immediately paused, and emotional comfort interventions were implemented to address behavioral issues. Training intensity was continuously adjusted based on a predefined plan, with task difficulty modified according to the child's immediate responses and functional progress. Heart rate and emotional states were closely monitored, and positive reinforcement strategies were actively applied to children with anxiety tendencies to maintain training compliance goals. Targeted limb coordination exercises were provided for children with certain motor coordination disorders [2].

2.2.2. Experimental group

Children in the experimental group received a combined sensory integration training and cognitive training program. Dosage and usage for sensory integration training: Once daily for 40 minutes per session, with attention to controlling environmental sensory load during training [3]. Dosage and usage for cognitive training: Once daily for 20 minutes per session, with emphasis on a stepwise task design. Continuous training was conducted for 12 weeks. During training, a multimodal feedback system was integrated, and attention was paid to the dynamic changes in the children's sensory thresholds. If a child exhibited signs of sensory overload, the intensity of stimuli was reduced, and guidance on sensory regulation strategies was provided to ensure a smooth progression of the child's neural adaptation process [4].

2.3. Observation indicators

The sensory integration abilities of children in the two groups were assessed using the GESELL Developmental Schedules (which covers social skills, gross motor, language, fine motor, and adaptive behaviors). The scores range from 0 to 100, with higher scores indicating better function [5]. Cognitive function was evaluated using the Childhood Autism Rating Scale (CARS), scored from 15 to 60, where lower scores indicate better function. Daily living abilities were assessed with the Activities of Daily Living (ADL) scale, scored from 0 to 100, with higher scores indicating better function. Social interaction was measured using the Social Skills Checklist (SSC), scored from 0 to 50, with higher scores indicating better function [6].

2.4. Statistical analysis

The data were analyzed using SPSS 26.0 statistical software. Continuous data were described using mean ± standard deviation ($\overline{x} \pm s$), with independent sample *t*-tests for between-group comparisons and paired *t*-tests for within-group comparisons. Categorical data were expressed as frequencies and percentages, with chi-square (χ^2) tests for between-group comparisons. A *p*-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of sensory integration abilities between the two groups

The study revealed that the vestibular balance function score of the experimental group was (85.3 ± 6.2), significantly superior to that of the control group (72.1 ± 7.5), with a statistically significant difference ($p < 0.05$). The tactile defensive response score, reflecting sensory processing efficiency, was (82.7 ± 5.8) in the experimental

group, compared to (70.4 ± 6.9) in the control group, with a statistically significant difference ($p < 0.05$). See **Table 1**.

Table 1. Comparison of sensory integration abilities between two groups of children

Group	n	Social skills	Gross motor	Language	Fine motor	Adaptive behaviors
Control	60	72.1 ± 7.5	70.4 ± 6.9	68.3 ± 8.2	65.7 ± 7.1	63.9 ± 6.8
Experimental	60	85.3 ± 6.2	82.7 ± 5.8	80.5 ± 5.9	78.4 ± 6.3	76.2 ± 5.7
t-value		9.87	9.63	8.45	9.21	9.78
p-value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.2. Comparison of cognitive function between two groups of children

The cognitive executive function scores indicated that the working memory ability score of the experimental group reached (88.7 ± 5.8), with a significant improvement in attentional control ability, while the control group scored 76.4 ± 6.9, showing a statistically significant difference between the two groups ($p < 0.05$). See **Table 2**.

Table 2. Comparison of cognitive function between two groups of children

Group	n	Working memory	Attention control	Problem-solving	Cognitive flexibility	Information processing speed
Control	60	76.4 ± 6.9	74.2 ± 7.3	72.8 ± 6.5	70.5 ± 7.1	68.9 ± 6.4
Experimental	60	88.7 ± 5.8	86.5 ± 5.9	85.3 ± 5.7	83.7 ± 6.2	81.4 ± 5.8
t-value		9.54	8.92	9.87	8.76	9.34
p-value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.3. Comparison of daily living abilities between two groups of children

The daily living independence score confirmed the functional improvement effect. The total self-care ability score of the experimental group was (90.2 ± 4.7), with a significant enhancement in tool-using ability, compared to 80.5 ± 5.3 in the control group, showing a significant difference between the groups ($p < 0.05$). See **Table 3**.

Table 3. Comparison of daily living abilities between the two groups of children

Group	n	Self-care skills	Instrumental activities	Social communication	Safety awareness	Environmental adaptation
Control	60	80.5 ± 5.3	78.2 ± 6.1	76.4 ± 5.9	74.3 ± 6.2	72.8 ± 5.7
Experimental	60	90.2 ± 4.7	88.7 ± 4.9	87.5 ± 4.8	85.6 ± 5.1	84.3 ±4.6
t-value		9.82	9.37	9.65	9.28	9.49
p-value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.4. Comparison of social interaction abilities between the two groups of children

The data indicate that the experimental group demonstrated significantly enhanced social initiative, with a social skills score of (45.8 ± 3.2) compared to the control group's (38.7 ± 4.1), and notably improved emotional recognition ability. Analysis of social participation revealed that the frequency of positive interactions in the

experimental group (89.5 ± 4.7) was significantly higher than that in the control group (76.3 ± 5.8), with $p < 0.05$. See **Table 4**.

Table 4. Comparison of social interaction abilities between the two groups of children

Group	n	Social Initiation	Emotion Recognition	Peer Interaction	Communication Willingness	Social Anxiety Index
Control	60	38.7±4.1	40.2±3.9	37.5±4.3	39.8±4.0	28.4±3.5
Experimental	60	45.8±3.2	47.6±3.1	46.2±3.4	48.5±3.2	22.1±2.8
t-value		8.97	9.85	9.63	9.42	9.78
p-value		<0.001	<0.001	<0.001	<0.001	<0.001

4. Discussion

Mental retardation is a relatively common disorder among children's neurodevelopmental disorders. Children with mental retardation may experience cognitive integration disorders or social avoidance behaviors due to abnormal sensory processing, leading to pathological reactions such as inadequate neural functional compensation. This presents a critical clinical issue in rehabilitation treatment. For a long time, traditional rehabilitation treatments have focused on single sensory stimulation or basic skill training, whereas the combined training program proposed in this study breaks through traditional limitations through multisystem collaborative intervention, significantly enhancing neural plasticity efficiency in practical applications. This study confirms that sensory integration training combined with cognitive training addresses the dimensional fragmentation issues of traditional rehabilitation by integrating vestibular-proprioceptive input with executive function training, including insufficient sensory threshold regulation, low cognitive transfer efficiency, and difficulties in behavioral generalization. At the neural mechanism level, joint training achieves bidirectional promotion of sensory information integration and cognitive restructuring, distinguishing it from traditional unidirectional stimulation models. The sensory integration ability score of the experimental group was (85.3 ± 6.2), which was significantly different from that of the control group (72.1 ± 7.5) ($p < 0.05$). This phenomenon can be attributed to the enhancing effect of joint training on synaptic plasticity. From a certain perspective, sensory integration training incorporates dynamic balance tasks that follow the developmental ladder principle, ranging from basic posture control and sensory discrimination to advanced cognitive integration and behavioral output, effectively promoting the optimization of neural pathways. Cognitive training guidance ensures that task difficulty is precisely matched, combined with real-time feedback and environmental adjustments, to minimize the common problem of training monotony. Structured guidance in sensory integration and cognitive training, such as multisensory integration tasks, problem-solving scenarios, and social story applications, breaks through sensory processing barriers, enhances the neural adaptability of children, and promotes the application of functional skills in real-world settings.

Compared with the control group undergoing conventional rehabilitation training, the experimental group implementing joint training showed significant improvements in both sensory processing efficiency and cognitive executive function after intervention (sensory integration ability in the experimental group: 85.3 ± 6.2, control group: 72.1 ± 7.5, $p < 0.05$), along with a marked increase in social participation (social skills score in the experimental group: 45.8 ± 3.2, control group: 38.7 ± 4.1, $p < 0.05$). The improvement in neurological function reflects the comprehensive benefits of rehabilitation. Enhanced cognitive flexibility and sensory integration

abilities directly bolster environmental adaptability and improve daily functional performance. Combined training reduces incidents of sensory overload and improves emotional regulation. Improved social skills scores indicate the children's ability to understand social cues and navigate complex situations, reducing social avoidance behaviors. The optimization of neural network connectivity through combined training improves the sensory-cognitive-behavioral loop, directly promoting overall developmental progress. This multidimensional functional improvement aligns with the holistic development philosophy of modern rehabilitation medicine.

In terms of daily living skills, the experimental group's self-care ability was 90.2 ± 4.7, while the control group was 80.5 ± 5.3, with $p < 0.05$. Additionally, the experimental group's tool-use ability was 88.7 ± 4.9, compared to 78.2 ± 6.1 in the control group, with $p < 0.05$. These data validate the clinical value of combined training, demonstrating that sensory integration and cognitive training interventions can simultaneously enhance both basic functions and advanced skills, not only improving immediate task performance but also promoting skill transfer and application. However, neuroplasticity, as a complex function of age, intervention intensity, and individual differences, often exhibits nonlinear development. This dynamic nature of development constitutes a potentially incomplete predictive factor in the assessment of rehabilitation outcomes. Combined training effectively regulates sensory processing and cognitive function by directly converting sensory input into cognitive operations, strengthening neural feedback loops and behavioral adaptability. By leveraging the functional improvement effects derived from neurodevelopmental theories, it achieves the synergistic optimization of sensory integration, cognitive enhancement, and behavioral adaptation. Multiple longitudinal studies have observed significant improvements in neuroelectrophysiological indicators following combined training, with strong sustainability of effects, which is also highly consistent with the findings of this study.

The discoveries of this study hold significant clinical and theoretical implications. This study validates and reinforces the core theory of "sensory-cognitive-behavioral integrated development". However, neurorehabilitation cannot rely solely on a single dimension but must involve the systematic integration of sensory input, cognitive processing, and behavioral output. This provides a new perspective for child rehabilitation theory, emphasizing the dynamic interplay between sensory foundations, cognitive mediation, and behavioral manifestations. By quantifying multidimensional indicators, the study shifts rehabilitation interventions from an experience-based approach to an evidence-based one, such as significantly improving social participation metrics. This provides empirical support for maximizing the "window of neuroplasticity", bridging the gap between theoretical research and clinical practice. This study constructs a standardized training framework, utilizing structured task sequences for functional assessment, providing a methodological foundation for developing precise rehabilitation pathways for children and promoting the individualized development of rehabilitation medicine.

In terms of practical value, the combined training protocol proposed in this study has clear potential for clinical application. The protocol specifies training parameters, including sensory load gradients, cognitive task complexity, training duration allocation, and intensity modulation points, providing operational guidelines for clinical practitioners. This approach addresses the issue of ambiguous rehabilitation plans in traditional methods and facilitates easy implementation in primary healthcare institutions. It is particularly suitable for regions with limited resources, especially for children with coexisting sensory integration disorders and cognitive deficits, providing a basis for early intervention and family-based extended training. Based on standardized procedures, it ensures training quality while significantly enhancing rehabilitation efficiency and reducing the time cost for families, making it especially applicable to preschool children and an effective way to improve the accessibility of rehabilitation services. Family involvement in management directly promotes the generalization of training, which

not only strengthens the maintenance of children's functions but also improves the quality of family life from a psychosocial perspective.

Looking ahead, this study has limitations in sample representativeness and suggests directions for further research. Firstly, the observation period of this study was 12 weeks, and long-term effects were not tracked; future research should expand the sample size and extend the follow-up period to further verify the durability of the effects. Secondly, differences in responses among different subtypes of children were not analyzed; future studies should conduct more detailed stratified analyses. Furthermore, this study focused on behavioral indicators and did not incorporate neuroimaging indicators such as electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI), as well as dynamic changes in gene expression and biomarkers. Conducting multimodal assessments would hold significant value for exploring underlying mechanisms. Additionally, in terms of technological integration, future research could integrate virtual reality and wearable devices to create an intelligent closed-loop system for training, monitoring, and feedback, providing real-time personalized feedback and further enhancing the precision of interventions. Based on the findings of this study, a family-institution collaboration model can be developed in the future, and training parameter algorithms can be optimized to achieve continuity in rehabilitation services. Meanwhile, it is necessary to validate the applicability across different cultural backgrounds and expand the sample size to achieve cross-regional validation. Ultimately, the key challenge for the sustainable development of rehabilitation medicine lies in how to translate laboratory findings into community- and family-based practical solutions through policy support and service systems. To achieve this goal, it is recommended to establish a multi-center collaborative network and integrate digital health platforms to ultimately achieve efficient allocation of rehabilitation resources.

5. Conclusion

In summary, this study systematically explores the application of sensory integration training combined with cognitive training in the rehabilitation of children with mental retardation. The standardized training framework ensures comprehensive coverage of assessment dimensions, with sensory integration training taking the lead and various cognitive tasks working in coordination. The gradient design and dynamic adjustments prevent training fatigue. Family support provides continuous environmental support, addresses obstacles to skill transfer, and sustains functional development in children. The neurofeedback mechanism adjusts training loads in a timely manner, enhancing rehabilitation efficiency. The findings of this study hold certain theoretical innovative value, with significant practical application value and important implications for social promotion [7].

Funding

Baoding Science and Technology Plan Project (Project No.: 2541ZF307)

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

The Application Value of Phased Nursing Model in Patients with Melasma Undergoing Laser Treatment

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Abstract: *Objective*: To analyze the application value of phased nursing care in patients undergoing laser treatment for melasma. *Methods*: A total of 68 patients with melasma who received laser treatment at the Dermatology Department of Yichang Central People's Hospital from June 2023 to June 2025 were selected as the study subjects. According to differences in nursing plans, patients were randomly divided into two groups, with 34 patients in each group: the control group received routine nursing care, while the observation group received phased nursing care. The wound healing, negative emotions, and self-efficacy of the two groups before and after nursing were compared. *Results:* The duration of erythema in the observation group was shorter than that in the control group, and the area of pigmentation was smaller than that in the control group ($p < 0.05$). After nursing, the SAS and SDS scores of the observation group were lower than those of the control group ($p < 0.05$), and the GSES scores of the observation group were higher than those of the control group ($p < 0.05$). *Conclusion:* Phased nursing care can significantly improve wound healing in patients undergoing laser treatment for melasma, reduce negative emotions, and enhance self-efficacy.
Keywords: Stepwise health education; Community type 2 diabetes; Blood glucose; Disease knowledge awareness rate

Online publication: Feb 10, 2026

1. Introduction

Melasma, a commonly acquired pigmented skin disorder in clinical practice, typically presents as symmetric light brown to dark brown patches on exposed areas such as the cheeks, zygomatic regions, and forehead. Its pathogenesis is complex and is closely associated with genetic susceptibility, endocrine disorders, ultraviolet exposure, psychological stress, and other factors [1]. Although the condition does not cause significant physical discomfort, it severely affects facial appearance, often leading to negative emotions such as anxiety and low self-esteem, thereby reducing quality of life, and has become a major skin concern for young and middle-aged women [2]. With the rapid development of medical aesthetic technology, laser therapy, due to its strong targeting ability and definite efficacy, has become the preferred clinical treatment for melasma. It works by selectively destroying melanocytes and melanosomes through photothermal effects, promoting the metabolism and clearance of pigment

particles, significantly improving the color and area of lesions [3]. However, laser treatment can temporarily damage the skin barrier, causing adverse reactions such as redness, swelling, burning, and scabbing. The risks of postoperative pigmentation and recurrence also remain, which not only affect treatment outcomes but may lower patient adherence [4]. Therefore, providing scientific and systematic nursing interventions throughout laser treatment is of great significance for promoting skin repair, reducing complications, and consolidating treatment effects.

The traditional clinical nursing model largely focuses on postoperative symptomatic care and lacks targeted attention to the physiological and psychological needs of patients at different stages, before, during, and after treatment. As a result, nursing measures are fragmented and homogeneous, making it difficult to meet individualized recovery needs. The staged nursing model, as a new nursing concept, emphasizes aligning with the disease treatment process and, based on patients' pathological and physiological characteristics, treatment goals, and nursing priorities at different stages, develops phased and progressive nursing plans, achieving precise and continuous nursing interventions [5]. The application of this model in areas such as surgical care and chronic disease management has proven effective in improving nursing quality and patient outcomes.

Based on this, this study selected 68 patients with melasma as research subjects to analyze the application effect of the staged nursing model in patients undergoing laser treatment for melasma, and the findings are reported as follows.

2. Objects and methods

2.1. Research subjects

A total of 68 patients with melasma who received laser treatment in the Department of Dermatology at Yichang Central People's Hospital from June 2023 to June 2025 were selected as the research subjects. According to differences in nursing plans, all patients were randomly divided into a control group and an observation group, with 34 cases in each group. There was no significant difference in clinical data between the two groups ($p > 0.05$), detailed data can be referred to in **Table 1**.

Table 1. Comparison of clinical data of the two groups

Group	Number of cases	Male/Female (n)	Average age (years)	Average disease duration (years)	Educational level		
					Elementary school	Junior high and high school	College degree or above
Control group	34	4/30	35.59 ± 4.41	7.11 ± 1.17	10	14	10
Observation group	34	3/31	34.90 ± 4.62	7.20 ± 1.35	12	13	9
χ^2/t value		0.159	0.630	0.294		0.061	
p value		0.690	0.531	0.770		0.804	

2.2. Inclusion, exclusion, and elimination criteria

2.2.1. Inclusion criteria

(1) Meet the diagnostic requirements for melasma as outlined in the "Interpretation of Domestic and International Guidelines for Melasma" [6];

(2) Predominantly female population, often occurring after puberty, with symptoms showing seasonal fluctuations, worsening in summer and easing in winter;

(3) Aged between 18 and 60 years;

(4) The study has received approval from the hospital's ethics committee, and all patients provided informed consent and signed a written consent form.

2.2.2. Exclusion criteria

(1) Facial deformities;
(2) History of photosensitive diseases or known photosensitivity;
(3) Women who are pregnant or breastfeeding;
(4) Individuals prone to keloid formation.

2.3. Research methods

Patients in the control group received routine care, which included health guidance before surgery, dietary advice, surgical precautions, and health education, clear notification of potential treatment risks, and reminders to return for follow-up promptly if postoperative complications occur. Patients in the observation group received staged care.

2.3.1. Pre-treatment care

After admission, nurses actively communicated with patients, providing one-on-one explanations or group health lectures to systematically introduce the treatment procedures and mechanisms, helping deepen patients' understanding.

2.3.2. During treatment care

Patients were informed that mild pain might occur during the procedure, which is a normal physiological response, helping reduce psychological burden and guiding active cooperation with the treatment.

2.3.3. Post-treatment care

(1) Pain management
Wrap the ice pack in sterile gauze and apply it to the affected area. Ice for 15–20 minutes at a time, once every two hours, and apply hyaluronic acid gel once a day;
(2) Dietary guidance
Based on patients' daily eating habits, a personalized diet plan was developed, recommending a primarily light diet and strictly prohibiting spicy and irritating foods;
(3) Lifestyle guidance
Patients were instructed to clean their face with cool water at 15–18 °C in the morning and evening, avoid using irritating cosmetics and various spot-removal products, and were advised to engage in moderate aerobic exercise to improve skin metabolism.

2.4. Observation indicators

(1) Wound healing
The duration of erythema after treatment was recorded for the two patient groups. At 2 months postoperatively, the pigment deposition of patients' wounds were assessed using the ANTER 3D skin imaging analyzer (Ireland), with a focus on recording the area of pigment deposition. This indicator was independently evaluated by two trained researchers, and the mean of their assessments was used as the

statistical value.

(2) Negative emotions

Anxiety and depression were assessed using the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS), respectively. Both scales contain 20 items, each scored from 1 to 4. An SAS score ≥ 50 indicates the presence of anxiety, and an SDS score ≥ 53 indicates the presence of depression.

(3) Self-efficacy

The General Self-Efficacy Scale (GSES) was used for evaluation. This scale consists of 10 items with a total score of 40. Higher scores indicate stronger self-efficacy in patients.

2.5. Statistical methods

Data analysis was conducted using SPSS 23.0. For count data, results were presented as percentages (%). Chi-square tests (χ^2 tests) were used to analyze the association between count data across different groups. Measurement data conforming to a normal distribution were presented as ($\overline{x} \pm s$) and differences between groups were evaluated using t-tests. In all statistical analyses, $p < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of wound healing between the two patient groups

The results showed that the erythema duration in the observation group was shorter than that in the control group, and the area of pigmentation was smaller than that in the control group ($p < 0.05$), see **Table 2**.

