

The Impact of Prophylactic Antibiotic Use in Emergency Treatment of Acute Pancreatitis on the Incidence of Infectious Pancreatic Necrosis

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Abstract: *Objective:* To analyze the value of prophylactic antibiotic use in reducing the incidence of pancreatic necrosis in patients with emergency acute pancreatitis (AP). *Methods:* A total of 70 AP patients who sought medical attention from January 2024 to January 2025 were randomly divided into groups by drawing lots. Group A received prophylactic antibiotic intervention, while Group B received conventional intervention. *Results:* Group A demonstrated superior outcomes compared to Group B in terms of therapeutic efficacy, duration of symptoms, inflammatory factors, symptom scores, and complication rates, with $p < 0.05$. *Conclusion:* Prophylactic antibiotic treatment in emergency AP patients leads to a decrease in inflammatory factor levels, alleviation of symptoms, a reduction in the incidence of infectious pancreatic necrosis, and is safe and effective.

Keywords: Prophylactic antibiotics; Acute pancreatitis; Infectious pancreatic necrosis

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1. Introduction

Acute pancreatitis (AP) accounts for a relatively high proportion of digestive emergencies and poses a significant threat to patients.

It is associated with the activation of pancreatic enzymes within the pancreas triggered by multiple etiological factors, leading to hemorrhage, edema, and necrosis of pancreatic tissue, thereby reducing the patient's quality of life.

The typical pathological features of acute pancreatitis (AP) include fever, nausea, vomiting, and elevated pancreatic enzymes. If AP is mild, the typical pathological feature is pancreatic edema, with most patients having a favorable prognosis and the condition being self-limiting. However, if AP is severe, it can increase the mortality rate^[1].

Additionally, AP itself is a sterile inflammatory lesion. If bacteria infect during the progression of the disease, it can rapidly exacerbate pancreatic inflammation and increase the difficulty of diagnosis and treatment, making early treatment extremely important. Prophylactic antibiotic therapy is a commonly used treatment regimen for AP, but reports on relevant antibiotic use lack comprehensiveness, and there are few studies on the reduction of the

risk of infectious pancreatic necrosis in AP patients by antibiotics ^[2].

This article explores the value of prophylactic antibiotic therapy using a sample of 70 AP patients treated from January 2024 to January 2025.

2. Materials and methods

2.1. Materials

Seventy AP patients were treated from January 2024 to January 2025 and were divided into groups by lottery drawing.

The baseline data of AP patients in Group A were compared with those in Group B, with $p > 0.05$, as shown in Table 1.

Table 1. Analysis of baseline data for AP

Group	n	Age range (years)	Age (years, Mean ± SD)	Duration range (days)	Duration (days, Mean ± SD)	Male [n (%)]	Female [n (%)]
A	35	26–77	56.81 ± 2.42	8–42	33.21 ± 2.14	20 (57.14)	15 (42.86)
B	35	26–78	56.79 ± 2.39	8–41	33.18 ± 2.12	21 (60.00)	14 (40.00)
Statistic (χ^2/t)			0.0348		0.0589		0.0589
p-value			0.9724		0.9532		0.8083

2.2 Inclusion and exclusion criteria

2.2.1. Inclusion criteria

- (1) Laboratory tests, imaging examinations, and clinical manifestations suggest pancreatitis
- (2) Signing of informed consent
- (3) Normal organ function
- (4) Initial diagnosis, with no prior surgical or pharmacological treatment before enrollment

2.2.2. Exclusion criteria

- (1) Organ lesions
- (2) Drug contraindications
- (3) Chronic diseases such as hyperglycemia and hypertension

2.3. Treatment methods

Group A received intravenous treatment with Piperacillin and Tazobactam for Injection (a single dose of 4.5 g, twice daily) + Levofloxacin (a single dose of 0.5 g, once daily) + Ornidazole (a single dose of 0.5 g, twice daily). The medication was administered for 7 days.

Group B followed medical advice to fast and reduce gastrointestinal pressure. Based on the patient’s physiological state, medications such as octreotide and proton pump inhibitors were administered to inhibit pancreatic secretion. Fluid replacement and nutritional support were provided as appropriate, along with analgesics and anti-shock drugs. Organ function was monitored, and amylase levels, blood routine tests, and abdominal CT scans were reviewed to target and prevent adverse indicators. Treatment lasted for 7 days.

2.4. Statistical research

Data was processed using SPSS 23.0, with the chi-square (χ^2) test and percentages used to describe count data, and the t -test and mean \pm standard deviation ($\bar{x} \pm s$) used to describe measurement data. Statistical differences were considered significant when $p < 0.05$.

3. Results

3.1. Efficacy

The efficacy of AP in Group A was higher than that in Group B, with $p < 0.05$. As shown in **Table 2**.

Table 2. Efficacy (n, %)

Group	Markedly effective	Effective	Ineffective	Effective rate
Group A (n = 35)	24 (68.57)	10 (28.57)	1 (2.86)	34 (97.14)
Group B (n = 35)	18 (51.43)	11 (31.43)	6 (17.14)	29 (82.86)
χ^2 -value				3.9383
p -value				0.0464

3.2. Duration of symptoms

The duration of AP symptoms in Group A was shorter than that in Group B, with $p < 0.05$. As shown in **Table 3**.

Table 3. Duration of symptoms ($\bar{x} \pm s$)

Group	Abdominal distension (days)	Abdominal pain (days)	Nausea & Vomiting (days)	Hospital Stay (days)
Group A (n = 35)	2.21 \pm 0.25	1.91 \pm 0.42	1.82 \pm 0.33	18.71 \pm 0.91
Group B (n = 35)	3.11 \pm 0.36	2.73 \pm 0.68	2.69 \pm 0.49	23.66 \pm 1.48
t -value	12.1482	6.0697	8.7125	16.8556
p -value	0.0000	0.0000	0.0000	0.0000

3.3. Serum inflammatory factors

After medication, the levels of WBC, CRP, and PCT in AP patients in Group A were all lower than those in Group B, with $p < 0.05$. As shown in **Table 4**.

Table 4. Serum inflammatory factors ($\bar{x} \pm s$)

Group	WBC ($\times 10^9/L$)		CRP (mg/L)		PCT ($\mu g/L$)	
	Before	After	Before	After	Before	After
Group A (n = 35)	14.28 \pm 1.81	10.33 \pm 0.48	259.43 \pm 8.73	81.46 \pm 4.82	11.58 \pm 1.42	5.11 \pm 0.81
Group B (n = 35)	14.29 \pm 1.79	11.15 \pm 0.81	259.61 \pm 8.71	98.63 \pm 6.99	11.62 \pm 1.41	6.25 \pm 0.99
t -value	0.0232	5.1524	0.0864	11.9635	0.1183	5.2725
p -value	0.9815	0.0000	0.9314	0.0000	0.9062	0.0000

3.4. Symptom scores

After medication, the symptom scores of AP patients in Group A were lower than those in Group B, with $p < 0.05$. As shown in **Table 5**.

Table 5. Symptom scores ($\bar{x} \pm s$)

Group	Abdominal pain (score)		Nausea & vomiting (score)		Fever (score)		Abdominal distension (score)	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Group A (n = 35)	2.51 \pm 0.46	0.88 \pm 0.21	2.53 \pm 0.41	0.87 \pm 0.26	2.48 \pm 0.32	0.78 \pm 0.21	2.42 \pm 0.33	0.79 \pm 0.18
Group B (n = 35)	2.52 \pm 0.49	1.39 \pm 0.37	2.54 \pm 0.44	1.42 \pm 0.38	2.49 \pm 0.33	1.42 \pm 0.29	2.41 \pm 0.31	1.46 \pm 0.33
<i>t</i>	0.0880	7.0919	0.0984	7.0669	0.1287	10.5747	0.1307	10.5448
<i>p</i>	0.9301	0.0000	0.9219	0.0000	0.8980	0.0000	0.8964	0.0000

3.5. Complications

The complication rate in Group A was lower than that in Group B, with $p < 0.05$, as shown in **Table 6**.

Table 6. Complication rate (n, %)

Group	Anastomotic leak	Bleeding	Infected pancreatic necrosis	Incidence rate
Group A (n = 35)	0 (0.00)	0 (0.00)	1 (2.86)	1 (2.86)
Group B (n = 35)	3 (8.57)	1 (2.86)	3 (8.57)	7 (20.00)
χ^2 -value	-	-	-	5.0806
<i>p</i> -value	-	-	-	0.0242

4. Discussion

Acute pancreatitis (AP) is associated with the activation of pancreatic enzymes in the human body, leading to the gradual digestion of pancreatic tissue. It is prevalent among adults and carries a high risk of organ dysfunction. Analyzing the etiology of AP, it is related to biliary obstruction, biliary tract infections, and other factors. After onset, bile refluxes into the pancreatic duct, increasing the activity of pancreatic enzymes and thus triggering AP. It is also associated with excessive alcohol consumption; alcohol continuously stimulates the body upon entering, increasing the secretion of pancreatic enzymes, which manifests as pancreatic duct obstruction and sphincter spasm. Additionally, it is linked to hyperlipidemia; continuous deposition of lipids in the pancreatic microvasculature leads to vascular obstruction and damage to pancreatic cells, which can also induce AP.

Furthermore, AP is also related to multiple factors such as daily medication use, iatrogenic procedures, metabolic diseases, trauma, and infections. After the onset of AP, the typical symptom is abdominal pain, mostly confined to the upper abdomen, with intense pain that can radiate to the back. The pain intensifies especially after a heavy meal or excessive alcohol consumption, and it can be alleviated by leaning forward or bending over. As AP progresses, patients develop symptoms such as nausea and vomiting, and the pain does not subside after vomiting gastric contents. In severe cases, the vomitus contains coffee-ground material or bile, and inflammatory

factors inhibit intestinal nerves, leading to intestinal paralysis, characterized by decreased bowel sounds.

Some patients with AP have severe conditions and may present with a series of systemic manifestations, such as fever during the onset (high fever in cases of secondary infection); after progressing to severe AP, the body releases a large number of inflammatory factors, resulting in hypotension, slowed pulse, and pallor; when complicated by biliary obstruction, jaundice may occur; after being complicated by ARDS, patients may develop hypoxemia due to respiratory distress^[3].

The main hazards of AP to the human body are summarized as follows:

(1) Pancreatic necrosis

Inflammatory lesions and ischemia of pancreatic tissue can lead to pancreatic necrosis, progressing to necrotizing AP, which requires surgical debridement.

(2) Peripancreatic fluid collection

Increased inflammatory exudate increases pressure on adjacent blood vessels and intestines, which can lead to venous thrombosis and intestinal obstruction. In cases complicated by pseudocysts, it can cause abdominal hemorrhage and infection.

(3) Acute kidney injury

Continuous release of inflammatory factors in AP patients stimulates renal tubules and renal blood vessels, which can damage renal function and prolong the course of the disease.

(4) Circulatory system failure

Long-term inflammatory stimulation induces dilatative shock and myocardial suppression, increasing the risk of inadequate tissue perfusion and hypotension, with a minority of patients developing organ failure.

(5) Liver function impairment

Inflammation stimulates the hepatobiliary system, elevating transaminase levels, which can lead to secondary liver failure and further damage liver function.

(6) Abnormal coagulation indicators

Inflammation in AP patients stimulates the coagulation system, inducing disseminated intravascular coagulation, which increases the risk of adverse conditions such as thrombosis and hemorrhage.

Therefore, treatment should be initiated as early as possible after the onset of AP, with active prevention and control of complications to reduce the incidence of infectious pancreatic necrosis. During routine medication management, fasting as prescribed by the doctor is implemented for gastrointestinal decompression, along with the administration of drugs to inhibit pancreatic secretion, neurotrophic agents, analgesics, and anti-shock medications. Regular follow-up examinations of various indicators as per medical advice can control the progression of AP but cannot effectively manage inflammation. The prophylactic use of antibiotics in the treatment of AP patients can reduce the incidence of infections in severe cases. By inhibiting the progression of inflammation and reducing pancreatic tissue necrosis, it protects intestinal barrier function, decreases the number of intestinal flora, and also reduces adverse events such as pancreatic abscesses and peripancreatic infections^[4]. Additionally, some high-risk AP patients may experience organ failure and extensive pancreatic necrosis, limit the effectiveness of routine treatment and potentially increasing the risk of mortality. Prophylactic antibiotic use can reduce the risk of multiple organ failure and systemic inflammatory response.

Based on the data analysis in this article, the prophylactic use of antibiotics as prescribed by the doctor demonstrates excellent efficacy and shortens the duration of symptoms. The reasons for this are as follows: the prophylactic use of piperacillin-tazobactam, which is effective against anaerobic bacteria and Gram-positive/

negative bacteria, can rapidly penetrate pancreatic tissue and is suitable for the treatment of pancreatic infections. However, the dosage and duration of administration should be adjusted based on the patient's physiological state during actual medication use. The active ingredient in levofloxacin inhibits bacterial DNA synthesis, providing broad-spectrum antibacterial effects. Ornidazole inhibits anaerobic bacteria and enhances the overall management of AP^[5]. During the actual medication treatment period, it is essential to guide AP (acute pancreatitis) patients in adjusting their diet reasonably. For instance, if abdominal pain occurs during disease flare-ups, patients should follow medical advice to fast, thereby avoiding food stimulation of the pancreas and reducing digestive fluid secretion, which in turn lowers the pancreatic burden. Once the abdominal pain subsides or eases and all indicators stabilize, patients can follow medical advice to consume liquid foods such as rice water and warm water. After AP patients' conditions stabilize, they should still avoid high-fat foods like fried dough sticks, fried chicken, and cream, and they should eat small, frequent meals to avoid consuming large amounts of food in a short period. It is recommended that patients engage in exercises such as Tai Chi or walking for about 30 minutes daily to maintain a normal weight range. Daily abstention from smoking, alcohol, beverages, and strong tea is advised, along with maintaining a calm mindset.

Another set of data indicates that the inflammatory factor indicators of patients decrease after the prophylactic use of antibiotics. Analyzing the reasons, after the onset of AP, the WBC (white blood cell) count in patients increases, which is directly proportional to the progression of AP. However, an isolated increase in the WBC count cannot serve as a definitive diagnostic basis for AP and requires comprehensive analysis with other indicators. Generally, the WBC count in mild AP patients ranges from 10 to $15 \times 10^9/L$, while in moderate to severe AP patients, it is $\geq 15 \times 10^9/L$. CRP (C-reactive protein) is an inflammatory marker that rapidly increases when the body develops AP and reaches its peak 48–72 hours later, assisting physicians in predicting the severity of AP. Generally, a CRP level > 150 mg/L in mild AP patients indicates a critical condition and poor prognosis. PCT (procalcitonin) is a protein polypeptide substance with extremely low levels in a healthy body and extremely high levels in severely infected individuals. Generally, the PCT level in mild AP patients is around 0.5–2 ng/L, and a PCT level > 10 ng/L in a few AP patients suggests concurrent sepsis^[6].

After the prophylactic use of antibiotics in this study, the levels of the aforementioned inflammatory factors decreased, suggesting that the rational use of antibiotics can rapidly control the progression of inflammation. Moreover, antibiotics can reduce the incidence of infectious pancreatic necrosis, further lowering inflammation levels. Another set of data indicates that prophylactic antibiotic use can alleviate symptoms of acute pancreatitis (AP). The analysis suggests that prophylactic antibiotics effectively prevent and control infections, particularly reducing conditions such as infectious necrosis and peripancreatic infections, which are beneficial for prognosis. However, it should be noted that while prophylactic treatment of AP with piperacillin-tazobactam, levofloxacin, and ornidazole does not directly alleviate AP-related symptoms, controlling the condition through anti-infection pathways can indirectly reduce patient discomfort. The final set of data demonstrates that prophylactic antibiotic therapy for AP can reduce AP-related complications, particularly lowering the rate of infectious pancreatic necrosis. Nevertheless, clinical studies have yielded varying results regarding the prevention of complications through prophylactic antibiotic use. Some scholars argue that prophylactic antibiotics may increase the rate of antibiotic misuse and the risk of multidrug-resistant bacteria, while others believe that prophylactic antibiotic therapy for AP can achieve excellent outcomes and reduce adverse events such as infections.

In the study by Gu Shen and colleagues, targeted therapy and prophylactic antibiotic therapy were administered to AP patients separately, revealing that after prophylactic antibiotic intervention, patients

experienced a lower complication rate and improved quality of life ^[7]. A thorough analysis of the factors influencing complications in patients with acute pancreatitis (AP) reveals that these are not solely determined by a single factor, namely clinical medication. Rational selection of antibiotics, along with adjustments in the timing and duration of administration, can reduce the incidence of drug resistance and ensure therapeutic efficacy in AP patients.

However, during the actual prophylactic use of antibiotics, bacteria in the intestinal tract may infiltrate the abdominal cavity, increasing the risk of extra-pancreatic infections. Blind selection of antibiotics can lead to dysbiosis, heighten the risk of excessive fungal proliferation, and even result in multidrug resistance.

Therefore, during the prophylactic use of antibiotics for AP treatment, the following considerations should be noted:

(1) Strictly control antibiotic indications

Antibiotics should only be administered to AP patients when there are clear indications for their use, to avoid antibiotic abuse.

(2) Scientifically select the type of antibiotics

It is recommended to use broad-spectrum antibiotics for prophylactic purposes and subsequently adjust the antibiotic regimen based on the patient's condition management. Additionally, when selecting antibiotic types, preference should be given to drugs with excellent pancreatic tissue penetration, enabling rapid penetration through the blood barrier.

(3) Regulate the timing of antibiotic administration and treatment duration

Prophylactic antibiotics should be administered as early as possible in the initial stage of AP, but not for prolonged periods. It is advisable to control the treatment duration to around 7 days. During the actual use of antibiotics, close attention should be paid to fluctuations in the patient's condition and the safety of antibiotic use should be analyzed. In this study, after the prophylactic use of antibiotics, the complication rate in AP patients decreased. However, due to the limited number of AP samples included, there may be biases in predicting infectious pancreatic necrosis.

Therefore, future studies should include a larger number of AP samples and conduct multicenter investigations to explore the safety of prophylactic antibiotic use and its value in reducing infectious pancreatic necrosis events.

5. Conclusion

In summary, during the prophylactic use of antibiotics in AP patients, levels of inflammatory factors decrease, symptoms are alleviated, and therapeutic efficacy is excellent, making it worthy of promotion.

Disclosure statement

The author declares no conflict of interest.

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Research on the Effects of Dexmedetomidine on Anesthesia Complications and Postoperative Analgesia in Patients Undergoing Thyroid Cancer Surgery

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Abstract: *Objective:* To investigate the application effect of dexmedetomidine in anesthesia for thyroid cancer (TC) surgery. *Methods:* A total of 90 patients admitted to our hospital from January 2023 to December 2023 were selected as the study subjects. The patients were divided into an observation group (given continuous intravenous infusion of dexmedetomidine during surgery) and a control group (given continuous intravenous infusion of an equal volume of sodium chloride injection during surgery) by lottery method, and the anesthesia indicators of the two groups were compared. *Results:* The dosages of remifentanyl and propofol in the observation group were lower than those in the control group ($p < 0.05$); the incidence of complications in the observation group was lower than that in the control group ($p < 0.05$); the Visual Analogue Scale (VAS) scores of the observation group at 4 h, 12 h, 24 h, and 48 h postoperatively, both at rest and during activity, were lower than those of the control group ($p < 0.05$). *Conclusion:* During surgery for TC patients, continuous intravenous infusion of dexmedetomidine can reduce the dosage of anesthetic drugs and the incidence of anesthesia-related complications, alleviate postoperative pain, and is worthy of promotion and application.

Keywords: Dexmedetomidine; Thyroid cancer; Complications; Analgesia

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1. Introduction

Thyroid cancer (TC) is a malignant tumor that occurs in thyroid cells and is one of the most common types of cancer in the endocrine system^[1]. If left untreated promptly, it may lead to hypothyroidism, cervical lymph node metastasis, distant metastasis (such as bone metastasis), as well as local compression symptoms like dyspnea and dysphagia. Surgical treatment is the primary approach, especially for aggressive or large-diameter tumors, as it can completely remove tumor tissue, reduce the risk of recurrence, and help determine the pathological type and degree of differentiation^[2]. Postoperative pain is a common issue faced by patients after surgery, which not only causes discomfort and affects recovery and quality of life but may also lead to a series of adverse reactions such as

pulmonary infection and deep vein thrombosis. Meanwhile, the surgical trauma is extensive and time-consuming, imposing high demands on intraoperative anesthetic medications. Selecting appropriate anesthetic drugs is of great significance for ensuring the smooth progress of surgery and reducing the occurrence of postoperative pain. Dexmedetomidine, an α_2 -adrenergic receptor agonist, has been widely used in intensive care units and operating rooms in recent years [3]. To further explore its application effect in surgery for patients with TC, this study included 90 patients as research subjects, aiming to investigate the anesthetic application effect of this drug in TC surgery. The report is as follows.

2. Materials and methods

2.1. General information

From January 2023 to December 2023, 90 patients were included and evenly divided into an observation group and a control group using a lottery method. There was no significant difference in baseline data between the two groups ($p > 0.05$). Specific data are shown in **Table 1**.

Table 1. Comparison of baseline data between the two groups

Group	n	Male (n)	Female (n)	Age (years)
Observation group	45	23	22	50.23 \pm 3.41
Control group	45	24	21	50.33 \pm 3.28
t/χ^2			0.044	0.142
p			0.832	0.888

2.1.1. Inclusion criteria

Patients should not have any serious systemic diseases such as heart disease, lung disease, or liver and kidney dysfunction that may affect the study outcomes or anesthesia risk; patients should not have a known history of allergies to the study drugs; patients should be able to understand and consent to participate in the study and provide informed consent.

2.1.2. Exclusion criteria

Patients with mental illness or cognitive dysfunction who are unable to provide informed consent; patients currently receiving medications that may affect the study results, such as long-term use of analgesics, antidepressants, etc.; patients who do not meet other requirements specified in the study design.

2.2. Methods

Both groups of patients received routine preoperative preparations before surgery, including an assessment of their overall health status, inquiry about medical history, physical examination, and review of relevant test results to determine their suitability for general anesthesia. Patients were routinely required to fast and abstain from water, and were given anti-anxiety and sedative medications as part of the preoperative routine. After entering the operating room, patients routinely had intravenous access established and were connected to electrocardiographic monitoring. Rapid induction was performed using intravenous anesthetics: midazolam (Fuan Pharmaceutical Group Qingyutang Pharmaceutical Co., Ltd., National Medical Products Administration

Approval Number H20243614, 1 mL: 5 mg) at a dose of 0.05 mg/kg, etomidate (Jiangsu Nhwa Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20020511, 20 mg) at a dose of 0.15–0.3 mg/kg, and sufentanil (Yichang Humanwell Pharmaceutical Co., Ltd., Approval Number 20054171, 50 µg) at a dose of 3–5 µg/kg. Subsequently, a muscle relaxant, cisatracurium besylate (Shanghai Pharmaceuticals (Group) Co., Ltd. Dongying Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20233427, 10 mg), was administered at a dose of 0.15 mg/kg to ensure muscle relaxation. Depending on the need, inhalational anesthetic sevoflurane may also be used for anesthesia maintenance. During the operation, propofol was continuously infused at a rate of 1–3 mg/(kg·h), remifentanyl (Yichang Humanwell Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20030198, 1 mg) at a rate of 3–5 µg/(kg·h), and cisatracurium besylate at a rate of 0.06–0.12 mg/(kg·h) to maintain an appropriate depth of anesthesia. Vital signs such as heart rate, blood pressure, respiration, and blood oxygen saturation were routinely monitored during the operation, and the doses of anesthetic drugs were adjusted based on the patient's response and surgical procedures, increasing or decreasing the amounts of propofol and remifentanyl as needed. Before the end of the surgery, the doses of anesthetic drugs were gradually reduced to facilitate patient awakening. After ensuring that the patient could breathe autonomously and was conscious, the endotracheal tube was removed. Postoperative monitoring continued until consciousness and physiological functions were restored, with the same postoperative pain management approach applied to both groups.

2.2.1. Observation group

On the aforementioned basis, a continuous intravenous infusion of dexmedetomidine hydrochloride (Sichuan Guorui Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20233657, 10 mL: 1.0 mg) at a rate of 0.3 µg/(kg·h) was administered after the initiation of anesthesia induction.

2.2.2. Control group

On a routine basis, a continuous intravenous infusion of an equal volume of sodium chloride injection (Southwest Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H50021610, 500 mL) was administered.

2.3. Observation indicators

The following indicators were compared between the two groups:

- (1) The doses of propofol and remifentanyl used during surgery in both groups of patients were recorded.
- (2) The incidence rates of adverse events such as dyspnea, dizziness, nausea and vomiting, and restlessness in the two groups after surgery were recorded.
- (3) The Visual Analogue Scale (VAS) for pain assessment was used to evaluate the pain levels of patients at rest and during activity at 4 hours, 12 hours, 24 hours, and 48 hours after surgery.

The VAS scale has a total score of 10 points, with patients rating their pain based on their personal experience; higher scores indicate stronger pain sensations.

2.4. Statistical analysis

All data in this experiment were subjected to statistical analysis using SPSS 28.0 software. Measurement data were presented in the form of $[\bar{x} \pm s]$ and analyzed using *t*-tests, while count data were expressed as percentages and

compared using chi-square tests. A p -value less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of remifentanyl and propofol dosages between the two groups

The dosages of remifentanyl and propofol in the observation group were lower than those in the control group ($p < 0.05$), as shown in **Table 2**.

Table 2. Comparison of remifentanyl and propofol dosages between the two groups [$\bar{x} \pm s$]

Group	n	Remifentanyl (μg)	Propofol (mg)
Observation group	45	671.62 \pm 89.67	378.64 \pm 88.49
Control group	45	809.78 \pm 92.47	511.37 \pm 94.57
t		7.195	6.875
p		0.000	0.000

3.2. Comparison of incidence rates of complications between the two groups

The incidence rate of complications in the observation group was significantly lower than that in the control group ($p < 0.05$), as shown in **Table 3**.

Table 3. Comparison of incidence rates of complications between the two groups (n = 90)

Group	n	Dyspnea	Dizziness	Nausea & Vomiting	Irritability	Incidence(%)
Observation group	45	1	3	4	2	22.22
Control group	45	0	1	1	0	4.44
t						6.153
p						0.013

3.3. Comparison of VAS scores at different postoperative time points between the two groups

When comparing VAS scores at different postoperative time points between the two groups, the observation group had lower scores than the control group both at rest and during activity ($p < 0.05$), as shown in **Table 4** and **5**.

Table 4. Comparison of VAS scores at different postoperative time points (4 and 12 hours) between the two groups ($\bar{x} \pm s$, points)

Group	n	4 hours postoperative		12 hours postoperative	
		At rest	During activity	At rest	During activity
Observation group	45	2.01 \pm 0.22	2.82 \pm 0.34	2.52 \pm 0.14	3.21 \pm 0.41
Control group	45	2.55 \pm 0.40	3.06 \pm 0.33	2.91 \pm 0.40	3.87 \pm 0.36
t		7.935	3.398	6.173	8.114
p		0.000	0.001	0.000	0.000

Table 5. Comparison of VAS scores at different postoperative time points (24 and 48 hours) between the two groups ($\bar{x} \pm s$, points)

Group	n	4 hours postoperative		12 hours postoperative	
		At rest	During activity	At rest	During activity
Observation group	45	3.11 \pm 0.30	3.40 \pm 0.51	2.12 \pm 0.21	2.45 \pm 0.32
Control group	45	3.67 \pm 0.18	3.99 \pm 0.32	2.61 \pm 0.29	2.90 \pm 0.26
<i>t</i>		10.738	6.574	9.180	7.321
<i>p</i>		0.000	0.000	0.000	0.000

4. Discussion

The clinical manifestations of patients with thyroid carcinoma (TC) are diverse and are influenced by various factors, including tumor cell invasion, tumor size, and the presence or absence of cervical lymph node metastasis or distant metastasis. Patients may present with symptoms such as neck masses, dysphagia, and dyspnea. Surgical treatment is the primary approach for TC, with common surgical methods including thyroid lobectomy, total thyroidectomy, and cervical lymph node dissection, depending on tumor size, invasiveness, and pathological type. The main objective is to completely remove the tumor tissue and reduce the risk of recurrence. During surgery, anesthetic drugs play a crucial role in ensuring the smooth progress of the operation, reducing postoperative pain, and minimizing the occurrence of complications. Anesthetic drugs primarily exert their sedative and analgesic effects by blocking the conduction of nerve impulses and the excitation of central neurons. Although anesthesia can alleviate pain and improve comfort during surgery, anesthetic drugs may have certain impacts on patients' physiological functions, such as inhibiting thyroid function and affecting the respiratory and circulatory systems [4]. Therefore, in clinical practice, when selecting anesthetic drugs, it is essential to ensure minimal impact on patients' physiological functions and avoid adverse effects. Additionally, the impact of anesthetic drugs on postoperative recovery should be considered, and drugs that promote rapid awakening in patients should be chosen.