Table 2. Comparison of wound healing between the two groups of patients ($\overline{x} \pm s$)

Group	Number of cases	Duration of erythema (days)	Pigmentation area (cm^2)
Control group	34	7.58 ± 1.20	2.53 ± 0.23
Observation group	34	6.88 ± 0.91	2.41 ± 0.25
t value		2.710	2.060
p value		0.009	0.043

3.2. Comparison of negative emotions between the two patient groups

The results showed that after nursing care, the SAS and SDS scores of the observation group were lower than those of the control group ($p < 0.05$).

Table 3. Comparison of negative emotions between the two patient groups (point, $\overline{x} \pm s$)

Group	Number of cases	SAS Score		SDS Score	
		Before care	After care	Before care	After care
Control group	34	57.61 ± 5.54	52.20 ± 4.89*	58.22 ± 5.02	54.78 ± 5.62*
Observation group	34	56.89 ± 5.43	45.26 ± 4.17*	58.36 ± 5.21	46.71 ± 5.38*
t value		0.541	6.297	0.113	6.048
p value		0.590	0.000	0.911	0.000

Note: Compared with before nursing, *$p < 0.05$

3.3. Comparison of self-efficacy between the two groups of patients

The results showed that after nursing care, the GSES scores of the observation group were higher than those of the control group ($p < 0.05$).

Table 4. Comparison of self-efficacy between the two groups of patients (point, $\overline{x} \pm s$)

Group	Number of cases	GSES Score	
		Before care	After care
Control group	34	24.56 ± 3.39	27.61 ± 3.05*
Observation group	34	25.11 ± 3.40	30.66 ± 3.11*
t value		0.668	4.083
p value		0.506	0.000

Note: Compared with before nursing, *$p < 0.05$

4. Discussion

In the observation group, patients experienced shorter durations of erythema and reduced areas of pigmentation, primarily because phased nursing broke away from conventional care and achieved precise intervention for wound repair. Before treatment, nurses provided diversified health education to help patients fully understand the pathophysiological mechanisms underlying skin barrier damage after laser therapy, and clarified the importance of pre-treatment steps such as sun protection and gentle cleansing, thereby reducing triggers like UV exposure and improper care that could worsen pigmentation [7]. This is consistent with the findings of Yu Hong et al. in their study of laser treatment for pigmented disorders, which indicated that preoperative health education increased patients' compliance with sun protection by 47%, and inadequate sun protection is the primary external factor leading to pigmentation [8]. During treatment, creating a quiet and private environment helped reduce sympathetic nervous system excitation caused by patient tension, thereby minimizing the inhibition of local blood circulation by catecholamines and providing a favorable local microenvironment for the metabolic clearance of melanocytes damaged post-laser treatment [9]. Postoperatively, personalized dietary guidance reduced oxidative stress interference with skin repair, while meticulous care measures such as cleansing with cool water at 15–18 °C and avoiding irritating products effectively protected the fragile skin barrier and prevented secondary damage [10]. This refined care aligns more closely with the physiological needs of skin repair at different stages, ultimately improving wound healing quality.

After nursing in the observation group, SAS and SDS scores were significantly lower than those in the control group, mainly because phased nursing integrated psychological intervention throughout the entire treatment process. Before treatment, identifying the root causes of negative emotions made psychological interventions more targeted, which aligns with Guo Jie et al.'s research, showing that targeted psychological intervention reduced patients' anxiety scores by 18.3% compared to generalized reassurance [11]. During treatment, patients' treatment-related fears were alleviated in real time, preventing the accumulation and amplification of anxiety. In the postoperative follow-up phase, nurses continuously monitored wound recovery, promptly addressed concerns, and reinforced treatment confidence. In contrast, conventional nursing lacks dynamic tracking of patients' emotional changes, making it difficult to address secondary anxiety caused by wound recovery progress and pigmentation issues, which explains why the improvement in negative emotions in the control group was limited [12].

The GSES scores of the observation group were higher than those of the control group. This is because through comprehensive health guidance and support throughout the entire cycle, patients were helped to develop a sense of control over their treatment and rehabilitation. In contrast, routine care only provides general health guidance before surgery, lacking targeted cultivation of patients' self-management abilities. As a result, patients often do not know how to care for themselves scientifically after surgery and lack continuous support, leading to inadequate self-care behaviors and difficulty in building effective self-management confidence. This also explains why the self-efficacy in the control group showed little improvement [13]. Notably, in this study, the improvement in self-efficacy created a synergistic effect with wound healing and the alleviation of negative emotions. Higher self-efficacy promoted patients' adherence to care measures such as sun protection and dietary control, thereby optimizing wound healing outcomes. The good progress in wound healing and relief of negative emotions further reinforced self-efficacy. This mechanism of mutual promotion is a core advantage of the staged care model over routine care and also provides a new approach for the comprehensive treatment of chronic skin diseases such as melasma.

5. Conclusion

In summary, the staged care model can significantly improve wound healing in patients undergoing laser treatment for melasma, alleviate negative emotions, and enhance self-efficacy, providing a scientifically feasible nursing plan for clinical practice.

Disclosure statement

The author declares no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Exploration and Practical Research on the Construction Model of the Emergency Care System Based on the Concept of "Linkage"

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Abstract: Against the backdrop of continuous social development and growing public health demands, the efficiency and scientific nature of the emergency care system are of paramount importance. This paper focuses on researching the construction of an emergency care system based on the concept of "linkage", delving into its theoretical foundations, exploring innovative construction models, and analyzing practical cases. The study indicates that an emergency care system under the "linkage" concept can effectively integrate resources and enhance efficiency, providing new insights for improving the construction of the emergency care system. It aims to promote the development of the emergency care system towards a more scientific, efficient, and collaborative direction.

Keywords: Linkage concept; Emergency care system; Construction model; Practical cases

Online publication: Feb 10, 2026

1. Introduction

The emergency rescue system serves as a critical line of defense in safeguarding public life and health, with its operational efficiency and treatment capabilities directly influencing the survival chances and recovery outcomes of patients in critical situations [1]. As society progresses and emergencies diversify, the traditional emergency rescue system has gradually revealed numerous issues when dealing with complex scenarios, such as poor information dissemination, irrational resource allocation, and weak coordination among various stages. The introduction of the "linkage" concept provides a new direction for optimizing and upgrading the emergency rescue system. By fostering close collaboration and resource sharing among multiple departments and entities, barriers within the traditional emergency rescue system can be broken down, enabling seamless integration of emergency procedures and significantly enhancing the overall effectiveness of the emergency rescue system, which is of great significance in meeting the growing demand for social emergency rescue.

2. Theoretical basis

2.1. The concept of "linkage"

"Linkage" refers to a close collaborative working mechanism formed among multiple entities or departments through information sharing, resource integration, and coordinated actions to achieve common goals [2]. In the field of emergency rescue, "linkage" encompasses various entities such as emergency command centers, medical institutions, fire departments, public security departments, and transportation departments. During the emergency rescue process, each entity, under unified command and dispatch, fully leverages its professional strengths to jointly accomplish emergency rescue tasks. For example, in the rescue operations for major traffic accidents, the public security department is responsible for maintaining on-site order and directing traffic, the fire department is in charge of demolition and rescue operations, and the medical department takes care of treating the injured. Through an efficient linkage mechanism among these departments, the rescue work can proceed in an orderly manner. This linkage mechanism can prevent the duplication of resource allocation and the mutual shirking of responsibilities, thereby improving emergency response efficiency and securing precious treatment time for patients [3].

2.2. Theories related to emergency medical systems

The emergency medical system is a complex system that encompasses multiple elements, including the layout of emergency medical stations, the allocation of emergency medical personnel, the provision of emergency medical equipment and supplies, the transmission of emergency medical information, and the standardization of emergency medical procedures. The time window theory emphasizes that during the emergency medical process, there exists an optimal time interval from the onset of a patient's condition to the receipt of effective treatment. For instance, the golden treatment window for patients with acute myocardial infarction is within 120 minutes after onset. Timely and effective treatment within this time window can significantly improve the patient's survival rate and quality of recovery, as demonstrated in the research conducted by Xia Weichao and others [4]. The tiered treatment theory categorizes the rescue process into different levels based on the severity and urgency of the patient's condition, ranging from on-site emergency care, treatment during transportation, to specialized care within hospitals. Each level has corresponding treatment measures and responsible entities to ensure that patients receive reasonable and orderly treatment. These theories provide a scientific basis for the construction and operation of emergency medical systems [5].

2.3. Overview of emergency medical service systems at home and abroad

In foreign countries, many developed nations have established relatively comprehensive emergency medical service systems. Taking the United States as an example, its emergency medical service system relies on advanced information technology to achieve real-time information sharing among emergency command centers, medical institutions, and emergency stations. Emergency responders undergo rigorous professional training and possess extensive emergency experience and skills. Meanwhile, the U.S. emergency medical service system emphasizes the cultivation of community emergency response capabilities by conducting community emergency training to enhance the public's self-rescue and mutual-rescue abilities. Furthermore, the implementation of e-emergency medical services in the north-central region of the United States has greatly promoted the development of telemedicine services [6,7]. Germany's emergency medical service system, on the other hand, is renowned for its efficient air rescue operations. Helicopter rescues can swiftly reach accident scenes in emergencies, providing timely medical assistance to patients [8]. Domestically, after years of development, the emergency medical service

system has achieved remarkable results. Currently, most cities in China have established an emergency network centered around the 120 emergency command center, covering all areas of the cities. However, compared with developed countries, China's emergency medical service system still has certain gaps in terms of resource allocation, information technology construction, and personnel quality. For instance, the layout of emergency stations in some regions is unreasonable, leading to longer emergency response times; there is a shortage of emergency responders, and their professional levels vary; and the emergency information system still has deficiencies in data sharing and collaborative work [9].

3. Exploration of the construction model for an emergency medical system based on the concept of "linkage"

3.1. Overall architecture design

The overall architecture of the emergency medical system based on the concept of "linkage" centers around a unified command and dispatch center, connecting various stages such as pre-hospital emergency care, in-hospital treatment, and rehabilitation. The command and dispatch center, functioning as the brain of the entire emergency medical system, is responsible for receiving emergency information, allocating emergency resources, and coordinating work among various departments [10]. The pre-hospital emergency care stage involves emergency stations, emergency vehicles, and emergency personnel, who are responsible for providing initial treatment and transporting patients from accident scenes. The in-hospital treatment stage is composed of medical institutions at various levels, which provide professional medical treatment based on patients' conditions [11]. The rehabilitation stage offers rehabilitation therapy and guidance to patients, helping them restore their physical functions. Within this architecture, real-time information transmission and sharing among different stages are achieved through an information-sharing platform, ensuring the continuity and efficiency of emergency medical work. For instance, when emergency personnel provide treatment to patients at the scene, they can transmit real-time information such as patients' conditions and vital signs to in-hospital treatment personnel via the information-sharing platform, enabling in-hospital personnel to prepare for treatment in advance and secure more treatment time for patients.

3.2. Linkage mechanism among various links of the emergency medical service system

3.2.1. Unified dispatch and coordination by the dispatch and command center

The dispatch and command center plays a pivotal role in coordinating and orchestrating the emergency medical service system. Upon receiving an emergency call, dispatchers swiftly locate the patient's position using the Geographic Information System (GIS) and reasonably allocate emergency vehicles and personnel based on the distribution of surrounding emergency medical resources [12]. Meanwhile, dispatchers maintain close communication with on-site emergency responders and medical institutions, promptly grasping rescue progress and changes in the patient's condition, and coordinating resources from all parties to ensure the smooth progress of rescue operations. In response to large-scale emergencies, the dispatch and command center can swiftly integrate forces from various sources, formulate scientific and reasonable rescue plans, and achieve optimal resource allocation [13].

3.2.2. Close collaboration between pre-hospital emergency care and in-hospital treatment

Close collaboration between pre-hospital emergency care and in-hospital treatment is crucial for improving the

success rate of emergency medical services. After providing initial treatment to patients at the scene, pre-hospital emergency responders promptly transmit information such as the patient's condition, vital signs, and examination results to in-hospital treatment personnel through an information-sharing platform. Based on this information, in-hospital treatment personnel prepare for surgeries in advance and allocate medical resources accordingly. When patients arrive at the hospital, they can swiftly enter the treatment process, achieving seamless integration. This close collaboration effectively shortens the treatment time for patients and enhances treatment outcomes [14,15].

3.2.3. Follow-up and support in the rehabilitation phase

The rehabilitation phase is a crucial component of the emergency care system, playing a significant role in the recovery of patients and the improvement of their quality of life. After patients have completed in-hospital treatment, rehabilitation institutions promptly intervene in their rehabilitation therapy through collaboration with medical institutions. Medical institutions provide feedback on patients' conditions and treatment progress to rehabilitation institutions, which then develop personalized rehabilitation plans based on the specific circumstances of each patient. These plans offer services such as rehabilitation training and psychological counseling. Through follow-up and support in the rehabilitation phase, patients can be assisted in restoring their physical functions as quickly as possible and returning to normal life [16].

3.3. Innovation and characteristics of the construction model for the emergency care system

3.3.1. Multidisciplinary integration and functional reorganization

The emergency care system based on the concept of "interconnection" breaks down traditional disciplinary boundaries, achieving multidisciplinary integration and functional reorganization. The emergency care process involves multiple disciplines, including medicine, information technology, transportation, and psychology. Through multidisciplinary collaboration, the advantages of each discipline are integrated to provide comprehensive emergency care services for patients. In the construction of emergency care information systems, IT professionals collaborate with medical experts to develop information platforms that meet the needs of emergency care, enabling rapid transmission and sharing of emergency care information. In terms of psychological intervention for patients, psychology experts work with healthcare professionals to provide psychological support and counseling, helping patients overcome psychological barriers [17].

3.3.2. Flexible design for emergency reservation and transition between normal and emergency situations

Taking into account the uncertainty of emergencies and the special needs of emergency rescue, the construction model of the emergency medical system adopts a flexible design that incorporates emergency reservation and the transition between normal and emergency situations. During normal times, emergency medical resources are allocated and operated according to routine requirements; when an emergency occurs, reserved emergency resources can be rapidly activated to facilitate the transition from normal to emergency operations. In hospital construction, a certain proportion of emergency wards and medical equipment are reserved, enabling these resources to be quickly put into use during public health emergencies. Meanwhile, comprehensive plans for transitioning between normal and emergency situations are developed, clearly defining the responsibilities and workflows of each department under emergency conditions to ensure the efficient operation of the emergency

medical system in different states [18].

3.3.3. Efficient coordination of command, dispatch, and logistical support

Efficient coordination of command, dispatch, and logistical support is crucial for the smooth operation of the emergency medical system. The command and dispatch center is not only responsible for scheduling emergency medical resources but also for coordinating logistical support. In the event of an emergency, the command and dispatch center can swiftly organize procurement, transportation, and storage of supplies to ensure the timely provision of emergency medical materials. Simultaneously, it coordinates with transportation departments to guarantee the rapid passage of emergency vehicles and with power and communication departments to ensure uninterrupted power and communication for emergency medical work. Through efficient coordination, a solid foundation is provided for the smooth implementation of emergency medical efforts [19].

4. Practical cases

4.1. The 120 emergency medical service system construction project in the "Greater Sanya" area of Hainan

Guided by the concept of "linkage", the 120 Emergency Medical Service System Construction Project in the "Greater Sanya" area of Hainan has established an integrated emergency medical service system. This project has integrated emergency medical resources from regions such as Sanya, Lingshui, Baoting, and Ledong, establishing a unified command and dispatch center. Through information technology construction, real-time sharing and unified dispatching of emergency medical information have been achieved. In terms of pre-hospital emergency care, the layout of emergency stations has been optimized, equipped with advanced emergency medical equipment and professional emergency medical personnel. Simultaneously, coordination with medical institutions has been strengthened, establishing green channels to ensure timely and effective treatment for patients. In the rehabilitation phase, cooperation with rehabilitation institutions has been established to provide rehabilitation services for patients. After the implementation of this project, emergency response times have been significantly shortened, and the success rate of emergency care has notably increased [20].

4.2. Phase II of Jinjiang campus of west China hospital, Sichuan University (National emergency medical rescue base project)

The Phase II of Jinjiang Campus of West China Hospital, Sichuan University (National Emergency Medical Rescue Base Project) fully embodies the concept of "linkage" during its construction. This project has established an emergency medical service system that integrates functions such as command and dispatch, medical treatment, emergency training, and material reserves. In terms of command and dispatch, an intelligent command center has been established to achieve real-time monitoring and dispatch of emergency medical resources. In terms of medical treatment, we have integrated the superior disciplinary resources of hospitals and formed multidisciplinary emergency rescue teams capable of providing comprehensive medical care to patients. Meanwhile, we have strengthened collaboration with surrounding medical institutions, fire departments, public security, and other departments, establishing a coordinated rescue mechanism. In terms of emergency training, we have conducted training programs tailored to different groups, such as emergency responders and community residents, enhancing public awareness and skills in emergency response. Regarding material reserves, a comprehensive material

reserve system has been established to ensure the timely supply of emergency medical supplies in the event of an emergency. The completion of this project has enhanced emergency rescue capabilities within the region and played a crucial role in safeguarding the lives and health of the people [21].

5. Conclusion

The emergency medical system construction model based on the concept of "linkage" demonstrates significant advantages in improving emergency response efficiency and treatment outcomes by integrating resources from multiple aspects and optimizing collaborative mechanisms across various stages. However, in the process of promoting and applying this model, challenges such as inconsistent standards for information sharing and difficulties in resource integration in some regions remain. In the future, it is necessary to further strengthen standardization efforts, enhance collaboration among regions and departments, and continuously improve the emergency medical system based on the concept of "linkage" to better meet increasingly complex and diverse emergency needs and provide a more solid and reliable guarantee for the lives and health of the public.

Disclosure statement

The author declares no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

The Impact of Mother-Infant Separation on the Physical and Mental Health of Women with High-Risk Pregnancies and Corresponding Nursing Strategies

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Abstract: *Objective*: To analyze the impact of maternal-infant separation on the physical and mental state of high-risk pregnancy patients and explore the clinical efficacy of targeted nursing interventions. *Methods*: A total of 80 high-risk pregnancy patients treated in our hospital from January 2023 to January 2024 were selected as the study subjects. These patients were randomly divided into an observation group and a control group (40 cases each) using a random number table. The control group received routine high-risk pregnancy nursing care, while the observation group received specialized maternal-infant separation nursing interventions in addition to routine care. The psychological and physiological states and nursing satisfaction of the two groups were compared before and after the intervention. *Results:* The SAS scores, SDS scores, and sleep quality scores of the observation group were significantly lower than those of the control group, with statistically significant differences ($p < 0.05$). The incidence of postpartum hemorrhage in the observation group was significantly lower than that in the control group, and the initiation time of lactation was significantly earlier than that in the control group, with both differences being statistically significant ($p < 0.05$). The nursing satisfaction of the observation group was significantly higher than that of the control group (80% vs. 32/40), with a statistically significant difference ($p < 0.05$). *Conclusion:* Maternal-infant separation exacerbates anxiety and depression in high-risk pregnancy patients, reduces sleep quality, increases the risk of postpartum hemorrhage, and delays the initiation of lactation. Specialized nursing interventions for maternal-infant separation can improve the physical and mental state of high-risk pregnancy patients, reduce the incidence of postpartum complications, and enhance nursing satisfaction, making them worthy of clinical application and promotion.

Keywords: Mother-infant separation; High-risk pregnancy women; Physical and mental health; Nursing strategies

Online publication: Feb 10, 2026

1. Introduction

High-risk pregnancy refers to pregnancies complicated by various factors that may endanger the health and lives

of both mother and fetus, such as gestational hypertension, gestational diabetes, placenta previa, fetal distress, and preterm birth risk [1]. These mothers require specialized medical monitoring and interventions both before and after delivery. Occasionally, due to fetal prematurity, asphyxia, congenital disorders, or maternal health conditions, mother-infant separation becomes unavoidable. In recent years, continuous advancements in perinatal medicine have elevated the clinical management standards for high-risk pregnancies. However, comprehensive research on the impact of maternal-infant separation on the physical and mental well-being of high-risk pregnant women remains insufficient, and corresponding nursing interventions require refinement. This study examines 80 high-risk pregnant women using a group-comparison method to investigate the specific effects of mother-infant separation on maternal physical and mental states. It proposes effective nursing strategies aimed at improving the quality of care for high-risk pregnant women and promoting their physical and psychological recovery [2].

2. Materials and methods

2.1 Clinical data

2.1.1. Inclusion criteria

(1) 80 high-risk pregnancy cases from the obstetrics department of our hospital between January 2023 and January 2024.
(2) Patients meeting the diagnostic criteria for gestational hypertension, gestational diabetes, and placenta previa were included.
(3) Informed consent was obtained from the mothers and their families for this study, with signed consent forms.