Dexmedetomidine is a highly selective α_2 -adrenergic receptor agonist that exerts corresponding pharmacological effects by acting on α_2 receptors in both the central and peripheral nervous systems. It primarily produces sedative and anxiolytic effects by activating α_2 receptors located in the locus coeruleus of the brain [5]. The locus coeruleus is a significant neuronal population in the brain, situated in the upper part of the brainstem, close to the thalamus and cerebral cortex. It consists of a large number of α -striatal cells that are rich in tyrosine hydroxylase, the primary enzyme for noradrenaline synthesis. These neurons are responsible for transmitting signals throughout the body, regulating emotions, attention, and wakefulness. Activation of α_2 receptors in the brain, particularly those in the locus coeruleus region, by this drug can effectively alleviate discomfort in patients experiencing tension and anxiety, providing a quieter and more relaxed anesthetic environment. Additionally, at the spinal cord level, it can activate α_2 receptors to exert analgesic effects. The spinal cord is a crucial hub for pain signal transmission, located within the vertebral canal of the spine, serving as the main conduit connecting the brain to other parts of the body. When the body is injured or affected by disease, pain receptors send signals to the spinal cord, which processes these signals and transmits them to the brain. The brain perceives pain and responds accordingly through these signals. Activation of α_2 receptors can effectively reduce the transmission of pain

signals, thereby alleviating the patient's pain, which is of great significance for patients undergoing surgery ^[6].

The results of this study show that the doses of remifentanyl and propofol in the observation group were lower than those in the control group ($p < 0.05$), indicating that the application of this drug can reduce the demand for remifentanyl and propofol in surgical patients. Remifentanyl is a potent sedative drug that produces its effects by activating μ -opioid receptors in the brain, while propofol is an intravenous anesthetic that induces hypnosis and sedation by inhibiting neuronal activity in the brain. However, both drugs may cause side effects such as respiratory depression, nausea, and vomiting, and may suppress the circulatory system, leading to a decreased heart rate and blood pressure. Dexmedetomidine produces sedative and sympatholytic effects by activating α_2 -adrenergic receptors, and can synergize with remifentanyl and propofol to reduce the doses of these two drugs, thereby lowering the anesthesia risk for patients. In this survey, the observation group outperformed the control group in terms of complication rates and postoperative pain control ($p < 0.05$), suggesting that the application of this drug has potential advantages in reducing postoperative adverse reactions and pain, and has a positive impact on patients' postoperative recovery. This drug has sedative, hypnotic, and sympatholytic effects, can weaken the body's stress response, and reduce the incidence of adverse reactions in patients. Postoperative pain is one of the important factors affecting patients' postoperative recovery. Alleviating pain helps patients engage in early activity, reduces the occurrence of postoperative complications, and promotes overall patient recovery. This medication can effectively reduce postoperative pain by activating α_2 -adrenergic receptors and decreasing the transmission of pain signals.

5. Conclusion

In summary, the application of dexmedetomidine in anesthesia for patients undergoing TC surgery offers significant advantages. It can reduce the dosage of anesthetic drugs, lower the incidence of adverse reactions in patients, alleviate postoperative pain, enhance patient comfort, and thus holds clinical value.

Disclosure statement

The authors declare no conflict of interest.

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Analysis on the Correlation Between Perceived Stress, Job Burnout, and Subjective Well-being Among Undergraduate Nursing Interns

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Abstract: *Objective:* To analyze the correlation between perceived stress, job burnout, and subjective well-being among undergraduate nursing interns. *Methods:* A total of 260 clinical nursing interns who interned in tertiary hospitals from July 2024 to April 2025 were selected as the survey subjects. They were administered the Chinese version of the Perceived Stress Scale (CPSS), the Maslach Burnout Inventory-Human Services Survey (MBI-HSS), and the General Well-being Schedule (GWB) to evaluate the correlation between perceived stress, job burnout, and subjective well-being. *Results:* The subjective well-being scores of those with higher perceived stress were lower than those with moderate stress; individuals with severe job burnout had lower subjective well-being compared to those without job burnout or with mild to moderate job burnout levels ($p < 0.05$). Correlation analysis revealed that the subjective well-being of undergraduate nursing interns was negatively correlated with perceived stress and job burnout ($p < 0.05$). *Conclusion:* Undergraduate nursing interns experience significant perceived stress and a strong sense of job burnout. Their subjective well-being is correlated with their perceived stress and job burnout. It is necessary to optimize the clinical teaching model and provide psychological skills training to alleviate the interns' perceived stress and job burnout, thereby significantly enhancing their subjective well-being.

Keywords: Undergraduate nursing interns; Perceived stress; Job burnout; Subjective well-being; Correlation

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1. Introduction

Perceived stress refers to the psychological response an individual makes, guided by self-cognition and evaluation, when faced with stimulating events. Its level can reflect an individual's mental health status. Undergraduate nursing interns need to master nursing skills within a short period, regularly undergo theoretical and practical assessments, and simultaneously write their graduation theses. Facing multiple pressures such as graduation and internships, they are prone to elevated perceived stress ^[1]. Job burnout refers to psychological issues such as

emotional exhaustion or a decline in a sense of accomplishment that individuals exhibit in highly stressful, high-demand work environments. Undergraduate nursing interns, at a turning point in their career development, are susceptible to job burnout due to the demanding nursing tasks and night shifts they face. Subjective well-being refers to an individual's evaluation of happiness in their current life and work, encompassing multiple dimensions such as cognition and emotion ^[2,3]. The subjective well-being of undergraduate nursing interns can directly affect their work enthusiasm, and the level of well-being is influenced by factors such as perceived stress. Based on this, this study selected 260 undergraduate nursing interns to evaluate the correlation between perceived stress, job burnout, and the subjective well-being of the interns.

2. Materials and methods

2.1. General information

The survey subjects were 260 clinical nursing interns who entered Grade-A Tertiary Hospitals for internships from July 2024 to April 2025. Among them, there were 19 males and 241 females; their ages ranged from 19 to 24 years old, with an average age of (22.05 ± 2.18) years; 242 were of Han ethnicity, and 18 were from ethnic minorities; 46 were only children, and 214 were non-only children; their family locations included 81 in cities, 42 in county towns, 39 in townships, and 98 in rural areas; they were enrolled in 8 private junior colleges, 3 public junior colleges, 140 public undergraduate institutions, 41 Double First-Class universities, and 68 private undergraduate institutions; 178 applied for nursing as their first choice, and 82 did not.

2.1.1. Inclusion criteria

Clinical nursing interns in tertiary-level hospitals; internship duration exceeding 10 months; complete basic information of interns; interns capable of independently completing questionnaire surveys, informed and consenting to participate in this study.

2.1.2. Exclusion criteria

Presence of mental illnesses such as depression or anxiety; currently on academic leave; difficulty in cooperating with questionnaire completion and related tasks; participation in other studies; withdrawal from this study midway.

2.2. Methods

Clinical instructors distributed survey questionnaires to the interns, clarifying the assessment significance and purpose of each questionnaire, explaining the completion methods and precautions, and requiring the interns to complete them independently, ensuring no items were missed or incorrectly filled out. The questionnaires were collected on-site. The questionnaire results showed 261 valid responses (260 agreed to participate, 1 did not agree). Due to the exclusion of the one who "did not agree to participate", the final analysis included 260 questionnaires. The specific questionnaires included

(1) CPSS questionnaire

It contains dimensions of a sense of loss of control and tension, each with 7 items. Each item is scored from 0 to 4 points, totaling 56 points. Perceived stress is positively correlated with the score, with a critical value of 26 points. Scores below 26 indicate moderate stress, while scores of 26 or above indicate high stress. The Cronbach's α coefficient of this questionnaire is as high as 0.78, indicating good reliability and validity.

(2) MBI-HSS scale

It comprises emotional exhaustion (9 items), depersonalization (5 items), and reduced personal accomplishment (8 items), with each item scored from 0 to 6. The first and second dimensions of job burnout are positively correlated with scores, with Cronbach's α coefficients of 0.88 and 0.83, respectively. The third dimension of job burnout is negatively correlated with scores, with a Cronbach's α coefficient of 0.82. Using one-third of the total score for each dimension as the cutoff value, the scale further divides job burnout into four categories: no burnout, mild, moderate, and severe burnout.

(3) GWB scale

It includes satisfaction and interest in life (2 items), energy (4 items), concern for health (2 items), depressed or happy mood (3 items), relaxation and tension (4 items), and control over emotions and behaviors (3 items). Items 1, 3, 4, and 8–14 are scored from 1 to 6, items 2, 5, 6, and 7 are scored from 1 to 5, and items 15–18 are scored from 1 to 10, totaling 124 points. Subjective well-being is positively correlated with scores, with a Cronbach's α coefficient of 0.63, indicating good reliability and validity.

2.3. Observation indicators

Analyze the scores of all interns on each scale, compare the differences in scores among interns with different levels of perceived stress and job burnout, and assess the correlations between perceived stress, job burnout, and subjective well-being among interns.

2.4. Statistical analysis

Data processing was conducted using SPSS 28.0 statistical software. Count data were expressed as [n/%] and analyzed using the chi-square (χ^2) test. Measurement data were tested for normal distribution using the Kolmogorov-Smirnov (K-S) test and expressed as [$\bar{x} \pm s$]. Comparisons between two groups were made using the independent samples *t*-test, while comparisons among multiple groups were made using the *F*-test. Correlation analysis was performed using Pearson's method. A *p*-value less than 0.05 was considered statistically significant.

3. Results

3.1. Analysis of scale scores among undergraduate nursing interns

Among the perceived stress scores of undergraduate nursing interns, the score for tension was relatively high. In the job burnout scores, emotional exhaustion scored higher. In the subjective well-being scores, the score for energy was relatively high (refer **Table 1**).

Table 1. Analysis of scale scores among undergraduate nursing interns [$\bar{x} \pm s$, points]

Dimension	Subscale	Items (n)	Total score
Perceived stress	Sense of uncontrollability	7	20.53 \pm 3.45
	Sense of tension	7	22.64 \pm 3.74
	Emotional exhaustion	9	32.66 \pm 4.18
Job burnout	Depersonalization	5	10.68 \pm 1.74
	Reduced personal accomplishment	8	18.45 \pm 2.93

Table 1 (Continued)

Dimension	Subscale	Items (n)	Total score
Subjective well being	Satisfaction & interest in life	2	6.37 ± 1.59
	Energy	4	16.92 ± 3.11
	Worry about health	2	11.85 ± 2.36
	Depressed or pleasant mood	3	15.46 ± 2.79
	Relaxation vs tension	4	15.99 ± 2.84
	Control over emotions & behaviors	3	7.98 ± 1.76

3.2. Comparison of subjective well-being scores among different levels of perceived stress

Based on the perceived stress levels, there were 152 individuals with high stress and 108 individuals with moderate stress. The subjective well-being scores of those with high perceived stress were lower than those with moderate stress ($p < 0.05$) (refer **Table 2**).

Table 2. Comparison of subjective well-being scores among different levels of perceived stress [$\bar{x} \pm s$, points]

Perceived stress level	n	Satisfaction & interest in life	Energy	Worry about health	Depressed or pleasant mood	Relaxation vs. tension	Control over emotions & behaviors
High stress	152	5.58 ± 1.64	14.56 ± 2.41	10.07 ± 1.98	13.75 ± 2.08	14.58 ± 2.44	8.94 ± 1.76
Moderate stress	108	6.08 ± 1.86	16.05 ± 2.78	11.92 ± 1.76	14.66 ± 2.97	15.94 ± 2.58	7.07 ± 1.63
<i>t</i>		2.290	4.607	7.770	2.906	4.324	8.703
<i>p</i>		0.023	0.000	0.000	0.004	0.000	0.000

3.3. Comparison of subjective well-being scores across different levels of job burnout

Based on job burnout levels, there were 26 individuals without burnout, 109 with mild burnout, 116 with moderate burnout, and 9 with severe burnout. The subjective well-being of those with severe job burnout was lower than that of those without job burnout and those with mild to moderate job burnout ($p < 0.05$) (refer **Table 3**).

Table 3. Comparison of subjective well-being scores across different levels of job burnout [$\bar{x} \pm s$, score]

Job burnout level	n	Satisfaction & interest in life	Energy	Worry about health	Depressed or pleasant mood	Relaxation vs. tension	Control over emotions & behaviors
No burnout	26	8.13 ± 1.35	19.06 ± 2.76	13.14 ± 2.15	18.02 ± 1.84	17.96 ± 2.76	9.12 ± 1.92
Mild burnout	109	7.28 ± 1.31	18.01 ± 2.63	12.12 ± 2.06	17.13 ± 1.74	16.05 ± 2.16	8.04 ± 1.72
Moderate burnout	116	6.05 ± 1.43	16.44 ± 2.37	10.78 ± 1.73	16.05 ± 1.42	13.55 ± 1.64	7.11 ± 1.06
Severe burnout	9	5.33 ± 1.06	14.02 ± 2.33	8.99 ± 1.43	14.33 ± 1.54	11.52 ± 1.60	6.03 ± 1.14
F		27.864	16.678	20.876	21.136	58.378	20.148
<i>p</i>		0.000	0.000	0.000	0.000	0.000	0.000

3.4. Correlation analysis of perceived stress, job burnout, and subjective well-being

Correlation analysis revealed that the subjective well-being of undergraduate nursing interns was negatively correlated with perceived stress and job burnout ($p < 0.05$) (refer **Table 4**).

Table 4. Correlation analysis of perceived stress, job burnout, and subjective well-being (r-value)

Variable		Satisfaction & interest in life	Energy	Worry about health	Depressed or pleasant mood	Relaxation vs. tension	Control over emotions & behaviors	Total score
Perceived stress	Sense of Uncontrollability	-0.114	-0.081	-0.208	-0.345	-0.050	-0.487	-0.182
	Sense of Tension	-0.125	-0.075	-0.163	-0.320	-0.048	-0.445	-0.159
	Emotional Exhaustion	-0.113	-0.106	-0.149	-0.284	-0.043	-0.498	-1.164
Job burnout	Depersonalization	-0.190	-0.109	-0.115	-0.255	-0.052	-0.491	-0.182
	Reduced Personal Accomplishment	-0.182	-0.080	-0.190	-0.264	-0.071	-0.441	-0.180

4. Discussion

Undergraduate nursing interns, during their clinical internships, need to balance their graduation theses, knowledge assessments, and clinical nursing responsibilities. As they assume dual roles as students and quasi-nurses, they face significant physical and mental stress. Therefore, it is essential to comprehensively evaluate the perceived stress and job burnout levels of undergraduate nursing interns, analyze their relationship with subjective well-being, and subsequently develop scientific and reasonable intervention measures ^[4].

The results showed that undergraduate nursing interns had relatively high scores in tension and emotional exhaustion, but also scored high in the energy aspect of subjective well-being. The reasons for this are as follows: Interns may face complex nurse-patient relationships, challenging nursing techniques, and heavy academic workloads in the hospital environment, which can easily lead to psychological issues such as anxiety and unease, significantly increasing their sense of tension. Prolonged physical and mental stress can induce avoidance behaviors in interns, affecting their personal lives and work performance, manifesting as emotional exhaustion ^[5]. However, in terms of subjective well-being, interns scored high in energy because they are relatively young and in a phase of vigorous energy. With appropriate guidance and scientific interventions, interns demonstrate strong self-regulation abilities, which are expected to alleviate their perceived stress and occupational burnout ^[6,7]. Among the results, those with higher perceived stress scored lower in subjective well-being compared to those with moderate stress, and those with severe burnout scored lower in subjective well-being than those without occupational burnout or with mild to moderate burnout. Correlation analysis revealed a negative correlation between subjective well-being and perceived stress as well as occupational burnout ($p < 0.05$). The reasons for this are: Transitioning from a campus environment to a hospital setting, most interns experience significant discomfort when faced with heavy tasks, strict standards, and a fast-paced work life, perceiving their emotional labor intensity as high ^[8]. Interns have limited abilities in handling peer relationships, teacher-student relationships, and nurse-patient relationships, and they face multiple pressures, leading to significant occupational burnout and a subsequent decrease in their subjective well-being. Additionally, the clinical teaching system primarily revolves around department rotations, resulting in low communication frequency between teaching instructors and interns. This

makes it difficult to provide emotional support, easily causing feelings of tension or anxiety among interns, which in turn affects their work enthusiasm and subjective well-being^[9,10].

Based on the above research findings, it is necessary to improve the clinical teaching system by implementing a “dual-mentor system”, where each intern is assigned a growth mentor responsible for their psychological counseling. The mentor can engage in one-on-one communication with the intern at irregular intervals, assess their sources of psychological stress, and provide targeted psychological counseling^[11,12]. It is also essential to strengthen psychological skills training by incorporating psychological skills courses into the internship content. Mindfulness-based stress reduction therapy or cognitive-behavioral therapy can be conducted in small class settings to enable interns to master psychological adjustment techniques^[13]. Meanwhile, a psychological counseling center should be established to provide free psychological counseling services to interns, encouraging them to undergo regular psychological assessments. Psychological counselors can then provide long-term interventions based on their psychological issues^[14].

5. Conclusion

In conclusion, undergraduate nursing interns experience significant perceived stress and notable occupational burnout, with their subjective well-being negatively correlated with these indicators. Targeted interventions are necessary to improve the mental health of interns.

Disclosure statement

The authors declare no conflict of interest.

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Application of Transvaginal Three-Dimensional Ultrasound in Assessing Endometrial Receptivity in Patients with Ovulation Disorder Infertility and the Impact on Subendometrial Vascular Index (VI) and Vascular Flow Index (VFI) Level

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Abstract: *Objective:* To analyze the diagnostic value of transvaginal three-dimensional ultrasound (3D-TVS) in evaluating endometrial receptivity (ER) for ovulation disorder infertility (ODI), and to investigate the impact of subendometrial endometrial vascular index (VI) and endometrial vascular flow index (VFI) levels on ODI. *Methods:* A total of 110 patients diagnosed with ODI admitted between January 2023 and June 2024 were selected. All patients underwent ovulation induction therapy, 3D-TVS examination, and sex hormone testing. Based on pregnancy outcomes, patients were divided into a successful pregnancy group (73 cases) and an unsuccessful pregnancy group (37 cases). ER parameters, sex hormone levels, and endometrial blood flow patterns were compared between the two groups. Receiver operating characteristic (ROC) curves were plotted to evaluate the predictive value of ER for ODI. *Results:* The spiral artery peak systolic velocity (PSV), endometrial volume (EMV), endometrial flow index (FI), and VFI in the successful pregnancy group were significantly higher than those in the unsuccessful pregnancy group ($p < 0.05$). No significant differences were observed in other ER parameters between the two groups ($p > 0.05$). There was no significant difference in sex hormone levels between the two groups on the day of human chorionic gonadotropin (hCG) treatment ($p > 0.05$). Among the endometrial blood flow classifications in the pregnant group, the proportion of Type II was lower than that in the non-pregnant group ($p < 0.05$). The Receiver Operating Characteristic (ROC) curve demonstrated that the area under the curve (AUC) for Endometrial Volume (EMV) in predicting pregnancy after Ovarian Dysfunction Infertility (ODI) treatment was 0.854, with a sensitivity of 92.61% and a specificity of 71.75%. The AUC for Vascularization Index (VI) was 0.771, with a sensitivity of 52.18% and a specificity of 88.70%. The AUC for Vascularization Flow Index (VFI) of the endometrium was 0.887, with a sensitivity of 80.01% and a specificity of 69.20%. *Conclusion:* Three-dimensional transvaginal sonography (3D-TVS) assessment of endometrial receptivity (ER) can effectively detect ODI, and the levels of subendometrial VI and VFI demonstrate superior predictive performance for pregnancy outcomes in this condition, serving as commonly used predictive indicators for the disease.

Keywords: Transvaginal three-dimensional ultrasound; Endometrial receptivity; Ovarian dysfunction infertility; VI; VFI

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1. Introduction

Ovarian dysfunction infertility (ODI) is a type of infertility caused by abnormal ovarian ovulation function, commonly accompanied by manifestations such as amenorrhea and endocrine disorders. It requires standardized ovulation induction therapy to expel mature follicles and enable successful pregnancy in patients ^[1]. Endometrial receptivity (ER) is a primary factor influencing pregnancy outcomes in ODI. It evaluates endometrial morphology and thickness, as well as the characteristics of endometrial blood flow distribution, thereby reflecting the endometrium's ability to accept an embryo ^[2]. At present, transvaginal three-dimensional ultrasound (3D-TVS) is a commonly used method for evaluating endometrial receptivity (ER) status. It offers the advantages of being non-invasive and repeatable, enabling accurate prediction of patients' pregnancy outcomes using ER parameters and demonstrating good diagnostic performance. Based on this, this study selected 110 patients with ovulation disorders and infertility (ODI) to analyze the predictive value of 3D-TVS-assessed ER for pregnancy outcomes.

2. Materials and methods

2.1. General information

A total of 110 patients diagnosed with ODI who were admitted to the hospital between January 2023 and June 2024 were selected for this study. This study was approved by the hospital's ethics committee. The patients were grouped according to their pregnancy status. The pregnancy group consisted of 73 patients, aged between 27 and 37 years, with a mean age of (32.15 ± 2.81) years; the duration of infertility ranged from 1 to 4 years, with a mean of (2.54 ± 0.97) years; the causes of ovulation disorders included 40 cases of polycystic ovary syndrome (PCOS) and 33 cases of premature ovarian failure (POF). The non-pregnancy group consisted of 37 patients, aged between 25 and 39 years, with a mean age of (32.38 ± 2.91) years; the duration of infertility ranged from 1 to 5 years, with a mean of (2.66 ± 0.86) years; the causes of ovulation disorders included 22 cases of PCOS and 15 cases of POF. There were no significant differences in the basic information between the two groups ($p > 0.05$).

2.1.1. Inclusion criteria

Normal sexual activity without contraception, failure to conceive for more than one year; unilateral or single-sided patency shown by hysterosalpingography; meeting the indications for ovulation induction therapy; normal menstrual cycle and volume; presence of dominant follicle development; normal semen analysis of the spouse; consistent ovulation induction protocols among patients; complete basic information; informed consent and agreement to participate in the study.

2.1.2. Exclusion criteria

Use of progestogens or estrogens in the past three months; previous treatment with ODI for symptomatic relief; concurrent uterine pathologies such as fibroids; history of allergy to ovulation induction drugs; developmental abnormalities of the reproductive organs; presence of psychiatric disorders; withdrawal from the study midway.

2.2. Methods

Patients underwent ovulation induction therapy on the 5th day of menstruation, taking oral clomiphene citrate capsules at a dose of 50 mg once daily until the 10th day of menstruation. Color Doppler ultrasound was used to measure endometrial thickness (EMT) in the longitudinal section of the uterus, identifying the point perpendicular to the midline of the uterine cavity between the anterior and posterior myometrium, and assessing the maximum

distance from this point to the endometrial interface, i.e., the maximum perpendicular endometrial distance. Pulse Doppler was employed to measure the peak systolic velocity (PSV) and end-diastolic velocity (EDV) of the spiral arteries at sites with prominent endometrial color flow. In 3D mode, endometrial volume data were evaluated. Simultaneously monitor the uterine blood supply status and follicular development.

When a dominant follicle is identified and its diameter is ≥ 18 mm, collect fasting venous blood (3 mL), centrifuge it for 10 minutes at a speed of 3000 r/min, extract the supernatant, and evaluate the levels of estradiol (E2) and progesterone (P) using the chemiluminescence immunoassay method. On the same day, administer human chorionic gonadotropin for injection via intramuscular injection at a dose of 5000 to 10000 U. After the injection, perform a 3D-TVS examination with a probe frequency of 9 MHz and a scanning angle of 146° . Have the patient assume the lithotomy position, fully expose the external genitalia, apply a sterile protective sheath to the probe, disinfect the sheath with a disinfectant, and slowly insert it into the vagina. Conduct a comprehensive scan in the three-dimensional volume imaging mode, analyze and process the images using the Vocal software provided with the instrument, and automatically obtain ER parameters such as VI.

2.3. Observation indicators

(1) ER parameters

Evaluate parameters such as EMT, spiral artery PSV, and EDV in both groups of patients.

(2) Sex hormone levels

Evaluate the sex hormone levels in both groups on the day of hCG treatment.

(3) Endometrial blood flow classification

According to the Applebaum classification method, Type I is characterized by blood vessels traversing the hypoechoic band on the lateral side of the endometrium without reaching the hyperechoic margin; Type II is characterized by blood vessels traversing the hyperechoic margin of the endometrial region without reaching the hypoechoic area; Type III is characterized by blood vessels traversing the hypoechoic area of the endometrial region.

(4) Predictive efficacy

Draw the ROC curve and calculate the AUC value to evaluate the predictive value of ER parameters for pregnancy status.

2.4. Statistical analysis

Data were processed using SPSS 28.0 statistical software. Count data were expressed as [n/%] and compared using the chi-square (χ^2) test. Measurement data were tested for normal distribution using the Kolmogorov-Smirnov (K-S) test and expressed as ($\bar{x} \pm s$) if they conformed to a normal distribution.

Comparisons between groups were made using the independent samples *t*-test, while comparisons within groups were made using the paired *t*-test. The ROC curve was drawn, and the AUC values of each parameter were calculated to evaluate the predictive efficacy. A *p*-value less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of ER parameters between the two groups

The peak systolic velocity (PSV), end-diastolic velocity (EMV), flow index (FI), and vascularization flow index

(VFI) of the spiral arteries in the pregnancy group were higher than those in the non-pregnancy group ($p < 0.05$). There were no significant differences in other endometrial receptivity (ER) parameters between the two groups ($p > 0.05$) (refer **Table 1**).

Table 1. Comparison of ER parameters between the two groups ($\bar{x} \pm s$)

Group	n	EMT (mm)	Spiral artery PSV (cm/s)	Spiral artery EDV (cm/s)	EMV (cm ³)	FI (%)	VI (%)	VFI (%)
Pregnant group	73	9.01 \pm 1.78	6.05 \pm 1.03	2.67 \pm 0.97	3.8 \pm 0.9	22.96 \pm 1.86	37.51 \pm 5.92	5.40 \pm 0.61
Non-pregnant group	37	8.69 \pm 1.82	5.16 \pm 1.05	2.57 \pm 0.95	3.1 \pm 0.8	21.17 \pm 1.90	38.16 \pm 5.97	4.62 \pm 0.53
<i>t</i>	-	0.884	4.254	0.514	3.996	4.735	0.543	6.612
<i>p</i>	-	0.379	< 0.001	0.608	< 0.001	< 0.001	0.589	< 0.001

3.2. Comparison of sex hormone levels between the two groups

There were no significant differences in sex hormone levels on the day of hCG treatment between the two groups ($p > 0.05$) (refer **Table 2**).

Table 2. Comparison of sex hormone levels between the two groups ($\bar{x} \pm s$)

Group	n	E2 (pmol/L)	P (nmol/L)
Pregnant group	73	3581.79 \pm 305.71	2.85 \pm 0.97
Non-pregnant group	37	3625.48 \pm 297.84	3.02 \pm 0.94
<i>t</i>	-	0.714	0.877
<i>p</i>	-	0.477	0.382

3.3. Comparison of endometrial blood flow patterns between the two groups

The proportion of Type II endometrial blood flow in the pregnancy group was lower than that in the non-pregnancy group ($p < 0.05$) (refer **Table 3**).

Table 3. Comparison of endometrial blood flow patterns between the two groups [n/%]

Group	n	Type I	Type II	Type III
Pregnant group	73	30 (41.10)	20 (27.40)	23 (31.51)
Non-pregnant group	37	7 (18.92)	21 (56.76)	9 (24.32)
χ^2	-	9.704		
<i>p</i>	-	0.008		

3.4. Predictive efficacy of ER parameters for pregnancy after ODI treatment

The receiver operating characteristic (ROC) curve showed that the area under the curve (AUC) for EMV in predicting pregnancy after ODI treatment was 0.854, the AUC for endometrial vascularization index (VI) was 0.771, and the AUC for endometrial VFI was 0.887.

Table 4. Predictive efficacy of ER parameters for pregnancy after ODI treatment

Index	AUC	95% CI (AUC)	Cut-off value	Sensitivity (%)	95% CI (Sensitivity)	Specificity (%)	95% CI (Specificity)
Endometrial volume (EMV)	0.854	0.761–0.927	5.2 cm3	92.61%	85.34–97.05	71.75%	61.54–80.62
Endometrial vascularization index (VI)	0.771	0.664–0.858	7.510%	52.18%	41.55–62.78	88.70%	80.51–94.23
Vascularization-flow index (VFI)	0.887	0.791–0.946	1.990	80.01%	72.64–86.17	69.20%	58.67–72.45

4. Discussion

The etiology of ODI is complex, encompassing hypothalamic-pituitary dysfunction such as excessive anxiety and hyperprolactinemia; ovarian dysfunction such as polycystic ovary syndrome or premature ovarian failure; and endocrine gland disorders such as thyroid dysfunction^[3,4]. Its symptoms include oligomenorrhea and amenorrhea, making it a common type of infertility. The key factors for successful embryo implantation in ODI patients are the quality of the ovulated follicles and embryos, as well as the embryo implantation environment. ER is an important indicator affecting the uterine environment, manifesting at levels such as EMT or EMV, while also reflecting the blood supply status of the endometrium. Previous studies have indicated that alterations in ER are a prerequisite for embryo implantation, as the endometrium and embryo are in a synchronous developmental state, and EMT and endometrial blood supply directly influence placental development^[5]. Based on this, improving ER status is necessary when administering assisted reproductive technology treatments to ODI patients to enhance the successful pregnancy rate. Currently, endometrial biopsy is the gold standard for ER evaluation, but it is costly, invasive, and has limited patient acceptance. Therefore, 3D-TVS examination can be conducted to observe uterine structure, blood flow distribution, and vascular characteristics using blood flow energy signals. This method is highly sensitive in detecting low-velocity blood flow and small blood vessels within the uterine cavity, offering high accuracy in ER assessment and the advantage of being non-invasive^[6].

To fully evaluate the independent predictive value of transvaginal three-dimensional ultrasound parameters for pregnancy outcomes, this study will elaborate on potential confounding factors such as age, BMI, duration of infertility, and ovulation induction protocols in the general information and inclusion/exclusion criteria. After effectively controlling for these factors, relevant research will be conducted. The results revealed that the spiral artery peak systolic velocity (PSV), endometrial motion velocity (EMV), flow index (FI), and vascularization flow index (VFI) were significantly higher in the pregnant group compared to the non-pregnant group ($p < 0.05$). The analysis suggests that following ovulation, the ovaries secrete substantial amounts of progesterone, and successful implantation leads to a marked increase in hCG levels, forming the corpus luteum of pregnancy, which in turn increases estrogen and progesterone secretion. Under these conditions, blood vessels dilate significantly, reducing tension in the uterine spiral arteries and inhibiting vascular resistance, thereby accelerating PSV and increasing blood flow parameters such as FI and VFI^[7]. High VFI indicates a large volume of endometrial blood perfusion and a dense microvascular network, providing essential nutrients like amino acids and oxygen for embryo implantation, thereby enhancing embryo survival rates. Additionally, high VFI facilitates the clearance of metabolic byproducts such as lactic acid and carbon dioxide from the embryo through high blood flow,

stabilizing the uterine microenvironment, preventing the accumulation of harmful substances, and ultimately improving pregnancy success rates. There were no significant differences in sex hormone levels on the day of hCG treatment between the two groups ($p > 0.05$). The proportion of endometrial blood flow type II was lower in the pregnant group compared to the non-pregnant group ($p < 0.05$). The reasons for the analysis are as follows: Ovulation induction therapy can create a relatively ideal hormonal environment, ensuring the maturity of follicular development. After treatment, the number and size of follicles exhibit standardized characteristics, enabling the sex hormones of patients in both groups to reach similar levels. In contrast, the endometrial blood vessels in the successful pregnancy group often undergo remodeling reactions, which increase blood perfusion and advance blood flow distribution to Type III. Consequently, the proportion of Type II blood flow is relatively low in this group^[8]. Comparatively, the non-pregnant group exhibits higher vascular resistance, leading to blood stagnation below the endometrium and resulting in Type II blood flow^[9]. The ROC curve demonstrates that the AUC value of EMV for pregnancy after ODI treatment is 0.854, the AUC value of endometrial VI is 0.771, and the AUC value of endometrial VFI is 0.887. Among the specific indicators, EMV can assess endometrial volume, VI can evaluate endometrial vascular density under three-dimensional ultrasound, and can assess the vascular density distributed within the endometrial volume. VFI can assess the blood flow intensity and specific quantity of endometrial blood vessels, as well as evaluate tissue blood cell density and vascularization. These three indicators can accurately predict changes in ER. Specifically, the higher the levels of EMV, endometrial VI, and VFI, the higher the likelihood of successful pregnancy in patients^[10]. However, it should be noted that the quality of 3D ultrasound in evaluating ER is influenced by factors such as the operator's expertise and the adjustment of equipment parameters. Therefore, it is necessary to select highly experienced operators and standardize equipment parameter settings to ensure the accuracy of ER parameters. Nevertheless, this study has certain limitations, including a small sample size, a relatively short research duration, and a lack of a control group consisting of normal pregnancies. In future research, it would be beneficial to categorize the etiologies and disease types of patients with this condition more meticulously, expand the sample size, extend the research period, and conduct multi-center studies to fully leverage the diagnostic advantages of 3D-TVS. Additionally, AI technology holds immense potential in imaging analysis. Future studies could incorporate AI algorithms to automatically segment the endometrium, quantitatively extract imaging features, and establish AI learning models based on clinical data, enabling earlier assessment of ER parameters.

5. Conclusion

In summary, 3D-TVS can effectively evaluate ER parameters in patients with ODI and predict pregnancy outcomes in these patients by utilizing EMV, endometrial VI, and FVI levels, demonstrating certain predictive efficacy. It can serve as a preferred predictive indicator for patients with ODI, but its predictive value for other types of ODI patients still requires further validation.

Disclosure statement

The author declares no conflict of interest.

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Research on Surgical Strategies for the Correction of Pectus Excavatum in Children via an Extrapleural Approach

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Abstract: *Objective:* To investigate the clinical efficacy and safety of the extrapleural approach versus the traditional intrathoracic approach in minimally invasive correction of pectus excavatum in children, providing a more scientific basis for selecting a more appropriate surgical method in clinical practice. *Methods:* This study included 50 children who underwent pectus excavatum correction at Harbin Children's Hospital from January 2023 to January 2025. All patients were divided into two groups based on surgical approach: the observation group ($n = 26$) and the control group ($n = 24$). Children in the observation group underwent correction surgery via an extrapleural approach, while those in the control group underwent correction surgery via the traditional intrathoracic approach. Both groups underwent Nuss bar placement surgery under thoracoscopic guidance. Intraoperative indicators were compared between the two groups, including operative time, blood loss, pain scores at 24 and 48 hours postoperatively, hospital stay duration, thoracic correction outcomes, and the incidence of complications during a 6-month postoperative follow-up. *Results:* The intraoperative blood loss in the observation group was significantly lower than that in the control group ($p < 0.05$), and the pain scores at 24 and 28 hours postoperatively were also significantly lower ($p < 0.05$). The improvement in thoracic index postoperatively was relatively similar between the two groups, with no statistically significant difference ($p > 0.05$). During the 6-month postoperative follow-up period, no complications such as pneumothorax, hemothorax, pleural effusion, plate displacement, or infection occurred in the observation group, whereas the overall complication rate in the control group was 25%, showing a significant difference ($p < 0.05$). *Conclusion:* The extrapleural approach for corrective surgery can ensure the efficacy of thoracic deformity correction while reducing intraoperative blood loss, lowering the incidence of complications, alleviating postoperative pain, and accelerating recovery. It is a safe and effective approach for minimally invasive Nuss correction of pediatric pectus excavatum.

Keywords: Pectus excavatum; Extrapleural approach; Thoracoscopy; Nuss procedure; Pediatric surgery

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1. Introduction

Pediatric pectus excavatum (PE) is a common thoracic deformity characterized primarily by sternal depression and

a shortened anteroposterior diameter of the thoracic cage. In severe cases, it may compress the cardiopulmonary organs, thereby affecting cardiopulmonary function and exercise tolerance ^[1].

Additionally, the noticeable depression in the chest of children can easily trigger negative emotions, increasing the risk of low self-esteem and social difficulties, and may also impact normal development and daily life. Therefore, timely and effective treatment is crucial for the physical and mental health of affected children.

The NUSS procedure, as a minimally invasive orthopedic surgery, is now widely applied. This surgery involves the implantation of a metal plate to elevate the sternum, thereby restoring the normal shape and function of the thoracic cage. The advantages of this technique lie in its minimal invasiveness and rapid recovery. In contrast, the traditional intrathoracic approach requires penetration of the pleura during surgery, making it prone to complications such as pneumothorax, hemothorax, pleural effusion, and mediastinal vascular injury in pediatric patients. Literature indicates that the incidence of postoperative complications in patients undergoing traditional intrathoracic approach surgery abroad has reached 21% to 67%, while in China, due to richer surgical experience, the incidence has been reduced to around 15%, yet further improvement is still needed ^[2].

For younger children or those with more severe thoracic deformities, the intraoperative risks and postoperative complication rates are even higher, making safe and reliable modified techniques particularly crucial.

In recent years, the modified extrapleural approach has gradually become a key focus of clinical research. This surgery is characterized by its operation through the extrapleural space, effectively avoiding damage to the thoracic cavity and mediastinal muscles, thereby reducing the incidence of complications and promoting postoperative recovery. Combined with thoracoscopic visualization, it can clearly display the boundaries of mediastinal vessels and the heart, effectively reducing the risks associated with blind operations. Meanwhile, by optimizing the plate fixation technique, such as the “W8 + S3” method, the stability of the plate can be increased, thereby reducing the probability of postoperative displacement and recurrence ^[3]. Single-center research results have indicated that even in complex cases, the extrapleural approach can successfully and safely facilitate the implantation of double plates, whereas the traditional intrathoracic approach is more prone to causing pleural effusion after double plate implantation.

Although preliminary studies suggest that the extrapleural approach offers certain advantages, systematic clinical data remains relatively limited thus far, particularly regarding its applicability in children of different ages, genders, and varying degrees of illness severity, which still requires further validation.

This study, based on a project approved by the Health Commission of Heilongjiang Province, selected children with pectus excavatum from Harbin Children’s Hospital and employed a modified extrapleural NUSS procedure, comparing it with a group undergoing the traditional intrathoracic approach. The focus was on analyzing surgical safety, postoperative recovery, complications, and the effectiveness of thoracic correction, providing scientific evidence and operational references for minimally invasive correction of pediatric pectus excavatum.

2. Materials and methods

2.1. General information

This study included 50 pediatric patients with pectus excavatum who met surgical indications at Harbin Children’s Hospital, with 26 cases in the observation group and 24 cases in the control group. There were 31 males and 19 females, with ages ranging from 3 to 12 years and an average age of (8.21 ± 1.03) years. Based on the Haller index, all patients were classified into mild (2.5–3.25), moderate (3.25–3.5), and severe (> 3.5) groups, with

balanced distribution across groups. Prior to surgery, all patients underwent three-dimensional reconstruction of chest CT scans, echocardiography, and electrocardiography to evaluate thoracic deformities and cardiac function, providing references for surgical planning.

2.1.1. Inclusion criteria

- (1) Meeting the diagnostic criteria for pectus excavatum with a thoracic index (HI) ≥ 3.2
- (2) Completion of preoperative evaluation and having indications for Nuss procedure
- (3) Aged 3–16 years and able to cooperate with follow-up
- (4) Family members signing informed consent for clinical research

2.1.2. Exclusion criteria

- (1) Patients with extremely severe deformities requiring thoracotomy
- (2) Those with severe pleural adhesions due to previous thoracotomy or pleural cavity surgery
- (3) Patients with severe cardiopulmonary dysfunction or coagulation abnormalities
- (4) Those with immune abnormalities or potential for severe rejection reactions
- (5) Patients unable to complete follow-up

2.2. Methods

Both groups underwent the placement of Nuss plates assisted by thoracoscopy. In the observation group, tunnels were established in the extrapleural space without entering the pleural cavity; in the control group, the stent channels were completed through an intrapleural approach. Perioperative management was standardized, including preoperative evaluation, anesthesia protocols, pain management, drainage, and anti-infection measures. Chest tubes and plates were removed postoperatively based on recovery status.

2.3. Observation indicators

- (1) Intraoperative indicators
Operation time, blood loss
- (2) Postoperative recovery
Pain scores (VAS) at 24 h and 48 h, and length of hospital stay
- (3) Orthopedic effect
Improvement rate of thoracic index
- (4) Postoperative complications
Pneumothorax, pleural reaction, atelectasis, plate displacement, etc.
- (5) Follow-up
Complications at 6 months.

2.4. Statistical methods

SPSS 26.0 was used. Measurement data were expressed as mean \pm standard deviation, and comparisons between two groups were made using the *t*-test; count data were analyzed using the χ^2 test or Fisher's exact test. A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of surgical and recovery indicators between the two groups

The observation group had shorter operation time, less intraoperative blood loss, and a shorter hospital stay compared to the control group ($p < 0.05$), indicating that this approach can shorten surgical and recovery times and reduce bleeding, as shown in **Table 1**.

Table 1. Comparison of surgical and recovery indicators between the two groups of children ($\bar{x} \pm s$)

Group	Operative time (min)	Intraoperative blood loss (mL)	Hospital stays (days)
Observation group (n = 26)	75.35 \pm 10.20	8.54 \pm 3.15	6.32 \pm 1.27
Control group (n = 24)	88.77 \pm 12.51	15.42 \pm 4.27	8.31 \pm 1.55
<i>t</i> -value	5.124	7.110	5.456
<i>p</i> -value	0.001	0.001	0.001

3.2. Comparison of postoperative complications between the two groups

The observation group had lower incidences of pneumothorax, hemothorax, and air leakage compared to the control group, with a significantly reduced overall complication rate ($p < 0.05$), demonstrating a marked safety advantage, as shown in **Table 2**.

Table 2. Comparison of postoperative complications between the two groups of children (n, %)

Group	Pneumothorax	Hemothorax	Pleural effusion	Plate displacement	Infection	Total complication rate
Observation group (n = 26)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Control group (n = 24)	2 (8.3%)	1 (4.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3/24 (12.5%)
χ^2 -value	4.00	2.00	1.00	1.00	1.00	7.50
<i>p</i> -value	0.046	0.157	0.317	0.317	0.317	0.006

3.3. Postoperative pain scores and thoracic cage recovery in the two groups

The observation group exhibited significantly lower postoperative pain compared to the control group ($p < 0.05$). Although the improvement rate in thoracic cage index was higher in the observation group, the difference was not statistically significant ($p > 0.05$). This indicates that the extrapleural approach offers superior postoperative comfort, as shown in **Table 3**.

Table 3. Comparison of postoperative pain and thoracic cage recovery between the two groups of children ($\bar{x} \pm s$)

Group	VAS score at 24 h	VAS score at 48 h	Thoracic index improvement rate (%)
Observation group (n = 26)	1.82 \pm 0.61	1.27 \pm 0.42	85.64 \pm 7.84
Control group (n = 24)	3.52 \pm 0.86	2.53 \pm 0.79	83.44 \pm 8.75
<i>t</i> -value	6.203	7.111	1.039
<i>p</i> -value	0.001	0.001	0.284

4. Discussion

Pediatric pectus excavatum is a highly prevalent thoracic deformity that not only affects the physical appearance of children but may also cause long-term disturbances to their cardiopulmonary function and mental health ^[4]. The NUSS procedure, a minimally invasive orthopedic surgery, utilizes steel plates to support the sternum, aiming to restore its anteroposterior diameter. This technique is widely applied in clinical settings due to its advantages of minimal trauma and rapid recovery. In contrast, the traditional intrathoracic approach requires penetration of the pleural cavity during the operation, and the operator's visual field is limited, which can easily lead to damage to thoracic organs, triggering complications such as pneumothorax, hemothorax, pleural effusion, and mediastinal vascular injury, with higher risks in younger children or those with severe thoracic deformities. This study compared the clinical outcomes of the traditional intrathoracic approach and the extrapleural approach in the correction of pediatric pectus excavatum. The results showed that the intraoperative blood loss in the observation group was significantly lower than that in the control group ($p < 0.05$), indicating that the extrapleural pathway has a milder impact on the pleura and lung tissue, helping to reduce the risk of vascular injury. In terms of operative time, the extrapleural approach still demonstrated certain operational advantages. Postoperative pain scores are a key factor in assessing the comfort of patients undergoing minimally invasive surgery ^[5]. This study revealed that the VAS scores of the observation group at 24 and 48 hours postoperatively were significantly lower than those of the control group ($p < 0.05$), suggesting that the extrapleural approach can effectively reduce surgical traction on the pleura and damage to tissue structures. The hospital stay in the observation group was also significantly shorter, further validating that the extrapleural approach can accelerate recovery, reduce medical costs, and alleviate economic burdens.

In terms of complications, none of the children in the observation group developed complications such as pneumothorax, hemothorax, pleural effusion, steel plate displacement, or infection. In contrast, two children in the control group developed pneumothorax and one developed hemothorax, resulting in an overall complication rate of 12.5% ($p < 0.05$). The results indicate that the extrapleural approach significantly reduces the incidence of intraoperative and postoperative complications, enhancing surgical safety. This is because the extrapleural approach operates through an extrapleural tunnel, avoiding direct exposure of the thoracic cavity and mediastinal organs, thereby effectively reducing surgical risks.

Regarding the thoracic deformity correction effect, both groups of children showed improvement in thoracic index after surgery, with good outcomes. The observation group demonstrated slightly better results, but the difference was not statistically significant ($p > 0.05$). This suggests that while both approaches can ensure satisfactory correction outcomes, the extrapleural approach offers a balance between intraoperative safety and postoperative comfort. Considering indicators such as intraoperative blood loss, postoperative pain scores, and hospital stay duration, the extrapleural approach demonstrates overall clinical advantages. However, it should be noted that the extrapleural approach is more challenging and requires higher technical proficiency from the operator. The operator must be well-versed in the extrapleural anatomical structures and steel plate channel manipulation techniques, and utilize the visualization capabilities of thoracoscopy to ensure safety and avoid blind spot injuries ^[6]. For children with severe thoracic deformities or a history of previous pleural cavity surgeries, the difficulty and complexity of the operation will be higher. Therefore, preoperative evaluation and intraoperative preparation are particularly crucial. The adoption of an optimized steel plate fixation protocol, such as the "W8 + S3" method, can enhance support stability and reduce postoperative displacement and recurrence. The results of this study confirm that the combination of an extrapleural approach and thoracoscopic-assisted NUSS procedure

offers significant advantages in the correction of pediatric pectus excavatum. This approach is characterized by minimal surgical trauma, low intraoperative blood loss, rapid recovery, and a low incidence of complications, with correction outcomes comparable to those of traditional approaches^[7]. This surgical method not only enhances the safety and comfort of the procedure for children but also shortens the recovery period and reduces the burden on families and healthcare systems, providing a reference for the clinical application of minimally invasive surgeries.

5. Conclusion

In summary, the extrapleural approach provides a surgical option for minimally invasive correction of pediatric pectus excavatum that ensures therapeutic efficacy while offering higher safety and greater comfort. Future multi-center studies can be conducted to verify its long-term efficacy and optimize the technique to provide individualized surgical plans.

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Disclosure statement

The authors declare no conflict of interest.

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Psychotherapeutic Interpretation and Enlightenment of Feng Youlan's Theory of Life Realm

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Abstract: This study mainly interprets Feng Youlan's "Theory of Life Realm" from the perspective of psychotherapy, redefining the concepts of "juejie" (awareness and understanding) and the criteria for realm classification. "Juejie" has two meanings: the psychological activity of processing cognitive objects and the awareness of the spirit itself. Realm is inherently a spatial-temporal concept. According to people's different time, space, and awakening levels, realm can be divided into clearer spatial-temporal dimensions. Such classification is more conducive to grasping its essence and realizing realm transformation. This study improves Feng Youlan's "Theory of Life Realm" and realizes the possibility of constructing a Chinese-style psychotherapy paradigm through the realm theory.

Keywords: Feng Youlan; Life realm; Juejie (awareness and understanding); Psychotherapy; Self-expansion; Realm elevation

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1. Introduction

Chinese philosophy is known as life philosophy, characterized by solving puzzles and settling the mind and body, with the method of promoting the elevation of human realm. The elevation of life realm can reconstruct the meaning and value of life and realize psychological healing, which is essentially the expansion of the "self" in time, space, and awakening level. The differentiation of psychological functions causes "division" between them, leading to blocked connections between psychological function modules. The "self" cannot freely transition between consciousness and unconsciousness, in the time dimension of past, present, and future, and in the spatial dimensions of body, psychology, society, and nature, thus generating a sense of psychological conflict and leading to psychological problems. Reconnecting these functional modules and realizing the free movement of the "self" in time and space is the process of realm transformation and psychological healing. Throughout the history of Chinese thought, the common point of various theories is to help people achieve the realm elevation of "from

ordinary to sage” through self-cultivation. In this process, various psychological puzzles and pains of people will be gradually resolved, which is the main paradigm of psychological healing in Chinese culture.

Mr. Feng Youlan proposed the theory of four life realms in *Xin Yuan Ren*: the Natural Realm, the Utilitarian Realm, the Moral Realm, and the Heavenly Realm. The criterion for distinction is the degree of “juejie”. People in the Natural Realm act according to instinct and habit, lacking awareness of self and society; those in the Utilitarian Realm take “seeking profit” as the core, with actions centered on the “self”; those in the Moral Realm “practice righteousness” and prioritize social interests; those in the Heavenly Realm “identify with heaven” and reach the highest state of harmony between man and nature^[1]. The classification criteria of the four realms integrate Confucian and Taoist thoughts such as “theory of mind-nature”, “distinction between righteousness and profit”, and “harmony between man and nature”, and construct a metaphysical system through logical analysis and the “combination of positive and negative methods”^[2,3]. However, many scholars have controversies and criticisms regarding the understanding of “juejie” and the criteria for realm classification. Liang Fuchao and Lu Yongzhao (2025) believe that the criteria for realm classification are vague, advocating “profit” and “self” as the classification criteria, and subdividing the four realms into seven, making the realm classification easier to understand and operate^[4]. Liu Jinpeng (2010) compares Feng’s four realms with personality types such as fools, ordinary people, virtuous people, and sages, emphasizing that realm elevation is a process of personality improvement^[5]. Chen Xiaoping (2025) proposes the “transcendental-empirical duality of the self”, understanding realm elevation from the perspective of the “self”, and emphasizing that its essence is the collaborative result of the transcendental self and the empirical self, which corrects the one-sidedness of Feng’s understanding of the “self”^[3]. However, scholars’ criticisms mainly proceed from philosophical and ethical perspectives with strong subjective colors, leading to constant controversies.

Up to now, there have been more and more research results related to realm and psychology. These studies have enriched the theory of life realm, but research from the perspective of psychotherapy needs to be further in-depth. Zhang Kezheng (2014) points out that the leap from the actual to the ideal realm is essentially the self-transcendence of spiritual life, which is inherently consistent with “self-growth” and “trauma recovery” in psychology^[6]. He Ganggang (2025) believes that “juejie” includes cognitive reconstruction and emotional experience, similar to “cognitive adjustment” in cognitive-behavioral therapy and “self-awareness” in humanistic therapy^[7]. Chen Xiaoping’s (2025) analysis of the duality of the “self” is highly consistent with the self-personality theory in psychology^[3]. However, these studies have not placed the realm theory under the framework of psychology or psychotherapy, nor have they solved the ambiguity in Feng Youlan’s explanation of “juejie” and realm classification. “Juejie” and “realm” belong to the research category of cognition and self-personality in psychology. This paper aims to reinterpret them through psychological language, improve Feng Youlan’s theory of life realm, and better export China’s local psychotherapy programs to the world.

2. Cognitive psychological interpretation of “juejie”

Juejie is the “spiritual root” for the elevation of life realm^[8]. Feng Youlan explains “juejie” as “understanding” and “self-awareness”: “jie” (understanding) is rational cognitive ability, the grasp of things and the principles of the universe and life; “jue” (awareness) is a state of perceptual cognitive awareness, the exertion of the mind’s “perceptual clarity”^[9]. Cheng Lin (2012) points out that Feng Youlan defines the essence of philosophy as “systematic reflective thinking on life”, and “juejie” is the core ability to reflect and reveal the meaning of

life. The presence or absence and the degree of “juejie” determine which realm a person is in ^[1]. Regarding the classification criteria for the degree of juejie, Chai Wenhua et al. (2025) believe that Mr. Feng Youlan mainly divides them based on thoughts such as “distinction between man and beast” in Confucian theory of mind-nature ^[2]. He Ganggang (2025) attempts to realize the understanding of axiology from an epistemological perspective, believing that four levels of cognition determine the level of realm: “no understanding” corresponds to the Natural Realm, “shallow understanding” to the Utilitarian Realm, “categorical understanding” to the Moral Realm, and “complete understanding” to the Heavenly Realm. These four levels of cognition are also vague, inevitably leading to ambiguous definition and loose logic of the four realms. He Ganggang (2025) points out that the fundamental reason why Feng’s Heavenly Realm is ultimately defined as “inconceivable” and “unspeakable” lies in its methodological issues ^[7]. Liu Jinpeng (2010), Liang Fuchao, and Lu Yongzhao (2025) believe that Feng Youlan’s definition of “juejie” does not consider the practical dimension, making juejie feel disconnected from real life. The root cause of this is the unclear definition of juejie. From a philosophical perspective, juejie is a concept that is difficult to clarify. Interpreting it from a psychological perspective should provide a clearer explanation.

Human cognitive activities mainly involve the processing of perceived objects and the awareness of cognition itself. This self-observation of the spiritual subject is called “juexing” in Chinese culture. Juexing is a reflection from the awareness of one’s own perception to the process and functions of psychological activities themselves ^[10]. Juejie mainly covers the psychological cognitive activities of processing cognitive objects and being aware of the spirit itself.

The development of the “self” progresses from the physical and psychological to the social and cosmic-natural, showing a hierarchical nature, and this process is based on “juejie”. At the beginning of life, we often regard the body and psychology as the “self”. When we gradually realize the spatial-temporal limitations of the body and mind, we need self-transcendence to seek higher-level life meaning, thus transitioning from the physical self and psychological self to the social self and cosmic self. “Establishing meritorious deeds, cultivating virtue, and leaving behind words” is to find a more eternal form than the physical and psychological self in the social self. However, human society also has spatial-temporal limitations, so we move towards a higher level, establishing a “Tao self” in the cosmic-nature, an absolutely eternal “self”, thereby finding the ultimate sense of meaning. The core of the development and transcendence of the self lies in the cognition of things in various time and space and the understanding of the relationship between the self and various time and space.

When we are in the “Natural Realm”, our ability of “jie” is insufficient, and we can only follow instinct, thus unable to understand the meaning of life; in the “Utilitarian Realm”, we understand our own needs and the value of things, so we will maximize gains; in the “Moral Realm”, we not only understand our own needs but also the needs of others and social laws, realizing that we are individual and social beings, with a sense of role and responsibility, and recognizing that the self and others are one, which is close to the Confucian realm of “ren” ; finally, the “Heavenly Realm”, which corresponds to the “Tao” ^[11]. In this realm, we realize that we come from the Tao, live in the Tao, and will eventually return to the Tao. We are part of the universe, which is the realm of “identifying with heaven”. We realize that we are the universe itself, and we become ultimately eternal.

In lower realms, “juejie” often shows cognitive characteristics such as “seeing only parts but not the whole, black-and-white thinking, and egocentrism”. In higher realms, juejie shows cognitive characteristics such as “dialectical thinking, metacognitive ability, systematic thinking, and decentration”. Among them, people in the Natural Realm and the Heavenly Realm seem to be dominated by natural and instinctive forces, but people in the Natural Realm do not understand this force, cannot control their own state, and are completely passive; while

people in the Heavenly Realm not only understand this force but also actively adjust themselves to be unified with it, experiencing higher-level meaning, which is an active state.

3. “Self” expansion in realm transformation

People have different degrees of juejie in the universe and life, so the universe and life will show different meanings to people, which constitutes a person’s certain realm. The realm is different for everyone, but people either know or do not know, see or do not see ^[12].