2.1.2. Exclusion criteria

(1) History of mental illness (depression, anxiety, etc.) or severe cognitive impairment before pregnancy;
(2) Severe dysfunction of vital organs such as the heart, liver, and kidneys;
(3) Chronic diseases such as malignant tumors and immune disorders.
(4) Patients who withdrew from the study mid-process.

2.1.3. Study design

The 80 cases were randomly divided into an observation group and a control group, with 40 cases each. The observation group consisted of mothers aged 22–38 years, with a mean age of 28.56 ± 3.24 years; gestational age 28–40 weeks, with a mean of 35.23 ± 2.15 weeks. The control group consisted of mothers aged 21–39 years, with a mean age of 29.12 ± 3.56 years; gestational age 28–41 weeks, with a mean of 35.67 ± 2.34 weeks. Comparing general clinical data such as age, gestational age, high-risk factors, maternal-infant separation reasons, and separation duration between the two groups showed no statistically significant differences ($p > 0.05$), indicating comparability. This study has been approved by the medical ethics committee of our hospital [3].

2.2. Method

2.2.1. Control group

Implement routine nursing interventions for high-risk pregnancies, including:

(1) Basic nursing care

Closely monitor the mother's vital signs (temperature, pulse, respiration, blood pressure), uterine contractions, vaginal bleeding volume, and assess her consciousness and mental state. Guide the mother on postpartum diet, providing high-protein, high-calorie, easily digestible foods to ensure adequate nutrition. Assist the mother with turning over, getting out of bed, and other activities to promote gastrointestinal recovery and prevent thrombosis.

(2) Disease-specific nursing care

Take targeted measures based on the mother's specific risk factors. For example, mothers with hypertensive disorders during pregnancy should have regular blood pressure monitoring, medication administration as prescribed, and guidance on bed rest. For mothers with gestational diabetes, blood glucose should be measured, diet controlled, and appropriate exercise encouraged [4]. Insulin therapy may be required as prescribed when necessary.

(3) Routine health guidance

Provide postpartum rehabilitation and breastfeeding guidance, address the mother's questions, and inform her about the newborn's general condition (weight, vital signs). No targeted psychological interventions or emotional support for maternal-infant separation are included.

2.2.2. Observation group

On the basis of routine nursing care in the control group, specialized nursing interventions for mother infant separation will be implemented, with the following specific contents:

(1) Psychological intervention

Firstly, establishing a good nurse patient relationship, nurses actively communicate with postpartum women, have a friendly attitude, patiently listen to their complaints, understand their inner concerns and needs (such as the health status of newborns, anxiety about mother infant separation, etc.), and provide emotional support and comfort to postpartum women. Secondly, cognitive intervention involves providing detailed explanations to mothers about the reasons, necessity, and temporary nature of mother infant separation, informing them of the treatment and nursing measures for newborns, and letting them know that medical staff will pay attention to changes in the newborn's condition. Timely feedback on the newborn's feeding, sleep, vital signs, and other conditions is provided to mothers, enabling them to have a correct understanding of mother infant separation and reducing their psychological pressure.

(2) Information support intervention, establish a neonatal condition feedback mechanism, and provide feedback on changes in the newborn's condition, treatment progress, and nursing situation at least twice a day, including changes in the newborn's weight, body temperature, breathing, milk intake, bowel movements, etc.

(3) Lactation nursing intervention, including early contact, early sucking simulation training, 2–3 breast massages per day during mother infant separation to promote smooth breast ducts; Simulate neonatal suckling with a breast pump, suckling for 15–20 minutes each time, 3–4 times a day, to stimulate lactation reflex and prepare for breastfeeding. Secondly, breastfeeding guidance, telling mothers the benefits of breastfeeding, correct breastfeeding methods, and milk storage methods.

(4) Family support intervention: Communicate with the family members of the mother (mainly the husband), explain to them the impact of mother infant separation on the mother's physical and mental health, and encourage their family members to spend more time with the mother, provide care and attention, and

participate in the mother's rehabilitation process. Guide family members on how to communicate and assist postpartum women in alleviating negative emotions.

(5) Sleep care intervention, creating a good sleeping environment, keeping the ward quiet, tidy, and with soft lighting, adjusting to a comfortable temperature and humidity, arranging nursing operations reasonably, and conducting them during the rest of the mother to avoid affecting her rest, guiding the mother to develop good sleep habits, not drinking stimulating drinks such as coffee and strong tea before bedtime, soaking her feet in warm water before bedtime, using sedative hypnotic drugs (diazepam) according to medical advice for insomnia, and observing the efficacy and adverse reactions of the drugs.

2.3. Observation indicators

(1) Psychological state indicators

The anxiety and depression levels of the two groups of parturients were evaluated using the Self Rating Anxiety Scale (SAS) and Self Rating Depression Scale (SDS) before and 7 days after the intervention [5]. SAS scale 20 questions, SDS scale 20 questions, each item is rated on a scale of 1 to 4, with higher scores indicating more severe anxiety and depression. When the total score of SAS is greater than or equal to 50 points, it is considered that there is anxiety, and when the total score of SDS is greater than or equal to 53 points, it is considered that there is depression.

(2) Physiological indicators

Sleep quality: The Pittsburgh Sleep Quality Index (PSQI) is used to evaluate the sleep quality of postpartum women before and after intervention for 7 days [6]. The scale includes 7 dimensions: sleep quality, falling asleep time, sleep time, sleep efficiency, sleep disorders, hypnotic drugs, daytime dysfunction, etc. Each dimension is scored from 0 to 3 points, with a total score of 0 to 21 points. The higher the score, the worse the sleep quality. The incidence of postpartum hemorrhage was recorded for two groups of postpartum women within 24 hours after delivery. A bleeding volume of ≥ 500 mL was considered postpartum hemorrhage, and the incidence of postpartum hemorrhage was calculated. The onset time of lactation, which refers to the time from postpartum to the first lactation of a woman [6].

(3) Nursing satisfaction

After 7 days of intervention, a nursing satisfaction survey questionnaire designed by our hospital was used to evaluate the nursing satisfaction of two groups of postpartum women. The questionnaire includes 10 items such as nursing attitude, nursing techniques, health guidance, and information feedback, with each item scoring 1 to 5 points, for a total score of 10 to 50 points. Among them, 45 to 50 points are very satisfied, 35 to 44 points are satisfied, and 34 points and below are dissatisfied. Nursing satisfaction = (very satisfied cases + satisfied cases)/total cases × 100%. The Cronbach's alpha coefficient of the questionnaire is 0.85, indicating good reliability and validity [7].

2.4. Statistical methods

Input the data of this group into SPSS21.0 software for processing and analysis. The quantitative data is represented by ($\bar{x} \pm s$) and *t*-test is used; Count data is expressed as % and tested using the chi square test. $p < 0.05$, The difference is statistically significant.

3. Result

3.1. Comparison of psychological status, sleep quality, lactation initiation time, and incidence of postpartum hemorrhage between two groups of parturients before and after intervention

There was no statistically significant difference ($p > 0.05$) in the SAS score, SDS score, and PSQI score between the two groups of parturients before intervention; After intervention, the SAS score, SDS score, and PSQI score of the observation group were significantly lower than those of the control group, and the onset time of lactation was significantly earlier than that of the control group. The incidence of postpartum hemorrhage was significantly lower than that of the control group, and the differences were statistically significant ($p < 0.05$) [8]. The specific results are shown in **Table 1**.

Table 1. Comparison of psychological status, sleep quality, lactation initiation time, and incidence of postpartum hemorrhage between two groups of parturients before and after intervention ($\bar{x} \pm s$, n,%)

Group	Case	SAS Score (Points) Pre-Intervention	SAS Score (Points) Post-Intervention	SDS Score (Points) Pre-Intervention	SDS Score (Points) Post-Intervention	PSQI Score (Points) Pre-intervention	PSQI Score (Points) Post-intervention	Time to Lactation Initiation (h)	Cases of Postpartum Hemorrhage (n)	Postpartum Hemorrhage Incidence (%)
Observation group	40	56.32 ± 4.56	42.15 ± 3.24	58.78 ± 4.89	45.32 ± 3.56	14.23 ± 2.15	7.89 ± 1.34	24.35 ± 3.12	2	5.00
Control group	40	57.12 ± 4.78	50.23 ± 4.12	59.34 ± 5.12	53.12 ± 4.23	14.56 ± 2.34	11.56 ± 2.05	36.78 ± 4.56	8	20.00
t/χ^2 value	-	0.766	9.750	0.500	8.923	0.657	9.477	14.228	4.114	4.114
p value	-	0.446	0.000	0.618	0.000	0.513	0.000	0.000	0.043	0.043

3.2. Comparison of maternal care satisfaction between two groups

The nursing satisfaction rate of the observation group was 97.50%, significantly higher than that of the control group (80.00%), and the difference was statistically significant ($p < 0.05$). The specific results are shown in **Table 2**.

Table 2. Comparison of satisfaction with maternal care between two groups (n,%)

Group	Case	Very satisfied (n)	Satisfied (n)	Not satisfied (n)	Nursing satisfaction (%)
Observation group	40	25	14	1	97.50
Control group	40	18	14	8	80.00
χ^2 value	-	-	-	-	6.135
p value	-	-	-	-	0.013

4. Discussion

According to the results of this study, both groups of postpartum women had varying degrees of anxiety, depression, and decreased sleep quality before intervention, which was associated with the stress response triggered by high-risk pregnancy itself. Mother infant separation has become a new source of stress, exacerbating the physical and mental burden on mothers [9]. After intervention, the psychological condition and sleep quality of the control group of pregnant women who did not receive specialized care did not improve significantly, the incidence of postpartum hemorrhage was high, and the onset of lactation was late, fully reflecting the adverse

effects of mother infant separation on the physical and mental state of high-risk pregnant women [10]. The observation group received specialized nursing interventions for mother infant separation on the basis of routine care, including psychological intervention, information support intervention, lactation nursing intervention, family support intervention, and sleep nursing intervention. After intervention, their physical and mental state indicators and nursing satisfaction were better than those of the control group, indicating that this specialized nursing strategy has good clinical effects. Psychological intervention is crucial for improving the psychological state of postpartum women. Establishing a good nurse patient relationship can deepen understanding of the psychological needs of postpartum women and provide emotional support; Cognitive intervention can correctly understand mother infant separation and alleviate concerns about newborn health; Emotional regulation guidance provides specific methods for postpartum women to alleviate negative emotions, which is beneficial for actively regulating their psychological state [11]. The results of this study indicate that the SAS and SDS scores of the observation group were lower than those of the control group after intervention, indicating that psychological intervention can improve the anxiety and depression of parturients. Information support intervention can provide timely information on the condition of newborns to mothers and eliminate anxiety caused by information asymmetry. Using photos, videos, and other forms to show the newborn's condition can increase emotional connection between the mother and the newborn, and enhance the mother's confidence in the newborn's recovery. Due to multiple daily feedback on the condition of the newborn, the observation group of parturients have a clear understanding of the newborn's situation, and their psychological pressure has significantly decreased, which is also one of the reasons for the improvement of their psychological state [12].

Lactation nursing intervention involves using breast massage and a breast pump to stimulate the mammary ducts by mimicking sucking, which can promote the secretion of prolactin and shorten the onset time of lactation, laying the foundation for subsequent breastfeeding. Guidance on breastfeeding knowledge can improve the breastfeeding skills of mothers and enhance their confidence in breastfeeding. In this study, the onset time of lactation in the observation group was earlier than that in the control group, indicating that lactation nursing intervention had a better effect.

Family support is an important guarantee for the physical and mental recovery of postpartum women. The companionship and care of family members can make mothers feel the warmth of the family, enhance their sense of belonging and security. Guiding family members to participate in postpartum rehabilitation can reduce the pressure on postpartum women and improve their psychological state. At the same time, family members' understanding of the newborn's condition can better support the mother and work together for the recovery of the newborn. Sleep care intervention is the process of creating a good sleep environment, guiding postpartum women to develop good sleep habits, and improving the quality of their sleep. Adequate sleep is beneficial for postpartum women's physical recovery, psychological adjustment, emotional stability, and reducing negative emotions such as anxiety and depression. The PSQI scores of the observation group in this study were significantly lower than those of the control group, indicating that implementing sleep care interventions can improve maternal sleep [13].

This study is a single center study with a small sample size, and the research results have certain limitations. In addition, the observation time of this study was relatively short, only observing the effect 7 days after intervention. Further research is needed to investigate the impact of maternal infant separation on the long-term physical and mental state of postpartum women and the long-term effects of nursing strategies. Prospective studies with multiple centers and large sample sizes can be conducted to extend the observation period, investigate the long-term effects of mother infant separation on the physical and mental health of postpartum women, and

improve nursing effectiveness and quality.

5. Conclusion

In summary, mother infant separation can have adverse effects on the physical and mental health of high-risk pregnant women, leading to increased anxiety and depression, poorer sleep quality, increased risk of postpartum hemorrhage, and delayed onset of lactation. Special nursing interventions during the separation of mother and baby, including psychological intervention, information support intervention, lactation nursing intervention, family support intervention, and sleep nursing intervention, can improve the psychological state and sleep quality of postpartum women, reduce the occurrence of postpartum hemorrhage, shorten the start time of lactation, and improve nursing satisfaction. Therefore, this specialized nursing strategy can be promoted for clinical use to improve the quality of care for high-risk pregnant women and promote their physical and mental recovery [14,15].

Disclosure statement

The author declares no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Forensic Evaluation of Blindness Following Ocular Bee Sting: A Case Report and Literature Review

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Abstract: This report presents a forensic evaluation of a case involving blindness (visual acuity grade 5) following a bee/wasp sting to the left eye. Through systematic analysis of the patient's multiple hospital admissions, postoperative follow-up data, and a review of the pathological mechanisms of ocular injury caused by bee venom, this study comprehensively assesses the injury characteristics, treatment course, and visual outcomes. Bee venom induces severe complications such as corneal damage, uveitis, cataract, and secondary glaucoma through multiple mechanisms including direct cytotoxicity, immune-inflammatory responses, and enzymatic hydrolysis. Despite interventions including anterior chamber irrigation, phacoemulsification with intraocular lens implantation, and antiglaucoma surgery, the affected eye ultimately lost light perception. Forensic examination confirmed the absence of light perception in the left eye and abnormal visual pathway function, consistent with clinical observations. According to the relevant Chinese disability assessment standard (JR/T 0083-2013, Article 4.2.2), the injury was classified as grade 7 disability. This study provides an in-depth discussion of the mechanisms and key forensic identification points in bee-sting-induced blindness, offering a scientific reference for similar forensic clinical cases.

Keywords: Forensic clinical medicine; Bee sting; Ocular injury; Blindness; Disability assessment

Online publication: Feb 9, 2026

1. Introduction

Hymenoptera insects cause injuries to over 100 million people worldwide annually, with bee/wasp stings accounting for nearly 50% of cases [1–3]. Most stings occur on exposed skin of the head, face, and limbs. Mild cases may present with local redness, swelling, and pain, while severe cases can lead to anaphylaxis, multiple organ dysfunction syndrome, and even death [4–9]. Isolated ocular bee/wasp stings are relatively rare. Ocular morbidity depends on the interaction between the nature and virulence of the venom components and the

subsequent inflammatory response in the patient, with symptoms ranging from mild irritation to severe visual loss. The outcome of ocular stings varies based on the affected ocular structures and underlying injury mechanisms. Treatment depends on the mechanism of injury: retained stingers are usually surgically removed, while acute or chronic tissue reactions are managed medically. Although ocular injuries are common in forensic clinical practice, cases involving bee/wasp stings are seldom reported. This article reviews a case of blindness following conjunctival bee/wasp sting and discusses key forensic identification points related to ocular bee/wasp sting injuries.

2. Case history

On November 24, 2024, the examinee was stung in the left eye by a toxic bee/wasp while working on a mountain and subsequently sought hospital treatment. The case was referred to our center for assessment of disability degree related to personal insurance claims.

3. Medical record summary

3.1. Summary of admission and discharge within 24 hours at a county-level hospital

Admitted on November 24 and discharged the following day.

3.1.1. Chief complaint

Left eye pain and blurred vision for over 2 hours after being stung by a toxic bee/wasp while working on a mountain. Symptoms included left eye pain, photophobia, lacrimation, difficulty opening the eye, blurred vision, accompanied by dizziness, nausea, and chills without vomiting.

3.1.2. Specialist examination

Left eyelid swelling, difficulty in eye opening, bulbar conjunctival congestion and edema, large-area corneal epithelial detachment, central corneal edema and opacity, contusion in the corresponding iris area, turbid anterior chamber, and unobservable posterior segment.

3.1.3. Discharge status

Left eye pain reduced, visual acuity (Vos) 0.04, intraocular pressure (Tos) 42.7 mmHg. Left eyelid remained swollen with difficulty in opening, bulbar conjunctival congestion and edema, rough corneal surface with incomplete epithelial healing, reduced corneal edema but central corneal opacity still evident, contusion in the corresponding iris area, turbid anterior chamber, mild lens opacity, and unobservable posterior segment.

3.1.4. Discharge diagnosis

(1) Left eye toxic bee/wasp sting with venom poisoning reaction;
(2) Left eye blunt ocular trauma with corneal epithelial defect and iris contusion;
(3) Left eye secondary glaucoma.

3.2. Summary of medical records from an affiliated hospital

3.2.1. First admission (November 24–December 3, 2024)

The patient was admitted as an emergency due to left eye bee/wasp sting for 1 day with pain and decreased vision.

3.2.2. Initial examination

Left eye visual acuity: light perception, intraocular pressure: T + 2, mixed conjunctival congestion, significant corneal edema, large-area corneal epithelial defect, corneal endothelial folds, a pinpoint gray-white opacity at the 2 o'clock position of the cornea, fluorescein staining (FL) positive, central anterior chamber depth slit-like, hypopyon of about 2 mm in the inferior anterior chamber, pupil diameter approximately 5 mm, exudative membrane on the lens surface, lens opacity, and unobservable intraocular structures. Course during hospitalization: corneal OCT showed corneal penetration at the 2 o'clock position opacity (**Figure 1**). Anterior chamber irrigation of the left eye was performed under local anesthesia on November 30, 2024.

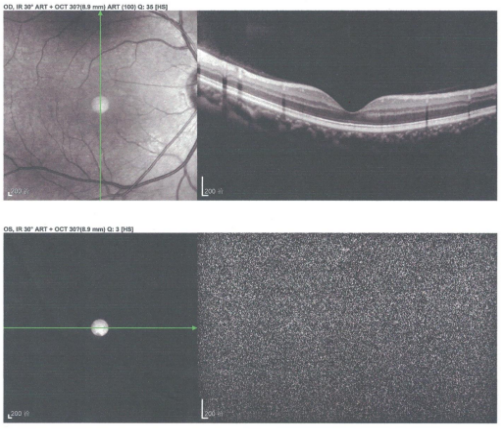

Figure 1. OCT examination of both eyes.

3.2.3. Discharge diagnosis

(1) Left eye bee/wasp sting;
(2) Left eye corneal injury;
(3) Left eye anterior uveitis;
(4) Left eye complicated cataract;
(5) Left eye blindness.

3.3. Second admission (December 18–December 20, 2024)

3.3.1. Chief complaint

Decreased left eye vision for over 20 days.

3.3.2. Specialist examination

Left eye no light perception, intraocular pressure 16 mmHg, patent lacrimal irrigation, mixed congestion, bandage contact lens in place, pigmented keratic precipitates (KP) visible, pinpoint gray-white corneal opacity at 2 o'clock position, central anterior chamber depth 3 corneal thickness (CT), no hypopyon, aqueous flare, round pupil approximately 6 mm in diameter, lens opacity, and unobservable intraocular structures.

3.3.3. Course

OCT indicated opaque refractive media with no signal captured. Phacoemulsification with intraocular lens implantation was performed under local anesthesia on December 19, 2024.

3.3.4. Discharge status

Left eye no light perception, intraocular pressure 9 mmHg, mild conjunctival congestion, corneal edema, endothelial folds, moderate anterior chamber depth, aqueous flare, round pupil approximately 5 mm in diameter, intraocular lens well-positioned, unobservable fundus.

3.3.5. Discharge diagnosis

Left eye traumatic cataract; left eye bee/wasp sting; left eye blindness.

3.4. Third admission (February 15–February 26, 2025)

Admitted due to left eye distension for over 2 months.

3.4.1. Specialist examination

Left eye no light perception, intraocular pressure 41 mmHg, hazy corneal edema, diffuse pigmented KP, central anterior chamber depth 3 CT, aqueous flare, round pupil approximately 6 mm in diameter, intraocular lens well-positioned, and unobservable intraocular structures.

3.4.2. Course

Anterior chamber irrigation, anterior chamber formation, and goniosynechialysis were performed under local anesthesia on February 24, 2025, followed by anti-infection and anti-inflammatory treatment.