In Shuowen Jiezi Zhu, “jing” is the same as “jing”, referring to the end of a piece of music, the completion in time; “jie” refers to the division of spatial boundaries. In ancient Chinese classics, realm refers to the termination or end in time or the boundary, limit, or territory in space, originally representing a material spatial concept that characterizes specific facts, and later extended to the spiritual space, the world of the mind, and even the ultimate state of the spirit. Fang Dongmei regarded realm as the life level and spiritual state achieved when individual life merges into cosmic life (Dao). Tang Junyi regarded realm as the domain or scope where the transcendent mind carries out perceptual communication activities. Zhang Shiyong believed that realm is a dynamic temporal field and time domain in which people operate ^[13].

Our perception is based on a certain spatial-temporal object or scope, and we think and practice within a certain spatial-temporal object or scope. This spatial-temporal scope constitutes our “realm”. In different realms, our understanding of the universe and life is different, so the meaning of the universe and life is also different. Chen Xiaoping (2025) proposed the view of “transcendental-empirical duality of the self”, believing that realm elevation is the orderly expansion of the self-structure. Through juejie, people gain cognition of different time and space and understand their relationship with themselves, thereby realizing the construction of meaning, which is the process of realm elevation.

Combining Confucian, Taoist, and Buddhist thoughts on people, Feng Youlan proposed the theory of life realm, taking realm elevation, i.e., human cultural generation, as the philosophical theme ^[14]. Feng Youlan’s realm classification mainly proceeds from the spatial dimension, and the contrast between the Natural Realm and the Heavenly Realm also reflects the dimension of consciousness and unconsciousness, but lacks the time dimension. The three dimensions cannot form a whole, so it cannot be clearly defined. Realm should be composed of time, space, and awakening level as a whole. From the spatial perspective, it includes physical, psychological, social, natural and other realms; from the time perspective, it includes past, present, and future realms; from the awakening level perspective, it includes the realm of knowledge and ignorance. The universe composed of time and space is only a small part perceived by humans, and only what enters consciousness can be “juejie”, which refers to the realm of knowledge or consciousness, and vice versa, the realm of ignorance or unconsciousness. Such a realm divided by time, space, and awakening level will exceed four. Such a classification of realms is more orderly and easier to connect, enabling us to grasp and understand each part of the realm as a whole and realize the transition between realms more easily. The development process of psychology, self, and personality is to a certain extent the process of realm expansion. The process of realm elevation is also the process of psychological energy flow and psychological healing.

4. Conclusion

“Human” is the core of traditional Chinese philosophy ^[15]. The elevation of life realm is a characteristic of Chinese

philosophy and a way for Chinese people to solve psychological difficulties. When facing problems, Westerners focus on the problems themselves, while Chinese people are better at finding reasons from themselves to achieve self-transcendence and thus surpass the problems. The theory of life realm can be interpreted as a systematic psychological therapy theory with unique Chinese characteristics. The essence of realm elevation is to achieve “self” expansion through juejie. The elevation of life realm is inherently isomorphic with personality growth and psychological healing. From a theoretical perspective, researching the realm theory from the perspective of psychotherapy can realize the application transformation of Chinese philosophy and provide a Chinese plan for psychotherapy. The psychological therapy theory of realm elevation has a better explanatory power for existing Western psychotherapy technologies; realm elevation also has important practical significance. From the perspective of realm elevation, “clients” are not patients, but “ordinary people” waiting for realm elevation, waiting to transition from a lower realm to a higher one. In this process, the psychotherapy relationship and psychotherapy technologies will also undergo subversive changes.

Disclosure statement

The author declares no conflict of interest.

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Perioperative Nursing Management of a Lateral Ventricle Trigone Meningioma Resected via a Contralateral Approach: A Case Report

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Abstract: This article summarizes the nursing experience with a patient who underwent resection of a lateral ventricle trigone meningioma via a contralateral interhemispheric approach. Key nursing measures included preoperative health education and psychological care, baseline neurological assessment, and comprehensive physiological preparation. Postoperative care focused on intensive vital sign monitoring and support, comprehensive neurological evaluation and early rehabilitation, as well as a proactive strategy for preventing secondary epilepsy and controlling intracranial infection. Through active treatment and systematic nursing care, the patient achieved an uncomplicated recovery and was discharged on postoperative day 9. The successful implementation of these structured nursing interventions contributed to favorable postoperative outcomes, offering a valuable reference for the perioperative management of similar complex neurosurgical cases.

Keywords: The lateral ventricle trigone; Meningioma; Perioperative nursing management

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1. Introduction

The lateral ventricle trigone (LVT) is a triangular space deep in the brain, sitting at the crossroads of the temporal and occipital horns of the lateral ventricle. Because it's surrounded by vital neural pathways and blood vessels, it's a common spot for tumors like meningiomas^[1]. Surgeons traditionally reach tumors here by cutting through the cortex of the parietal, temporal, or parieto-occipital lobes. The problem with these standard routes is that they often involve removing or pulling back healthy brain tissue. This can make it hard to get a clear view of the arteries feeding the tumor and often leads to heavy bleeding. Worse, these approaches risk damaging the optic radiation, which can cause permanent blind spots, or harming language and motor areas, especially when dealing with large tumors in the dominant hemisphere^[2-4].

In contrast, the contralateral interhemispheric transfalcine precuneus approach avoids critical functional cortices and minimizes vascular interference. This technique leverages the advantages of endoscopy by utilizing natural anatomical corridors to reach the lesion, allowing close visualization for early devascularization and precise hemostasis ^[5,6]. It also reduces the likelihood of postoperative isolated hydrocephalus. However, both the complexity of the region and the technique impose high demands on the surgical and nursing teams. Successful execution requires not only exceptional patience and meticulous microneurosurgical skills from the medical team but also individualized perioperative care throughout the patient's treatment cycle. At present, this procedure is performed in only a limited number of institutions worldwide, and related nursing experiences remain unreported.

In April 2025, our department admitted a patient diagnosed with a lateral ventricle trigone meningioma. The medical team performed tumor resection via the contralateral transfalcine precuneus approach. Through multidisciplinary collaboration and meticulous nursing care, the patient was successfully discharged on the ninth postoperative day. The following report details the nursing experience in this case.

2. Case materials

A 58-year-old woman was admitted to the hospital for a persistent headache, which she had been experiencing for a year along with hearing loss in her left ear and worsening vision. The headaches started a year ago for no clear reason. They came in episodes, mainly affecting the left frontoparietal area of her head. Around the same time, she developed left-sided hearing loss, deteriorating vision, tinnitus, and occasionally had trouble swallowing. She also reported intermittent dizziness and vertigo. Her symptoms grew noticeably worse in the two weeks leading up to her admission.

Her past medical history was notable for a few things. She had been dealing with cervical spondylosis, lumbar spine issues, and rheumatoid arthritis for the last two years. For these conditions, she had been taking Xuesaitong orally, though the specifics of her other medications are not known. She was also diagnosed with hypertension about three months ago but hadn't started any treatment for it. Physical examination on admission showed the patient was alert and conscious. Both pupils were equal and round, approximately 2.5 mm in diameter, with prompt light reflexes. Vital signs were as follows: body temperature 36.2 °C, pulse 91 beats/min, respiratory rate 20 breaths/min, blood pressure 151/90 mmHg, and oxygen saturation 98%. Left-sided visual and hearing acuity were reduced, while the right side was normal. Muscle strength in all four limbs was normal, and the pain score was 3. Contrast-enhanced magnetic resonance imaging (MRI) of the head revealed a round nodular lesion in the posterior horn of the left lateral ventricle, suggestive of a likely benign neoplasm. The admission diagnosis was intracranial space-occupying lesion (tumor in the left lateral ventricle trigone).

3. Treatment and clinical course

After admission, a full preoperative evaluation confirmed the patient was a good candidate for surgery. The multidisciplinary team agreed on the plan, and the patient was taken to the operation on April 7, 2025. Patient was put under general anesthesia and removed the tumor in the trigone of the left lateral ventricle. For access, the endoscopic was used, contralateral interhemispheric transfalcine precuneus approach. The surgery took about six hours, with an estimated blood loss of 400 mL. Before closing, A lumbar drainage catheter was placed and a subcutaneous drain. The patient was then transferred to the Neurosurgical Intensive Care Unit (NICU) for

monitoring.

After surgery, the immediate focus was on controlling bleeding, managing blood pressure, and preventing seizures. On the first day, the patient's vision in her left eye hadn't changed, but she complained of dizziness, headache, and a painful, swollen feeling in her left leg with some loss of sensation. After a clinical check-up, her breathing tube was removed. Lab work showed a high white blood cell count ($11.14 \times 10^9/L$), anemia (hemoglobin at 97.0 g/L), and a spike in neutrophils (90.6%). The tests also pointed to low protein levels, slightly elevated liver enzymes, and an electrolyte imbalance. Given these results, her treatment was stepped up, adding dehydration therapy, medication to prevent vascular spasms, antibiotics, and agents to protect her liver. She was then stable enough to be transferred to the general ward. Two days after the procedure, the patient was still experiencing numbness and a swollen, painful feeling in her left leg, so the neurotrophic medication was started. The next day, her temperature rose to 38.2 °C. A spinal tap revealed a very high cell count and elevated protein and lactate levels, prompting a switch to stronger, broader-spectrum antibiotics to cover a suspected infection. By post-operative day seven, the patient had been afebrile for two full days and her left leg sensation had improved enough to remove the lumbar drain. She was discharged on day nine in stable condition, recovering well. At her one-month follow-up in May 2025, she reported better vision and hearing. Her visual fields were intact, the numbness in her left leg had almost completely resolved, and she only experienced occasional headaches with no other issues.

4. Nursing interventions

4.1. Preoperative nursing management

Before surgery, nursing care focuses on getting the patient physically and mentally ready. Good preparation helps lower the risks of surgery and makes it easier for the patient to handle the procedure^[7]. In fact, studies show that organized preoperative nursing can cut down on complications after surgery by as much as 20–30%^[8].

For this particular patient, few things should be considered: their age, high blood pressure, and a history of neck problems (cervical spondylosis). With that in mind, the nursing team put together a detailed plan covering health education, getting them physically prepared, checking their neurological function, and talking with their family. This whole process took about three to five days. Close attention was paid to providing emotional support and taking preventive steps, to head off any potential problems during the operation.

4.1.1. Preoperative health education and psychological care

When the patient arrived, one-on-one interview was conducted to get a sense of their emotional state. Using the Hamilton Anxiety Rating Scale (HAMA), they found a score of 18, which points to moderate anxiety^[9]. Since managing anxiety before surgery can lead to less pain and a quicker recovery, then mapped out a psychological support plan for the patient^[10]. The roots of their anxiety were first explored, noting specific fears like “worried about surgical failure”. The next day, a simple deep breathing exercise was introduced: inhale for four seconds, hold for four, and exhale for six, repeated in three sets daily. By day three, mindfulness meditation was included, guiding the patient to picture a successful surgery^[11]. Since the initial assessment pointed to clear triggers, fear of the operation itself, potential complications, and the tumor coming back, our approach was direct. The listening therapy was used to help the patient open up, paired with the breathing exercises and progressive muscle relaxation. The guided sessions were run for about 15–20 minutes each day so the patient could get comfortable with the techniques. This plan worked well, bringing the preoperative HAMA score down to 10.

To educate the patient and her family on the upcoming surgery, audiovisual materials and printed leaflets were mixed. Benefits of our chosen surgical path were discussed, the contralateral interhemispheric transfalcine precuneus approach, and explained how this route helps us steer clear of critical areas in the dominant brain hemisphere, lowers the risk of damaging the optic radiation, and reduces bleeding. Of course, the potential downsides were covered, including a 10–15% chance of worsened vision, a less than 5% risk of hearing loss, and a small possibility (under 10%) of sensory changes in the lower limbs. For post-op care, few key instructions were highlighted. Patients need to rest in a semi-upright position (30–45°) to help cerebrospinal fluid circulate properly and to prevent lung issues. She was also told to avoid any straining that mimics a Valsalva maneuver¹³ like holding their breath while coughing hard or during a bowel movement, to keep the pressure inside their head from rising^[12]. The patient's condition and treatment were described to her step-by-step, making sure the information wasn't overwhelming. Research shows this kind of layered teaching helps people learn more and stick to their recovery plan after surgery, compliance rates often hit around 85%^[13]. Her family was also involved inside the conversation. They learned how to spot emergency signs like a sudden, severe headache, blurred vision, or weakness in an arm or leg. To check that everyone was on the same page, the “teach-back” method was used, where they would explain the information back to us. Ultimately, both the patient and her family understood the basics of her condition and were ready to work with us on the treatment.

4.1.2. Baseline neurological function recording

Before surgery, a detailed neurological baseline was established to monitor any postoperative changes. Visual acuity measured 0.4 in the left eye and 0.8 in the right. Hearing was normal on the right, with a moderate 50 dB hearing loss on the left. Visual field testing revealed no deficits. Language function was fully intact, with fluent speech and no evidence of aphasia. Motor examination demonstrated full strength (5/5) throughout. The patient also reported symptoms requiring monitoring, including left-sided tinnitus occurring approximately 3–5 times per day and intermittent dysphagia with liquids a few times per week. Pain levels were low, rated between 0 and 4 on the NRS scale.

4.1.3. Preoperative preparation

Studies indicate that adequate preoperative preparation can reduce hospital length of stay by several days^[14]. In this case, preoperative optimization focused on several key measures to ensure the patient was well prepared for surgery. Blood pressure was closely monitored every four hours. If readings exceeded 150/90 mmHg, a 10 mg oral dose of sustained-release nifedipine was administered. Cardiopulmonary function was also evaluated; pulmonary function testing demonstrated normal respiratory status, with an FEV1/FVC ratio greater than 70%. Nutritional risk was assessed using the NRS-2002 screening tool, with a score of 2 indicating moderate nutritional risk. To support neuroprotection and overall recovery, a high-protein diet including foods such as eggs and milk was initiated, along with B-vitamin supplementation. Comprehensive laboratory testing, including complete blood count, liver and renal function tests, and coagulation studies, was performed to identify any contraindications or conditions requiring intervention prior to surgery. The overall aim of these measures was to provide targeted support and optimize the patient's condition before the operation. Preoperative fasting protocols were followed: solid food was discontinued 6 hours before surgery, and clear liquids were allowed until 2 hours prior to anesthesia. At the 2-hour mark, the patient also consumed a carbohydrate-rich solution. Surgical site preparation followed standard protocols. On the day before surgery, hair at the incision site was clipped using electric clippers, and the patient

completed two showers with antimicrobial soap, with particular attention to the scalp. After the second shower, the hair was braided, and clean bed linens were provided. Immediately before surgery, the scalp and surrounding hair were disinfected with povidone-iodine, after which the patient was transferred to the operating room.

4.2. Postoperative nursing care

Postoperative care was the most critical part of this patient's treatment journey. Every morning, the nursing team met to check on her progress, tweak the care plan, and decide on the best next steps. Their main goals were simple but vital: keep infections at bay, help her recover smoothly, and prevent any accidental harm during treatment.

4.2.1. Postoperative early vital-sign monitoring and support (0–24 h)

The first 24 hours after surgery represent the highest-risk period, during which complications such as postoperative hemorrhage or acute cerebral edema are most likely to occur. Accordingly, nursing priorities focused on intensive life support and continuous monitoring of vital signs to maintain physiological stability and enable early detection of adverse events ^[15–17].

Following surgery, the patient was transferred directly to the neurological intensive care unit (NICU). The overarching goal was a “zero tolerance for acute adverse events” approach. To achieve this, a comprehensive protective nursing plan was implemented, encompassing condition monitoring, postural management, circulatory support, and psychological care.

(1) Condition monitoring

Hourly assessments were conducted, including level of consciousness, pupillary response, vital signs, and limb motor function, to promptly identify any signs of neurological deterioration or systemic complications.

(2) Postural management

Appropriate positioning is critical after meningioma surgery, as it can reduce the risk of elevated intracranial pressure and promote recovery ^[18]. Rather than maintaining a fixed position, a dynamic positioning strategy was adopted. The head of the bed was initially elevated to 15° and gradually increased to 45° in 5° increments every few hours. In addition, the patient was repositioned every two hours to facilitate cerebrospinal fluid circulation and prevent pressure injuries and pulmonary complications.

(3) Circulatory management

Circulatory care focused on two primary objectives. First, systolic blood pressure was maintained at approximately 130 mmHg to minimize the risk of rebleeding during the initial 24-hour postoperative period. Second, Goal-Directed Fluid Therapy (GDFT) was employed to optimize fluid balance and support earlier resumption of oral intake. Arterial blood gas analysis was performed every four hours to guide fluid management.

(4) Psychological care

Psychological and emotional support was provided based on Swanson's Theory of Caring, emphasizing understanding the patient's needs, maintaining a supportive presence, and promoting comfort throughout recovery.

The postoperative course was uneventful, with no complications observed. The patient recovered as expected and was transferred from the NICU to the general ward within 24 hours.

4.2.2. Postoperative neurological assessment and rehabilitation

After surgery, close monitoring of neurological function was essential to evaluate the effectiveness of the surgical technique and to enable early detection of potential complications^[19,20]. Regular neurological assessments were conducted to identify signs of cerebral edema, postoperative hemorrhage, or injury to the optic radiation or deep brain structures. Continuous observation allowed timely intervention to support recovery. Assessments were performed hourly immediately after surgery, then every four hours once the patient stabilized, and finally every eight hours during the later recovery phase.

(1) Visual function assessment

The trigone of the lateral ventricle is anatomically adjacent to Meyer's loop and the occipital visual cortex. As a result, the optic radiation is vulnerable to stretching or injury during surgery in this region, making visual impairment the most common postoperative complication. Once the patient regained consciousness, a basic visual assessment was performed, including fixation on a finger, finger counting, and subjective comparison of vision between the two eyes. A confrontation visual field test was then conducted to assess all four quadrants of each eye, specifically screening for hemianopia or quadrantanopia. Findings were compared with the preoperative baseline. Serial visual assessments were emphasized, as progressive visual field deterioration accompanied by worsening headache could indicate postoperative edema or hemorrhage compressing the occipital cortex. Throughout monitoring, the patient's visual acuity and visual fields remained unchanged from baseline, with no new deficits identified.

(2) Limb motor function assessment

The trigone of the lateral ventricle lies close to critical structures such as the posterior limb of the internal capsule and parts of the thalamus, which contain dense motor and sensory pathways. Consequently, even mild intraoperative traction, postoperative edema, or transient ischemia can affect limb movement or sensation^[21,22]. Muscle strength was routinely evaluated using the Medical Research Council (MRC) scale. Sensory function on both sides of the body was also assessed, using light touch with a cotton swab and pinprick testing for pain, with particular attention to the progression or spread of hypoesthesia or reduced pain sensation. Postoperatively, muscle strength remained intact. However, the patient reported a sensation of fullness, pain, and numbness in the left leg, suggesting transient sensory pathway disturbance, likely related to manipulation or pressure near the thalamus or internal capsule during surgery. With coordinated medical and nursing management, these sensory symptoms improved significantly by the time of discharge.

(3) Auditory assessment

Once consciousness was restored, a bedside hearing assessment was conducted using simple methods such as finger rubbing and whispered speech to evaluate sound perception and localization. The primary objective was to compare postoperative hearing with preoperative status and detect any decline, particularly on the side with preexisting hearing impairment. The patient described hearing as "muffled", with sounds perceived as "distant", along with a sensation of ear blockage. These symptoms were carefully documented, as they could be associated with temporal lobe edema from surgical traction or postoperative pressure changes. Following appropriate therapeutic interventions, the patient's hearing improved and was reported to be better than preoperatively.

4.2.3. Postoperative secondary-seizure prevention and management

After surgery, factors such as cortical edema, microhemorrhage, or alterations in cerebrospinal fluid dynamics

can significantly increase the risk of seizures^[23]. This risk profile made the implementation of a proactive nursing management strategy essential.

(1) Dynamic monitoring

The patient's level of consciousness, language function, and limb mobility were continuously assessed and carefully documented. Any abnormal findings were promptly reported and addressed, with the frequency of nursing rounds increased as needed to ensure early detection and intervention.

(2) Pharmacological prevention

Maintaining a stable and effective serum concentration of antiepileptic medication is central to seizure prevention^[24]. Levetiracetam was administered at a dose of 500 mg intravenously every 12 hours, with a transition to oral maintenance therapy after 3 days. Health education was provided to the patient and family, emphasizing that the medication regimen should not be altered without medical authorization to ensure therapeutic drug levels and effectiveness.

(3) Daily risk factor monitoring

Potential seizure triggers, including electrolyte disturbances and signs of infection, were evaluated daily. Patient and family education formed a key component of care, focusing on the identification and avoidance of common precipitating factors such as caffeine intake and emotional stress.

(4) Acute seizure management

In the event of a seizure, immediate measures were implemented to ensure airway patency and prevent injury from falls or external impact. Supplemental oxygen was administered, and vital signs were closely monitored. Benzodiazepines were administered as prescribed when necessary to terminate seizure activity. Detailed documentation followed each event, including seizure characteristics, duration, and patient response. Once the patient stabilized, reassurance and targeted health education were provided.

Through this comprehensive and anticipatory approach, the patient remained seizure-free throughout the hospital stay and demonstrated full adherence to the prescribed antiepileptic regimen.

4.2.4. Postoperative intracranial infection prevention and control

The contralateral interhemispheric approach provides an extensive surgical field; however, prolonged exposure of cerebrospinal fluid (CSF) substantially increases the risk of intracranial infection^[25]. Therefore, a comprehensive and well-structured infection prevention and control strategy was essential.

(1) Antibiotic protocol

Ceftriaxone was administered intravenously at a dose of 2 g every 12 hours for 3 days. Escalation to higher-tier antimicrobial agents, such as vancomycin or meropenem, was implemented when clinically indicated.

(2) Infection prevention related to lumbar drainage

Meticulous management of the lumbar cistern drainage system was critical to preventing retrograde bacterial entry into the central nervous system. Preventive measures focused on three key areas.

① Aseptic technique

Strict sterile procedures were adhered to during all drainage-related interventions, including hand hygiene and aseptic technique during bag changes and CSF sample collection. Drainage ports were disinfected with povidone-iodine prior to each connection.

② Maintenance of a closed system

Tubing connections were inspected hourly to ensure secure and airtight fittings, and the catheter was properly fixed to prevent kinking or accidental dislodgement. Drainage volume, color, and clarity were monitored hourly as prescribed. Cloudy CSF or the presence of particulate matter was treated as a potential indicator of infection, prompting immediate sample collection and physician notification.

③ Insertion site care

The puncture site was routinely inspected for signs of CSF leakage. Dressings were changed promptly if leakage was observed, and the patient was instructed to avoid scratching the area to reduce the risk of infection or catheter displacement.

(3) Monitoring for clinical indicators of infection

Body temperature was closely monitored for unexplained fever. New or worsening signs of meningeal irritation, such as headache, vomiting, altered mental status, or neck stiffness were carefully assessed. In parallel, CSF characteristics and inflammatory markers, including complete blood count, C-reactive protein (CRP), and procalcitonin (PCT), were regularly evaluated.

(4) Targeted nutritional support:

In collaboration with nutrition specialists, an individualized nutritional plan was developed to support immune function and recovery. The target intake was approximately 30 kcal/kg/day and 1.2–1.5 g/kg/day of protein, corresponding to 1500–1800 kcal and 72–90 g of protein daily. As oral intake alone was insufficient to meet these requirements, whey protein supplementation was added.

Through comprehensive management and targeted interventions, no serious postoperative infections occurred, and the patient's body temperature gradually returned to normal.

5. Conclusion

This case study describes the nursing management of a patient undergoing resection of a lateral ventricle trigone meningioma via a contralateral interhemispheric transfalcine approach to the ipsilateral precuneus. This complex surgical route posed distinct challenges for perioperative and postoperative care. Preoperatively, nursing priorities centered on alleviating patient anxiety through individualized health education and psychological support, while systematically documenting baseline neurological function to establish a reliable reference for postoperative comparison.

Postoperatively, care focused on dynamic neurological monitoring and early rehabilitation. Particular emphasis was placed on seizure prevention, given the elevated risk associated with this surgical approach. In addition, a multilayered infection prevention strategy was implemented, including strict lumbar drainage management and continuous monitoring of clinical and laboratory infection indicators. Through a structured yet individualized nursing care plan, secondary seizures and intracranial infections were successfully avoided. The patient's neurological function improved steadily, leading to discharge in good condition. The nursing strategies outlined in this case may provide practical guidance for the care of patients undergoing similarly complex intracranial procedures.

Disclosure statement

The authors declare no conflict of interest.

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Application of Phased Nursing Guidance Program in Early Rehabilitation Training for Patients after Minimally Invasive Spinal Surgery

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Abstract: *Objective:* To explore the application effect of a phased nursing guidance program in early rehabilitation training for patients after minimally invasive spinal surgery, providing references for clinical rehabilitation nursing. *Methods:* A total of 148 patients who underwent minimally invasive spinal surgery in our hospital from July 2023 to June 2025 were selected as the study subjects. They were randomly divided into an observation group and a control group using a random number table method, with 74 cases in each group. The control group received conventional nursing guidance after minimally invasive spinal surgery, while the observation group implemented a phased nursing guidance program. The pain levels (VAS scores), spinal function (JOA scores), quality of life (SF-36 scores), rehabilitation training compliance, and complication rates of the two groups of patients at different postoperative time points were compared. *Results:* At 7, 14, and 30 days postoperatively, the Visual Analogue Scale (VAS) scores in the observation group were significantly lower than those in the control group (all $p < 0.001$). At 7, 14, and 30 days postoperatively, the Japanese Orthopaedic Association (JOA) scores in the observation group were significantly higher than those in the control group (all $p < 0.0001$). Moreover, the JOA scores in both groups gradually increased over time, with a more pronounced increase observed in the observation group. At 30 days postoperatively, the scores in all dimensions of the Short Form-36 (SF-36) scale in the observation group were significantly higher than those in the control group (all $p < 0.001$). The compliance rate with rehabilitation training in the observation group was 95.95%, significantly higher than the 82.43% in the control group ($\chi^2 = 7.008$, $p < 0.05$). The complication rate in the observation group was 4.05%, significantly lower than the 14.86% in the control group ($\chi^2 = 5.049$, $p < 0.05$). *Conclusion:* The phased nursing guidance program can effectively alleviate pain, improve spinal function and quality of life, enhance compliance with rehabilitation training, and reduce the incidence of complications in patients after minimally invasive spinal surgery, making it worthy of clinical promotion and application.

Keywords: Minimally invasive spinal surgery; Phased nursing guidance; Early rehabilitation training; Pain management; Spinal function

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1. Introduction

Minimally invasive spinal surgery, characterized by minimal trauma, reduced bleeding, and rapid recovery, has become the mainstream treatment for spinal diseases such as lumbar disc herniation, lumbar spinal stenosis, and cervical spondylosis ^[1]. However, spinal stability remains relatively weak in the early postoperative period. Improper or delayed rehabilitation training can easily lead to issues such as muscle atrophy, spinal stiffness, and chronic pain, thereby affecting the surgical outcome and the patient's prognosis ^[2].

Early rehabilitation training is crucial for promoting the recovery of spinal function, but patients often exhibit low rehabilitation compliance and poor training outcomes due to factors such as fear of pain, lack of rehabilitation knowledge, and non-standardized training methods. Conventional nursing guidance typically consists of uniform and general suggestions, lacking specificity tailored to the physiological characteristics and rehabilitation needs of patients at different postoperative recovery stages, making it difficult to align with individual patient recovery processes. Phased nursing guidance formulates personalized rehabilitation goals and training plans in stages based on the postoperative recovery patterns of patients, achieving gradual and precise rehabilitation guidance ^[3]. This study took 148 patients who underwent minimally invasive spinal surgery and were treated from July 2023 to June 2025 as the research subjects to explore the application effect of phased nursing guidance plans in early rehabilitation training. The findings are now reported as follows.

2. Materials and methods

2.1. General information

A total of 148 patients who underwent minimally invasive spinal surgery in the orthopedics department of our hospital from July 2023 to June 2025 were selected as the study subjects.

2.1.1. Inclusion criteria

- (1) Meeting the surgical indications for spinal diseases and undergoing minimally invasive spinal surgery (including percutaneous endoscopic lumbar discectomy, full-endoscopic spinal canal decompression, percutaneous vertebroplasty, etc.);
- (2) Aged between 18 and 75 years old;
- (3) Having clear consciousness and basic communication and comprehension abilities
- (4) Voluntarily participating in this study and signing the informed consent form

2.1.2. Exclusion criteria

- (1) Concurrent severe dysfunction of vital organs such as the heart, liver, and kidneys;
- (2) Presence of coagulopathy;
- (3) Occurrence of severe postoperative complications (such as infection, massive hemorrhage, nerve injury);
- (4) Patients with mental disorders;
- (5) Pregnant or lactating women

2.1.3. Study design

Patients were randomly assigned to an observation group and a control group using a random number table method, with 74 patients in each group. In the observation group, there were 41 males and 33 females, with an

average age of (52.36 ± 8.42) years. The surgical types included 38 cases of percutaneous endoscopic lumbar discectomy, 22 cases of full-endoscopic spinal canal decompression, and 14 cases of percutaneous vertebroplasty. In the control group, there were 39 males and 35 females, with an average age of (51.89 ± 8.67) years. The surgical types included 36 cases of percutaneous endoscopic lumbar discectomy, 23 cases of full-endoscopic spinal canal decompression, and 15 cases of percutaneous vertebroplasty. There were no statistically significant differences in general information such as gender, age, and surgical type between the two groups ($p > 0.05$), indicating comparability.

2.2. Nursing methods

The control group received routine nursing guidance after minimally invasive spinal surgery: explaining the importance of rehabilitation and distributing handbooks, instructing patients on bed turning and limb movements, orally informing them about lumbar and back muscle training one-week post-surgery (without specifying frequency or intensity), regularly answering questions, and providing discharge rehabilitation precautions.

The observation group was guided by a professional rehabilitation nursing team, which implemented precise nursing guidance in four stages according to the recovery process after minimally invasive spinal surgery, as follows:

(1) Days 1–3 post-surgery (acute phase)

Rehabilitation goals: Alleviate pain and edema, maintain spinal stability, and prevent early complications such as pressure ulcers and venous thrombosis. Nursing guidance: Position the patient in a supine position with a lumbar pillow, and perform axial turning every 2 hours; assess pain using the VAS score, administer medications as prescribed, and incorporate relaxation therapy; instruct the patient in ankle pump exercises (10 repetitions per set, 3–4 sets daily) and quadriceps contraction training (15 repetitions per set, 3 sets daily); emphasize spinal protection to the patient and their family, and avoid premature weight-bearing^[4].

(2) Days 4–7 post-surgery (muscle activation phase)

Rehabilitation goals: Activate the muscle strength of the core muscle groups, improve the range of motion of the spinal joints, and lay the foundation for subsequent rehabilitation. Nursing guidance: Instruct on the five-point support method (lying supine with knees bent and lifting the buttocks, holding for 3–5 seconds, 10 repetitions per set, 2–3 sets per day, increasing as needed); slowly perform neck/waist flexion, extension, and rotation movements under pain-free conditions (5–8 repetitions in each direction, 2 sets per day); evaluate training progress daily and adjust intensity promptly; encourage the intake of high-protein, high-calcium, and vitamin-rich foods to promote recovery.

(3) 8–14 days post-surgery (muscle strengthening phase)

Rehabilitation goals: Strengthen the core muscle groups, improve spinal function, and enhance daily living activities. Nursing guidance: Increase the five-point support method to 15–20 repetitions per set (3 sets per day), gradually transition to the three-point support method (10 repetitions per set, 2 sets per day), and add isometric neck contraction training for cervical spine surgeries; instruct on sitting up at the bedside and walking with assistance (starting with 50–100 meters, twice daily, gradually increasing); standardize sitting, standing, and walking postures, use a lumbar support pillow, avoid prolonged sitting or standing, and move the spine every 30 minutes.

(4) 15 to 30 days post-surgery (functional consolidation phase)

Rehabilitation goals: Consolidate rehabilitation outcomes, enhance spinal functional independence, and facilitate the patient's return to family and society. Nursing guidance: Strengthen core muscle groups and increase the "Little Swallow Flying" exercise (lying prone, raising the head, chest, and legs, maintaining the position for 3 to 5 seconds, 10 repetitions per set, 2 sets daily, adjusting intensity as needed); instruct on daily activities, advising against bending over to lift heavy objects (lifting objects by bending the knees and squatting); develop a post-discharge rehabilitation plan, inform patients of follow-up appointments at 1, 3, and 6 months post-surgery, and establish a WeChat follow-up group for answering questions and correcting posture ^[5].

2.3. Observation indicators

The Visual Analog Scale (VAS) was used to assess patients' pain levels at 3 days, 7 days, 14 days, and 30 days post-surgery; the Japanese Orthopaedic Association (JOA) evaluation score was used to assess patients' spinal function ^[6].

The Short Form Health Survey (SF-36) was used to evaluate patients' quality of life at 30 days post-surgery; a self-made compliance scale was used to assess patients' compliance rates; and the occurrence of complications in patients was recorded.

2.4. Statistical methods

Data analysis was performed using SPSS 26.0 statistical software. Continuous data are presented as ($\bar{x} \pm s$), with repeated measures analysis of variance used for comparisons within groups and independent samples *t*-tests for comparisons between groups; categorical data are presented as [n (%)], with χ^2 tests used for comparisons. A *p*-value < 0.05 indicates a statistically significant difference.

3. Results

3.1. Comparison of VAS scores at different time points after surgery between the two groups

At 7 days, 14 days, and 30 days post-surgery, the VAS scores in the observation group were significantly lower than those in the control group (all *p* < 0.001). See **Table 1**.

Table 1. Comparison of VAS scores at different time points after surgery between the two groups

Group	Postoperative Day 3	Postoperative Day 7	Postoperative Day 14	Postoperative Day 30
Observation group (n = 74)	4.86 ± 1.03	3.21 ± 0.85	2.15 ± 0.72	1.32 ± 0.56
Control group (n = 74)	4.92 ± 1.05	3.98 ± 0.91	2.97 ± 0.83	1.98 ± 0.64
<i>t</i> -value	0.351	5.319	6.420	6.676
<i>p</i> -value	0.726	< 0.001	< 0.001	< 0.001

3.2. Comparison of JOA scores at different time points after surgery between the two groups

At 7 days, 14 days, and 30 days post-surgery, the JOA scores in the observation group were significantly higher than those in the control group (all *p* < 0.001). Moreover, the JOA scores in both groups gradually increased over

time, with a more pronounced increase observed in the observation group. See **Table 2**.

Table 2. Comparison of JOA scores at different time points after surgery between the two groups ($\bar{x} \pm s$, points)

Group	Postoperative Day 7	Postoperative Day 14	Postoperative Day 30
Observation group (n = 74)	16.83 \pm 2.15	20.56 \pm 2.32	24.38 \pm 2.51
Control group (n = 74)	14.25 \pm 2.08	17.32 \pm 2.26	20.15 \pm 2.43
<i>t</i> -value	7.419	8.605	10.416
<i>p</i> -value	< 0.001	< 0.001	< 0.001

3.3. Comparison of SF-36 scores at 30 days after surgery between the two groups

At 30 days post-surgery, the scores in all dimensions of the SF-36 scale in the observation group were significantly higher than those in the control group (all $p < 0.001$). See **Table 3**.

Table 3. Comparison of SF-36 scores at 30 days after surgery between the two groups

Group	Physical functioning	Role-physical	Bodily pain	General health	Vitality	Social functioning	Role-emotional	Mental health
Observation group (n = 74)	82.36 \pm 7.45	78.52 \pm 8.13	85.43 \pm 6.87	79.65 \pm 7.68	81.24 \pm 7.32	83.51 \pm 6.98	80.13 \pm 7.85	82.46 \pm 7.21
Control group (n = 74)	73.15 \pm 8.26	69.23 \pm 8.75	76.21 \pm 7.54	70.34 \pm 8.32	72.56 \pm 8.15	75.32 \pm 7.65	71.45 \pm 8.42	73.68 \pm 8.03
<i>t</i> -value	7.123	6.691	7.776	7.073	6.816	6.803	6.486	6.999
<i>p</i> -value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.4. Comparison of compliance with rehabilitation training between the two groups

The compliance rate with rehabilitation training in the observation group was 95.95%, significantly higher than that in the control group (82.43%) ($\chi^2 = 7.008$, $p < 0.05$). See **Table 4**.

Table 4. Comparison of compliance with rehabilitation training between the two groups

Group	Fully Adherent	Partially Adherent	Non-Adherent	Total Adherence
Observation group (n = 74)	52 (70.27)	19 (25.68)	3 (4.05)	71 (95.95)
Control group (n = 74)	38 (51.35)	23 (31.08)	13 (17.57)	61 (82.43)
χ^2 value				7.008
<i>p</i> -value				0.008

3.5. Comparison of complication rates between the two groups of patients

The complication rate in the observation group was 4.05%, significantly lower than that in the control group at 14.86% ($\chi^2 = 5.049$, $p < 0.05$). See **Table 5**.

Table 5. Comparison of complication rates between the two groups of patients

Group	Pressure injury	Venous thrombosis	Spinal stiffness	Surgical site infection	Total incidence
Observation group (n = 74)	0	1 (1.35)	2 (2.70)	0	3 (4.05)
Control group (n = 74)	2 (2.70)	3 (4.05)	5 (6.76)	1 (1.35)	11 (14.86)
χ^2 -value					5.049
<i>p</i> -value					0.025

4. Discussion

Although minimally invasive spinal surgery involves minimal trauma, postoperative soft tissue damage still occurs. Early rehabilitation requires balancing spinal stability with gradual training. Traditional nursing guidance lacks specificity and offers generalized plans, often leading to non-standardized training in patients due to pain fear and unclear methods, which affects recovery. Staged nursing guidance, based on evidence-based nursing and postoperative recovery patterns, formulates goals and content in stages to achieve individualized and precise guidance.

The results of this study showed that the VAS scores in the observation group were significantly lower than those in the control group at 7 days, 14 days, and 30 days postoperatively, while the JOA scores were significantly higher, confirming that staged nursing guidance can effectively alleviate pain and promote spinal function recovery^[7]. The core reason lies in adapting to the patient's recovery process in stages: focusing on body position care and pain management in the acute phase to reduce spinal stimulation; strengthening core stability during the muscle activation phase; enhancing daily activity capabilities during the muscle strengthening phase; and consolidating rehabilitation outcomes during the functional consolidation phase. Gradual training can prevent exacerbation of pain due to premature weight-bearing or excessive activity, while promoting local blood circulation, reducing inflammatory responses, and accelerating tissue repair^[8]. Quality of life serves as a crucial evaluation metric for rehabilitation outcomes, and the SF-36 scale comprehensively reflects patients' postoperative status. In this study, the scores of all dimensions of the SF-36 at 30 days post-surgery in the observation group were significantly higher than those in the control group. This indicates that phased nursing guidance not only improves spinal function but also enhances patients' physiological comfort, social participation, and mental health through comprehensive measures such as health education, psychological support, and dietary guidance.

The compliance with rehabilitation training in the observation group was significantly higher than that in the control group, primarily because the phased nursing guidance was both personalized and operable: the training content was concise and easy to grasp, the rehabilitation nursing team monitored and adjusted the plan in real-time, promptly addressing any queries, and the WeChat follow-up group provided continuous tracking and guidance. Additionally, the emphasis on family involvement further enhanced patient compliance through their supervision and support.

Complication prevention is a critical aspect of postoperative care following minimally invasive spinal surgery^[9]. The incidence of complications in the observation group was significantly lower than that in the control group. Phased nursing guidance prevented venous thrombosis through early postoperative ankle pump exercises and quadriceps contraction training, prevented pressure ulcers through axial turning, and prevented spinal stiffness through gradual spinal movement training. It also strengthened wound care and dietary guidance to reduce the risk of infection^[10]. In contrast, the control group exhibited a higher incidence of complications due to irregular rehabilitation training,

with some patients engaging in premature activities or lacking effective training.

5. Conclusion

In conclusion, the phased nursing guidance program can effectively alleviate pain, improve spinal function and quality of life, enhance compliance with rehabilitation training, and reduce the incidence of complications in patients following minimally invasive spinal surgery. It is therefore worthy of clinical promotion and application.

Disclosure statement

The authors declare no conflict of interest.

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Research on the Application of High-Fidelity Simulation Teaching in the Training of Emergency Management for Difficult Airways among Anesthesia Nursing Students

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Abstract: *Objective:* To explore the application effect of high-fidelity simulation teaching in the training of emergency management for difficult airways among anesthesia nursing students, providing practical references for enhancing their clinical emergency response capabilities. *Methods:* Eighty-four anesthesia nursing students who interned in the Department of Anesthesiology of our hospital from September 2023 to March 2024 were selected as the research subjects. They were randomly divided into a control group ($n = 42$) and an observation group ($n = 42$) using the random number table method. The control group adopted the traditional teaching mode (theoretical lectures + video demonstrations), while the observation group adopted the high-fidelity simulation teaching mode. After the training, the theoretical assessment scores, operational assessment scores, emergency response capability scores, and teaching satisfaction of the two groups of students were compared. *Results:* The observation group scored significantly higher than the control group in both theoretical assessment (90.35 ± 4.82) points and practical assessment (92.17 ± 3.96) points, with scores of (79.26 ± 5.78) points and (81.34 ± 5.21) points, respectively, in the control group. The differences were statistically significant ($p < 0.05$). The observation group also scored higher than the control group in all dimensions of emergency response capabilities and total scores, including airway assessment (18.92 ± 2.05) points vs. (14.56 ± 2.37) points, equipment selection (19.15 ± 1.83) points vs. (13.89 ± 2.24) points, operation execution (19.36 ± 1.78) points vs. (14.23 ± 2.41) points, teamwork (18.73 ± 2.11) points vs. (13.98 ± 2.53) points, and total score (76.16 ± 6.84) points vs. (56.66 ± 7.92) points. All differences were statistically significant ($p < 0.05$). The teaching satisfaction rate in the observation group was 97.62% (41/42), significantly higher than that in the control group at 78.57% (33/42), with a statistically significant difference ($p < 0.05$). *Conclusion:* High-fidelity simulation teaching can effectively enhance the theoretical knowledge, practical skills, and emergency response capabilities of anesthesia nursing students in managing difficult airways, as well as improve teaching satisfaction. It is an efficient clinical teaching model for anesthesia nursing and is worthy of promotion and application.

Keywords: High-fidelity simulation teaching; Anesthesia nursing students; Difficult airway; Emergency management; Teaching effectiveness

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1. Introduction

Difficult airway is a common critical situation in clinical anesthesia practice. If not managed promptly or appropriately, it can lead to patient hypoxia, cardiac arrest, or even death^[1]. As the main force in future anesthesia nursing work, anesthesia nursing students must possess solid knowledge of emergency management for difficult airways and proficient operational skills to cope with unexpected clinical situations^[2]. However, the traditional teaching model, primarily based on theoretical lectures and video demonstrations, lacks simulated training in real clinical scenarios, making it difficult for students to translate theoretical knowledge into practical emergency response capabilities. As a result, they are prone to issues such as nervousness and operational errors when faced with real-life difficult airway cases^[3].

High-fidelity simulation teaching utilizes equipment such as high-fidelity simulation mannequins and simulated operating rooms to recreate authentic clinical scenarios, allowing students to engage in repetitive training in a safe and controlled environment. Through a cycle of “practice-feedback-improvement”, students gradually enhance their clinical emergency response capabilities^[4]. In recent years, this teaching model has been widely applied in medical education, yet systematic research on its use in emergency management training for difficult airways among anesthesia nursing students remains limited. This study applies high-fidelity simulation teaching to the emergency management training for difficult airways among anesthesia nursing students and compares its effectiveness with that of the traditional teaching model, aiming to provide a basis for optimizing anesthesia nursing teaching plans.

2. Materials and methods

2.1. Research subjects

Eighty-four anesthesia nursing students who underwent internships in the Department of Anesthesiology at our hospital from September 2023 to March 2024 were selected as the research subjects.

2.1.1. Inclusion criteria

- (1) Full-time nursing students with a bachelor's degree or higher, currently in the internship stage in the Department of Anesthesiology;
- (2) Having not received systematic specialized training in emergency management of difficult airways;
- (3) Volunteering to participate in this study and signing an informed consent form

2.1.2. Exclusion criteria

- (1) Those who interrupted training or assessment during the internship for personal reasons;
- (2) Those with communication or operational impairments that prevent normal participation in training

2.1.3. Study design

The research subjects were randomly divided into a control group ($n = 42$) and an observation group ($n = 42$) using a random number table method. There were no statistically significant differences in general information such as gender, age, educational background, and previous internship duration between the two groups of students ($p > 0.05$), indicating comparability. See **Table 1** for details.

Table 1. Comparison of general information between two groups of anesthesia nursing students ($\bar{x} \pm s$, n/%)

Indicator	Control group (n = 42)	Observation group (n = 42)	Statistical value (t/χ^2)	<i>p</i> -value
Gender (Female/Male, n)	36 / 6	34 / 8	0.38	0.54
Age (years, Mean \pm SD)	23.56 \pm 1.24	23.89 \pm 1.17	1.21	0.23
Education level (Bachelor/Master, n(%))	38 (90.48)	37 (88.10)	0.18	0.67
Previous internship duration (months, Mean \pm SD)	8.23 \pm 1.56	8.57 \pm 1.42	1.05	0.30

2.2. Teaching methods

The training content for both groups revolves around emergency management of difficult airways, encompassing the following aspects:

(1) Theoretical knowledge

Definitions and classifications of difficult airways (predicted difficult airways and unanticipated difficult airways), assessment methods (such as Mallampati classification, mouth opening, thyromental distance, etc.), principles and indications for commonly used airway management devices (laryngoscopes, laryngeal masks, fiberoptic bronchoscopes, etc.), and emergency response procedures (e.g., the management protocol for the “cannot ventilate–cannot intubate” scenario);

(2) Practical skills

Operations such as laryngoscopic intubation, laryngeal mask insertion, fiberoptic bronchoscope-assisted intubation, and cricothyroidotomy;

(3) Emergency response

Strategies for handling unexpected difficult airway scenarios in clinical simulations, such as emergency management when ventilation and intubation are impossible after general anesthesia induction in patients. The training duration for both groups is three weeks, with 10 class hours per week, totaling 30 class hours.

2.2.1. Traditional teaching model

The traditional model of “theoretical instruction + video demonstration + simple hands-on practice” is adopted:

(1) Theoretical instruction (12 class hours)

Senior anesthesiologists (with over 10 years of working experience) deliver lectures on the theoretical knowledge of emergency management for difficult airways using PowerPoint presentations, focusing on organizing emergency response procedures;

(2) Video demonstration (6 class hours)

Videos of operations such as laryngoscopic intubation and laryngeal mask insertion are played, with teachers simultaneously explaining key operational points and precautions;

(3) Simple hands-on practice (12 class hours)

Practice is conducted in a simulation training room using ordinary mannequins (without vital sign simulation functions). After the teacher demonstrates, students take turns to perform the operations, and the teacher corrects obvious mistakes;

(4) Pre-examination review (1 class hour)

Before the end of the training, teachers conduct a centralized Q&A session to review key knowledge points.

2.2.2. Observation group: High-fidelity simulation teaching model

A four-stage teaching model of “theoretical preview–scenario simulation training–debriefing and summary–intensive training” was constructed, with specific implementation as follows:

(1) Theoretical preparation phase (1 week, 10 class hours)

Online learning resources related to the emergency management of difficult airways were distributed to students through the hospital’s teaching platform, including theoretical micro-lectures (five topics, each 20 minutes, covering areas such as difficult airway assessment and the use of emergency equipment), the latest clinical guidelines (e.g., the Chinese Guidelines for the Management of Difficult Airways, 2023 edition), and typical case videos (three videos, such as the management of a difficult airway in an obese patient after induction of general anesthesia). In addition, the platform administered a theoretical preparation test consisting of 20 multiple-choice questions with a total score of 100, and students were required to achieve a score of at least 80 to proceed to the scenario simulation training phase. All preparation and testing were completed within one week, during which teachers monitored students’ learning progress and test results via the platform and provided one-on-one guidance to students who failed to meet the required standards.

(2) Scenario simulation training phase (1.5 weeks, 15 class hours)

High-fidelity scenario training was conducted in a dedicated simulation operating room in the Department of Anesthesiology, equipped with a high-fidelity simulator (Laerdal SimMan 4G), a simulated monitor displaying vital signs such as heart rate, blood pressure, and oxygen saturation, and a full set of airway management equipment, including various laryngoscopes, laryngeal masks, fiberoptic bronchoscopes, and cricothyroidotomy needles. Based on common clinical difficult airway situations, three types of scenarios were designed: Scenario 1 (predicted difficult airway) simulated airway assessment and equipment preparation before general anesthesia induction in a patient with Mallampati Class IV and a mouth opening of 2 cm; Scenario 2 (unpredicted difficult airway–inability to ventilate) simulated a patient developing an inability to ventilate via face mask after induction, with oxygen saturation dropping to 85%; Scenario 3 (unpredicted difficult airway–inability to intubate) simulated a Cormack-Lehane Class IV laryngeal exposure with multiple failed intubation attempts and heart rate dropping to 50 beats per minute. Forty-two students were divided into seven groups of six, with each group sequentially training on all three scenarios. For each scenario, the process included: a) scenario introduction (5 minutes), during which the instructor presented patient information, initial vital signs, and the current critical situation; b) emergency response (15 minutes), where students discussed and divided tasks (e.g., airway management, vital signs monitoring, recording/assisting) and performed operations on the simulator with real-time vital sign feedback; c) instructor intervention (5 minutes), in which the instructor paused training to correct errors (e.g., delayed cricothyroidotomy) and explained the proper handling methods before students continued; and d) scenario summary (5 minutes), where the instructor reviewed the group’s performance, highlighted strengths and weaknesses, and emphasized key points, such as taking emergency airway measures within three minutes when ventilation is impossible.

(3) Review and summary phase (0.3 weeks, 3 class hours)

Video review was conducted using the recording system in the simulated operating room to replay each group’s scenario training. Teachers guided students in examining operational details and analyzing the

root causes of problems, such as poor exposure from failing to adjust head position during laryngoscope intubation or inadequate communication during team collaboration. Following the review, all students participated in group discussions on topics including priority handling in different difficult airway scenarios and decision-making logic for selecting emergency instruments. Students shared their training experiences, and teachers summarized and highlighted the core principles and standardized procedures for emergency management of difficult airways.

(4) Intensive training phase (0.2 weeks, 2 class hours)

Specialized intensive training is set up to address common issues identified during the review and summary phase (e.g., unskilled fiberoptic bronchoscopy operation, non-standardized emergency procedures). Students can independently choose their weak areas for repeated practice, with teachers providing guidance throughout the process to ensure that each student masters the correct operational methods and emergency response procedures.

2.3. Observation indicators

2.3.1. Training assessment scores

After the training, students from both groups took the assessment simultaneously, with identical assessment content and standards:

(1) Theoretical assessment

This was conducted as a closed-book examination, featuring multiple-choice questions (40 points), short-answer questions (30 points), and case analysis questions (30 points), totaling 100 points, with an assessment duration of 90 minutes;

(2) Practical assessment

Conducted in a high-fidelity simulated operating room, students randomly selected one difficult airway simulation scenario (such as “inability to intubate or ventilate after the patient is under general anesthesia”). Students were required to complete emergency response operations within 20 minutes. The assessment criteria included operational standardization (40 points), timeliness of response (30 points), and operational effectiveness (30 points), totaling 100 points.

2.3.2. Scoring of emergency response capability

The evaluation was conducted using the self-designed “Rating Scale for Emergency Response Capability of Difficult Airway in Anesthesia Nursing Students”. This scale was developed based on the “Guidelines for Difficult Airway Management” and relevant literature ^[5,6]. It encompassed four dimensions: airway assessment (5 items), instrument selection (5 items), operational execution (5 items), and teamwork (5 items), totaling 20 items. Each item was scored from 1 to 5 points (1 point = “completely inconsistent”, 5 points = “completely consistent”), with a total score ranging from 20 to 100 points. A higher score indicated stronger emergency response capability.

2.3.3. Teaching satisfaction

Teaching satisfaction was evaluated using the “Teaching Satisfaction Questionnaire for Anesthesia Nursing Students”. This questionnaire encompasses four dimensions: teaching content (3 items), teaching methods (3 items), instructor guidance (2 items), and learning outcomes (2 items), totaling 10 items. Each item is scored on a scale of 1 to 5 (1 = “very dissatisfied”, 5 = “very satisfied”), with a total possible score ranging from 10 to 50.

Satisfaction levels are categorized into three grades: satisfied (40–50 points), generally satisfied (30–39 points), and dissatisfied (< 30 points). Satisfaction rate is calculated as (number of satisfied cases + number of generally satisfied cases) / total number of cases \times 100%.

2.4. Statistical methods

Data analysis was conducted using SPSS 26.0 statistical software. Continuous data are presented as ($\bar{x} \pm s$), and comparisons between groups were made using independent sample *t*-tests. Categorical data are presented as (n/%), and comparisons between groups were made using the χ^2 test. A *p*-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of training assessment scores between two groups of students

The theoretical assessment scores and practical assessment scores of the observation group were significantly higher than those of the control group, with statistically significant differences ($p < 0.05$). See **Table 2** for details.

Table 2. Comparison of training assessment scores between two groups of anesthesia nursing students ($\bar{x} \pm s$, points)

Assessment type	Control group (n = 42)	Observation group (n = 42)	<i>t</i> -value	<i>p</i> -value
Theoretical score	79.26 \pm 5.78	90.35 \pm 4.82	9.87	< 0.05
Practical score	81.34 \pm 5.21	92.17 \pm 3.96	10.53	< 0.05

3.2. Comparison of emergency response ability scores between two groups of students

The scores for each dimension of emergency response ability and the total score in the observation group were significantly higher than those in the control group, with statistically significant differences ($p < 0.05$). See **Table 3** for details.

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

Assessment type	Control group (n = 42)	Observation group (n = 42)	<i>t</i> -value	<i>p</i> -value
Airway assessment	14.56 \pm 2.37	18.92 \pm 2.05	9.25	< 0.05
Equipment selection	13.89 \pm 2.24	19.15 \pm 1.83	11.02	< 0.05
Operation execution	14.23 \pm 2.41	19.36 \pm 1.78	10.87	< 0.05
Team collaboration	13.98 \pm 2.53	18.73 \pm 2.11	8.96	< 0.05
Total score	56.66 \pm 7.92	76.16 \pm 6.84	11.34	< 0.05

3.3. Comparison of teaching satisfaction between two groups of students

The teaching satisfaction rate in the observation group was 97.62%, significantly higher than the 78.57% in the control group, with statistically significant differences ($p < 0.05$). See **Table 4** for details.

Table 4. Comparison of teaching satisfaction between two groups of anesthesia nursing students (n/%)

Assessment type	Control group (n = 42)	Observation group (n = 42)	χ^2 value	<i>p</i> -value
Satisfied	19 (45.24)	33 (78.57)	7.89	< 0.05
Basically satisfied	14 (33.33)	8 (19.05)		
Dissatisfied	9 (21.43)	1 (2.38)		
Total satisfaction	33 (78.57)	41 (97.62)		

4. Discussion

High-fidelity simulation teaching constructs a “knowledge-action-reflection” learning loop through an integrated model of “theoretical preview-scenario practice”. The micro-lectures in the online preview stage break down complex knowledge into visual content (such as demonstrating the path of fiberoptic bronchoscope intubation through animations), and accompanying quizzes compel students to actively organize knowledge logic. The high-fidelity equipment in the scenario simulation stage provides an “immersive” learning experience, the simulation mannequins can simulate critical situations such as decreased oxygen saturation and sudden drops in heart rate, requiring students to adjust their operations based on real-time vital signs (for example, when oxygen saturation falls below 80%, they must immediately stop attempting intubation and switch to laryngeal mask ventilation). This immediate interaction of “problem-response-feedback” deeply integrates theoretical knowledge with practical operations^[7].

Additionally, repetitive practice targeting weak links during the intensive training phase further consolidated the standardization of operations. For instance, in the observation group, students’ success rate of fiberoptic bronchoscope intubation increased by over 30% compared to the control group, and the operation time was shortened by 2 to 3 minutes, owing to multiple simulation trainings. The results of this study revealed that the observation group scored significantly higher than the control group in both theoretical assessment (90.35 ± 4.82) and operational assessment (92.17 ± 3.96) ($p < 0.05$), indicating that high-fidelity simulation teaching can effectively enhance anesthesia nursing students’ mastery of emergency management knowledge for difficult airways and their proficiency in operational skills. In traditional teaching models, theoretical knowledge is primarily imparted through “one-way indoctrination”, leading students to merely grasp abstract concepts (such as “Cormack-Lehane laryngoscope exposure grading” and “anatomical localization for cricothyrotomy”) at a textual level. Moreover, ordinary simulators lack vital sign feedback, making operational practice more inclined towards “mechanical imitation” and hindering the formation of in-depth knowledge cognition^[8].