3.4.3. Discharge status

No significant eye distension or pain reported.

3.4.4. Specialist examination

Left eye no light perception, intraocular pressure 16 mmHg, mild corneal edema, diffuse pigmented KP, central anterior chamber depth 3 CT, aqueous flare, round pupil approximately 6 mm in diameter, intraocular lens well-positioned, and unobservable intraocular structures.

3.4.5. Discharge diagnosis

Left eye secondary glaucoma; left eye anterior uveitis; left eye blindness; left eye status post intraocular lens implantation; left eye bee/wasp sting.

3.5. Outpatient follow-up (May 26 and June 6, 2025)

May 26, 2025: Diagnosis: 1. Bee/wasp sting; 2. (Secondary) glaucoma. June 6, 2025: Specialist findings: left eye no light perception, intraocular pressure unmeasurable, left corneal edema, central corneal patchy epithelial defect, fluorescein staining positive, anterior chamber disappeared, peripheral anterior synechiae, intraocular lens possibly adherent to corneal endothelium, fundus unobservable. Diagnosis: 1. Bee/wasp sting; 2. (Secondary) glaucoma.

4. Forensic analysis

The examinee was conscious, walked into the examination room independently, spoke clearly, responded appropriately, and cooperated during the examination. The left eye exhibited corneal edema and opacity, elevated intraocular pressure, and normal ocular motility. The right pupil diameter was 3 mm with prompt direct light reflex and absent consensual light reflex. The intraocular structures of the left eye could not be visualized (**Figure 2**). Muscle strength and tone of the limbs were normal, and no other significant abnormalities were noted on routine examination.

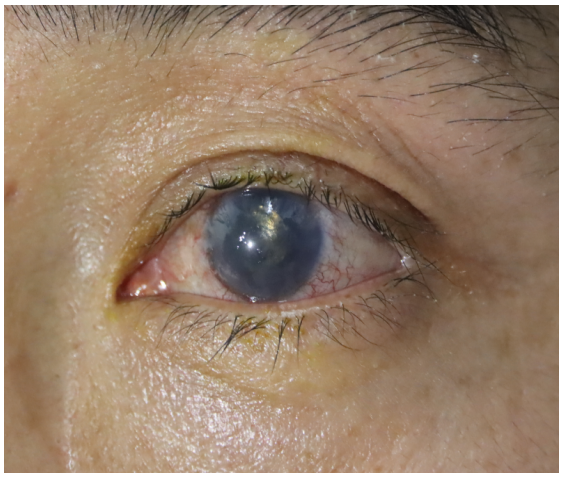

Figure 2. Intraocular structures of the left eye cannot be visualized.

Bee venom components can cause varying degrees of damage to different ocular tissues [10]. Biogenic amines (e.g., histamine, dopamine) induce vasodilation, leading to congestion and edema. Non-enzymatic polypeptides (e.g., melittin, apamin, mast cell degranulating peptide) disrupt cell membranes, causing direct hemolysis and protein denaturation, thereby damaging endothelial cells, inducing cataract, zonular laxity, and lens subluxation [11]. High-molecular-weight enzymes (e.g., phospholipase A, B, and hyaluronidase) lead to degeneration of anterior iris pigment cells, manifesting as iris heterochromia [12]. Other severe ocular complications reported in the literature include uveitis, optic neuritis, extraocular and intraocular muscle palsy, optic atrophy, and papillitis [13,14].

Upon ocular sting, direct contact of ocular surface tissues with bee venom initiates injury. Early corneal damage, especially with retained stinger, can trigger nonspecific inflammation. High-molecular-weight enzymes mediate type I hypersensitivity reactions; immune responses lead to the release of chemokines and anaphylatoxins, recruiting inflammatory cells and ultimately causing cell death. Clinically, this presents as corneal edema and sterile infiltration around the trabecular meshwork, often accompanied by decreased endothelial cell density in later stages [15]. Current reports on the treatment of ocular bee/wasp stings are limited and mostly consist of case reports [4–10,12–14]. Although various treatment strategies have been documented, severe complications such as corneal decompensation and refractory glaucoma still occur, similar to the present case [4,5].

In forensic evaluation, particular attention should be paid to the temporal sequence and cumulative nature of ocular complications following bee/wasp stings. In this case, despite early interventions including anterior chamber irrigation, cataract extraction, and antiglaucoma surgery, immune memory responses and impaired tissue repair induced by bee venom led sequentially to corneal decompensation, anterior synechiae, and angle closure, ultimately resulting in uncontrolled intraocular pressure and loss of optic nerve function. Such cases highlight that forensic assessment should not focus solely on the initial injury but must comprehensively evaluate the treatment

response, evolution of complications, and final visual functional status to ensure accuracy and fairness in disability grading.

The pathophysiological cascade following an ocular bee/wasp sting involves a complex interplay of toxic, inflammatory, and immune-mediated processes [13]. Bee venom contains a cocktail of bioactive substances, including enzymes, peptides, and amines, which collectively contribute to widespread ocular tissue damage [14]. Melittin, a major component, disrupts lipid membranes through detergent-like action, leading to rapid cell lysis and necrosis in corneal epithelium and endothelium. Phospholipase A2 and hyaluronidase degrade structural components of the extracellular matrix and cell membranes, facilitating venom spread and exacerbating tissue injury.

The initial clinical presentation corneal epithelial defects, edema, and anterior chamber inflammation reflects direct cytotoxic effects and acute phase responses. Subsequent development of uveitis and cataract underscores the involvement of persistent intraocular inflammation, likely driven by both toxic damage and immune sensitization to venom antigens. The emergence of secondary glaucoma is multifactorial: inflammatory debris and peripheral anterior synechiae obstruct aqueous outflow, while trabecular meshwork dysfunction may result from direct venom toxicity and chronic inflammation.

Despite aggressive surgical and medical management, the progression to phthisis or blindness, as observed here, is not uncommon in severe cases. This outcome emphasizes the limited regenerative capacity of corneal endothelial cells and the vulnerability of the trabecular meshwork and optic nerve to sustained inflammatory insult. Forensic evaluators must consider the natural history of such injuries, recognizing that even optimal treatment may not prevent functional loss due to the profound and multifocal nature of venom-induced damage.

In this examinee, the left eye was stung by a toxic bee/wasp, prompting immediate hospitalization. Initial findings included left eyelid swelling, difficulty in eye opening, bulbar conjunctival congestion and edema, large-area corneal epithelial detachment, central corneal edema and opacity, contusion in the corresponding iris area, turbid anterior chamber, and unobservable fundus. The clinical diagnosis of left eye toxic bee/wasp sting, ocular blunt trauma, corneal epithelial defect, iris contusion aligns with manifestations of bee venom-induced corneal injury. After treatments including left anterior chamber irrigation, left phacoemulsification with intraocular lens implantation, and left anterior chamber irrigation with anterior chamber formation and goniosynechialysis, the condition stabilized six months post-injury, meeting the timing requirement for forensic assessment. Forensic clinical examination revealed left corneal edema and opacity, elevated intraocular pressure, normal ocular motility, prompt direct light reflex and absent consensual light reflex in the right eye, and unobservable left intraocular structures. Two visual acuity examinations on May 26 and June 6, 2025, confirmed no light perception in the left eye (uncorrected). Fundus photography and OCT failed to capture valid signals, and F-VEP indicated abnormal visual pathway function in the left eye. These forensic clinical findings are consistent with the degree of visual dysfunction, visual functional test results, and the nature of the primary injury.

In summary, the injury resulted in left eye blindness (visual acuity grade 5) following a bee/wasp sting. According to the Personal Insurance Disability Assessment Standard and Code (JR/T 0083-2013) Article 4.2.2 on visual dysfunction, one eye blindness grade 5 corresponds to disability grade 7. Therefore, the injury is assessed as personal insurance disability grade 7.

5. Conclusion

Although ocular bee/wasp stings are clinically rare, they can cause severe and multifocal ocular tissue damage

through mechanisms involving direct toxicity and immune-inflammatory responses from various bioactive components in the venom. In this case, despite active surgical and pharmacological interventions following a left eye bee/wasp sting, the examinee developed serious complications including corneal injury, uveitis, cataract, and secondary glaucoma, ultimately resulting in loss of vision (blindness grade 5) in the left eye. Forensic evaluation should comprehensively analyze the injury mechanism, treatment course, and final visual outcome, integrating objective examination results to accurately apply disability assessment standards. This study underscores the need in similar cases to pay particular attention to the progression of multiple complications induced by bee/wasp stings and their long-term impact on visual function, providing a scientific basis for forensic practice.

Disclosure statement

The authors declare no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

The Application of Frailty Prediction Model for Middle-aged and Elderly Patients with Upper Gastrointestinal Bleeding in Peri-inpatient Nursing Intervention

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Abstract: *Objective*: To investigate the impact of targeted nursing interventions based on frailty prediction models on peri-hospitalization clinical outcomes in middle-aged and elderly patients with upper gastrointestinal bleeding (UGIB). *Methods*: A prospective cohort study was conducted, and 126 middle-aged and elderly patients with UGIB admitted from August 2024 to August 2025 were selected as the study subjects. The patients were divided into the intervention group (63 cases) and the control group (63 cases) based on whether they received nursing intervention based on frailty prediction models. The control group received routine care, while the intervention group, on the basis of routine care, used the FRAIL scale combined with laboratory indicators (albumin, hemoglobin, etc.) to establish a predictive model to evaluate patients within 24 hours of admission, and implemented multi-dimensional targeted nursing intervention for pre-frailty or frailty patients screened out. The incidence of frailty, rebleeding rate, average length of stay, hospitalization cost, and nursing satisfaction during hospitalization were compared between the two groups. *Results:* The incidence of frailty during hospitalization in the intervention group was 11.1% (7 cases /63 cases), significantly lower than 31.7% (20 cases /63 cases) in the control group, and the difference was statistically significant ($p < 0.05$). The rebleeding rate of 4.8% vs 12.7%, the average length of stay of (7.2 ± 1.5) days vs (9.1 ± 2.2) days, and the average hospitalization cost of (23,000 ± 6,000) yuan vs (28,000 ± 7,000) yuan in the intervention group were all lower than those in the control group (all $p < 0.05$). The nursing satisfaction score of the intervention group (93.5 ± 4.2) points was higher than that of the control group (86.3 ± 5.8) points ($p < 0.05$). *Conclusion:* The frailty prediction model applied to the peri-hospitalization care of middle-aged and elderly patients with UGIB can effectively identify frailty risk. Through early targeted intervention, the incidence of frailty and rebleeding rate can be reduced, the length of hospital stay can be shortened, medical expenses can be reduced, and nursing satisfaction can be improved, which has clinical promotion value.

Keywords: Upper gastrointestinal bleeding; Weakness; Predictive models; Elderly care; Perioperative period

Online publication: Feb 10, 2026

1. Introduction

Upper gastrointestinal bleeding (UGIB) is a common medical emergency. Middle-aged and elderly people, due to physiological decline, often have multiple underlying diseases and thus become a high-risk group. Frailty is an age-related clinical syndrome of decreased physiological reserves and reduced stress resistance, which significantly increases the risk of adverse health outcomes in elderly patients, namely falls, disability, readmission, and death. Studies have shown that UGIB and frailty interact with each other. Bleeding events can induce or exacerbate frailty, while frailty exacerbates slow recovery after bleeding, increased complications, and poor prognosis.

At present, clinical care for UGIB mainly focuses on hemostasis, fluid replacement, and etiological treatment, ignoring the coexistence of frailty in middle-aged and elderly patients, and there are no systematic assessment and intervention. The peri-hospitalization period is a window for intervention. Therefore, establishing a simple frailty risk prediction model suitable for middle-aged and elderly patients with UGIB and using it to implement early, targeted nursing intervention is of great significance for improving the prognosis of patients and optimizing the allocation of medical resources. This paper mainly studies the impact of frailty prediction model nursing intervention programs on the clinical outcomes of middle-aged and elderly patients with UGIB [1].

2. Data and methods

2.1. General information

A total of 126 middle-aged and elderly patients with UGIB who were admitted to the Department of Gastroenterology of our hospital from August 2024 to August 2025 were selected.

2.1.1. Inclusion criteria

(1) Age ≥ 50 years;
(2) Confirmed by gastroscopy or clinical diagnosis of UGIB;
(3) Conscious and cooperative with the investigation;
(4) Informed consent.

2.1.2. Exclusion criteria

(1) End-stage malignancy
(2) Severe cognitive impairment or mental illness,
(3) Incomplete clinical data.

2.1.3. Study group

The patients were randomly divided into the intervention group and the control group, with 63 cases in each group using a random number table. There were no statistically significant differences ($p > 0.05$) between the two groups in terms of age, gender, cause of bleeding, underlying diseases (hypertension, diabetes, coronary heart disease), hemoglobin at admission, and Rockall score, and they were comparable (**Table 1**). This study was reviewed and approved by the medical ethics committee of our hospital (approval number: 2024ZRY25), and all patients or their families signed the informed consent form [2].

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

Items	Intervention group (n = 63)	Control group (n = 63)	t/χ^2 value	p value
Age (years, $\overline{x}$ ±s)	68.5 ± 7.2	69.1 ± 6.8	0.498	0.619
Gender (male/female, e.g.)	40/23	38/25	0.130	0.718
Cause of bleeding (example)			0.721	0.868
Peptic ulcer	35	33		
Acute gastric mucosal lesions	18	20		
Esophageal and gastric fundus varices	10	9		
Others	0	1		
Combined hypertension (example)	32	29	0.297	0.586
Diabetes mellitus (case)	18	21	0.314	0.575
Admission hemoglobin (g/L,±s)	85.3 ± 15.6	82.9 ± 16.8	0.843	0.401
Admission Rockall score ($\overline{x}$ ±s)	3.8 ± 1.2	4.0 ± 1.3	0.916	0.361

2.2. Methods

The control group was given routine UGIB care, including absolute bed rest, fasting and water deprivation, electrocardiogram monitoring, rapid establishment of intravenous access in combination with infusion, administration, observation of bleeding and vital signs, health education and discharge guidance [3].

In addition to the routine care, the intervention group received nursing intervention with a frailty prediction model [4].

(1) Frailty risk assessment

Within 24 hours of admission, patients were initially screened using the FRAIL scale by uniformly trained specialist nurses. The scale consists of five items: fatigue, endurance, free movement, illness, and weight loss. A score of ≥ 3 indicates frailty, 1–2 indicates pre-frailty, and 0 indicates no frailty. Laboratory indicators such as serum albumin (Alb), hemoglobin (Hb), and lymphocyte count (TLC) were also collected. Based on clinical experience and literature, a FRAIL score of ≥ 1, or Alb < 35g/L, or Hb < 90g/L and TLC < 1.5×10^9/L was defined as a high risk of frailty.

(2) Targeted nursing intervention

For patients assessed as at high risk of frailty, a multidisciplinary collaborative targeted nursing intervention was initiated immediately and continued until discharge.

(3) Nutritional support intensification

After bleeding stops, develop individualized dietary plans with a nutritionist to ensure high-quality protein intake. For patients with insufficient intake, provide timely advice to the doctor and assist with enteral or parenteral nutrition support. Objective: Stable or elevated Alb levels during hospitalization.

(4) Develop a progressive activity plan under the guidance of a rehabilitation therapist when the condition permits

Do ankle pump exercises and passive limb movements while lying in bed; You can do bedside standing and short walking after getting out of bed, and record the duration and intensity of your activities daily to prevent muscle weakness caused by absolute bed rest.

(5) Cognitive and psychological intervention

Pay attention to changes in the patient's mood and assess the risk of anxiety and depression. Psychological counseling is provided through methods such as disease knowledge lectures, successful case sharing, and mindfulness relaxation training to boost confidence in treatment.

(6) Medication and safety care, fine medication management, multi-medication risk assessment, fall prevention

Simplify medication regimens, use medicine kits as an aid, and enhance medication education. Ensure the safety of the environment and increase patrols at night.

(7) Family co-education

Train family members in debilitating knowledge and care skills, and encourage them to participate in nutritional support, activity companionship, and emotional support for the patient.

2.3. Observation indicators

(1) The incidence of frailty during hospitalization was based on a pre-discharge FRAIL score of ≥ 3.

(2) Secondary outcomes

Rebleeding rate (with hematemesis, aggravated melena, a decrease in hemoglobin > 20g/L or the need for re-endoscopic hemostasis during hospitalization); Average length of hospital stay; Average hospitalization expenses.

(3) Nursing satisfaction

Evaluation was conducted at discharge using a self-made satisfaction questionnaire (Cronbach's α = 0.89), with a maximum score of 100.

2.4. Statistical processing

Using SPSS 25.0 software. Measurement data were expressed as ($\overline{x}$ ± s), and comparisons between groups were conducted using the independent sample *t*-test; Count data were expressed as cases (%), and comparisons between groups were conducted using the χ^2 test or Fisher's exact test. A difference was considered statistically significant when $p < 0.05$.

3. Fruiting

3.1. Comparison of clinical outcomes during hospitalization between the two groups of patients

The incidence of new or frailty exacerbation during hospitalization in the intervention group was 11.1% (7/63), which was much lower than 31.7% (20/63) in the control group, and the difference was statistically significant ($\chi^2 = 8.254$, $p = 0.004$). There were 3 cases (4.8%) of rebleeding events in the intervention group and 8 cases (12.7%) in the control group. The difference between the two groups was statistically significant after continuous correction of the χ^2 test ($\chi^2 = 4.547$, $p = 0.033$).

Hospitalization efficiency and economic indicators: The average length of stay in the intervention group was (7.2 ± 1.5) days, significantly shorter than (9.1 ± 2.2) days in the control group, which was statistically significant ($t = 5.829$, $p < 0.001$). Meanwhile, the average hospitalization cost of the intervention group was (23,000 ± 0.6) yuan, which was much lower than that of the control group (28,000 ± 0.7) yuan ($t = 4.381$, $p < 0.001$). See **Table 2** for the specific data.

Table 2. Comparison of clinical outcomes between the two groups (n = 63)

Observation indicators	Intervention group	Control group	Statistics	*p* value
Frailty during hospitalization [cases (%)]	7 (11.1%)	20 (31.7%)	$\chi^2 = 8.254$	0.004
Rebleeding events [cases (%)]	3 (4.8%)	8 (12.7%)	$\chi^2 = 4.547$*	0.033
Average length of stay (days, $\bar{x} \pm s$)	7.2 ± 1.5	9.1 ± 2.2	$t = 5.829$	< 0.001
Average hospitalization cost (ten thousand yuan, $\bar{x} \pm s$)	2.3 ± 0.6	2.8 ± 0.7	$t = 4.381$	< 0.001

Note: Use the continuously corrected χ^2 test.

3.2. Comparison of nursing satisfaction between the two groups of patients

The results of the nursing satisfaction survey at discharge showed that the satisfaction score of the intervention group was 93.5 ± 4.2 points, which was much higher than that of the control group (86.3 ± 5.8 points), and the difference was highly statistically significant ($t = 8.127$, $p < 0.001$).

4. Conclusion

This study, through comparative analysis, found that implementing peri-inpatient nursing interventions based on frailty prediction models could significantly improve the clinical prognosis of middle-aged and elderly patients with upper gastrointestinal bleeding. The intervention reduced the incidence of frailty during hospitalization by about 20 percentage points (from 31.7% to 11.1%), indicating that early detection and proactive intervention play an important role in breaking the vicious cycle between bleeding and frailty. The acute stress of UGIB and the requirement of fasting and bed rest in conventional treatment can easily lead to accelerated muscle protein breakdown and functional decline. Early admission evaluation, comprehensive intervention, enhanced nutrition and individualized rehabilitation can effectively maintain the physiological reserves of patients, which is likely an important factor in reducing the incidence of frailty [5].

The intervention group also had an advantage in secondary outcome measures. The rebleeding rate was reduced (12.7% versus 4.8%), which was associated with the improvement of overall nutritional status, tissue repair ability, and stress levels in patients with targeted intervention. The average length of hospital stay was shortened by about 2 days (9.1 days, 7.2 days), reflecting the economic "benefit" of frailty prevention, that is, the reduction of complications and the acceleration of the recovery process to improve the utilization efficiency of medical resources. The intervention group had higher nursing satisfaction scores (93.5 versus 86.3), indicating that the integrated nursing model was more in line with the physical and mental needs of patients and improved their medical experience [6].

Therefore, the frailty prediction model and nursing intervention measures adopted in this study have positive significance both from the perspectives of clinical effect and health economics. Bringing frailty management forward and into the routine care pathway of UGIB is a patient-centered approach worthy of promotion. The limitations of this study are that it is a single-center study and the interventions are implemented in a package. Future multi-center, large-sample studies will be needed to test the universality of the conclusions and further analyze the causes to determine the independent effects of each intervention.