Emergency response capability is a critical ability for anesthesia nursing students to cope with clinical emergencies, requiring a combination of rapid assessment, precise decision-making, efficient execution, and teamwork skills^[9]. In this study, the observation group scored significantly higher than the control group in overall emergency response capability (76.16 ± 6.84 vs. 56.66 ± 7.92) ($p < 0.05$), with the most notable improvements observed in the dimensions of instrument selection and teamwork, closely related to the scenario-based and collaborative characteristics of high-fidelity simulation teaching.

The teaching satisfaction in the observation group (97.62%) was significantly higher than that in the control group (78.57%) ($p < 0.05$), which was closely related to the “student-centered” teaching philosophy and diversified teaching forms of high-fidelity simulation teaching. In traditional teaching, students are in a passive learning position, with weak classroom interaction, which is prone to causing learning fatigue. Moreover, the

lack of realism in operational practice makes it difficult to stimulate students' learning enthusiasm ^[10]. High-fidelity simulation teaching enhances students' learning experience in the following ways: Firstly, it gives students autonomy in learning. During the online preview stage, students can adjust their learning progress according to their own pace (for example, repeatedly watching videos on the difficulties of laryngoscope intubation), and during the intensive training stage, they can independently choose weak areas to practice. Secondly, scenario-based training enhances learning fun. The "real vital sign changes" presented by the simulation manikins make students feel the urgency of "clinical combat" and stimulate their learning interest. Thirdly, personalized feedback enhances the sense of learning achievement. During the review and summary, teachers provide one-on-one guidance on each student's operational issues (such as "laryngoscope insertion too deep" and "insufficient inflation of the laryngeal mask"), helping students clarify the direction for improvement and boosting their learning confidence.

This study has the following limitations:

- (1) The sample size is relatively small and drawn from a single teaching hospital, which may limit the generalizability of the findings. Further validation through multi-center, large-sample studies is needed.
- (2) Long-term follow-up (e.g., six months post-training) was not conducted, making it impossible to evaluate the long-term impact of high-fidelity simulation teaching on students' clinical practice abilities. Future research should track students' performance in managing difficult airways after they enter clinical practice (e.g., success rates in handling difficult airways, incidence of complications).
- (3) The study did not analyze differences in ability improvement among students with different educational backgrounds (undergraduate vs. postgraduate) or varying lengths of internships, making it difficult to determine the applicability of the teaching model to students with different foundational levels. Subsequent studies could design teaching plans stratified by students' foundational levels.
- (4) The high cost of high-fidelity simulation equipment may restrict the widespread adoption of this teaching model in primary hospitals. Future efforts should explore "low-cost, high-efficiency" simulation teaching solutions (e.g., simulation training combined with virtual reality technology).

5. Conclusion

In summary, high-fidelity simulation teaching, through its four-stage model of "theoretical preview–scenario simulation training–debriefing and summary–intensive training", effectively enhances the theoretical knowledge, operational skills, and emergency response capabilities of anesthesia nursing students in managing difficult airways, significantly improving teaching satisfaction.

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The authors declare no conflict of interest.

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Effect of Family-Centered Prenatal Education on Anticipatory Fear of Childbirth Among Primigravida Mothers

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Abstract: *Objectives:* Childbirth fear affects 34.2% of Chinese primigravida women, leading to adverse birth outcomes. Family-centered prenatal education (FCPE) may reduce fear through enhanced support systems. *Methods:* This quasi-experimental study examined the effectiveness of FCPE among 120 primigravida women (14–20 weeks' gestation) at Yancheng Third People's Hospital. Participants with elevated Childbirth Fear Questionnaire (CFQ) scores (≥ 81) were assigned to either the experimental group (FCPE + standard care, $n = 60$) or the control group (standard care only, $n = 60$). FCPE consisted of five weekly 2-hour sessions involving pregnant women and family members. *Results:* Both groups showed moderate baseline fear levels (experimental: 85.68 ± 6.30 ; control: 88.57 ± 6.41 , $p = 0.112$). Post-intervention, the experimental group achieved significantly lower fear scores (80.43 ± 8.53 vs. 87.35 ± 6.91 , $p = 0.001$, Cohen's $d = 0.88$). 58.3% of experimental participants transitioned to low fear levels, compared to 16.7% in the control group. Educational level significantly moderated the outcomes within the experimental group ($p = 0.031$). *Conclusion:* FCPE effectively reduces anticipatory childbirth fear with a large effect size, supporting implementation in Chinese prenatal care for improving maternal psychological well-being.

Keywords: Anticipatory childbirth fear; Family-centered prenatal education; Primigravida; Childbirth fear questionnaire; China

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1. Introduction

Pregnancy represents a critical life transition characterized by complex physiological and psychological adaptations. Psychological challenges of pregnancy can manifest in different forms of fear. Psychological challenges can manifest as fear of pregnancy itself or fear of childbirth (tokophobia). This study focused on anticipatory fear of childbirth during 14–20 weeks of gestation.

Childbirth fear typically manifests during the second trimester (13–26 weeks). Global prevalence varies from 6–10% in Western countries to higher rates in Asian contexts ^[1].

Primigravida women face distinct challenges: lack of experiential knowledge, greater uncertainty about coping with labor pain, higher anxiety about complications, lower self-efficacy, and role transition anxiety ^[2]. In China, prenatal education participation is low (29.1%) ^[3]. Cultural factors further influence fear: traditional beliefs, family expectations, preference for male children, and collectivist values amplify anxiety ^[4,5]

Family-centered prenatal education addresses these concerns, prioritizing the family's role throughout prenatal, intrapartum, and postnatal periods. Structured programs improve maternal outcomes and reduce anxiety ^[6]. Most fear-reduction interventions focus on individual counseling or group education ^[7].

Given these gaps, this study aims to evaluate the effectiveness of a structured family-centered prenatal education program in reducing anticipatory childbirth fear among primigravida women at a tertiary hospital in China.

1.1. Research aim

This study examined whether a structured five-week family-centered prenatal education program reduces anticipatory fear of childbirth among primigravida women, compared with standard prenatal care.

1.2. Specific objectives

- (1) To compare pre and post intervention levels of anticipatory fear of childbirth between primigravida women in the experimental and control groups.
- (2) To evaluate within group changes in fear of childbirth before and after intervention
- (3) To examine subgroup differences in post intervention fear scores in the experimental group according to age, educational level, and gestational age at recruitment

1.3. Significance of the study

This study demonstrates that family-centered prenatal education can effectively reduce anticipatory fear of childbirth among primigravida women. The findings provide evidence for nurses to implement targeted psychological support and structured health education during the prenatal period. The results may serve as a reference for improving clinical prenatal care protocols and developing family-involved intervention strategies in maternity nursing. In addition, the study offers a basis for future research exploring fear-reduction interventions and contributes to the growing evidence supporting family-centered care in maternal health.

2. Synthesis

Family-centered prenatal education can reduce maternal anxiety and childbirth fear, but evidence in Chinese healthcare settings is limited. Effectiveness is influenced by maternal age, education, timing of intervention, and cultural context. Most studies focus on the pregnant woman and her partner, with little attention to broader family involvement or integration of digital tools. These gaps highlight the need for culturally adapted, structured interventions that include mandatory family participation, use childbirth-specific outcome measures, and target the second trimester. The present study addresses these gaps through a five-session program, assessing its impact on anticipatory childbirth fear among primigravida women in a Chinese tertiary hospital.

3. Hypothesis

H₀1: There is no statistically significant difference in post-intervention anticipatory fear of childbirth scores among primigravida women in the experimental group based on: a) age groups (22–26, 27–31, 32–35 years); b) educational level (high school, college, post-graduate); and c) gestational age at recruitment (14–16, 17–20 weeks).

H₀2: There is no significant difference in the level of anticipatory fear of childbirth before and after the intervention in the control group.

H₀3: There is no significant difference in the level of anticipatory fear of childbirth between the control and experimental groups before the intervention.

H₀4: There is no significant difference in the level of anticipatory fear of childbirth before and after the intervention in the experimental group.

H₀5: There is no significant difference in the level of anticipatory fear of childbirth between the control and experimental groups after the intervention.

4. Conceptual framework

This study's conceptual framework is grounded in Johnson's (2008) core concepts of family-centered care, theoretically supported by Social Support Theory and Self-Efficacy Theory. These theoretical foundations explain the mechanisms through which family-centered prenatal education reduces anticipatory childbirth fear among primigravida women.

4.1. Johnson's framework for family-centered care

Family-centered care involves healthcare providers partnering with families to achieve safe, high-quality, and satisfying care. Four core concepts underpin this approach 2008^[8].



Figure 1. Core concepts of family-centered care.

- (1) Dignity and respect
Recognize patients' and families' values, beliefs, and cultural backgrounds.
- (2) Information sharing
Provide timely, accurate, and unbiased information to enable informed decision-making.
- (3) Participation model
Support active participation of patients and families in care and decisions.
- (4) Cooperation
Collaborate with families in care planning, policy, and program implementation.

4.2. Theoretical framework

Social Support Theory explains how family-centered care reduces childbirth fear by providing both structural support (availability of family) and functional support (emotional, informational, appraisal, and instrumental) ^[9,10]. Dignity and Respect enhance emotional support; Cooperation strengthens appraisal support, helping families provide constructive feedback.

Self-Efficacy Theory complements this by showing how family-centered education builds maternal confidence through mastery experiences, vicarious learning, verbal persuasion, and emotional reframing ^[11]. Johnson's core concepts operationalize these mechanisms in prenatal education.

Together, these frameworks explain how family-centered prenatal education reduces childbirth fear by enhancing social support and building maternal self-efficacy, addressing the vulnerabilities of primigravida women (limited experience, uncertainty about coping, anxiety about the unknown). The approach is culturally appropriate in Chinese contexts, where family support plays a central role in maternal well-being.

5. Research paradigm

The diagram illustrating the interaction of the variables in this study is presented in **Figure 2** below.

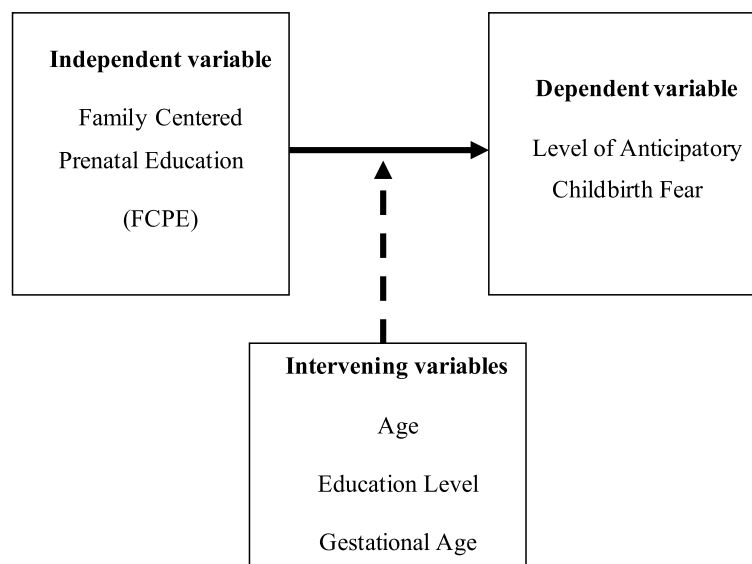


Figure 2. Research diagram on the effect of Family-Centered Prenatal Education on anticipatory fear of childbirth among primigravida.

The research diagram illustrates the relationship between Family-Centered Prenatal Education (FCPE) as the independent variable and Level of Anticipatory Childbirth Fear as the dependent variable. The diagram illustrates how FCPE directly influences the Level of Anticipatory Childbirth Fear, as shown by the solid arrow connecting these two variables. Additionally, the framework identifies three intervening variables (Age, Education Level, and Gestational Age), indicated by a dashed arrow. This paradigm suggests that while FCPE may directly affect the Level of Anticipatory Childbirth Fear, the effectiveness of the intervention could be influenced by these demographic and pregnancy-related factors.

6. Definition of terms

6.1. Fear of childbirth

Anticipatory fear of childbirth refers to anxiety and concern about the birthing process, which may manifest as psychological and physiological responses ^[1,7]. In this study, it is measured using the 40-item Childbirth Fear Questionnaire (CFQ), with scores ranging from 0–160: minimal (0–40), low (41–80), moderate (81–120), and high fear (121–160). A score ≥ 81 indicates elevated fear and serves as an inclusion criterion.

6.2. Family-centered prenatal education

FCPE is a structured educational program promoting maternal and family well-being through infant care, breastfeeding, postpartum support, and coping strategies for pregnancy and childbirth. In this study, it consists of a five-week program with weekly 2-hour group sessions, requiring participation of the pregnant woman and at least one family member, addressing stage-specific fear components.

6.3. Primigravida mother

A primigravida mother is a woman experiencing her first pregnancy with no history of prior pregnancies (miscarriage, ectopic pregnancy, or abortion). Participants in this study were 22–35 years old, carrying a single viable fetus, at 14–20 weeks gestation, and without diagnosed pregnancy complications.

6.4. Standard prenatal care (control group)

Standard prenatal care includes routine medical visits with physical exams, laboratory tests, ultrasounds, and health guidance on nutrition, lifestyle, and delivery preparation, without participation in the structured FCPE program.

7. Research methodology

This chapter covers the research design, demographics and sampling, research location, instrument, data collection process, statistical analysis of the data, and ethical considerations.

7.1. Research design

This study employed a non-equivalent quasi-experimental pretest-posttest control group design, appropriate when randomization is not feasible in clinical settings ^[12]. This design has been successfully implemented in similar prenatal education studies in Asian contexts ^[13].

Participants were primigravida women aged 22–35 years, at 14–20 weeks' gestation, carrying singleton

pregnancies. Those with pregnancy complications or psychiatric disorders were excluded to prevent confounding. Baseline equivalence testing and demographic matching ensured comparability between the experimental and control groups.

The experimental group received a five-week Family-Centered Prenatal Education (FCPE) program in addition to standard prenatal care, while the control group received standard care only. Both groups completed pretest and posttest assessments using the Childbirth Fear Questionnaire (CFQ) at baseline (T1) and post-intervention (T2, 21–26 weeks' gestation).

FCPE consisted of five weekly 2-hour sessions incorporating fear-specific content, interactive skill-building exercises, structured family involvement, and multiple teaching modalities, grounded in Johnson's (2008) core concepts of family-centered care. Standard care included routine prenatal education and medical monitoring. The key difference was that FCPE explicitly targeted psychological preparation and fear reduction, whereas standard care emphasized physical health and medical management.

7.2. Population and sampling

The study population comprised primigravida women attending prenatal outpatient clinics at Yancheng Third People's Hospital, Jiangsu Province, China. A priori power analysis using G*Power 3.1 indicated a minimum sample size of 50 participants per group (total $n = 100$) based on a moderate effect size ($d = 0.4$), $\alpha = 0.05$, and power = 0.80. Ultimately, 60 participants per group were recruited using purposive sampling.

Eligible participants met the following inclusion criteria: first-time mothers aged 20–35 years, 14–20 weeks gestation, carrying a single healthy pregnancy, literate in Chinese, and demonstrating elevated childbirth fear (CFQ ≥ 81). Exclusion criteria included multiparity, pregnancy complications, severe medical or psychiatric conditions, and inability to participate fully in the study.

Participants were screened through medical record review and baseline CFQ assessment. Eligible respondents were alternately assigned to the experimental or control group. For the experimental group, family member availability was confirmed prior to enrollment to ensure participation in the family-centered prenatal education sessions.

7.3. Research locale

The study was conducted at Yancheng Third People's Hospital, a 1600-bed tertiary care facility in Jiangsu Province, China. This setting was selected due to its high volume of prenatal cases (approximately 1,000 primiparas per month) and well-equipped facilities for educational interventions.

7.4. Research instrument

Two instruments were used: a demographic questionnaire and the Childbirth Fear Questionnaire (CFQ). The demographic questionnaire collected basic information, including age, education, and relevant socioeconomic factors.

The CFQ is a 40-item self-report instrument scored on a 5-point Likert scale (0 = not at all fearful, 4 = extremely fearful), with total scores ranging from 0 to 160. This study targeted women with moderate to high fear (CFQ ≥ 81). The Chinese version demonstrated good reliability (Cronbach's $\alpha = 0.845$).

Translation followed standard forward-back translation procedures, with review by a translation expert to ensure semantic and conceptual equivalence. Reliability testing was conducted in a sample of 182 primigravida

women from the same hospital using the same inclusion criteria. Standardized data collection protocols were followed throughout the study.

7.5. Data gathering timeline

The selection of specific gestational age windows for recruitment, intervention, and assessment was based on extensive research regarding the optimal timing for prenatal interventions and the development of fear trajectories during pregnancy.

(1) Recruitment window (14–20 weeks of gestation):

Participants were recruited between 14 and 20 weeks of gestation.

(2) Intervention period (15–20 weeks for a 5-week program):

The intervention was delivered during weeks 15–20 of gestation to ensure completion before 21 weeks.

(3) Post-Intervention Assessment Window (21–26 weeks of gestation):

The post-intervention assessment occurred at 21–26 weeks, 5–6 weeks after baseline. Both groups experienced identical gestational age progression.

7.6. Data collection process

7.6.1. Phase 1: Preparatory phase

The preparatory phase commenced with securing the necessary approvals and establishing the study foundations. This study received ethical approval from the Far Eastern University Ethics Review Committee (FEU-ERC) (Approval Number: REB-2025-98, dated March 5, 2025) and from the Research Ethics Committee of Yancheng Third People's Hospital (dated May 1, 2025). All procedures were conducted in accordance with the ethical standards and regulations governing healthcare research. Written informed consent was obtained from all participants before the commencement of any study procedures.

A crucial component of the preparatory phase involved translating and validating the Childbirth Fear Questionnaire (CFQ). The validation process followed these steps. First, the translation phase involved forward translation from English to Chinese by a professional translator, followed by back-translation to English by a different professional translator who had not seen the original version. A translation expert then reviewed the translations to assess semantic, idiomatic, and conceptual equivalence between versions and resolve any discrepancies. Following translation, the reliability testing phase was conducted with 182 primigravida women recruited from the same hospital setting, using the same inclusion/exclusion criteria as the main study.

Two types of reliability were assessed: internal consistency reliability, where Cronbach's alpha will be calculated from the first administration of the translated CFQ to determine how well the items measure the same underlying construct; and test-retest reliability, the main study commenced only after establishing satisfactory reliability coefficients (Cronbach's $\alpha \geq 0.70$ and test-retest correlation ≥ 0.70).

7.6.2. Phase 2: Initial medical record screening

Initial screening commenced with a review of medical records at Yancheng Third People's Hospital. The researcher identified potentially eligible respondents based on fundamental criteria (primigravida status, age between 20 and 35 years, gestational age between 14 and 20 weeks, single healthy pregnancy status, Chinese literacy, and absence of severe medical or psychiatric conditions).

The process of accessing medical records followed hospital privacy regulations, and only minimum necessary

information was collected for eligibility.

7.6.3. Phase 3: Informed consent

Women meeting these initial eligibility requirements were approached during their scheduled prenatal visits to discuss participation in the study.

The process of accessing medical records followed hospital privacy regulations, and only minimum necessary information was collected for eligibility.

7.6.4. Phase 4: Baseline assessment and final eligibility determination

Respondents completed demographic information and CFQ in a private setting. This CFQ served to determine eligibility and provide baseline data.

7.6.5. Phase 5: Group assignment

Respondents with elevated CFQ scores (≥ 81) were alternately assigned to control or intervention groups. Additional screening verified family member availability for the intervention. Contact information was collected follow-up.

7.6.6. Phase 6: Intervention implementation

The intervention phase employed a parallel-group design, with all respondents recruited between 14 and 20 weeks of gestation. Control group: Received standard prenatal care per existing hospital protocols. Experimental group: The five-week FCPE was delivered by trained obstetric nurses. Treatment fidelity was maintained through a standardized curriculum, checklist, and separate assessors. Scheduling was consistent across five sessions.

7.6.7. Phase 7: Post-intervention assessment

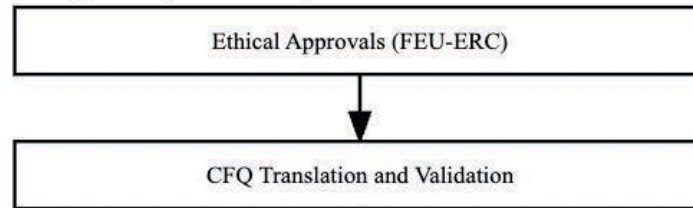
The post-intervention assessment was conducted at 21–26 weeks of gestation. Both groups completed the CFQ, and data were matched using unique identifiers.

7.6.8. Phase 8: Data processing and analysis

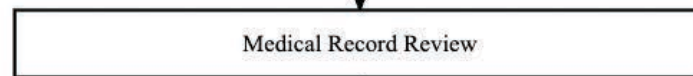
All collected data underwent analysis using SPSS V26.

7.7. Research flow

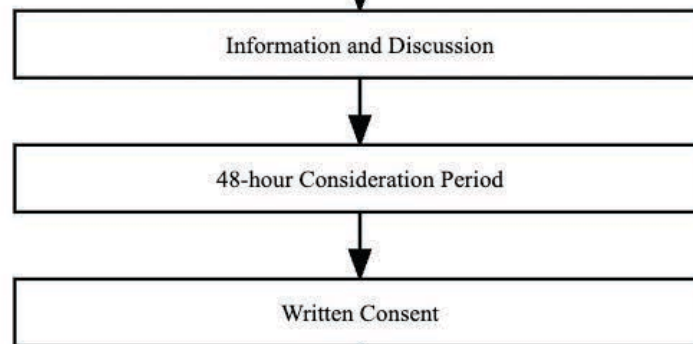
Phase 1: Preparatory or Pre-Implementation



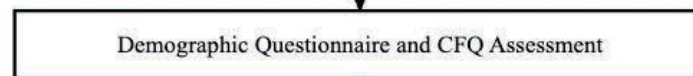
Phase 2: Initial Medical Record Screening



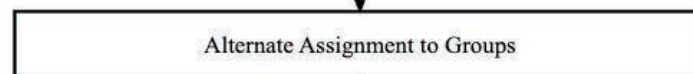
Phase 3: Informed Consent



Phase 4: Baseline Assessment



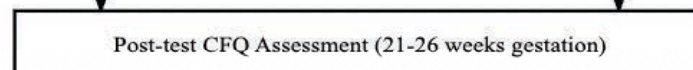
Phase 5: Group Assignment



Phase 6: Intervention Implementation



Phase 7: Post-intervention Assessment



Phase 8: Data Processing and Analysis

Figure 3. Data collection process.

7.8. Statistical analysis

The questionnaire data collected in this study were entered into IBM SPSS Statistics version 26 for data creation and statistical analysis. Descriptive statistical analysis was used to answer research questions one and two. Inferential Statistical analysis was applied to answer research questions three and four. *p*-values less than 0.05 determined statistical significance.

7.8.1. Descriptive statistics

Demographic and baseline characteristics were summarized using appropriate descriptive statistics. For continuous variables (such as age and gestational age), Categorical variables (such as education level) were presented as frequencies and percentages.

7.8.2. Inferential statistics

Independent sample *t*-tests and one-way ANOVAs were used to analyze the differences in socio-demographic characteristics and childbirth fear levels among primiparas.

7.9. Ethical consideration

This study adhered strictly to ethical guidelines for research involving human subjects. The study protocol was approved by the Far Eastern University Ethics Review Committee (Approval No.: FEU-ERC-2025-98) and the Research Ethics Committee of Yancheng Third People's Hospital. Written informed consent was obtained from all participants prior to enrollment.

8. Presentation, analysis, and interpretation of data

A total of 120 primigravida women were recruited from the outpatient clinics of Yancheng Third People's Hospital between May and July 2025. Sixty respondents were assigned to the experimental group and sixty to the control group. All respondents met the inclusion criteria, including elevated fear of childbirth scores (≥ 81 on the Childbirth Fear Questionnaire). There was a 100% retention rate, with all participants completing the post-intervention assessment.

8.1. Research question 1

What are the demographic characteristics of participants in the experimental group, specifically in terms of: a) Age; b) Education level; and c) Gestational age?

The demographic characteristics of the study participants are presented in **Table 1**, revealing a well-balanced distribution across both groups.

8.2. Research question 2

What are the levels of anticipatory fear of childbirth among primigravida women before and after the intervention in the control group? At baseline, all 60 participants (100%) in the control group exhibited moderate levels of anticipatory fear (scores 81–120). The mean CFQ score at pre-intervention was 88.57 (SD = 6.41, 95% CI: 86.9–90.2). Post-intervention, 10 participants (16.7%) moved to low-fear category, 50 participants (83.3%) remained in moderate-fear. The mean CFQ score decreased slightly to 87.35 (SD = 6.30, 95% CI: 84.1–87.3) (refer **Table 2**).

Table 1. Baseline demographic characteristics of study participants

Characteristic	Control group (n = 60)	Experimental group (n = 60)	Total (N = 120)
Age (years)			
Mean \pm SD	28.8 \pm 3.2	28.1 \pm 3.4	28.4 \pm 3.3
22–26 years	13 (21.7%)	21 (35.0%)	34 (28.3%)
27–31 years	24 (40.0%)	27 (45.0%)	51 (42.5%)
32–35 years	23 (38.3%)	12 (20.0%)	35 (29.2%)
Education level			
High school or below	16 (26.7%)	13 (21.7%)	29 (24.2%)
College/university	33 (55.0%)	38 (63.3%)	71 (59.2%)
Graduate degree	11 (18.3%)	9 (15.0%)	20 (16.7%)
Gestational age			
Mean \pm SD	17.1 \pm 1.7	17.3 \pm 1.8	17.2 \pm 1.8
14–16 weeks	19 (31.7%)	16 (26.7%)	35 (29.2%)
17–20 weeks	41 (68.3%)	44 (73.3%)	85 (70.8%)

Table 2. Pre-intervention and post-intervention childbirth fear questionnaire (CFQ) scores in the control group

Scores interval	Level of fear	Pre-intervention		Post-intervention	
		Frequency	Percentage	Frequency	Percentage
0–40	Minimal	0	0	0	0
41–80	Low	0	0	10	16.7
81–120	Moderate	60	100	50	83.3
121–160	High fear	0	0	0	0
Mean (SD)		88.57 (6.41) (95% CI: 86.9–90.2)		87.35 (6.30) (95% CI: 84.1–87.3)	

8.3. Research question 3

What are the levels of anticipatory fear of childbirth among primigravida women before and after the intervention in the experimental group? Pre-intervention mean CFQ = 85.68 (SD 6.30, 95% CI 85.6–89.1), 100% moderate fear. Post-intervention mean CFQ = 80.43 (SD 8.53, 95% CI 78.2–82.6). 35 participants (58.3%) reached low-fear, 25 (41.7%) remained moderate-fear, 0 high-fear (refer **Table 3**).

8.4. Research question 4

What are the levels of anticipatory fear of childbirth among primigravida women in the control and experimental groups before the intervention? Control mean CFQ = 88.57 \pm 6.41; Experimental mean CFQ = 85.68 \pm 6.30; Both groups 100% moderate fear (refer **Table 4**).

Table 3. Pre-intervention and post-intervention childbirth fear questionnaire (CFQ) scores in the experimental group

Scores interval	Level of fear	Pre-intervention		Post-intervention	
		Frequency	Percentage	Frequency	Percentage
0–40	Minimal	0	0	0	0
41–80	Low	0	0	35	58.3
81–120	Moderate	60	100	25	41.7
121–160	High fear	0	0	0	0
Mean (SD)		85.68 (6.30) (95% CI: 85.6–89.1)		80.43 (8.53) (95% CI: 78.2–82.6)	

Table 4. Pre-Intervention childbirth fear questionnaire (CFQ) scores by group

Scores Interval	Level of fear	Control group		Experimental group	
		Frequency	Percentage	Frequency	Percentage
0–40	Minimal	0	0	0	0
41–80	Low	0	0	0	0
81–120	Moderate	60	100	60	100
121–160	High fear	0	0	0	0
Mean (SD)		88.57 (6.41) (95% CI: 86.9–90.2)		85.68 (6.30) (95% CI: 85.6–89.1)	

8.5. Research Question 5

What are the levels of anticipatory fear of childbirth among primigravida women in the control and experimental groups after the intervention? Post-intervention, the experimental group showed a substantial reduction in childbirth fear (mean 80.43 ± 8.53), with 58.3% achieving low fear levels, whereas the control group remained largely in the moderate range (mean 87.35 ± 6.30). These results indicate the effectiveness of the Family-Centered Prenatal Education (FCPE) program in reducing anticipatory fear (refer **Table 5**).