Funding

Construction and Application of Frailty Trajectory Prediction Model for Middle-aged and Elderly Patients with Upper Gastrointestinal Bleeding, Project Source: Sichuan Vocational College of Nursing (Project No.: 2024ZRY25)

Disclosure statement

The authors declare no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Clinical Efficacy of Different Parameter Modes of Electrophysiological Therapy in Chronic Pelvic Pain Syndrome

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Abstract: *Objective*: To investigate the clinical efficacy of electrophysiological therapy under different parameter modes in chronic pelvic pain syndrome (CPPS). Methods: A total of 95patients with CPPS from the Department of Urology, First Affiliated Hospital of Jinan University, were selected and treated with electrophysiological therapy. They were randomly divided into three groups: the fixed-parameter AA7 treatment group, the P2 + P4 treatment group, and the precision treatment group (individualized parameter treatment). Pain scores of patients in each group were compared before and after treatment, with a pain score of 0 indicating cure. The cure rate of each group was observed. *Results:* The average ages of the AA7 group, P2 + P4 group, and precision treatment group were 34 ± 14.17 years, 35.58 ± 12.57 years, and 35.5 ± 11.27 years, respectively. There was no significant difference in age among the three groups ($p > 0.05$). Before treatment, the pain scores of the AA7 group, P2 + P4 group, and precision treatment group were 4.14 ± 1.74, 4.64 ± 1.72, and 3.50 ± 1.89, respectively, with no significant differences among the groups ($p > 0.05$). After treatment, the pain scores were 0.71 ± 0.99 for the AA7 group (cure rate: 57%), 0.49 ± 0.79 for the P2 + P4 group (cure rate: 67%), and 0.50 ± 0.77 for the precision treatment group (cure rate: 64%), with no significant differences among the groups ($p > 0.05$). The cure rates for different pain locations were as follows: 83% for lower abdominal pain, 74% for perineal pain, 62% for dysuria, 49% for testicular pain, and 75% for inguinal pain. *Conclusion:* The pathogenesis of CPPS is complex and diverse, with numerous treatment options and uncertain efficacy, posing significant challenges to clinical practice. This study showed that electrophysiological therapy under different parameter modes significantly reduced pain scores before and after treatment, indicating significant therapeutic effects on CPPS. All three modes demonstrated good cure rates. Individualized precision treatment and fixed-mode P2 + P4 or AA7 treatment were safe and effective in CPPS treatment and are worth promoting. Fixed-mode P2 + P4 and AA7, due to their easier standardization of parameters and patch modes, reduced the learning curve and had better potential for widespread application.

Keywords: Electrophysiological therapy; Chronic pelvic pain syndrome; Biofeedback; Efficacy evaluation

Online publication: Feb 6, 2026

1. Introduction

Chronic Pelvic Pain Syndrome (CPPS) is a disorder of the urinary system characterized primarily by pelvic pain, urinary symptoms, and sexual dysfunction [1,2]. The etiology of CPPS is complex and multifactorial, involving infectious, immunological, neurological, and psychological factors [3]. As a result, CPPS has a substantial negative impact on the quality of life of affected patients. Conventional treatment strategies for CPPS include pharmacological therapy, psychological intervention, and physical therapy [4]. However, the clinical effectiveness of these treatments is often limited, and some approaches are associated with adverse effects. In recent years, electrophysiological therapy has gained increasing attention as a noninvasive physical treatment modality for chronic pain management [5]. By applying electrical stimulation with specific parameter settings, electrophysiological therapy can modulate neural transmission, alleviate pain, improve local blood circulation, and promote tissue repair processes [6]. Despite these potential benefits, current evidence regarding the use of electrophysiological therapy in CPPS remains limited, particularly with respect to comparisons of different parameter modes [7,8]. Variations in stimulation parameters may lead to significant differences in therapeutic outcomes. Therefore, identifying optimal electrophysiological therapy parameter modes for patients with CPPS is of considerable clinical importance.

2. Materials and methods

2.1. Clinical data

A total of 95 patients diagnosed with Chronic Pelvic Pain Syndrome (CPPS) who visited the Department of Urology at the First Affiliated Hospital of Jinan University between January 2023 and July 2024 were enrolled in this study. The patients were aged between 26 and 59 years, with a median age of 36 years. All patients were diagnosed with CP/CPPS based on medical history, physical examination including digital rectal examination, routine laboratory tests, NIH Chronic Prostatitis Symptom Index (NIH-CPSI) score, bacterial culture, and ultrasonography [9]. There were no statistically significant differences among the groups in terms of age, NIH-CPSI scores, maximum urinary flow rate, or average urinary flow rate (Qavg) ($p > 0.05$), indicating good comparability [10,11].

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

Patients who met the diagnostic criteria for chronic pelvic pain were included. Chronic pelvic pain was defined as pain located in the pelvic region or surrounding tissues caused by functional and or organic factors and lasting for more than six months [12,13].

2.2.2. Exclusion criteria

Patients were excluded if they met any of the following conditions:

(1) Diagnosis of prostate cancer or having undergone prostate biopsy within the previous one month
(2) History of pelvic radiotherapy, transurethral surgery, or urethral trauma
(3) Presence of skin allergy, neurological disorders, or severe systemic diseases
(4) Diagnosis of acute or chronic urethritis, epididymitis, varicocele, perianal or rectal diseases, or sexually transmitted diseases

(5) Use of antibiotics, nonsteroidal anti-inflammatory drugs, or medications affecting the genitourinary system within one month before enrollment, including diuretics, alpha receptor blockers, or 5 alpha reductase inhibitors
(6) Receipt of investigational drug treatment within the past six months [14,15]

2.3. Grouping of patients

Patients were randomly assigned into three groups: Group A included 14 patients receiving fixed parameter AA7 (analgesic mode) treatment. Group B included 45 patients receiving combined P2 and P4 treatment (analgesia plus arterial circulation mode). Group C included 36 patients receiving precision treatment with individualized parameter settings. The mean ages were 34 ± 14.17 years in Group A, 35.58 ± 12.57 years in Group B, and 35.5 ± 11.27 years in Group C. No significant differences were found among the three groups regarding baseline characteristics (all $p > 0.05$). All patients and their family members voluntarily participated in the study and signed written informed consent forms. Pain intensity was evaluated before and after treatment using the visual analogue scale (VAS). A VAS score of 0 was considered complete pain relief. Cure rates were compared among the groups.

2.4. Treatment methods

2.4.1. Stimulation method

All patients received transcutaneous electrical nerve stimulation (TENS). TENS is a noninvasive method that delivers electrical stimulation through surface electrodes placed on the skin to activate nerve fibers and relieve pain.

2.4.2. Electrode placement

Electrodes were placed at treatment sites such as the pelvic floor muscles and lower abdomen. Proper contact between electrodes and skin was ensured, and electrode positions were adjusted according to body contour and treatment area to optimize stimulation effectiveness and patient comfort.

2.4.3. Parameter settings

Electrical stimulation parameters were adjusted according to patient tolerance and therapeutic goals, including current intensity, frequency, and waveform. Current intensity was initiated at a low level and gradually increased to a comfortable and effective range. Stimulation frequency was adjusted based on treatment mode and patient response, generally ranging from 1 to 150 Hz. Waveforms included square, triangular, and sinusoidal waves, which have different effects on neural and muscular stimulation.

2.4.4. Stimulation procedure

Electrical stimulation was initiated after parameter adjustment. Patient responses were continuously observed to ensure safety and effectiveness. Medical staff monitored facial expression and body movement during treatment and adjusted parameters when necessary to manage discomfort.

2.4.5. Electrode positions for different treatment modes

(1) Group A precision parameter treatment: Parameters were individualized based on infrared detection results. Electrode placement included: (a) Sensory, neural, and muscular stimulation at pain points and

sacral region. (b) Circulation stimulation at the Qugu acupoint and bilateral dorsum of the feet. (c) Bladder meridian stimulation along the lumbosacral bladder meridian pathway

(2) Group B fixed parameter treatment (AA7 Mode): Electrode placement: pain points and sacral region. Parameters: 80, 120, and 80 Hz with pulse widths of 20, 80, and 120 microseconds, and 1, 4, and 1 Hz with pulse widths of 270, 230, and 270 microseconds

(3) Group C P2 plus P4 treatment: P2 analgesic mode: electrodes placed at the Baliao points, Zhongji, and Guanyuan acupoints with parameters of 100, 150, and 100 Hz and pulse widths of 150, 100, and 150 microseconds. P4 arterial circulation mode: electrodes placed at Shenque, Mingmen, and Yongquan acupoints with parameters of 10 Hz and pulse width of 300 microseconds

2.5. Outcome measures

Pain intensity was assessed using the visual analogue scale (VAS). A reduction of 2 points or more on the 0 to 10 scale was considered clinically meaningful. The VAS is a simple and widely used tool for pain assessment. Patients marked their pain level on a 10 cm horizontal line, where 0 represented no pain and 10 represented the most severe pain imaginable. Changes in VAS scores before and after treatment were used to evaluate pain relief.

3. Results

3.1. Comparison of pain scores among treatment groups

There were no significant differences in baseline VAS scores among the three groups before treatment ($p > 0.05$). After treatment, the mean VAS score was 0.71 ± 0.99 in the AA7 group, with a cure rate of 57 percent. The P2 plus P4 group had a mean VAS score of 0.49 ± 0.79 and a cure rate of 67 percent. The precision treatment group showed a mean VAS score of 0.50 ± 0.77, with a cure rate of 64 percent. Pain scores were significantly reduced in all three groups after treatment, while no statistically significant differences were observed among the groups ($p > 0.05$). During the treatment period, patients in the AA7 group experienced relatively slower pain relief during the first one to two weeks, followed by gradual improvement. The P2 plus P4 group showed more rapid pain relief in the early treatment stage with a stable overall improvement trend.

In the precision treatment group, some patients achieved marked pain relief at an early stage due to individualized parameter settings, while a small number of patients required parameter adjustment because of variability in treatment response. The results are summarized in **Table 1** and **Figure 1**.

Table 1. Comparison of pre- and post-treatment VAS scores among three electrophysiological treatment modalities

	AA7 group mean VAS score	P2 + P4 group mean VAS score	Precision treatment group mean VAS score
Pre treatment	4.14 ± 1.74 points	4.64 ± 1.72 points	3.50 ± 1.89 points
Post treatment	0.71 ± 0.99 points	0.49 ± 0.79 points	0.50 ± 0.77 points
Cure rate	57%	67%	64%

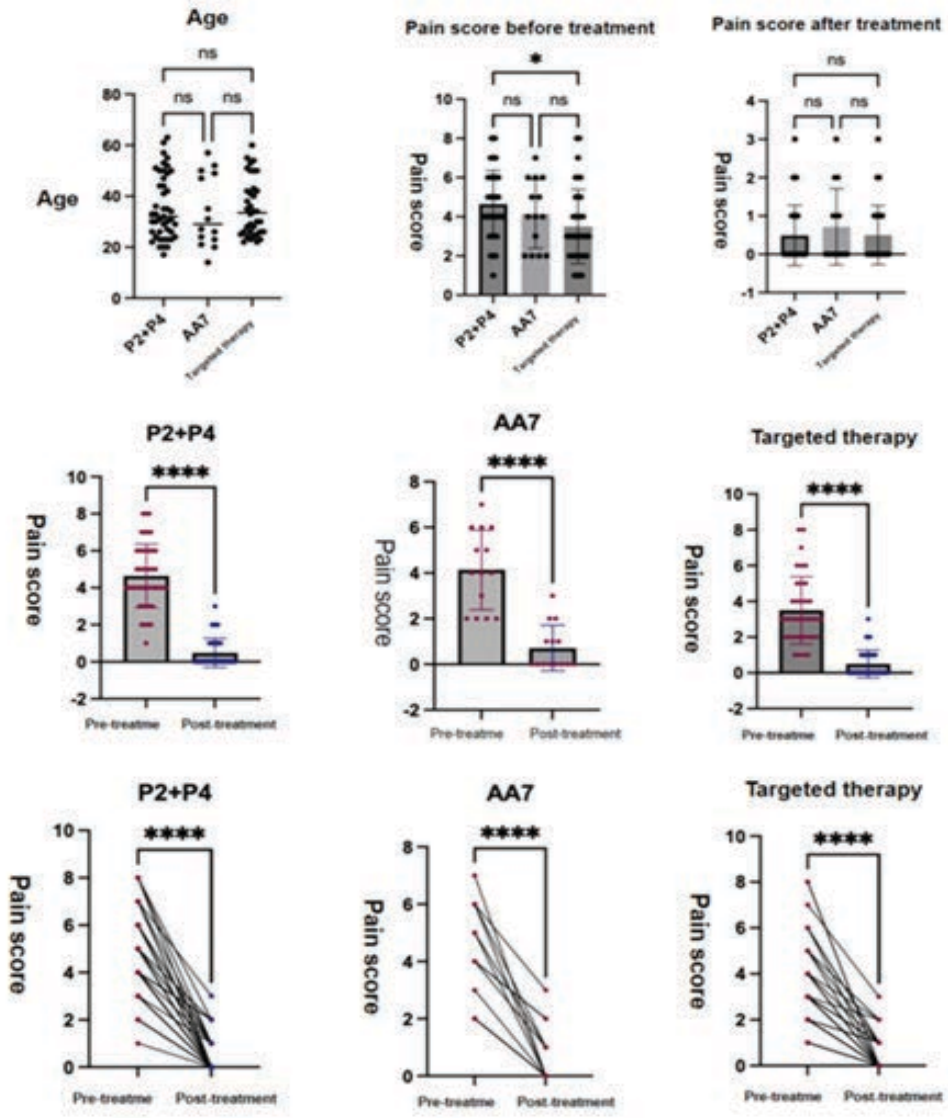

Figure 1. Comparison of pain scores among different treatment modalities.

3.2. Cure rates according to different pain locations

The cure rate for lower abdominal pain was 83%, followed by inguinal pain (75%), perineal pain (74%), dysuria-related pain (62%), and testicular pain (49%). During treatment, patients with lower abdominal and inguinal pain showed relatively better responses to electrophysiological therapy. This may be attributed to the more concentrated neural distribution and richer blood supply in these regions. In contrast, patients with testicular pain demonstrated a relatively lower cure rate, which may be related to the unique characteristics of testicular tissue, including highly sensitive and complex nerve endings, as well as a relatively independent blood supply, resulting in a weaker response to electrical stimulation. The cure rates for perineal pain and dysuria-related pain were at an intermediate level, which may be associated with interactions between nerves and muscles in the perineal and periurethral regions, as well as inflammatory responses. See **Table 2**.

Table 2. Cure rates according to different pain locations

Pain location	Lower abdominal pain	Perineal pain	Urinary pain	Testicular pain	Groin pain
Cure rate (%)	83	74	62	49	75

4. Discussion

The pathogenesis of CP/CPPS is complex and multifactorial, involving infectious, immunological, neurological, and psychological factors. Traditional treatment approaches, including pharmacological therapy, psychological intervention, and physical therapy, often show limited efficacy and may be associated with adverse effects. In recent years, electrophysiological therapy, as a non-invasive and non-traumatic physical treatment modality, has attracted increasing attention in the management of chronic pain. By delivering electrical stimulation with specific parameters, electrophysiological therapy can modulate neural transmission, alleviate pain, improve local blood circulation, and promote tissue repair.

In the present study, VAS scores were significantly reduced after electrophysiological treatment under different parameter modes, indicating that electrophysiological therapy is effective for CP/CPPS across various treatment modes. All three treatment modes demonstrated favorable cure rates. Both individualized precision therapy and fixed modes (P2 + P4 and AA7) were shown to be safe and effective in the treatment of CP/CPPS and therefore merit wider clinical application. Notably, the fixed P2 + P4 and AA7 modes allow easier standardization of parameters and electrode placement, which may reduce the learning curve and make them particularly suitable for implementation in primary healthcare settings.

Furthermore, analysis based on pain location revealed that the cure rates for lower abdominal pain and inguinal pain were relatively high (83% and 75%, respectively), whereas the cure rate for testicular pain was comparatively low (49%). These differences may be related to variations in neural distribution, blood supply, and underlying pathophysiological characteristics among different anatomical sites. This finding suggests that treatment strategies may be optimized by tailoring electrophysiological therapy according to pain location or by combining it with other therapeutic modalities to improve overall efficacy. For example, patients with lower abdominal or inguinal pain may preferentially benefit from the P2 + P4 or AA7 modes, whereas patients with testicular pain may require adjunctive treatments, such as pharmacotherapy or physical rehabilitation, in addition to electrophysiological therapy, to enhance treatment outcomes.

Although the overall cure rate of the individualized precision therapy group was comparable to those of the other two groups, this approach demonstrated advantages in addressing individual patient needs during treatment. It is particularly suitable for patients with complex clinical conditions, multiple pain locations, or poor responses to conventional therapies. By performing detailed physiological parameter assessments and designing personalized treatment protocols, precision therapy enables more targeted modulation of neural transmission and blood circulation, thereby improving treatment specificity and effectiveness.

However, individualized precision therapy requires higher technical expertise and specialized equipment, as well as experienced healthcare professionals for parameter adjustment and operation. These requirements may limit its widespread application in primary medical institutions. Therefore, in clinical practice, the choice of electrophysiological treatment mode should be based on institutional resources, patient characteristics, and economic considerations to achieve optimal therapeutic outcomes and patient satisfaction. Future large-scale, multicenter clinical studies are warranted to further explore the optimal parameter settings, treatment duration, and long-term

efficacy of electrophysiological therapy in CP/CPPS, thereby providing stronger evidence for its clinical application.

Disclosure statement

The authors declare no conflict of interest.

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Application and Effectiveness Evaluation of Standardized Protective Care Procedures in Hydrofluoric Acid Operations within Dental Departments

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Abstract: *Objective*: To evaluate the implementation effectiveness of standardized protective care procedures during hydrofluoric acid procedures in the dental department. *Methods*: This study was conducted from June 2023 to June 2025, selecting 90 patients who underwent hydrofluoric acid-related treatments in the outpatient dental department of this hospital during this period as subjects. Forty-five patients treated between June 2023 and June 2024 received conventional protective care (pre-intervention group), while 45 patients treated between June 2024 and June 2025 underwent the standardized protective care protocol (post-intervention group). Thirteen healthcare personnel participated in both pre- and post-intervention treatment phases. Based on the different nursing models, indicators such as the incidence of adverse events in patients and the exposure rate of healthcare personnel before and after implementation were compared to evaluate the effectiveness of the nursing intervention. *Results:* The incidence of oral mucosal irritation reactions in patients was lower after implementation, $p < 0.05$. Compared with the pre-implementation period, the incidence of procedure-related adverse events decreased after implementation, $p < 0.05$. There was a significant difference in the occupational exposure rate of healthcare personnel before and after implementation, with a higher rate observed before implementation ($p < 0.05$). Post-implementation, healthcare personnel achieved higher compliance scores for pre-procedure preparation, intra-procedure protection, and post-procedure handling ($p < 0.05$). Patient satisfaction with treatment was lower pre-implementation than post-implementation ($p < 0.05$). *Conclusion:* Adherence to standardized protective care procedures during hydrofluoric acid operations by dental department staff in outpatient settings standardizes practitioner techniques, effectively prevents oral mucosal irritation in patients, reduces occupational exposure risks for staff, minimizes adverse procedural events, and consequently enhances patient treatment satisfaction. This demonstrates significant practical value.

Keywords: Standardized protective care procedures; Dental department; Outpatient clinic; Hydrofluoric acid handling

Online publication: Feb 6, 2026

1. Introduction

In clinical dentistry, hydrofluoric acid is frequently employed during therapeutic procedures such as inlay restoration to perform efficient acid etching. This process ensures robust bonding between porcelain inlays and soft tissues, facilitating subsequent treatment steps and guaranteeing restorative outcomes. However, hydrofluoric acid is an inorganic acid with exceptionally high reactivity, exhibiting strong corrosiveness and high permeability. Inadequate protective measures during handling may lead to occupational exposure, such as skin contact, resulting in chemical burns, respiratory tract damage, or oral mucosal irritation in patients [1,2]. Consequently, effective protective measures are essential during hydrofluoric acid procedures in dentistry to mitigate safety risks and safeguard the health of both healthcare personnel and patients. This study aims to establish a standardized protective nursing protocol for comprehensive management throughout the entire hydrofluoric acid procedure, evaluating its application efficacy. The findings are reported as follows.