Table 5. Post-intervention childbirth fear questionnaire (CFQ) scores by group

Score interval	Level of fear	Control group		Experimental group	
		Frequency	Percentage	Frequency	Percentage
0–40	Minimal	0	0	0	0
41–80	Low	10	16.7	35	58.3
81–120	Moderate	50	83.3	25	41.7
121–160	High Fear	0	0	0	0
Mean (SD)		87.35 (6.30) (95% CI: 84.1–87.3)		80.43 (8.53) (95% CI: 78.2–82.6)	

8.6. Research question 6

Among primigravida women in the experimental group, is there a statistically significant difference in post-intervention anticipatory fear of childbirth scores based on: a) Age (22–26, 27–31, 32–35 years); b) Educational level (high school, college, post-graduate); c) Gestational age at recruitment (14–16, 17–20 weeks) (refer **Table 6**).

Table 6. Influence of demographic factors on post-intervention childbirth fear questionnaire (CFQ) scores in the experimental group

Profile	n	Mean	Computed value	p-value
Age				
22–26 years old	21	81.19	Kruskal-Wallis H= 1.146	0.564
27–31 years old	27	81.00		
32–35 years old	12	77.83		
Educational level				
High School	13	85.46	Kruskal-Wallis H = 6.964	0.031
College	38	79.95		
Post-graduate	9	75.22		
Gestational age				
14–16 weeks	16	80.70	Mann-Whitney U = 320	0.592
17–20 weeks	44	80.43		

8.7. Research question 7

Is there a significant difference in the level of anticipatory fear of childbirth before and after the intervention in the control group? (see **Table 7**)

Table 7. Post hoc analysis of educational level differences in post-intervention childbirth fear questionnaire (CFQ) scores

Variables	Mean difference	p-value	Interpretation
High School vs College	5.514	0.113	Not Significant
High School vs Post-graduate	10.239	0.018	Significant
College vs Post-graduate	4.725	0.294	Not Significant

Age and gestational age showed no significant effect on post-intervention CFQ scores. Educational level significantly influenced outcomes: participants with high school education had higher post-intervention fear scores than those with postgraduate education ($p = 0.018$).

8.8. Research question 8

Is there a significant difference in the level of anticipatory fear of childbirth among primigravida women between the control and experimental group before the intervention? The mean CFQ score in the control group decreased slightly from 88.57 to 87.38. Although statistically significant ($p = 0.001$), the reduction was minimal, indicating

that standard prenatal care alone has limited impact on reducing anticipatory fear among primigravida women (see **Table 8**).

Table 8. Comparison of pre-intervention and post-intervention childbirth fear questionnaire (CFQ) scores in the control group

Control group	Mean	Computed Wilcoxon signed rank test	<i>p</i> -value
Before intervention	88.57	-6.203	0.001
After intervention	87.38		

8.9. Research question 9

Is there a significant difference in the level of anticipatory fear of childbirth before and after the intervention in the experimental group? No statistically significant difference was found between groups at baseline ($p = 0.112$), confirming comparability in initial fear levels before the intervention (see **Table 9**).

Table 9. Comparison of pre-intervention childbirth fear questionnaire (CFQ) scores between groups

Group	Mean	Computed Mann Whitney test value (U)	<i>p</i> -value
Control group	88.57	1498.00	0.112
Experimental group	85.68		

8.10. Research question 10

Is there a significant difference in the level of anticipatory fear of childbirth among primigravida women between the control and experimental group after the intervention? The mean CFQ score decreased significantly from 85.68 to 80.43 ($p = 0.001$), demonstrating that the family-centered prenatal education intervention effectively reduced anticipatory fear of childbirth. This reduction was substantially greater than that observed in the control group, highlighting the intervention's effectiveness.

Post-intervention, the experimental group demonstrated a mean CFQ score of 80.43, compared to 87.35 in the control group. Statistical analysis showed a significant between-group difference ($U = 1007.50$, $p = 0.001$), with a medium-to-large effect size (Cohen's $d = 0.88$), indicating that the family-centered prenatal education intervention substantially reduced anticipatory fear of childbirth. The control group showed minimal change (1.22-point reduction), confirming that standard prenatal care alone is insufficient for addressing elevated childbirth fear. These results highlight the clinical and practical significance of structured family-centered interventions in reducing childbirth anxiety among primigravida women (see **Table 10** and **11**).

Table 10. Comparison of pre-intervention and post-intervention childbirth fear questionnaire (CFQ) scores in the experimental group

Experimental group	Mean	Computed Wilcoxon signed rank test	<i>p</i> -value
Before intervention	85.68	-6.634	0.001
After intervention	80.43		

Table 11. Comparison of post-intervention childbirth fear questionnaire (CFQ) scores between groups

Group	Mean	Cohen's d	Computed Mann Whitney test value	<i>p</i> -value
Control group	87.35	0.88	1007.50	0.001
Experimental group	80.43			

9. Summary of findings

This quasi-experimental study examined the effect of family-centered prenatal education on anticipatory fear of childbirth among 120 primigravida women at Yancheng Third People's Hospital between May and July 2025. Sixty participants were assigned to the experimental group and sixty to the control group.

9.1. Participant characteristics

(1) Age

Predominantly late twenties to early thirties.

(2) Education

Majority college/university, smaller proportions high school or postgraduate.

(3) Gestational age at recruitment

Mostly later second trimester; groups were comparable in demographics.

9.2. Baseline fear levels

All participants had moderate levels of anticipatory childbirth fear ($CFQ \geq 81$). No significant difference between groups at baseline (Control: $M = 88.57$, Experimental: $M = 85.68$).

9.3. Control group fear levels over time

Minimal reduction in fear after standard care (post-intervention $M = 87.35$). Most participants remained in the moderate fear category.

9.4. Experimental group fear levels over time

Significant reduction in fear after FCPE (post-intervention $M = 80.43$). Over half of participants achieved low fear levels; remaining participants showed reduced scores within the moderate range.

Between-group post-intervention difference was significant with a large effect size (Cohen's $d = 0.88$).

9.5. Moderating factors

Age and gestational age at recruitment had no significant effect on outcomes. Educational level significantly influenced post-intervention fear: higher education corresponded to greater reduction, particularly between high school and postgraduate participants.

9.6. Within-group changes

Both groups showed statistically significant reductions from baseline to post-intervention ($p < 0.001$), but the magnitude of change was much greater in the experimental group.

10. Conclusion

Family-centered prenatal education effectively reduces anticipatory childbirth fear among primigravida women. Standard prenatal care alone produces only minimal reductions in fear. Higher educational attainment enhances the effectiveness of FCPE, whereas age and gestational age at recruitment do not significantly affect outcomes. FCPE demonstrates both statistical and clinical significance, supporting its use as a structured, family-inclusive intervention in prenatal care.

11. Recommendations

11.1. For nursing practice

Implement FCPE programs to reduce childbirth fear and enhance maternal confidence. Engage family members actively in prenatal education to strengthen support systems.

11.2. For nursing education

Integrate family-centered approaches and psychological preparation strategies into nursing curricula.

Train nurses to recognize and address anticipatory childbirth fear in primigravida women.

11.3. For nursing research

Explore tailored interventions for women with lower educational attainment to ensure equitable outcomes. Investigate long-term effects of FCPE on birth outcomes and postpartum mental health.

11.4. For policy development

Support the integration of family-centered prenatal education into standard prenatal care protocols.

Allocate resources to provide structured, evidence-based prenatal programs in hospitals and community clinics.

Disclosure statement

The authors declare no conflict of interest.

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Pathogenesis of Hyaline Membrane Disease in Newborns and Advances in Non-invasive Ventilation Therapy

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Abstract: Hyaline Membrane Disease (HMD) in newborns, also known as neonatal respiratory distress syndrome, is a common critical illness in premature infants, with an incidence inversely correlated with gestational age, posing a serious threat to the life and health of newborns. This paper systematically reviews the core pathogenesis of HMD, focusing on the abnormal metabolism of pulmonary surfactant (PS), genetic factors, immature lung development, and the synergistic effects of inflammatory oxidative stress. It highlights the advances in non-invasive ventilation (NIV) therapy for HMD, including the mechanisms of action, clinical application effects, and optimization strategies of mainstream modalities such as nasal continuous positive airway pressure ventilation (NCPAP), nasal intermittent positive pressure ventilation (NIPPV), and heated humidified high-flow nasal cannula ventilation (HHHFNC). The aim is to provide references for standardized clinical treatment.

Keywords: Hyaline membrane disease in newborns; Pathogenesis; Pulmonary surfactant; Non-invasive ventilation; Therapeutic advances

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1. Introduction

Hyaline Membrane Disease (HMD) in newborns is an acute respiratory failure caused by a deficiency or dysfunction of Pulmonary Surfactant (PS), presenting primarily with progressive dyspnea, cyanosis, and respiratory failure shortly after birth^[1]. Pathologically, it is characterized by the attachment of eosinophilic hyaline membranes to the alveolar walls and the walls of terminal bronchioles^[2]. With the advancement of perinatal medicine, the survival rate of premature infants has significantly improved, yet HMD remains one of the leading causes of mortality among premature infants, particularly those with extremely low birth weights and gestational ages less than 32 weeks^[3]. Traditional treatment primarily relies on invasive mechanical ventilation, which is prone to complications such as ventilator-associated pneumonia and bronchopulmonary

dysplasia. In recent years, Non-invasive Ventilation (NIV) technology has emerged as a core treatment for HMD due to its advantages of minimal trauma and fewer complications, with its application scope and treatment strategies continuously being optimized ^[4]. Meanwhile, in-depth research into the pathogenesis of HMD has provided new targets for clinical intervention.

2. Pathogenesis

The onset of HMD is not the result of a single factor but rather a complex pathological process involving the interplay and synergistic effects of multiple factors, including abnormal PS metabolism, genetic regulation, immature lung development, and inflammatory oxidative stress. These mechanisms collectively exacerbate pulmonary dysfunction, ultimately leading to respiratory failure.

2.1. Abnormal PS metabolism

PS is a crucial substance for maintaining pulmonary ventilation function. It is synthesized, stored, and secreted by alveolar type II epithelial cells, with its main components being phospholipids and surfactant proteins ^[5]. Its core function is to reduce alveolar surface tension, prevent alveolar collapse at the end of expiration, and maintain alveolar stability, while also participating in processes such as lung defense and inflammation regulation. The core pathogenic mechanism of HMD is PS deficiency or dysfunction, with premature birth being the primary cause of insufficient PS synthesis.

At 18–20 weeks of gestational age, fetal alveolar type II epithelial cells begin to synthesize PS. However, it is not until 35–36 weeks of gestational age that the synthesis amount and activity of PS reach the levels of full-term infants ^[6]. The alveolar type II epithelial cells in premature infants are immature in development, with low activity of PS synthesis enzymes, leading to an imbalance in the proportion of phospholipid components and insufficient expression of surfactant proteins, particularly the lack of SP-B and SP-C, which directly affects the surface activity and distribution stability of PS ^[7]. In addition, pathological conditions such as perinatal asphyxia, acidosis, and hypoxemia can inhibit the secretion of pulmonary surfactant (PS) by alveolar type II epithelial cells, while activating the inflammatory response, leading to increased degradation of PS and further exacerbating PS deficiency. Feng Chiguang found that PS dysfunction is closely related to oxidative stress ^[8]. Reactive oxygen species can damage the phospholipid structure and surfactant proteins of PS, reducing its ability to reduce surface tension, and forming a vicious cycle of “PS deficiency - lung injury - oxidative stress - further impairment of PS function”.

2.2. Regulatory role of genetic factors

Genetic factors play a significant role in the onset of Hyaline Membrane Disease (HMD). Multiple studies have confirmed that variations in surfactant-related genes are closely associated with susceptibility to HMD ^[9]. Mutations in the SP-B gene (SFTPB) are important genetic factors contributing to severe HMD. For instance, deletion of exon 4 in the SFTPB gene can result in a complete lack of SP-B synthesis, leading to severe respiratory failure in newborns within hours of birth, with a very high mortality rate. Mutations in the SP-C gene (SFTPC) can cause structural abnormalities in SP-C, affecting the assembly and function of PS, increasing the risk of HMD in premature infants, and potentially being associated with the subsequent development of bronchopulmonary dysplasia ^[10]. In addition, the ATP-binding cassette transporter encoded by the ABCA3 gene

is involved in the processing and secretion of pulmonary surfactant (PS) within alveolar type II epithelial cells, and mutations in this gene can lead to abnormalities in the formation of PS storage vesicles, thereby triggering Hyaline Membrane Disease (HMD). In addition to genes related to surfactant, variations in genes associated with fetal lung development may also increase the risk of HMD by affecting lung tissue differentiation ^[11].

2.3. Immature lung development and inflammatory oxidative stress

The immature development of lung tissue in premature infants is not only characterized by a low number of alveoli and small alveolar cavities, but also by issues such as delayed pulmonary vascular development and proliferation of pulmonary interstitium. These factors contribute to impaired pulmonary ventilation and gas exchange, serving as an important anatomical basis for the occurrence of HMD. Meanwhile, various factors during the perinatal period can trigger inflammatory responses in lung tissue, further exacerbating lung injury. For example, intrauterine infections (such as chorioamnionitis) can activate the fetal immune system, leading to infiltration of neutrophils and macrophages into lung tissue, releasing inflammatory cytokines such as tumor necrosis factor-alpha (TNF- α) and interleukin-6 (IL-6), damaging alveolar type II epithelial cells, and inhibiting PS synthesis; stimuli such as postnatal infections and mechanical ventilation can intensify the inflammatory response, forming a pathological process of “inflammation-lung injury-respiratory failure” ^[12]. Oxidative stress is another key mechanism in the pathogenesis of HMD. The antioxidant system in premature infants is not fully developed, with low activity of antioxidant enzymes such as superoxide dismutase and glutathione peroxidase. Perinatal exposure to hypoxia, hyperoxia, and inflammatory responses can lead to the massive generation of reactive oxygen species (ROS), triggering oxidative stress injury ^[13]. ROS can disrupt the cell membrane structures of alveolar epithelial cells and vascular endothelial cells, leading to cell apoptosis. At the same time, they can damage the phospholipid and protein components of pulmonary surfactant (PS), reducing its function. ROS can also activate signaling pathways such as nuclear factor-kappa B (NF- κ B), exacerbating inflammatory responses and further deteriorating lung function.

3. Advances in treatment

Non-invasive ventilation (NIV) refers to a ventilation mode that provides respiratory support to newborns through nasal masks or face masks without establishing an artificial airway. Its core advantage lies in avoiding complications associated with invasive ventilation, such as airway injury and infection, thereby protecting lung function. In recent years, the application of NIV technology in the treatment of hyaline membrane disease (HMD) has become increasingly widespread, forming a treatment system based on nasal continuous positive airway pressure (NCPAP) and complemented by modes such as nasal intermittent positive pressure ventilation (NIPPV) and heated humidified high-flow nasal cannula (HHHFNC).

3.1. Nasal continuous positive airway pressure (NCPAP)

3.1.1. Mechanism of action and clinical application

NCPAP serves as the first-line modality for non-invasive ventilation therapy in HMD. By continuously delivering positive pressure to the airways, it maintains alveolar patency at the end of expiration, prevents alveolar collapse, improves the ventilation/perfusion ratio in the lungs, reduces intrapulmonary shunting, thereby enhancing blood oxygen saturation and reducing respiratory work ^[14]. Concurrently, NCPAP can reduce

the consumption of pulmonary surfactant (PS), buying time for alveolar type II epithelial cells to synthesize PS. Multiple randomized controlled trials (RCTs) have confirmed that for neonates with mild to moderate HMD, early application of NCPAP can significantly reduce the rate of endotracheal intubation, shorten the duration of mechanical ventilation, and decrease the incidence of bronchopulmonary dysplasia (BPD) and ventilator-associated pneumonia. For instance, an analysis incorporating 47 RCT studies revealed that compared to pulmonary surfactant therapy, NCPAP can significantly improve blood gas parameters and enhance clinical outcomes in neonates with HMD ^[15].

3.1.2. Optimization strategies

The therapeutic efficacy of NCPAP is closely related to pressure settings and interface selection. Currently, the clinically recommended initial pressure ranges from 5 to 8 cm H₂O, which should be dynamically adjusted based on the neonate's respiratory status and blood oxygen saturation to avoid complications such as pneumothorax and circulatory depression caused by excessive pressure, or the inability to maintain alveolar patency due to insufficient pressure. Regarding interface selection, nasal masks and nasal prongs are commonly used types. Nasal masks offer superior sealing and are suitable for neonates with rapid breathing or significant nasal congestion; nasal prongs have minimal impact on oral care and are more appropriate for neonates requiring oral feeding. In recent years, the research and development of new types of interfaces (such as bilateral nasal prongs and integrated nasal masks) have further enhanced wearing comfort and ventilation effectiveness. In addition, the combined use of pulmonary surfactant (PS) replacement therapy represents a significant optimization direction for nasal continuous positive airway pressure (NCPAP) treatment. For neonates with moderate to severe hyaline membrane disease (HMD), early intratracheal administration of PS under NCPAP support can rapidly improve lung function, increase the success rate of non-invasive ventilation (NIV), and reduce the need for intubation ^[16].

3.2. Nasal intermittent positive pressure ventilation (NIPPV)

3.2.1. Mechanism of action and clinical application

Building upon NCPAP, NIPPV cyclically delivers inspiratory positive pressure higher than the baseline pressure, simulating the assisted ventilation mode of invasive mechanical ventilation. It provides stronger respiratory support, helping neonates overcome airway resistance, increase tidal volume, and improve ventilation efficiency ^[17]. Compared to NCPAP, NIPPV is more suitable for neonates with moderate to severe HMD or cases where NCPAP treatment has failed. Studies have shown that NIPPV can significantly reduce the intubation rate and mortality rate in neonates with severe HMD, particularly in extremely preterm infants with a gestational age of less than 28 weeks, where NIPPV better maintains respiratory stability and reduces the occurrence of apnea.

3.2.2. Technological advancements

Traditional Non-Invasive Positive Pressure Ventilation (NIPPV) suffers from poor synchronicity, which can easily lead to patient-ventilator asynchrony. In recent years, the development of synchronous triggering technologies has significantly improved the therapeutic efficacy of NIPPV, such as flow triggering, pressure triggering, and diaphragmatic electrical activity (EAdi) triggering. These technologies can precisely provide inspiratory positive pressure in accordance with the spontaneous breathing rhythm of newborns, thereby

reducing patient-ventilator asynchrony^[18]. Additionally, Bilevel Positive Airway Pressure (BiPAP), as a special form of NIPPV, provides respiratory support while preserving the spontaneous breathing function of newborns by setting a higher inspiratory positive airway pressure (IPAP) and a lower expiratory positive airway pressure (EPAP). It is suitable for newborns with Hyaline Membrane Disease (HMD) who have severe respiratory failure but still retain some degree of spontaneous breathing.

3.3. Heated humidified high-flow nasal cannula (HHHFNC)

3.3.1. Mechanism of action and clinical application

HHHFNC delivers heated (37 °C) and humidified (relative humidity 100%) high-flow gas to newborns through nasal cannulas. Its mechanisms of action include establishing positive airway pressure to maintain alveolar patency, flushing out the nasal dead space to improve ventilation efficiency, enhancing oxygenation and carbon dioxide elimination, and reducing respiratory mucosal injury. HHHFNC offers the advantages of comfort and ease of use, making it suitable for initial treatment of mild HMD in newborns or as a sequential ventilation mode following NCPAP/NIPPV therapy. Research has shown that for newborns with mild HMD, there is no significant difference in the success rate of treatment between HHHFNC and NCPAP. However, HHHFNC offers better tolerance and reduces complications such as facial pressure ulcers and nasal injuries^[19].

3.3.2. Application controversies and optimization

Currently, there is some controversy regarding the application of HHHFNC in the treatment of HMD, with the core focus being whether its ventilatory support intensity can meet the needs of moderate to severe HMD. Some studies suggest that the positive airway pressure provided by HHHFNC is unstable and significantly influenced by factors such as the newborn's respiratory rate and tidal volume. For newborns with severe respiratory failure due to HMD, HHHFNC may delay treatment and increase the risk of intubation^[20]. Therefore, strict indications should be followed in clinical practice. For newborns with moderate to severe HMD, NCPAP or NIPPV is recommended as the priority choice; for newborns treated with HHHFNC, close monitoring of respiratory status and blood oxygen saturation is necessary, and timely adjustment of the ventilation mode should be made if the condition worsens.

4. Conclusion

The pathogenesis of HMD is complex, involving multiple aspects such as abnormal PS metabolism, genetic factors, immature lung development, and inflammatory oxidative stress. These mechanisms interact with each other, collectively leading to pulmonary dysfunction. As a core treatment for HMD, NIV has established a treatment system based on NCPAP, complemented by modes such as NIPPV and HHHFNC. Combined with measures such as PS replacement therapy and lung protection strategies, it can significantly improve the prognosis of newborns with HMD and reduce complications associated with invasive ventilation. In the future, with the in-depth research on the pathogenesis and the innovation of non-invasive ventilation technology, individualized and precise treatment will become the development trend for the treatment of Hyaline Membrane Disease (HMD), providing stronger guarantees for the life and health of premature infants.

Disclosure statement

The authors declare no conflict of interest.

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A Study on the Effect of Symptom Management Education Based on the Knowledge-Attitude-Practice (KAP) Theory on the Symptom Cluster of Fatigue, Pain, and Sleep Disturbances in Lung Cancer Patients

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Abstract: *Objective:* To investigate the intervention effect of symptom management education based on the Knowledge-Attitude-Practice (KAP) theory on the symptom cluster of fatigue, pain, and sleep disturbances in lung cancer patients. *Methods:* A total of 232 lung cancer patients treated in the oncology department from October 2024 to October 2025 were included and randomly divided into an experimental group and a control group, with 116 cases in each group. The control group received routine nursing care for lung cancer, while the experimental group received additional symptom management education intervention based on the KAP theory. Fatigue, pain, and sleep conditions were quantified at the 4th and 8th weeks after the intervention. *Results:* After 4 and 8 weeks of intervention, the RPFS scores, VAS scores, and PSQI scores in the experimental group were lower than those in the control group at the same time points ($p < 0.05$); moreover, the scores in the experimental group at each time point were lower than those before the intervention ($p < 0.05$). *Conclusion:* Symptom management education based on the KAP theory can effectively improve the symptom cluster of fatigue, pain, and sleep disturbances in lung cancer patients, enhance their quality of life, and has clinical promotion value. **Keywords:** Knowledge-Attitude-Practice (KAP) theory; Lung cancer; Symptom management education; Fatigue; Pain; Sleep disturbances; Symptom cluster

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1. Introduction

Lung cancer ranks first in terms of both incidence and mortality among the global cancer spectrum. In China, there are over 800,000 new cases each year, with approximately 70% already at an advanced stage at the time of initial diagnosis^[1]. A longitudinal survey published by Zhang Huanhuan et al. revealed that lung cancer surgery patients consistently experience a cluster of symptoms including pain, fatigue, and sleep disturbances during

the perioperative period ^[2]. Although these symptom clusters exhibit dynamic changes at different time points, they persist steadily, and their incidence remains high across all stages of the perioperative period. Current ward management primarily focuses on symptomatic nursing, with interventions that are fragmented and have single objectives, lacking an integrated perspective on symptom clusters and resulting in suboptimal intervention outcomes. The Knowledge-Attitude-Practice (KAP) theory, through its progressive interventions targeting cognition, beliefs, and behaviors, has been proven effective in improving patients' health behaviors in chronic disease management ^[3]. Based on this context, this study took 232 lung cancer patients as subjects to analyze the intervention effects of symptom management education based on the KAP theory on symptom clusters. The specific content is presented below.

2. Materials and methods

2.1. General information

A total of 232 lung cancer patients who received treatment in the oncology department from October 2024 to October 2025 were selected as the research subjects. They were divided into an experimental group and a control group using the random number table method, with 116 cases in each group. In the experimental group, there were 72 male and 44 female patients, with a mean age of (62.35 ± 7.89) years. The clinical staging was as follows: 32 cases in stage II, 56 cases in stage III, and 28 cases in stage IV. In the control group, there were 75 male and 41 female patients, with a mean age of (63.12 ± 8.15) years. The clinical staging was as follows: 30 cases in stage II, 58 cases in stage III, and 28 cases in stage IV. The baseline data distribution between the two groups was balanced ($p > 0.05$), indicating comparability. This study was approved by the Medical Ethics Committee of our hospital.

2.1.1. Inclusion criteria

- (1) Pathologically confirmed primary lung cancer ^[4]
- (2) Age ≥ 18 years, clear consciousness, able to communicate normally and cooperate in completing scale assessments
- (3) Accompanied by fatigue, pain, and sleep disorders
- (4) Patients and their family members are informed and consent to the research content

2.1.2. Exclusion criteria

- (1) Concurrent other malignant tumors
- (2) Concurrent severe liver or kidney dysfunction
- (3) Cognitive or psychiatric disorders
- (4) Withdrawal or loss to follow-up

2.2. Methods

2.2.1. Control group

Patients in this group received conventional nursing care for lung cancer, which included

- (1) Basic nursing care
Dynamic monitoring of vital signs, assessment of disease progression, medication education, and

supplementary psychological support interventions

(2) Symptom guidance

Informing patients about the common causes of fatigue, pain, and sleep disturbances, as well as simple coping strategies.

2.2.2. Experimental group

In addition to the conventional care, patients in this group received symptom management education interventions based on the Knowledge-Attitude-Practice (KAP) theory. The specific intervention contents are as follows.

(1) Cognitive intervention (Weeks 1–2)

Through individualized face-to-face guidance, distribution of graphic promotional materials, and observation and learning from popular science audiovisual materials, patients were educated on concepts related to the disease and symptom clusters, their occurrence mechanisms, impacts on disease treatment and quality of life, as well as symptom management methods based on the KAP theory. Weekly centralized lectures were conducted, each lasting 60 minutes.

(2) Belief intervention (Weeks 3–4)

Through case sharing, group discussions, and one-on-one communication, patients who had achieved good symptom management outcomes were invited to share their experiences, thereby enhancing patients' confidence in symptom management, helping them establish the belief that "active interventions can improve symptoms" and stimulating their willingness to actively participate in symptom management. Weekly group discussions were held, each lasting 45 minutes, with 8–10 patients per group.

(3) Behavioral intervention (Weeks 5–8)

Develop personalized symptom management behavior plans based on each patient's specific condition and guide patients in their implementation.

2.2.3. Integrated management of fatigue–pain–sleep symptom cluster

(1) Fatigue management

Instruct patients to arrange reasonably rest and activity times, engage in moderate aerobic exercises such as brisk walking or Tai Chi for 20–30 minutes each session, 3–4 times a week; conduct breathing relaxation training for 15 minutes per session, twice a day.

(2) Pain management

Guide patients in the correct use of pain assessment tools, master non-pharmacological pain relief methods such as heat therapy, cold therapy, massage, and distraction techniques; if necessary, collaborate with doctors for pharmacological pain relief treatment while observing drug efficacy and adverse reactions.

(3) Sleep management

Assist patients in establishing healthy sleep habits and optimizing their sleep environment, including maintaining an appropriate bedroom temperature, soft lighting, and quietness; instruct patients to perform pre-sleep relaxation training 30 minutes before bedtime, including progressive muscle relaxation or mindfulness breathing, lasting approximately 20 minutes.

(4) Symptom cluster interaction management

Address the interrelated nature of fatigue, pain, and sleep disturbances by guiding patients to recognize the interconnected relationships among these symptoms. When sleep disturbances are caused by pain, first employ cold compress or distraction techniques from pain management to alleviate the pain, while simultaneously optimizing the sleep environment and conducting relaxation training as part of sleep management to concurrently improve both pain and sleep issues and reduce fatigue. If muscle soreness arises due to reduced physical activity caused by fatigue, intervene through moderate stretching combined with local massage to prevent pain from affecting sleep. Additionally, establish a symptom cluster diary to guide patients in recording daily the onset time and severity of fatigue and pain, as well as the duration and quality of sleep, while noting factors that exacerbate the interconnectedness of these three symptoms. Nurses will analyze the patterns of interconnection weekly based on the diary entries and adjust personalized intervention plans accordingly.

2.3. Observation indicators

The following indicators will be assessed before intervention (T0), at 4 weeks post-intervention (T1), and at 8 weeks post-intervention (T2).

(1) Fatigue severity

Quantified using the Revised Piper Fatigue Scale (RPFS), which encompasses behavioral, emotional, sensory, and cognitive dimensions, with scores ranging from 0 to 10 in ascending order, where higher scores indicate more severe fatigue.

(2) Pain severity

Assessed using the Visual Analog Scale (VAS), with 0 representing pain-free and 10 representing extreme pain, where a linear increase indicates worsening pain.

(3) Sleep quality

Assessed using the Pittsburgh Sleep Quality Index (PSQI), which encompasses seven aspects: subjective quality, latency, duration, efficiency, disturbances, use of sleep medication, and daytime dysfunction. The total score ranges from 0 to 21, with higher scores indicating poorer sleep quality.

2.4. Statistical methods

Comparisons were made using SPSS 23.0 software. Count data were expressed as percentages (%) and tested using the χ^2 test. Measurement data conforming to a normal distribution were expressed as (mean \pm standard deviation) and tested using the *t*-test. A statistically significant difference was considered when $p < 0.05$.

3. Results

3.1. Comparison of RPFS scores

As shown in **Table 1**, the RPFS scores of the experimental group at T1 and T2 were both lower than those of the control group, with $p < 0.05$.

Table 1. Comparison of RPFS scores before and after intervention between groups [$\bar{x} \pm s$, score]

Group	n	RPFS score		
		T0 (Baseline)	T1	T2
Experimental group	116	7.34 \pm 1.12	4.12 \pm 1.11	2.32 \pm 1.18
Control group	116	7.38 \pm 1.17	5.78 \pm 1.13	3.89 \pm 1.16
<i>t</i> -value		0.266	11.287	10.219
<i>p</i> -value		0.790	0.001	0.001

3.2. Comparison of VAS scores

As shown in **Table 2**, the VAS scores of the experimental group at T1 and T2 were both lower than those of the control group, with $p < 0.05$.

Table 2. Comparison of VAS scores before and after intervention between groups [$\bar{x} \pm s$, score]

Group	n	RPFS score		
		T0 (Baseline)	T1	T2
Experimental group	116	8.21 \pm 1.09	4.45 \pm 1.21	1.50 \pm 0.34
Control group	116	8.23 \pm 1.07	5.67 \pm 1.15	2.96 \pm 0.38
<i>t</i> -value		0.141	7.871	30.839
<i>p</i> -value		0.888	0.001	0.001

3.3. Comparison of PSQI scores

As shown in **Table 3**, the PSQI scores of the experimental group at T1 and T2 were both lower than those of the control group, with $p < 0.05$.

Table 3. Comparison of PSQI scores before and after intervention between groups [$\bar{x} \pm s$, points]

Group	n	RPFS score		
		T0 (Baseline)	T1	T2
Experimental group	116	17.67 \pm 1.22	8.56 \pm 1.42	5.47 \pm 1.21
Control group	116	17.56 \pm 1.25	10.45 \pm 1.44	7.56 \pm 1.26
<i>t</i> -value		0.678	10.065	12.886
<i>p</i> -value		0.498	0.001	0.001

4. Discussion

The Knowledge-Attitude-Practice (KAP) theory, as a health behavior change theory, consists of three core elements: cognition, belief, and behavior. Its core concept lies in promoting behavioral changes by altering individuals' cognition and beliefs ^[5]. In recent years, this theory has been widely applied in the field of health management for chronic disease patients and has achieved promising results. This study applied symptom management education based on the KAP theory to the intervention of symptom clusters of fatigue, pain, and

sleep disturbances in lung cancer patients. The results indicated that after 4 and 8 weeks of intervention, the RPFS scores, VAS scores, and PSQI scores of the experimental group were all lower than those of the control group ($p < 0.05$). This suggests that symptom management education based on the KAP theory can effectively improve fatigue, pain, and sleep disturbances in lung cancer patients. The reasons for this are analyzed as follows.

- (1) During the cognitive intervention phase, through various forms of health education, patients were fully informed about the knowledge related to the symptom cluster of fatigue, pain, and sleep disturbances, correcting their misconceptions about the symptoms ^[6].
- (2) During the belief intervention phase, through methods such as case sharing and group discussions, the patients' willingness to actively participate in symptom management was stimulated, leading to a transformation from "passively receiving care" to "actively participating in management" ^[7].
- (3) During the behavioral intervention phase, personalized symptom management behavior plans were formulated based on the individual conditions of patients. With continuous follow-up and guidance, patients were helped to translate health knowledge into practical health behaviors, effectively improving their symptom status.

In clinical interventions, there was a case of a stage III lung cancer patient who scored 7 on the VAS, 18 on the PSQI, and 7.5 on the RPFS before intervention. The patient suffered from night awakenings due to chest and back pain and was too fatigued to get out of bed, creating a vicious cycle and lacking confidence. In the initial stage of intervention, cognitive education was used to clarify the mechanism of symptom interaction, and successful cases were utilized to strengthen belief. During the behavioral phase, cold compresses combined with deep breathing were employed for pain relief, while the sleep environment was simultaneously optimized and relaxation training was conducted. After identifying emotional triggers through symptom diaries, the plan was adjusted accordingly. After 4 weeks of intervention, the three scores dropped to 4, 10, and 5, respectively, and after 8 weeks, they reached 2, 6, and 3. The patient was able to engage in independent activities, fully demonstrating the efficacy of the "cognition-belief-behavior" and symptom cluster interaction management approach. From a mechanistic perspective, the Knowledge-Attitude-Practice (KAP) theory utilizes cognitive restructuring to correct negative perceptions of "uncontrollable symptoms", reducing sympathetic nervous system excitability and cortisol levels, thereby alleviating stress-related fatigue and sleep disturbances. Strengthening beliefs can enhance self-efficacy and activate endogenous analgesic mechanisms to alleviate pain. Behavioral interventions such as regular exercise and relaxation training can improve mitochondrial function, regulate circadian rhythms, and break the neuroendocrine vicious cycle of "fatigue-pain-sleep disorders" ^[7]. Zhou Ningning et al. conducted similar research ^[8], and their results showed that the intervention group had lower quantitative scores for the severity of three core symptoms, including cough, fatigue, and respiratory distress if compared to the conventional group ($p < 0.05$). Moreover, the scores across all dimensions of quality of life were significantly better in the intervention group than in the control group ($p < 0.05$). This indicates that a group education model centered on the knowledge-attitude-practice framework can simultaneously reduce the burden of lung cancer-related symptom clusters and enhance patients' overall life experiences, providing evidence-based support for clinical promotion.

5. Conclusion

In summary, symptom management education based on the knowledge-attitude-practice theory can effectively improve symptom clusters of fatigue, pain, and sleep disorders in lung cancer patients and enhance their quality of life. This intervention method is simple to operate and highly feasible, making it worthy of clinical promotion and application. However, this study has limitations: single-center samples are prone to bias and have limited generalizability; the follow-up period was only 8 weeks, leaving the long-term effects unclear; and quality of life and adherence were not evaluated. Subsequent research should involve multi-center, large-sample, long-term follow-up studies with the addition of multidimensional indicators to comprehensively validate the efficacy of knowledge-attitude-practice interventions.

Disclosure statement

The author declares no conflict of interest.

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Clinical Efficacy and Safety Analysis of Ultrasound-Guided Local Anesthesia for Endovenous Laser Combined with Sclerotherapy in the Treatment of Varicose Great Saphenous Veins

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Abstract: *Objective:* To investigate the clinical efficacy and safety of ultrasound-guided local anesthesia for endovenous laser combined with sclerotherapy in the treatment of varicose great saphenous veins. *Methods:* A total of 53 patients with varicose great saphenous veins admitted to our hospital from December 2023 to June 2025 were selected and divided into a traditional surgery group (18 cases) and a laser combined with sclerotherapy group (35 cases) according to the surgical method. The venous clinical severity score (VCSS), chronic venous insufficiency quality of life questionnaire (CIVIQ) score, visual analog scale (VAS) score for pain, complication rate, surgical time, treatment cost, recovery time, and patient satisfaction were compared between the two groups at 1 week, 1 month, and 3 months postoperatively. *Results:* The VCSS scores of the laser group at each postoperative time point were lower than those of the traditional group, and the CIVIQ scores were higher than those of the traditional group (all $p < 0.05$). The incidence of complications in the laser group (8.57%), the VAS score at 24 hours postoperatively, the duration of pain, and the utilization rate of analgesic medications were all significantly lower than those in the conventional group (all $p < 0.05$). The laser group also demonstrated shorter operative and recovery times compared to the conventional group, along with higher patient satisfaction, albeit at a higher treatment cost ($p < 0.05$). *Conclusion:* Endovenous laser combined with sclerotherapy under ultrasound guidance for the treatment of great saphenous vein varicosis offers advantages such as minimal trauma, rapid recovery, mild pain, and fewer complications, demonstrating significant clinical efficacy and good safety, thus possessing high clinical application value.

Keywords: Great saphenous vein varicosis; Endovenous laser therapy; Sclerosant; Ultrasound guidance; Clinical efficacy

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1. Introduction

Great saphenous vein varicosis is a common vascular disease caused by incompetence of the venous valves in the lower extremities, characterized primarily by tortuous and dilated veins, as well as heaviness and soreness in the lower limbs. In severe cases, skin ulcers may develop, affecting the patient's quality of life ^[1]. Traditional treatment methods primarily involve high ligation and stripping, which, although effective in removing diseased veins, have drawbacks such as significant trauma, slow recovery, and a high incidence of complications ^[2]. With the development of minimally invasive techniques, ultrasound-guided endovenous laser combined with sclerotherapy has gradually been applied in clinical practice due to its advantages of high precision and minimal trauma. This study aims to provide a reference for the minimally invasive treatment of varicose veins of the great saphenous vein by comparing the clinical efficacy and safety of two surgical methods.

2. Materials and methods

2.1. General information

A total of 53 patients with varicose veins of the great saphenous vein who were treated in the surgical department of our hospital from December 2023 to June 2025 were selected and divided into two groups based on different surgical methods: the traditional group (18 cases) and the laser group (35 cases). In the traditional group, there were 10 males and 8 females, with ages ranging from 32 to 68 years old and an average age of (51.36 ± 8.24) years; 15 cases had unilateral disease and 3 cases had bilateral disease. In the laser group, there were 19 males and 16 females, with ages ranging from 30 to 69 years old and an average age of (50.78 ± 7.96) years; 29 cases had unilateral disease and 6 cases had bilateral disease. The comparison of general information between the two groups ($p > 0.05$) indicated comparability. This study was approved by the Medical Ethics Committee of the hospital, and all patients signed informed consent forms.

2.1.1. Inclusion criteria

Diagnosis of primary great saphenous vein varicosis; age between 18 and 70 years old; unilateral or bilateral involvement; CEAP classification: C2–C6.

2.1.2. Exclusion criteria

Non-primary varicose veins; severe liver and kidney diseases; acute thrombosis in the great saphenous vein or deep veins; allergy to local anesthetic drugs; patients with malignant tumors; patients with uncontrolled active systemic infectious diseases.

2.2. Research methods

2.2.1. Experimental equipment and materials

Semiconductor laser therapy device (Model FD-30-A), Sino peristaltic pump (iPump6S), Philips intelligent ultrasound diagnostic system (PHILIPS EPIQ7), 1% or 3% polidocanol sclerosant.

2.2.2. Preoperative preparation

All subjects underwent blood analysis, including red blood cell count (RBC) and mean corpuscular volume (MCV), coagulation time measurement, liver and kidney function tests, as well as bilateral limb vascular ultrasound

examinations to determine the presence of absolute or relative contraindications for surgery; they also completed a baseline information form recording CEAP classification, VCSS score, and CIVIQ questionnaire results; the laser group additionally underwent perineal and inguinal skin preparation, and fasting was not required before surgery.

2.2.3. Surgical methods

(1) Traditional group

After general anesthesia or epidural anesthesia, an incision was made below the inguinal ligament. The main trunk and branches of the great saphenous vein were dissected and ligated. A stripping device was inserted to strip the vein, and the varicose vein masses were subjected to punctate stripping. The incision was then sutured and compressed with bandages.

(2) Laser group

Under local tumescent anesthesia, the great saphenous vein was punctured under ultrasound guidance, and a vascular sheath was placed. A laser fiber was introduced to a point 2 cm distal to the saphenofemoral junction, and the main trunk of the great saphenous vein was ligated. Tumescent anesthesia was administered under ultrasound guidance, and the laser fiber was withdrawn segmentally at a power of 12–15 W to close the vein. Subsequently, a sclerosing agent was injected, and punctate stripping of the varicose veins was performed, followed by suturing of the incision.

2.2.4. Postoperative management

Both groups received anti-infective, analgesic, and anticoagulant therapy. Elastic stockings were changed 48 hours postoperatively and worn for 2 weeks to 3 months. Symptomatic treatment was provided for conditions such as allergies and exudation.

2.3. Observation indicators

2.3.1. Efficacy indicators

At 1 week, 1 month, and 3 months postoperatively, VAS scores (ranging from 0 to 3, with lower scores indicating better recovery of motor function) and CIVIQ scores (ranging from 0 to 100, with higher scores indicating better quality of life) were assessed in both groups, and recurrence was recorded.

2.3.2. Complication and pain indicators

The occurrence of complications in patients from both groups was statistically analyzed, and the Visual Analogue Scale (VAS) scores [ranging from 0 to 10 (VAS is a visual analog scale, with higher scores indicating more severe pain)] at the 24th hour post-surgery, the duration of pain, and the proportion of patients using analgesic medications were recorded for each case.

2.3.3. Other indicators

Record the operation time, treatment cost, and time to return to daily activities; assess satisfaction using a Likert five-point scale at 1 week, 1 month, and 3 months post-surgery, and calculate the overall satisfaction rate (the proportion of grades C, D, and E).

2.4. Statistical methods

Data analysis was conducted using SPSS 26.0 software. Measurement data were expressed as ($\bar{x} \pm s$), and comparisons of mean values between the two groups were performed using the *t*-test; measurement data were expressed as [n(%)], and comparisons between groups were conducted using the χ^2 test; a *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of efficacy indicators between the two groups

There were no significant differences in preoperative VCSS and CIVIQ scores between the two groups (*p* > 0.05); at each postoperative time point, the laser group had lower VCSS scores and higher CIVIQ scores than the traditional group (*p* < 0.05). No recurrence was observed in either group during the follow-up period. See **Table 1** for details.

Table 1. Comparison of efficacy indicators ($\bar{x} \pm s$, points)

Group	1-Week Postop VCSS	1-Month Postop VCSS	3-Month Postop VCSS	1-Week Postop CIVIQ	1-Month Postop CIVIQ	3-Month Postop CIVIQ
Traditional (n = 18)	5.26 ± 1.13	3.87 ± 0.95	2.76 ± 0.73	68.43 ± 7.21	76.59 ± 6.42	83.74 ± 5.86
Laser (n = 35)	3.12 ± 0.85	1.98 ± 0.62	1.25 ± 0.41	82.56 ± 6.34	91.32 ± 5.17	96.48 ± 3.29
<i>t</i> -value	7.071	7.645	8.140	7.033	8.430	8.556
<i>p</i> -value	0.000	0.000	0.000	0.000	0.000	0.000

3.2. Comparison of complications and pain indicators between the two groups

The incidence of complications, 24-hour VAS score, duration of pain, and the usage rate of analgesics in the laser group were all lower than those in the traditional group (*p* < 0.05). See **Table 2** for details.

Table 2. Comparison of complications and pain indicators

Group	Complication rate [n (%)]	24h postop VAS score (points)	Pain duration (d)	Analgesic use rate [n (%)]
Traditional (n = 18)	6 (33.33)	4.86 ± 1.24	5.72 ± 1.36	12 (66.67)
Laser (n = 35)	3 (8.57)	2.15 ± 0.78	2.31 ± 0.85	5 (14.29)
Statistical value	5.170	8.452	9.707	14.970
<i>p</i> -value	0.023	0.000	0.000	0.000

3.3. Comparison of other indicators between the two groups

The operation time and the time to resume daily activities in the laser group were shorter than those in the traditional group, while patient satisfaction was higher. However, the treatment cost in the laser group was higher than that in the traditional group (*p* < 0.05). See **Table 3** for details.

Table 3. Comparison of other indicators between the two groups of patients

Group	Operative time (min, Mean \pm SD)	Treatment cost (CNY, Mean \pm SD)	Time to resume daily life (days, Mean \pm SD)	Patient satisfaction [n (%)]
Traditional (n = 18)	78.34 \pm 12.56	8732.45 \pm 1124.63	10.57 \pm 2.14	12 (66.67)
Laser (n = 35)	42.65 \pm 8.37	12865.34 \pm 1562.78	4.12 \pm 1.03	33 (94.29)
t/χ^2 value	10.877	11.044	12.088	7.075
p -value	0.000	0.000	0.000	0.000

4. Discussion

The core pathological mechanism of varicose veins of the great saphenous vein is the obstruction of deep venous return caused by dysfunction of the communicating branches between deep and superficial veins and the calf muscle pump, accompanied by venous valve defects and/or incompetence, resulting in retrograde blood flow. This leads to an increase in proximal venous pressure, causing the diameter of distal veins to increase, and ultimately resulting in tortuous dilation ^[3]. Traditional surgical methods are prone to damaging adjacent tissues. The treatment approach combining ultrasound-guided endovenous laser therapy with sclerotherapy organically integrates the two methods, with the following characteristics

- (1) Utilizing the photocoagulation effect of the laser to cause shrinkage and adhesion of the venous wall, completely blocking the reflux in the main trunk of the great saphenous vein;
- (2) Injecting sclerosants such as polidocanol into the varicose veins to disrupt the venous endothelial cell layer and induce a series of reactions including thrombus formation and collagen deposition, ultimately achieving the permanent occlusion of the varicose veins in the lower leg ^[4]
- (3) Using an ultrasound probe to accurately display the location of the veins requiring treatment and avoid important structures, thereby reducing the risk of neurovascular injury caused by blind puncture
- (4) Local anesthesia reduces the risks associated with general anesthesia and aligns with the principles of enhanced recovery after surgery ^[5]

This study demonstrates that the laser group had lower postoperative VCSS scores and higher CIVIQ scores, confirming the efficacy advantages of minimally invasive techniques. Traditional surgery often causes postoperative pain and swelling due to traction on surrounding tissues during the stripping process. In contrast, the laser group, with its minimally invasive local anesthesia, experiences less trauma, and the swelling anesthesia fluid can mitigate thermal damage and pain transmission. Consequently, the 24-hour VAS score, duration of pain, and the use of analgesics were significantly reduced in the laser group ^[6].

In terms of complications, the incidence rate in the laser group was only 8.57%, significantly lower than the 33.33% in the traditional group. The drawbacks of traditional surgery include large wound areas, extensive resection ranges, and a higher likelihood of postoperative bleeding, infection, and saphenous nerve injury due to unclear anatomical layers and incomplete separation of vital structures ^[7]. In this trial, ultrasonic scalpel treatment was employed, where ultrasonic waves effectively transmit energy into the body, accelerating molecular vibrations in the target area to generate heat. This achieves high-temperature inactivation, reduces tissue damage, and lowers the incidence of complications such as ecchymosis and induration.

Regarding efficiency and satisfaction, the laser group experienced a 45.5% reduction in surgical time and a 61.1% reduction in the time required to resume daily activities. This is directly related to the characteristics of minimally invasive techniques, which require less extensive dissection, result in less intraoperative bleeding,

and facilitate faster postoperative recovery. Patient satisfaction reached as high as 94.29%, attributed not only to the therapeutic and recovery advantages but also to the small surgical scars and improved aesthetic outcomes, particularly appealing to younger patients^[8].

In terms of treatment costs, the laser group was higher than the traditional group, primarily due to the relatively expensive prices of laser surgical instruments and medications^[9]. However, when considering the overall situation, the potential benefits of laser therapy, such as shortening patients' hospital stays and postoperative recovery times, as well as reducing the likelihood of various complications and sequelae, still result in a high cost-effectiveness ratio^[10].

5. Conclusion

In summary, endovenous laser combined with sclerotherapy under ultrasound-guided local anesthesia for the treatment of great saphenous vein varicosis can effectively improve clinical symptoms and quality of life. It offers advantages such as minimal trauma, mild pain, rapid recovery, and fewer complications. Although the treatment costs are relatively high, its overall safety and effectiveness are significant, making it worthy of clinical promotion and application.

Disclosure statement

The authors declare no conflict of interest.

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A Case of Myocardial Biopsy in Fulminant Myocarditis

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Abstract: Clinical Data A 25-year-old female patient was admitted to our hospital on September 4, 2019, with “fever for 3 days and chest tightness and shortness of breath for 2 days”. She had no previous history of coronary heart disease or hypertension. Three days before admission, she developed chills, low-grade fever, dry cough, and clear nasal discharge after catching a cold. Two days before admission, she experienced chest tightness and shortness of breath after mild physical activity, which relieved after rest. Admission physical examination: Temperature 37.3 °C, blood pressure 85/55 mmHg, clear consciousness, poor mental state, pale complexion, respiratory rate 27 breaths/min, heart rate 108 beats/min, regular rhythm, no murmurs. Abdomen (-), no edema of lower extremities. Admission ECG: Sinus rhythm; ST segment elevation of 0.1–0.3 mv in leads II, III, aVF, V1-V6, and pathological Q waves in leads II, III, aVF. Initial diagnosis after admission: Fulminant myocarditis? Acute ST-segment elevation myocardial infarction (to be excluded). Laboratory tests on admission: D-dimer: 0.45 mg/L, B-type natriuretic peptide (BNP): 7401.8 pg/mL, high-sensitivity troponin I (cTnI): 11.41 ng/mL; creatine kinase isoenzyme (CK-MB): 59.2 ng/mL, myoglobin: 132.5 ng/mL; total white blood cell count: $3.74 \times 10^9/L$; hemoglobin: 125 g/L, C-reactive protein (CRP): 19 mg/L, erythrocyte sedimentation rate (ESR): 24 mm/1 h, procalcitonin: 0.07 ng/mL. Blood gas analysis (without oxygen inhalation): pH value: 7.403; partial pressure of carbon dioxide: 31.60 mmHg; partial pressure of oxygen: 45.50 mmHg; blood oxygen saturation: 79.00%; blood lactic acid (lac): 2.3 mmol/L. Transthoracic echocardiography showed: Left atrial diameter 31 mm, left ventricular diameter 35 mm, right atrial diameter 31 mm, right ventricular diameter 23 mm, interventricular septum 13 mm, left ventricular ejection fraction (LVEF) 60%. Chest CT plain scan: No exudative lesions in both lungs. Coronary CTA: No coronary artery stenosis. Cardiac magnetic resonance imaging (MRI): Normal diameters of each cardiac chamber, normal left ventricular function, no definite myocardial fibrosis or edema.

Keywords: Fulminant; Myocarditis; Myocardial biopsy

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1. Introduction

Fulminant myocarditis is myocardial injury caused by pathogen infection, immune factors, chemical drugs, etc.

It has an acute onset and severe condition, and can rapidly progress to heart failure or shock in a short period ^[1–4].

2. Case presentation

On September 5, 2019, right heart catheterization + myocardial biopsy was performed with intra-aortic balloon pump (IABP) support. After IABP insertion, blood pressure recovered from 85–90/50–60 mmHg to 100–105/60–70 mmHg. Results of right heart catheterization: Right atrial pressure 13/12/11 mmHg; right ventricular pressure 27/17/6 mmHg; mean pulmonary artery pressure 17 mmHg; pulmonary capillary wedge pressure 12 mmHg; cardiac output (CO) 2.4 L/min; cardiac index (CI) 1.8 L/min/m²; pulmonary artery oxygen saturation 56.8%. Endomyocardial biopsy: Pathological specimens were taken from 3 different sites of the right ventricular septum. Postoperative immunohistochemical results showed: Inflammatory cells: CD3 (+), CD19 (-), CD20 (scattered few +), CD56 (-), CD68 (scattered +). Postoperative pathology: Myocardial cell degeneration, interstitial edema, mild proliferation of fibrous tissue, massive lymphocytic infiltration, occasional neutrophilic infiltration, consistent with myocardial interstitial inflammation.

The myocardial biopsy results supported the diagnosis of myocarditis. Treatment included methylprednisolone intravenous pulse therapy + intravenous immunoglobulin, diuretics, and symptomatic supportive care. Laboratory indicators such as BNP, cTnI, and lactic acid gradually decreased to normal, and hemodynamics was stable. Follow-up after 2 months showed no discomfort, normal exercise tolerance, normal myocardial enzymes, and normal echocardiography ^[5–9]. See **Figure 1** and **2**.

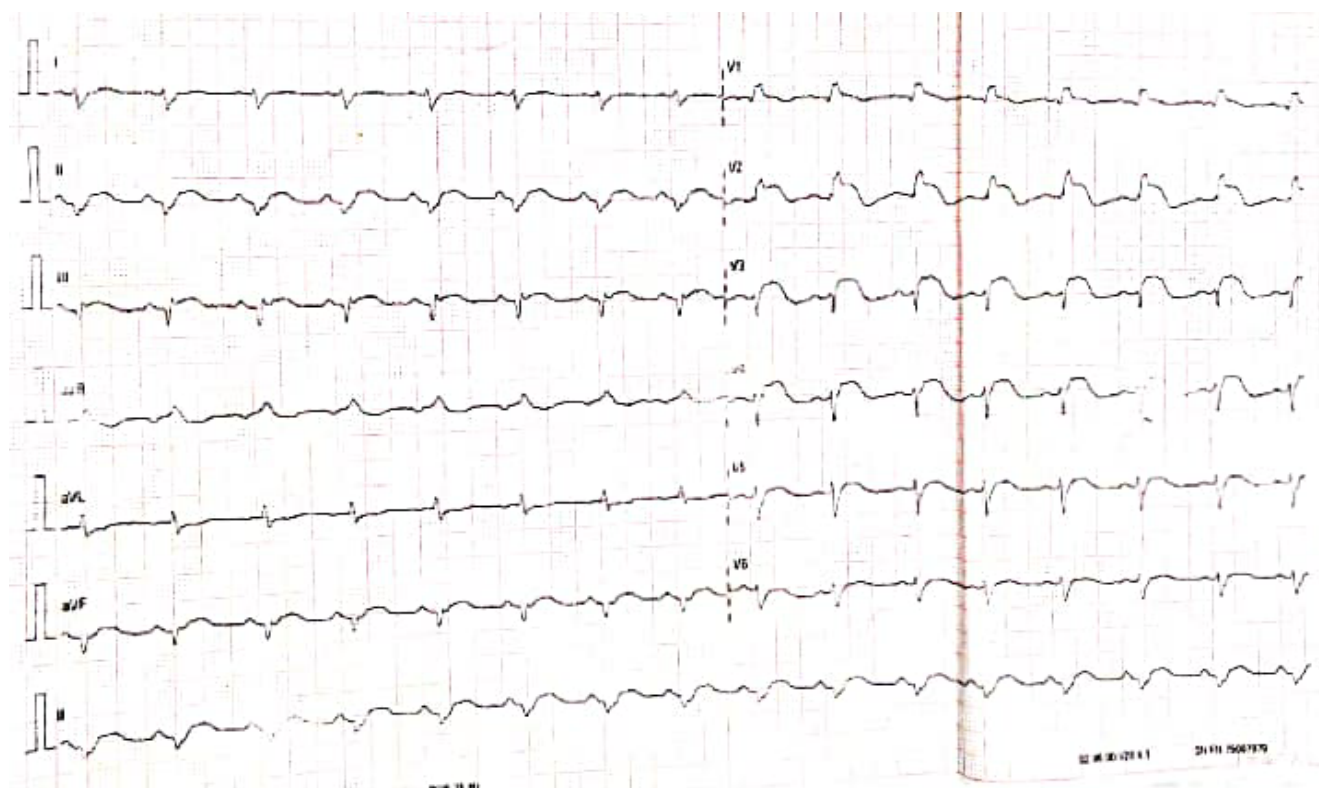


Figure 1. Admission ECG: ST segment elevation of 0.1–0.3 mv in leads II, III, aVF, V1–V6, and pathological Q waves in leads II, III, aVF.