2. Materials and methods

2.1. General information

This study involved 90 patients undergoing hydrofluoric acid-related treatment, all of whom attended the outpatient dental department of our hospital between June 2023 and June 2025. Protective nursing measures were implemented according to the sequence of their appointments. The conventional care group (pre-implementation) comprised 24 males and 21 females, aged 20–68 years (mean 43.27 ± 3.62). The standardized protective care group (post-implementation) included 25 males and 20 females, with ages ranging from 20 to 69 years (mean 43.51 ± 3.70 years). Thirteen healthcare personnel participated in both groups: five physicians and eight nurses, aged 24 to 45 years (mean 32.51 ± 3.47 years). Baseline data showed no significant differences before and after implementation ($p > 0.05$), indicating comparability.

2.1.1. Inclusion criteria

(1) All subjects must undergo hydrofluoric acid treatment;
(2) Subjects must be conscious and able to cooperate with treatment and nursing care;
(3) Subjects must provide informed consent to participate in the study.

2.1.2. Exclusion criteria

(1) Concurrent oral mucosal lesions;
(2) Severe hepatic or renal impairment;
(3) Hypersensitivity to hydrofluoric acid therapy.

2.2. Methodology

Between January and December 2023, routine protective care was implemented for 45 patients undergoing treatment. Prior to procedures, nursing staff briefed patients on precautions for hydrofluoric acid handling while wearing masks, gloves, and protective gowns. During operations, protective measures were applied based on established protocols. Post-procedure, the treatment area was thoroughly cleaned, and all used instruments were disinfected.

Between January and December 2024, a standardized protective nursing protocol was established for the

treatment of 45 patients, with nursing duties conducted accordingly.

(1) Standardized protective nursing team

Led by the Head Nurse, a standardized protective nursing team was formed comprising dentists, nurses and other relevant personnel. This team developed a standardized protective nursing protocol based on applicable operational safety guidelines and protocols. All healthcare personnel were required to undergo systematic training and pass an assessment before being permitted to participate in nursing duties [3].

(2) Pre procedure preparation

During pre-procedure preparation, all healthcare personnel underwent joint training covering hydrofluoric acid hazards, protective protocols, and emergency response measures, with participation in treatment nursing contingent upon passing assessments. Nursing staff conducted comprehensive patient assessments based on prior allergy history, oral condition, and general health status to formulate individualized protective plans [4]. Patients and their families are informed about hydrofluoric acid procedures in plain language, emphasizing potential risks and protective measures to enhance compliance. Protective equipment such as acid-resistant gloves, goggles, and protective face shields is prepared according to operational standards. Hydrofluoric acid reagents are inspected for expiry dates and packaging integrity to prevent leakage. Prepare emergency supplies for hydrofluoric acid exposure, such as calcium gluconate gel and physiological saline [5]. Affix hydrofluoric acid warning signs in the operational area, clear away unrelated items, arrange necessary reagents and instruments appropriately, and strictly demarcate contaminated and clean zones to prevent cross-contamination. Activate ventilation equipment in the operating room to maintain adequate airflow.

(3) Implement protective measures during procedures

Healthcare personnel must correctly wear acid-resistant masks, aprons, and nitrile gloves to ensure comprehensive protection. Strictly adhere to protocol requirements, controlling HF dosage and concentration to prevent overuse. Establish dedicated splash-proof zones on treatment tables with acid-resistant mats. Implement personalized patient protection by applying petroleum jelly around the oral cavity. Use a saliva ejector to promptly remove vapors and waste liquid generated during the procedure, minimizing irritation [6]. Healthcare personnel should inspect the integrity of protective equipment seals every 5 minutes. Should reagent leakage occur, cease operations immediately. Clean up using specialized absorbent materials and flush contaminated areas with copious amounts of water. Upon completion of acid etching, immediately rinse the porcelain inlay and surrounding area three times with physiological saline solution. Collect the rinsing solution in dedicated corrosion-resistant containers.

(4) Post-procedure management

After completion, rinse the patient's oral cavity with physiological saline to ensure no residual hydrofluoric acid remains. Inspect the oral mucosa for burns or other abnormalities, treating any findings with oral ulcer ointment. Seal any residual hydrofluoric acid reagent and store it in a dedicated corrosion-resistant cabinet. Wipe the operating area clean with water, then disinfect it by spraying with a chlorine-based disinfectant. After half an hour, wipe again with water. Immerse used etching instruments in a 5% calcium hydroxide solution for 40 minutes to neutralize them, then dispose of them according to medical waste regulations. Medical staff shall remove protective equipment in the prescribed sequence and disinfect hands using a quick-drying hand sanitizer [7]. Advise patients to avoid consuming spicy, hot, or hard foods for 2 hours post-procedure, maintain oral hygiene, and return promptly for review should any discomfort arise.

2.3. Observation indicators

2.3.1. Assessment of patient mucosal irritation

Observe and record patients' oral mucosal irritation reactions, such as pain, redness, swelling, and burns, following hydrofluoric acid procedures, comparing incidence rates before and after implementation.

2.3.2. Assessment of operational safety incidents

Adverse events occurring during statistical operations, including hydrofluoric acid leaks, accidental patient injuries, and reagent misuse, shall be compared in terms of their incidence rates.

2.3.3. Assessment of healthcare staff exposure rates

Record instances of respiratory inhalation, skin and eye contact occurring during hydrofluoric acid handling by healthcare personnel before and after implementation, and compare occupational exposure rates.

2.3.4. Assessment of personal protective equipment compliance

Assessment of compliance with protective procedures for healthcare personnel, evaluating the standard of practice in donning protective equipment prior to procedures, implementation of protective measures during procedures, and post-procedure handling. Scored out of 100 points, with higher scores indicating greater compliance.

2.4. Statistical analysis

Data obtained in this study are presented as (n, %). Count data conforming to normal distribution are expressed as (n, %). All data were entered into SPSS 23.0 software. Following categorization, *t*-tests (for continuous data) and chi-square tests (for categorical data) were conducted. Differences were assessed based on *p*-values, with $p < 0.05$ indicating statistically significant differences.

3. Results

3.1. Comparison of the incidence of oral mucosal irritation reactions before and after implementation

The incidence of oral mucosal irritation reactions in patients prior to implementation was 20.00%, which was significantly higher than that observed post-implementation ($p < 0.05$). See **Table 1**.

Table 1. Comparison of the incidence of oral mucosal irritation reactions before and after implementation (n, %)

Group	Example count	Redness and swelling	Pain	Burn	Overall incidence rate
Prior to implementation	45	5 (11.11)	3 (6.67)	1 (2.22)	9 (20.00)
Upon implementation	45	1 (2.22)	1 (2.22)	0 (0.00)	2 (4.44)
c^2	-	-	-	-	5.075
p	-	-	-	-	0.024

3.2. Comparison of adverse event incidence rates before and after implementation

The incidence rate of adverse events prior to implementation was 15.56%, while the incidence rate after implementation was 2.22%. The incidence rate prior to implementation was higher than that after implementation (*p*

< 0.05). See **Table 2**.

Table 2. Comparison of adverse event incidence related to operations before and after implementation (n, %)

Group	Example count	Hydrofluoric acid leak	Collateral casualty	Reagent misuse	Overall incidence rate
Prior to implementation	45	1 (2.22)	2 (4.44)	4 (8.89)	7 (15.56)
Upon implementation	45	0 (0.00)	0 (0.00)	1 (2.22)	1 (2.22)
c^2	-	-	-	-	4.939
p	-	-	-	-	0.026

3.3. Comparison of healthcare workers' occupational exposure rates before and after implementation

Following the implementation of standardized protective care procedures, no occupational exposures occurred among healthcare personnel, with a significantly lower incidence rate compared to the pre-implementation period ($p < 0.05$). See **Table 3**.

Table 3. Comparison of healthcare workers' occupational exposure incidence rates before and after implementation (n, %)

Group	Example count	Skin contact	Respiratory inhalation	Eye contact	Overall incidence rate
Prior to implementation	45	1 (7.69)	2 (15.38)	1 (7.69)	4 (30.77)
Upon implementation	45	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
c^2	-	-	-	-	4.727
p	-	-	-	-	0.030

3.4. Comparison of healthcare personnel compliance scores before and after implementation

Following implementation, healthcare professionals' scores for procedural compliance were significantly higher than pre-implementation levels ($p < 0.05$). See **Table 4**.

Table 4. Comparison of healthcare personnel compliance with operating procedures before and after implementation ($\overline{x} \pm s$)

Group	Example count	Preparation prior to operation	Protective measures during operation	Post-processing
Prior to implementation	13	77.94 ± 3.41	75.28 ± 3.50	78.12 ± 3.37
Upon implementation	13	92.45 ± 4.08	91.86 ± 3.94	93.09 ± 3.15
t	-	9.839	11.343	11.701
p	-	0.000	0.000	0.000

4. Discussion

Hydrofluoric acid is a highly corrosive chemical reagent that exerts potent irritation on human skin, respiratory tract, and mucous membranes. In clinical dentistry, it is frequently employed in inlay restorations to achieve secure bonding of porcelain inlays, thereby ensuring restorative efficacy [8]. To guarantee treatment safety, meticulous protective measures must be implemented during hydrofluoric acid procedures in dental practice, mitigating safety risks and hazards to safeguard both practitioner and patient wellbeing. Currently, routine protective measures are employed during hydrofluoric acid procedures in dental departments. However, inadequate protective awareness among some healthcare personnel, failure to properly wear protective equipment, or poor ventilation in operating rooms may increase operational hazards [9]. Consequently, standardizing protective care protocols and establishing a formalized protective care process is of paramount importance.

Following implementation, the probability of patients experiencing oral mucosal pain, burns, and other irritant reactions was significantly lower, with procedure-related adverse event rates also reduced compared to pre-implementation levels ($p < 0.05$). Analysis indicates that the standardized protective care protocol facilitates comprehensive patient assessment, enabling the development of personalized protective measures tailored to individual circumstances. Pre-procedure communication regarding the risks and precautions associated with hydrofluoric acid procedures enhances patient cooperation. During procedures, applying Vaseline around the patient's mouth and using saliva ejectors to aspirate vapors generated during handling reduced irritation to the oral mucosa from hydrofluoric acid vapors and waste liquid, thereby decreasing the incidence of irritation reactions [10–12]. The standardized protective care protocol also provided systematic training for healthcare personnel, enhancing their awareness and skills in protective measures while standardizing operational procedures, thus reducing procedure-related adverse events [13]. Concurrently, healthcare personnel demonstrated significantly higher scores for procedural compliance post-implementation compared to pre-implementation, $p < 0.05$. The incidence of occupational exposure among healthcare personnel was markedly lower following implementation, $p < 0.05$. This indicates that standardized protective nursing protocols effectively mitigate occupational exposure risks during hydrofluoric acid procedures, primarily through enhanced procedural standardization and compliance, thereby safeguarding occupational safety for healthcare personnel.

5. Conclusion

In summary, when performing hydrofluoric acid procedures in dental outpatient departments, standardized protective care protocols must be strictly adhered to. This ensures healthcare professionals operate within established guidelines, minimizes safety risks for both staff and patients, and guarantees both therapeutic efficacy and safety. Such protocols may be promoted for implementation across dental treatment settings.

Funding

Construction of Standardized Protective Nursing Plan for Hydrofluoric Acid Operation in Stomatology and Re search on Injury Prevention Effect (Project No.: FZ2025101)

Disclosure statement

The author declares no conflict of interest.

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Publisher's note

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

Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Integrated Predictive Nursing Care for a Case of Imported Severe Malignant Malaria with Spontaneous Splenic Rupture

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Abstract: A case of imported severe falciparum malaria with spontaneous splenic rupture was reported in this paper. The patient, an African migrant worker, developed hemolytic anemia, sepsis, thrombocytopenia, coagulation dysfunction, liver failure, renal insufficiency, electrolyte disturbance and other clinical manifestations after returning to the local area. Plasmodium falciparum was found by peripheral blood smearscopy and was diagnosed as severe falciparum malaria. After standardized anti-malaria treatment, plasma exchange + cytokine adsorption therapy, the establishment of "forewarning–forewarning–prevention–emergency" predictive nursing management model, the establishment of an integrated nursing team, the division of medical care is clear, professional knowledge is complementary, after three months of regular follow-up, the patient has no malaria recurrence, no refire, the function of all organs returned to normal.

Keywords: Severe falciparum malaria; Imported malaria; Splenorrhagia; Integration of health care; Predictive care; Plasma exchange; Cytokine adsorption

Online publication: Feb 6, 2026

1. Introduction

Malaria is a parasitic disease transmitted by the bites of Anopheles mosquitoes, mainly caused by the human malaria parasite [1]. It is a significant global public health issue, especially with a higher incidence rate in tropical and subtropical regions [2]. Since 2017, China has achieved zero reports of local malaria cases. However, with the increasingly frequent international exchanges along the Belt and Road Initiative, imported malaria cases continue to rise [3]. Imported malaria usually refers to symptomatic cases with a travel history to malaria-endemic areas 1 to 3 months before the onset of the disease and with clear evidence of infection from abroad [4]. Among them, severe malignant malaria is caused by Plasmodium falciparum. It has an acute onset, rapid progression, complex clinical manifestations, and is prone to serious complications [5]. Splenomegaly is a common sign of malaria infection, but spontaneous splenic rupture is a rare and life-threatening complication [6]. The etiology of severe malignant malaria

combined with spontaneous splenic rupture is complex. It often has no clear history of trauma, which can easily lead to missed diagnosis, misdiagnosis, delayed treatment and even endanger life. Therefore, early identification, diagnosis and intervention are crucial for improving the prognosis of patients [7].

The integrated medical and nursing model, through multi-disciplinary collaboration (covering medical treatment, nursing, rehabilitation, nutrition, psychology, etc.), provides patients with all-round and full-process high-quality services, which is conducive to promoting disease recovery [8]. The construction of a predictive nursing management model of "foresight–early warning–prevention–emergency response" aims to promptly identify potential nursing risks, formulate targeted prevention and control measures, demonstrate forward-looking thinking, minimize related risks to the greatest extent, thereby improving the treatment effect of severe malignant malaria with spontaneous splenic rupture, enhancing the medical experience of patients, and strengthening the trust between nurses and patients [9].

This article reports a case of a patient with imported severe malignant malaria complicated with spontaneous splenic rupture. On the basis of plasma exchange combined with cytokine adsorption therapy, integrated predictive nursing care was implemented, achieving good therapeutic effects.

2. Clinical data

2.1. General information

The patient is a 38-year-old male. A week ago, he developed a fever without any cause, with the highest body temperature reaching 40 °C. The fever was irregular, accompanied by chills and shivering, as well as dizziness. In the past two days, he has experienced diarrhea, accompanied by nausea and vomiting of gastric contents several times. He came to the hospital on his own and was admitted to our department in the emergency department with a fever. Since the onset of the disease, the patient's spirit and appetite have been average, sleep has been poor, diarrhea has occurred (on average once every 1 to 2 hours), urination has been normal, physical strength has declined, and there has been no significant change in weight. The patient has a long history of working in Africa and denies any other medical history. Abdominal CT examination from 2008 to 2011 indicated splenic hematoma (see **Figure 1A** and **1B**). On August 13, 2020, the blood *Plasmodium* test was positive. Both microscopic examination and colloidal gold test were positive (malignant malaria). Bone marrow puncture results on August 15, 2025:32 phagocytic tissue cells per piece, with the phagocytic substances being red blood cells, white blood cells, and platelets. *Plasmodium* (see **Figure 2**). Chest CT of 08-17 shows splenic hematoma (see **Figure 3**). Liver color Doppler ultrasound on 08-20 indicated abnormal echoes in the spleen. MRI of the liver, gallbladder and spleen on 08-25 suggested subacute hematoma of the spleen (see **Figure 4**)

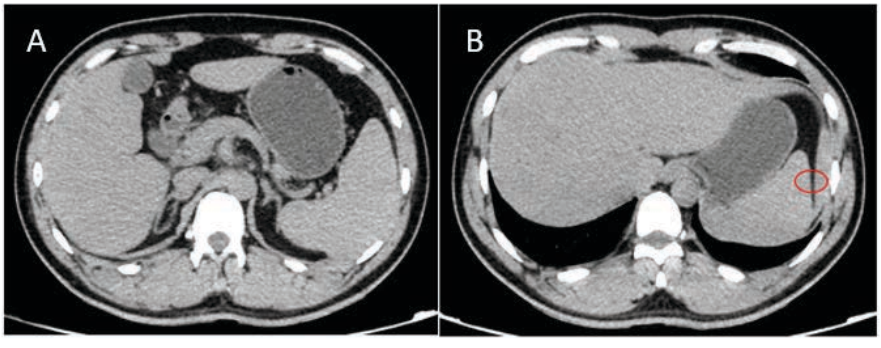

Figure 1. A. Splenomegaly. B. Suspected splenic hemorrhage.

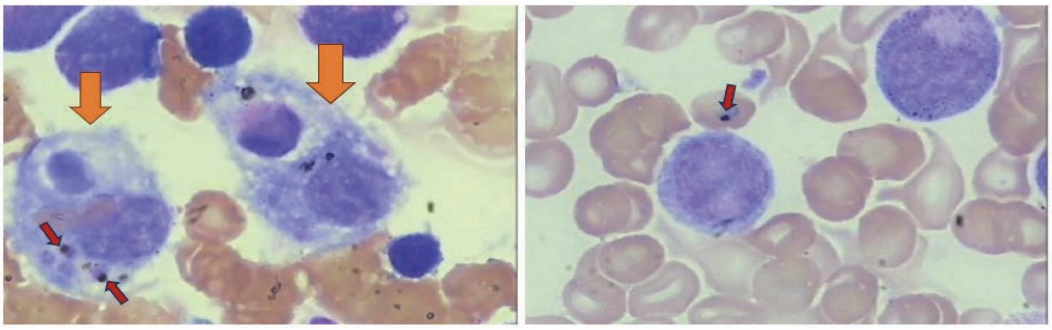

Figure 2. Bone marrow image: 32 phagocytic tissue cells per plate, with red blood cells, white blood cells and platelets as phagocytes (indicated by orange arrows); *Plasmodium* (red arrow).

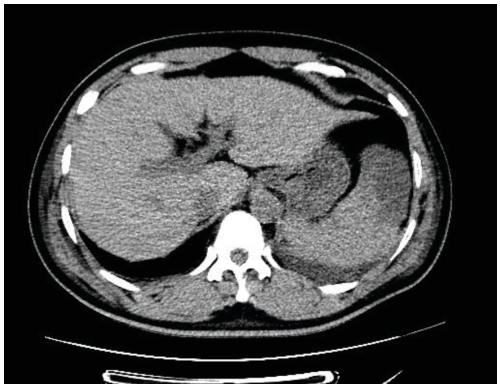

Figure 3. Splenic hematoma on chest CT.

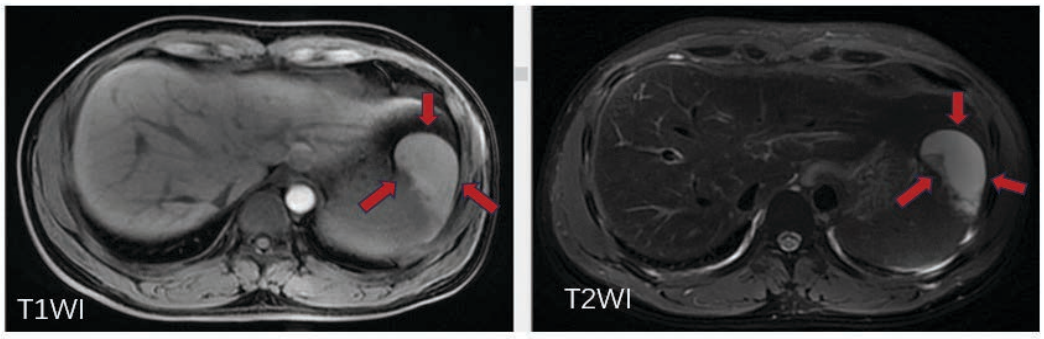

Figure 4. Enhanced MRI: The spleen is slightly enlarged, and cystic abnormal signals are shown in the spleen: hematoma? Subacute stage? (Indicated by the red arrow), both T1WI and T2WI show high signals. A low-signal septal image on T2WI can be seen within the lesion, with the lesion range approximately 6.9 cm × 3.8 cm × 3.2 cm. DWI shows unevenly high signals, and there are a few fluid signal shadows around the spleen.

2.2. Inspection report

The diagnostic results shown in **Table 1** include abnormal laboratory values and imaging features consistent with severe malaria and splenic involvement.

Table 1. Diagnosis report

Check the category	Inspection item	Inspection result
Laboratory inspection	Blood routine examination	WBC 4.80 g/L, NE 3.97 g/L, RBC 5.08 g/L, Hb 161 g/l, PLT 11 g/L
	Liver and kidney functions, blood lipids	WBC 4.80 g/L, NE 3.97 g/L, RBC 5.08 g/L, Hb 161 g/L, PLT 31 g/L
	Coagulation function	PT 16.9 s, PTA 55%, D-Dimer 7.13 mg/L
	Inflammatory indicators	PCT 3.55 ng/mL; IL-6 123.1 pg/mL; hs-CRP 106.36 mg/L; ferroprotein 8964 ng/mL
	Screening for infectious diseases	Hepatitis B, hepatitis C, HIV and syphilis are all negative
Imagological examination	Chest CT	1. A small amount of accumulative inflammation in the lower lobe of the left lung. 2. Scattered small nodules and hard nodules in both lungs have slightly increased compared to before.
	CT full abdominal CT	Inflammation of the proximal jejunum is possible. 2. Prostate calcification foci; 3. Enlarged spleen.
	Brain CT	Calcification foci or foreign bodies on the frontal scalp.

2.3. Treatment method

Antimalarial treatment (artesunate for injection + dihydroartemisinin piperquine tablets); Anti-inflammatory Protect the liver and reduce jaundice. Protect the stomach Increase platelet count; Plasma exchange + cytokine adsorption therapy; Splenic artery embolization therapy (PSE).

2.4. Therapeutic effect

2.4.1. Microscopic examination of Plasmodium in blood

All three tests on August 15, 20, 25, 19 and 23 were negative

2.4.2. All indicators improved after treatment

From **Table 2**, it can be seen that after undergoing plasma exchange combined with cytokine adsorption therapy, the patient's indicators such as total bilirubin (TBIL), C-reactive protein (hs-CRP), and interleukin-6 (IL-6) showed a significant decreasing trend, while platelet counts (PLT) gradually recovered, indicating the effectiveness of the treatment.

Table 2. Improving of the indicators post treatment

Date	WBC (g/L)	Hb (g/L)	PLT (g/L)	TBIL (μmol/L)	ferritin (ng/mL)	Cr (μmol/L)	PCT (ng/mL)	IL-6 (pg/mL)	hs-CRP (mg/L)
8/11	4.8	161	31	120.69	-	127.2	3.55	123.1	106.36
8/12	4.93	142	10	140	8964	-	-	-	-
8/13	7.22	128	11	166.78	-	-	-	-	-
8/14	5.11	135	22	249.89	10928	89	-	-	64.35
8/15	7.16	115	41	182.93	-	58.9	1.009	11.3	65.1
8/16	8.11	107	37	88.35	4114	-	1.8	17.76	31.9
8/17	4.75	105	64	89.72	-	-	0.364	39.8	30.38
8/18	3.89	100	68	59.79	1062.1	-	0.57	30.01	-

Table 2 (Continued)

Date	WBC (g/L)	Hb (g/L)	PLT (g/L)	TBIL (μmol/L)	ferritin (ng/mL)	Cr (μmol/L)	PCT (ng/mL)	IL-6 (pg/mL)	hs-CRP (mg/L)
8/19	3.19	92	106	52.13	1585	57.45	0.243	14.5	33.55
8/23	5.09	94	172	31.42	1139	66.07	0.137	12	7.01
8/26	3.79	112	149	-	-	-	-	-	-
10/9	5.02	144	193	16.78	232.8	-	-	-	-

2.4.3. Liver ultrasound follow-up

Re-examination of liver color Doppler ultrasound indicated: No localized abnormal echoes were found.

2.4.4. Changes in total bilirubin, C-reactive protein and platelet count during the treatment process

Figure 5 clearly demonstrates the changes in total bilirubin, C-reactive protein, and platelet count during the treatment process, highlighting the positive response to therapy.

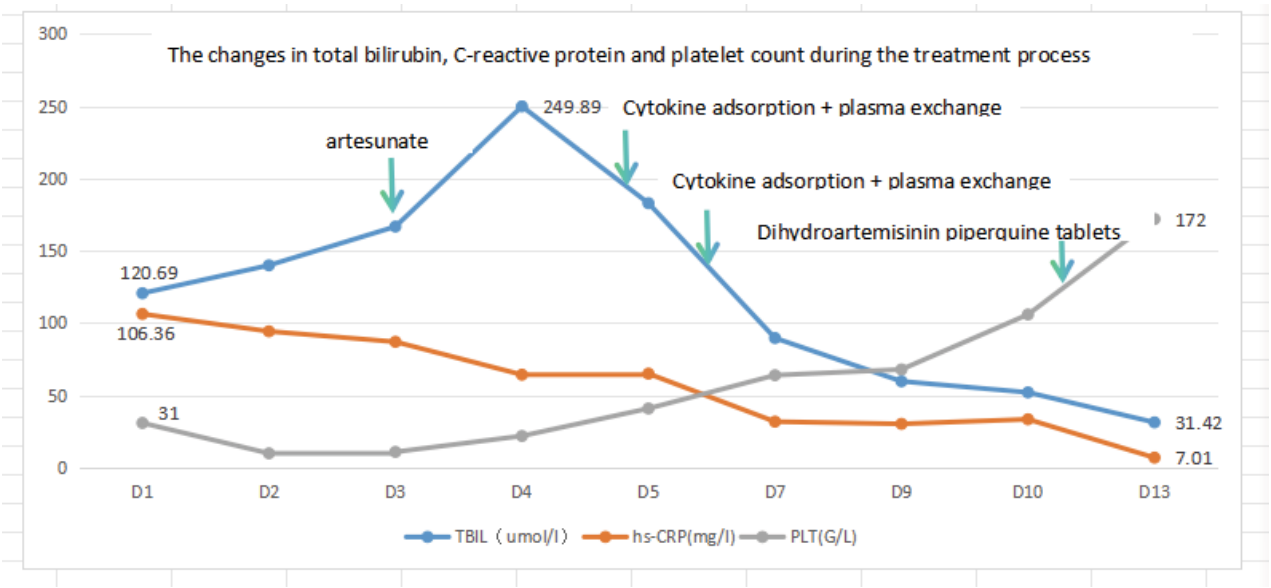

Figure 5. Changes of total bilirubin, C-reactive protein and platelet count during the treatment process.

2.5. Integrated medical and nursing predictive care

The integrated medical and nursing team is composed of one chief physician, one attending physician, one infection control physician, one head nurse, one responsible nurse, one psychotherapist and one nutritionist. The group, through multidisciplinary collaboration, jointly assesses the patient's condition and potential risks, and formulates practical and feasible care plans. Each member has clear responsibilities and works in close cooperation: The psychotherapist focuses on providing psychological counseling to the patient. Nutritionists provide personalized dietary guidance. Infection control physicians regularly organize infection prevention and control training and supervise the implementation of measures to prevent cross-infection. The head nurse serves as the leader of the nursing team. Every day, she feeds back the progress in the team work group and promptly analyzes, continuously tracks and effectively improves the existing problems. The team adheres to the

work focus of "ensuring safety, enhancing quality, improving service and increasing efficiency", and strives to build a predictive nursing management model of "prediction–early warning–prevention–emergency response", continuously deepening the connotation of clinical nursing and expanding the thickness of service, so as to achieve the goal of better nursing and more efficient service.

2.5.1. Training of predictive thinking

Through the training of predictive thinking, the awareness and ability of predictive nursing can be enhanced, potential nursing risks can be accurately and quickly identified, and relevant risk factors and expected clinical challenges can be determined.

2.5.2. Organize and carry out specialized training

Organize the study of knowledge related to malignant malaria and spontaneous splenic rupture, and cultivate the predictive thinking ability of members of the integrated medical and nursing care team.

2.5.3. Comprehensive assessment of the patient's condition

Based on evidence-based evidence, scientific and professional assessment tools are adopted, combining qualitative and quantitative predictions to conduct multi-angle, all-round and accurate evaluations of the patient. Through comprehensive analysis and precise observation of the patient's condition, changes in the patient's condition and nursing risks are predicted.

2.5.4. Accurately identify nursing risks

Clearly identify the risk points and weak points existing in the care of patients with severe malignant malaria and spontaneous splenic rupture, analyze the predictable nursing risk factors and formulate response measures, and form a standardized predictive nursing risk management operation manual. Such as emergency treatment procedures for bleeding, standard operating procedures for septic shock, key points for preventing black urine, etc.

2.5.5. Early warning

While implementing measures to reduce nursing risks, early warnings should be issued through visual and information-based means to alert medical staff and ensure they are always ready for emergencies.

2.5.6. Sorting out risk thresholds

For common complications that malaria can cause, such as black urine fever, intracranial hypertension, nephritis, and nephrotic syndrome, a warning threshold manual should be formulated one by one, including the names of complications, life-threatening symptoms, signs, indicators, and the content of nurses' rapid emergency response, to identify them as early as possible and activate the warning immediately [10].

2.5.7. Innovate visualized risk early warning

In light of the actual needs and risk characteristics of the patients, single room admission is implemented, and prominent insect-borne transmission risk signs are made and posted at the door of the ward and the patient's bedside to clearly remind medical staff and family members to implement isolation and protection. At the same time, record popular science audio and video about the transmission routes and prevention knowledge of malaria.

The content is vivid and easy to understand, enhancing the disease awareness level of patients and their families. In addition, strictly enforce the accompanying care management system, strengthen mosquito prevention and control measures, and comprehensively reduce the risk of infection.

2.5.8. Identify the clinical signs of spontaneous splenic rupture

Spontaneous splenic rupture is a fatal complication of malignant malaria. Although it is rare, if it is not identified and treated early, it will seriously threaten the patient's life. This disease is usually characterized by sudden abdominal pain, mainly persistent dull or severe pain in the upper left abdomen, which may be accompanied by symptoms such as abdominal distension, nausea, vomiting, cold sweats or fainting. The onset of the disease often has no obvious cause, or only occurs after actions such as coughing, sneezing, vomiting, and defecation. Early spontaneous splenic rupture patients often have atypical abdominal signs, usually only mild tenderness in the upper left abdomen, without rebound tenderness or muscle tension. If abdominal distension occurs and mobile dullness on percussion is positive, it indicates that the disease is progressing. There has been a large amount of intra-abdominal hemorrhage, which can rapidly develop into shock within a few hours. Laboratory and imaging examinations are crucial in early diagnosis: dynamic monitoring of hemoglobin and hematocrit helps assess blood loss. B-ultrasound is a commonly used imaging examination method in clinical practice due to its rapidity, convenience and strong repeatability [11]. The integrated medical and nursing team used the shock index (pulse rate/systolic blood pressure) to assess the degree of shock [12]. A shock index of ≤ 0.5 indicated no shock and normal blood volume; An index of 1 indicates mild shock, with a blood loss of approximately 800 to 1200 mL, accounting for 20% to 30% of the total blood volume. An index greater than 1 indicates shock, among which a value greater than 1.5 is considered severe shock, with blood loss ranging from 1200 to 2000 mL, accounting for 30% to 50% of the total blood volume. An index greater than 2 indicates severe shock, with blood loss exceeding 2000 mL, accounting for more than 50% of the total blood volume. The shock index of this patient was 1.26. The medical team promptly established two venous access routes, followed the doctor's advice to quickly replenish fluid to restore blood volume, assisted the patient in taking the supine fovea position, and actively completed the preoperative preparations. Eventually, splenic artery embolization (PSE) was performed in a timely manner.

2.5.9. Prevention

For identified potential nursing risks, formulate targeted preventive nursing measures to reduce the incidence of risks.

(1) Prevention of bleeding

The platelet count of the patient in this case dropped to a minimum of 1×10^{10} g/L, and plasma infusion and platelet support therapy have been given. To prevent bleeding, during the nursing process, the patient's vital signs and coagulation function were closely monitored, including changes in prothrombin time, platelet count, hemoglobin and other indicators. At the same time, pay close attention to whether there are any signs of local or systemic bleeding, such as petechiae and ecchymosis at the puncture site, gum bleeding, nosebleeds, hematemesis, hematochezia, etc. In daily life care, patients should be guided to avoid bumps and knocks, not to pick their noses with their hands, not to use toothpicks to pick their teeth, and to use soft-bristled toothbrushes to brush their teeth. Strengthen the dynamic assessment of heart rate, blood pressure, blood oxygen saturation, state of consciousness, urine output and clinical manifestations. Once any abnormality occurs, take effective intervention measures immediately to minimize the existing

and potential bleeding risks of patients to the greatest extent [13].

(2) Prevention of common complications of cytokine adsorption and plasma exchange

Plasma was separated using a Fresenius Kabi COM.TEC centrifugal blood cell separator and then adsorbed by a cytokine adsorption column (CA280, Jianfan Biotechnology Group Co., LTD., China), with the right internal jugular vein as the vascular access. In accordance with the requirements of the Expert Consensus on the Clinical Application of Artificial Liver Blood Purification Technology (2022 Edition), the tubing and adsorption column should be thoroughly pre-flushed, with low-molecular-weight heparin anticoagulation [14]. Before each treatment, 5 mg of dexamethasone should be intravenously injected to prevent allergic reactions to the adsorption column and tubing. To prevent hypotension, 400 mL of isoplasma was intravenously infused peripheral before the end of cytokine adsorption to maintain blood volume balance. Before sequential plasma exchange therapy, 25 mg of promethazine was intramuscularly injected and 5 mg of dexamethasone was intravenously injected to prevent plasma hypersensitivity. Continuous intravenous infusion of 10% calcium gluconate prevents hypocalcemia; During the operation, electrocardiogram monitoring and oxygen inhalation were performed throughout the process. The blood flow rate was 50 to 60 mL/min, the plasma separation rate was 25 to 33 mL/min, the plasma exchange volume was 1600 to 2000 mL (fresh frozen plasma), and the treatment duration was 2 to 3 hours. During both treatments, the patient had no adverse reactions.

(3) Prevention of black urine fever

Reduce unnecessary movement to avoid inducing heart failure. Ensure a daily fluid intake of 3000 to 4000 mL and a daily urine output of ≥ 1500 mL. In cases of acute renal failure such as anuria or oliguria, treat it as acute renal failure. Accurately record the 24-hour fluid intake and output.

(4) Prevention of complications of splenic artery embolization (PSE)

Post-embolization syndrome: Almost all patients after partial splenic embolization have transient fever, left upper abdominal pain and loss of appetite [15]. Fever is generally around 38℃, with a few cases reaching above 39℃, lasting for 1 to 3 weeks. There is moderate abdominal pain, and symptomatic treatment is sufficient. Bronchopneumonia and pleural effusion are more common on the left side, which is related to the pain after splenic embolization restricting the left respiratory movement and reactive pleurisy. It can be relieved through anti-infection and symptomatic treatment. Splenic abscess is caused by bacterial infection. Controlling the embolization range, strict aseptic operation and the application of perioperative prophylactic antibiotics can effectively reduce the incidence of splenic abscess. Once splenic abscess occurs, active anti-infection treatment should be carried out. Chen Jing and other scholars have studied the safety and effectiveness of intraluminal injection of 10% sodium chloride in the treatment of splenic abscess after PSE [16].

(5) Prevention of malnutrition

Patients with malignant malaria have persistent high fever, high energy consumption and poor appetite. Adequate calorie supply is of great significance. This patient has symptoms of nausea, vomiting and diarrhea. They have been given parenteral nutrition preparations such as fat emulsion and amino acids as prescribed by the doctor. During the infusion process, be vigilant about the occurrence of phlebitis [17]. After the treatment to regulate the intestinal flora, the diarrhea improved and the appetite improved. The nutritionist formulated a personalized diet plan and recipe for the patient. The dietary principle was light and refreshing, and it was advisable to consume easily digestible and absorbable high-protein and high-

vitamin foods.

(6) Prevention of negative emotions

Psychotherapists provide targeted psychological intervention based on the patient's personality traits and adverse psychological triggers to minimize the impact of negative emotions on the treatment outcome to the greatest extent. Adopt reasonable emotive therapy to transform patients' wrong beliefs and cognition, solve their emotional and behavioral problems, and maintain a positive attitude and belief as much as possible to correctly deal with the disease [18]. Select appropriate psychological counseling techniques such as mindfulness meditation training, aromatherapy, music therapy, etc.

(7) Prevention of adverse reactions of antimalarial drugs

Artesunate for injection needs to be properly and thoroughly dissolved. Before use, add 0.6ml of the attached 5% sodium bicarbonate injection, shake for 2 minutes until completely dissolved, then add 5.4ml of 5% glucose injection or glucose-sodium chloride injection for dilution, ensuring that each 1ml of the solution contains 10mg of artesunate, and inject slowly intravenously. Allergic reactions: Be vigilant about allergic reactions such as anaphylactic shock, urticaria, rash and pruritus. Delayed hemolysis (PADH) occurs at least 7 days after treatment and can last for several weeks. It is recommended to closely monitor the signs of hemolytic anemia within 4 weeks after treatment. Severe cases may require blood transfusion. If necessary, direct antiglobulin tests can be conducted to determine whether glucocorticoid treatment is needed.

(8) Disease prevention

Mosquito prevention and control, avoiding mosquito bites, is the most important means of preventing malaria. When traveling to malaria-endemic areas, one should take personal protective measures, such as wearing long-sleeved shirts and long pants, using mosquito nets and other physical protective measures, using repellents, mosquito coils to repel mosquitoes or taking preventive drugs and other chemical protective measures, and reduce or avoid going outdoors during the peak mosquito activity periods of dusk and night. If symptoms such as chills, fever, sweating, diarrhea, and joint pain occur within one month after returning from a short-term trip to an epidemic area or within two years after returning from a long-term stay in an epidemic area, medical attention should be sought promptly. When entering the country and seeking medical treatment, one should proactively inform the doctor of their travel history to enhance the timeliness of diagnosis and reduce misdiagnosis and missed diagnosis. After being diagnosed with malaria, one should take antimalarial drugs in full and in the prescribed dosage as directed by a doctor to prevent recurrence and drug resistance. Emergency response: Enhance the emergency handling capabilities and teamwork levels of the members of the integrated medical and nursing care team, quickly initiate emergency response procedures, and smoothly complete remedial measures.

2.5.10. Medical and nursing assistance in emergency drills

Regularly carry out integrated medical and nursing emergency drills and training for spontaneous splenic rupture, refine the process measures for each link, assign specific responsibilities to individuals, identify loopholes and shortcomings, continuously optimize emergency plans, and enhance practical combat capabilities.

(1) Develop various potential risk emergency procedures. Members of the integrated medical and nursing care team used the brainstorming method to develop various potential risk emergency procedures based on the actual condition of the patient, such as hemorrhagic shock and black urine fever, requiring everyone to be

aware of the risks and be capable of responding to emergencies.

(2) Diversified interactive extended services. Reduce the incidence of complications. Establish a diversified interactive wechat group to regularly push disease health care knowledge through text, voice, pictures, videos, etc. Follow up at frequencies of 2 weeks, 4 weeks, 8 weeks, and 12 weeks. Group members build a guiding and cooperative relationship with the community hospital where the patient is located, forming a positive interaction [19]. Ensure the effective continuation and operation of the care model, and integrate each piece of feedback information and patient suggestions to adjust the home management plan.

3. Summary

The patient's condition was extremely critical. The successful emergency treatment was attributed to the following three aspects.

3.1. Collaborative role and efficacy of the integrated medical and nursing team

In the integrated medical and nursing team, all members work closely together, both recognize their job responsibilities, divide the work, and strive to achieve the common goal [20]. Medical staff jointly observe the patient's condition, detect potential risks early, and can identify the signs of spontaneous splenic rupture at an early stage. They also pay attention to the patient's subjective feelings and psychological state. Increase the trust between medical staff and patients, and enhance patients' confidence in defeating the disease.

3.2. Advantages and efficacy of the predictive nursing management model

The predictive nursing management model of "foresight–early warning–prevention–emergency response" helps nurses to be well-informed and targeted in their nursing work. Through pre-assessment and analysis, nurses can promptly identify and address potential issues, thereby reducing the incidence of nursing deficiencies. By closely observing and thoroughly understanding the dynamic changes in patients' conditions, they can make patients feel the psychological need to be respected and cared for. Predictive thinking and the ability to handle emergencies on the spot help nurses make correct judgments and actions quickly in emergency situations. Ensure the medical safety of patients [21].

3.3. Technical characteristics and clinical effectiveness of the CA280 cytokine adsorption column

CA280 cytokine adsorption column with nano-scale three-dimensional pore size adjustment technology, specifically adsorbs cytokines. It can be precisely designed based on the molecular structure and size of cytokines, and selectively removes cytokines such as IL-6 and TNF-α. At the same time, hydrophilic molecule graft coating was utilized to comprehensively optimize the hydrophilicity of the resin while maintaining its effectiveness, enhance blood compatibility, and protect blood cells and beneficial components. After two sequential plasma exchange sessions of cytokine adsorption in this patient, total bilirubin, ferritin, interleukin, IL-6, and C-reactive protein all decreased significantly. This patient was complicated with liver failure and severe infection. The effect is remarkable.

In conclusion, the causes of severe malignant malaria with spontaneous splenic rupture are diverse, the onset is insidious, and the mortality rate is extremely high [22]. The development of new cytokine adsorption technology

and the application of the integrated predictive nursing management model of medical care and nursing can significantly improve the prognosis of patients and enhance their quality of life. However, due to the limited number of cases, some related technical specifications are still unclear. How to build a scientific, systematic and complete prevention and treatment system as soon as possible poses new challenges for future development.

Funding

"Artificial Liver Special Fund" of Beijing Gan Dan Xiang Zhao Public Welfare Foundation (Project No.: iGandanF-1082024-RGG055)

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Analysis of Sleep Quality Improvement in Patients with Lumbar Disc Herniation Following Auricular Acupuncture Combined with Chinese Herbal Medicine Packing Therapy

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Abstract: Objective: To evaluate the nursing effects of auricular seed therapy combined with Chinese herbal poultice treatment for patients with lumbar disc herniation (LDH). *Method:* A total of 80 patients with LDH were randomly divided into two groups. The combined group received auricular acupuncture with seed application combined with Chinese herbal poultice therapy, while the reference group received auricular acupuncture with seed application alone. The therapeutic outcomes of both groups were compared. *Results:* The combined intervention group demonstrated decreased sleep quality scores, reduced pain neurotransmitter levels, and improved lumbar spine function scores post-intervention, with significant intergroup differences ($p < 0.05$). *Conclusion:* Auricular seed therapy combined with Chinese herbal poultice care effectively improves sleep quality and lumbar spine function while alleviating pain perception in patients with lumbar disc herniation, indicating superior therapeutic efficacy.

Keywords: Auricular acupressure with seed application; Chinese herbal poultice therapy; Lumbar disc herniation; Sleep quality

Online publication: Feb 11, 2026

1. Introduction

LDH is an orthopedic condition characterized by typical symptoms such as low back pain, cauda equina syndrome, and numbness in the lower limbs. Its etiology involves lumbar disc degeneration leading to nucleus pulposus protrusion and compression of surrounding nerves. The condition has a prolonged course and can significantly impact patients' quality of life over the long term [1]. Additionally, patients with LDH experience more severe chronic pain symptoms, which can lead to psychological distress such as anxiety and irritability, thereby reducing their sleep quality. The conventional treatment for this condition involves conservative approaches like oral medication and physical traction. While these methods can alleviate symptoms, their long-term efficacy

remains suboptimal. Therefore, nursing interventions for these patients primarily involve lifestyle guidance, pain management, and rehabilitation training. Clinical practice has revealed that conventional nursing measures are relatively limited and struggle to meet patients' increasingly complex care needs [2]. In contrast, traditional Chinese medicine possesses extensive experience in managing LDH and can utilize distinctive TCM nursing techniques to improve patient outcomes. Ear acupuncture with bean-sized pressure seeds and herbal poultice therapy are both commonly employed TCM nursing methods. The former stimulates ear acupuncture points to promote blood circulation, unblock meridians, and regulate Qi and blood; the latter generates a thermal effect to reduce swelling, relieve pain, and activate blood circulation to resolve stasis. The combination of these two approaches demonstrates superior efficacy in alleviating pain symptoms and improving sleep quality, exhibiting a synergistic mechanism. Based on this, this study enrolled 80 patients with LDH to evaluate the therapeutic effects of auricular seed therapy combined with Chinese herbal poultice care.

2. Materials and methods

2.1. General information

A total of 80 LDH patients admitted between August 2022 and August 2025 were selected and randomly assigned. The combined group included 40 patients, comprising 23 males and 17 females. Their ages ranged from 36 to 77 years, with a mean age of (51.78 ± 4.19) years. The control group included 40 patients, comprising 24 males and 16 females. Their ages ranged from 34 to 76 years, with a mean age of 51.63 ± 4.22 years. Comparison of the above data between groups yielded $p > 0.05$.

2.1.1. Inclusion criteria

(1) Diagnosed with LDH based on imaging studies;
(2) First episode;
(3) Normal mental status and language expression;
(4) Fully informed about the study.

2.1.2. Exclusion criteria

(1) History of lumbar surgery;
(2) Other joint diseases;
(3) Immune system deficiencies;
(4) Malignant tumors;
(5) Chronic pain caused by other reasons;
(6) Withdrawal from the study.

2.2. Method

Both groups received standard care including surgical treatment, medication guidance, and functional training, with strict bed rest required for patients. Control group received auricular seed therapy: Points selected included Subcortex, Shenmen, Lumbosacral Vertebrae, and the sciatic nerve area, along with corresponding liver and kidney zones. Disinfect the above points with 75% alcohol. Apply Wangbuluxing seeds (0.5 × 0.5 cm) onto medical adhesive tape and affix them to the designated points. Knead or press each point for 1–2 minutes, three times daily.

Replace the patches after 3 days and continue treatment for 4 weeks. The combined group received Chinese herbal poultice therapy alongside auricular acupuncture with seed pressure. The formula comprised: Chuan Niuxi (15 g), Chuanxiong (10 g), Du Huo (10 g), Fangfeng (10 g), Fengxian Tougucao (15 g), Guizhi (10 g), Qianghuo (10 g), Shenjincao (30 g), Weilingxian (10 g), Honghua (10 g), and Jingjie (10 g). The herbs were ground into powder and placed in gauze pouches. The pouches were boiled in water for 30 minutes, then 170 mL of yellow rice wine and 280 mL of aged vinegar were added. After simmering for another 15 minutes, the mixture was removed. Wrap the medicated pouch in a thick towel and place it on the patient's waist. Apply heat in a downward, clockwise motion, then position the pouch over the affected area. Each treatment lasts 30 minutes, administered twice daily for 4 weeks.

2.3. Observation indicators

(1) Sleep quality score

The Pittsburgh Sleep Quality Index (PSQI) was used, selecting three components: sleep duration, sleep disturbances, and sleep onset latency. Each component is scored from 0 to 3 points, with sleep quality scored negatively.

(2) Pain mediator levels

Blood samples were collected in the fasting state. Serotonin (5-HT) was measured using high-performance liquid chromatography (HPLC), while substance P (SP) was assessed via enzyme-linked immunosorbent assay (ELISA).

(3) Lumbar spine function score

The Japanese Orthopaedic Association (JOA) assessment score is used, comprising subjective symptoms (9 points), clinical signs (6 points), and limitations in daily activities (14 points). Lumbar spine function is scored positively.

2.4. Statistical analysis

Data were processed using SPSS 28.0 software. Quantitative variables underwent *t*-tests for comparison/analysis, while categorical variables underwent binary comparisons/tests. Statistical significance was defined as $p < 0.05$.

3. Results

3.1. Sleep quality scores compared between the two groups

The sleep quality score decreased after the joint nursing intervention, with a significant difference between groups ($p < 0.05$).

Table 1. Sleep quality scores compared between two groups [$\overline{x} \pm$ s, points]

Grouping	Example count	Sleep duration		Sleep disorders		Time to fall asleep	
		Before nursing	After care	Before nursing	After care	Before nursing	After care
Joint group	40	2.03 ± 0.45	0.71 ± 0.19	1.95 ± 0.38	0.64 ± 0.17	1.92 ± 0.46	0.61 ± 0.15
Control group	40	2.01 ± 0.47	1.04 ± 0.22	1.97 ± 0.41	0.95 ± 0.20	1.90 ± 0.43	0.98 ± 0.19
t		0.194	7.180	0.226	7.469	0.201	9.667
p		0.846	0.000	0.822	0.000	0.841	0.000

3.2. Pain mediator levels compared between the two groups

Pain neurotransmitter levels decreased after combined group nursing, with a significant difference between groups ($p < 0.05$).

Table 2. Pain mediator levels compared between two groups [$\overline{x} \pm s$]

Grouping	Example count	5-HT (μmol/L)		SP (μg/mL)	
		Before nursing	After care	Before nursing	After care
Joint group	40	0.80 ± 0.19	0.34 ± 0.11	360.53 ± 28.74	208.65 ± 20.11
Control group	40	0.82 ± 0.21	0.49 ± 0.14	361.12 ± 29.03	265.98 ± 21.43
t		0.447	5.328	0.091	12.338
p		0.656	0.000	0.927	0.000

3.3. Comparison of lumbar function scores between the two groups

The lumbar spine function score increased after the combined group care intervention, with a significant difference between groups ($p < 0.05$).

Table 3. Comparison of lumbar function scores between the two groups [$\overline{x} \pm s$, points]

Grouping	Example count	Subjective symptoms		Clinical signs		Daily life is restricted	
		Before nursing	After care	Before nursing	After care	Before nursing	After care
Joint group	40	5.21 ± 1.09	7.31 ± 1.52	2.44 ± 0.53	4.23 ± 0.91	8.22 ± 1.46	11.49 ± 2.03
Control group	40	5.23 ± 1.13	6.08 ± 1.14	2.46 ± 0.57	3.64 ± 0.86	8.20 ± 1.51	9.78 ± 1.54
t		0.081	4.094	0.163	2.980	0.060	4.244
p		0.936	0.000	0.871	0.004	0.952	0.000

4. Discussion

LDH is a spinal surgical condition with a relatively high incidence rate. Its pathological manifestations include nerve root compression and lumbar disc degeneration. Patients commonly experience persistent and severe low back pain, which significantly impairs their daily functioning. At present, Western medical treatment for this condition primarily involves oral medications such as muscle relaxants and nonsteroidal anti-inflammatory drugs (NSAIDs), which take effect relatively quickly and can rapidly alleviate pain symptoms [3,4]. However, these medications carry a high risk of dependency and are associated with a significant relapse rate upon discontinuation. To enhance long-term clinical outcomes, patients with this condition typically receive nursing care services. Through structured rehabilitation exercises and personalized health guidance, these interventions gradually restore lumbar spine function and shorten the duration of LDH. However, conventional care is generally not very feasible, produces slow results, and cannot provide long-term improvement in patients' conditions.

Traditional Chinese medicine classifies LDH under the category of "low back pain". Its pathogenesis involves deficiency of liver and kidney essence, Qi stagnation, and blood stasis. The pathological location is in the lumbar region. External factors include invasion by wind, cold, dampness, and heat, as well as excessive fatigue. Internal factors stem from inadequate nourishment of the lumbar region, insufficiency of kidney essence, and obstruction of

collaterals [5]. The combined effects of these factors can impair kidney function, thereby damaging the tendons and meridians in the lower back. This leads to stagnation of Qi and blood, ultimately triggering the disease. Based on this, the intervention principles for LDH include relaxing tendons and unblocking meridians, as well as promoting blood circulation and resolving blood stasis. Ear acupressure with seeds and Chinese herbal poultice application are both commonly used distinctive TCM nursing techniques. Among these, ear acupressure with seeds is a safe, feasible, and convenient non-invasive nursing method. It stimulates the Shenmen acupoint and subcortical regions, inducing sensations such as soreness, distension, and numbness at the acupoints. This stimulation of ear acupoints facilitates the unblocking of meridians, regulates organ functions, dispels dampness and cold, and promotes the circulation of Qi and blood [6]. Herbal pouches integrate the efficacy of traditional Chinese medicine with thermal therapy. When applied as a heat pack to the lower back, the pouch facilitates transdermal absorption of herbal ingredients into the body, enabling consistent therapeutic effects.

Results showed that sleep quality scores and pain neurotransmitter levels decreased after the combined care intervention, with $p < 0.05$ between the two groups. The mechanism involves ear acupuncture seeds exerting sustained stimulation on nerve endings in the auricular region, thereby generating nerve impulses that transmit signals to various body parts. This induces physiological responses, activating the pain regulation system and exerting analgesic effects through neural reflex mechanisms, ultimately alleviating sleep disturbances caused by pain symptoms [7,8]. The auricular region features a dense network of blood vessels and lymphatics, forming vascular and lymphatic plexuses that connect to spinal nerves and cerebral cortex areas. Stimulating auricular points can influence these neural pathways, enhancing neurological function. This inhibits signal transmission in lumbar nerves, alleviating symptoms associated with LDH and improving patients' sleep quality. Chinese herbal poultice therapy utilizes the warming stimulation to facilitate the penetration of herbal components into tissues, regulating blood circulation in the lumbar region, improving the flow of Qi and blood, and alleviating pathological manifestations such as Qi and blood stagnation. The application of heat and pressure further promotes blood circulation, disperses stasis, warms meridians, and unblocks channels, thereby reducing muscle spasms and relieving pain sensations. Furthermore, the warmth helps maintain balance between the parasympathetic and sympathetic nervous systems, thereby relaxing the body and promoting faster sleep onset for patients. In the composition of Chinese herbal medicine packets, Sichuan Achyranthes root (Chuan Niuxi) nourishes the liver and kidneys; Ligusticum root (Chuanxiong) promotes blood circulation, strengthens tendons and bones, and directs the action downward; Angelica root (Duhuo) dispels dampness and alleviates pain; Fangfeng dispels wind and cold; Fengxian Tougucao alleviates pain, disperses stasis, and promotes blood circulation to relax tendons; Guizhi and Qianghuo eliminate dampness, relieve pain, and disperse cold; Shenjincao and Weilingxian unblock meridians to relieve pain; Honghua Schizonepeta reduces swelling and alleviates pain. The combined use of these herbs nourishes the liver and kidneys, promotes blood circulation, and alleviates pain. Coupled with the localized heating effect from warm compresses, this treatment regulates microcirculation in the lumbar region, accelerates the absorption of hematomas and exudate, thereby reducing pain intensity and improving sleep quality for patients.

The lumbar function scores increased after combined group therapy, with a statistically significant difference between the two groups ($p < 0.05$). This improvement stems from the fact that the auricular acupoints selected for seed pressure therapy are all related to the lumbar region. The stimulation generated by pressing Wangbuluxing seeds regulates Qi and blood circulation while balancing Yin and Yang. This enhances blood flow to the lumbar area, increases nutrient supply, and consequently strengthens lumbar vertebral function. The herbal composition of traditional Chinese medicine poultices includes Sichuan cow knee, which contains

polysaccharides and sterols that promote the effective synthesis of collagen and proteoglycans, thereby repairing intervertebral discs. Sichuan lovage contains components such as ligustilidine, which effectively dilates blood vessels, regulates microcirculation in the lumbar disc region, and inhibits platelet aggregation. It also exhibits anti-neuroinflammatory effects, alleviating symptoms of nerve root edema. Angelica pubescens contains volatile oils and coumarins, which possess sedative and anti-inflammatory properties while reducing prostaglandin synthesis. *Saposhnikovia divaricata* contains components such as saponins, offering anti-inflammatory, analgesic, and antipyretic effects alongside immune-modulating functions. *Impatiens capensis* contains phenylpropanoid and flavonoid components that reduce the synthesis of substances such as prostaglandin E2 and cyclooxygenase-2, thereby inhibiting the expression of inflammatory mediators and exerting anti-inflammatory and analgesic effects. Additionally, this herb enhances tissue permeability, allowing active components from other Chinese herbal medicines to fully penetrate joints, ligaments, and other tissues. It also dilates blood vessels to improve blood supply, thereby alleviating tissue hypoxia or ischemia. Cinnamon twig contains components such as cinnamaldehyde, which exhibits anti-inflammatory and anti-allergic properties. Notopterygium contains volatile oils and other active constituents that reduce the secretion of inflammatory mediators, thereby exerting anti-inflammatory effects. *Scutellaria baicalensis* relaxes skeletal muscles, alleviating symptoms such as muscle spasms. *Dictamnus dasycarpus* relaxes smooth muscles and improves cartilage metabolic function. Safflower contains components such as crocin and hydroxycrocin A, which can inhibit platelet aggregation and enhance fibrinolytic activity. This reduces blood viscosity and regulates blood circulation around the lumbar intervertebral discs. Additionally, safflower can significantly scavenge free radicals and prevent oxidative stress, thereby protecting lumbar disc cells and improving lumbar mobility [9]. Schizonepeta has mild antispasmodic effects and can alleviate pain symptoms.

5. Conclusion

In summary, ear acupuncture combined with herbal poultice therapy demonstrates favorable outcomes for LDH patients. This approach effectively alleviates pain symptoms while simultaneously improving sleep quality and lumbar spine function, highlighting its significant therapeutic value.

Disclosure statement

The authors declare no conflict of interest.

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Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

A Case of Ventilator-associated Pneumonia in Neonatology: Investigation and Analysis of the Source of *Ralstonia mannitolilytica* Infection

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Abstract: This study examined a case of ventilator-associated pneumonia caused by Ralstonia mannitolilytica in a neonatal department in order to determine the source of infection and mode of transmission. Symptoms of infection began to appear on day 16 of admission, and both sputum and catheter tip cultures revealed R. mannitolilytica. The infection control department of the hospital later sampled and identified R. mannitolilytica in the ventilator tube that was used by the patient with the exact gene sequence as the infecting strain. These findings indicate that ventilator tubing is a significant contamination source of this pathogen, and hospitals need to enhance their disinfection methods of ventilator-related devices.

Keywords: Neonatology; Ventilator-associated pneumonia; Ralstonia mannitolilytica; Infection source; Hospital infection control

Online publication: Feb 9, 2026

1. Introduction

1.1. Background of research

Ventilator-associated pneumonia (VAP) is pneumonia that develops following the placement of an artificial airway, either endotracheal intubation or tracheostomy, and the initiation of mechanical ventilation > 2 consecutive calendar days, including those where mechanical ventilation was initiated within 48 hours before the development of pneumonia [1]. VAP is a prevalent nosocomial infection in the neonatal intensive care unit (NICU) and is particularly prevalent in preterm or critically ill infants undergoing mechanical ventilation. Not only do this condition increase hospitalization and increase medical expenses, but can also lead to serious complications and even death. An evaluation of the global literature reveals that the occurrence rates of VAP among neonates have a broad spectrum of 2.7–37.2 cases per 1000 ventilator days [2]. Domestic surveys in China have also reported incidence rates of 12.5 to 58.4 and a mortality of 18.1 to 33.3% [3–5]. The broad variation in the incidence rates reported in the various hospitals

could be attributed to challenges in defining VAP, differences in the patient populations or unit-specific issues such as patient acuity, admission rates, and preventive measures. Since VAP may result in serious issues during ventilator weaning, the duration of hospital stays, medical expenses and even the survival of neonatal life in severe cases, it is important to prevent it as early as possible, diagnose it in time and treat it immediately. The main interventions towards VAP management are the rational use of antibiotics to minimize multidrug-resistant bacterial and fungal infections, the use of aseptic practices, and the minimization of the time spent on mechanical ventilation.

Ralstonia mannitolilytica is an opportunistic pathogen, which has been given more attention in hospital-acquired infections, but there are few reports in China. The available literature has indicated that this bacterium exhibits a high level of environmental flexibility and possible multidrug resistance (MDR), and hence a significant risk to immunocompromised patients and a significant contributor to the spread of the bacterium in healthcare institutions [6].

1.2. Research objective

This paper seeks to examine a case of VAP due to *R. mannitolilytica* in the neonatology department, the objectives of which are to determine the cause of the infection, and to learn how the infection spreads in the NICU. The results are supposed to be used as a guideline in preventing such instances of infections in the future.

2. Materials and methods

2.1. Case data

2.1.1. Patient data

The patient was a female who was very preterm with birth weight of 640 g. Our hospital was chosen to deliver the baby through cesarean section due to maternal conditions of "1. Acute fetal distress; 2. Pregnancy with identical twins (monochorionic diamniotic)." The patient was an extremely preterm female infant with a birth weight of 640 g. She was delivered by cesarean section in our hospital because of maternal complications, including

(1) Acute fetal distress
(2) Monochorionic diamniotic

Apgar scores were 6 minutes, 9 minutes, and 9 minutes. The amniotic fluid volume was normal and clear at birth. The placenta was delivered intact and the umbilical cord was not wrapped around the neck. The infant had no crying at birth and no meconium staining was seen. Admission diagnoses included the following:

(1) Extremely preterm infant;
(2) Extremely low birth weight infant;
(3) Neonatal respiratory distress syndrome; and
(4) Neonatal respiratory failure.

2.1.2. Condition changes

On the day of admission, after emergency cesarean section delivery, the infant was transferred to the neonatology department and assisted with oxygen via nasal catheter. On day 2 (August 8), the invasive mechanical ventilation was started. The invasive ventilator was taken off on day 8 and replaced with non-invasive ventilation. On day 10 post-admission, the infant developed a fever, with a temperature of 37.9 °C. On day 14 the fever rose again, reaching a maximum of 38 °C, with tachypnea and moist rales bilaterally. Chest x-ray examination showed coarse bilateral lung markings. Additional symptoms were worsening respiratory distress and falling oxygenation. Auxiliary examinations and test results after admission are as follows: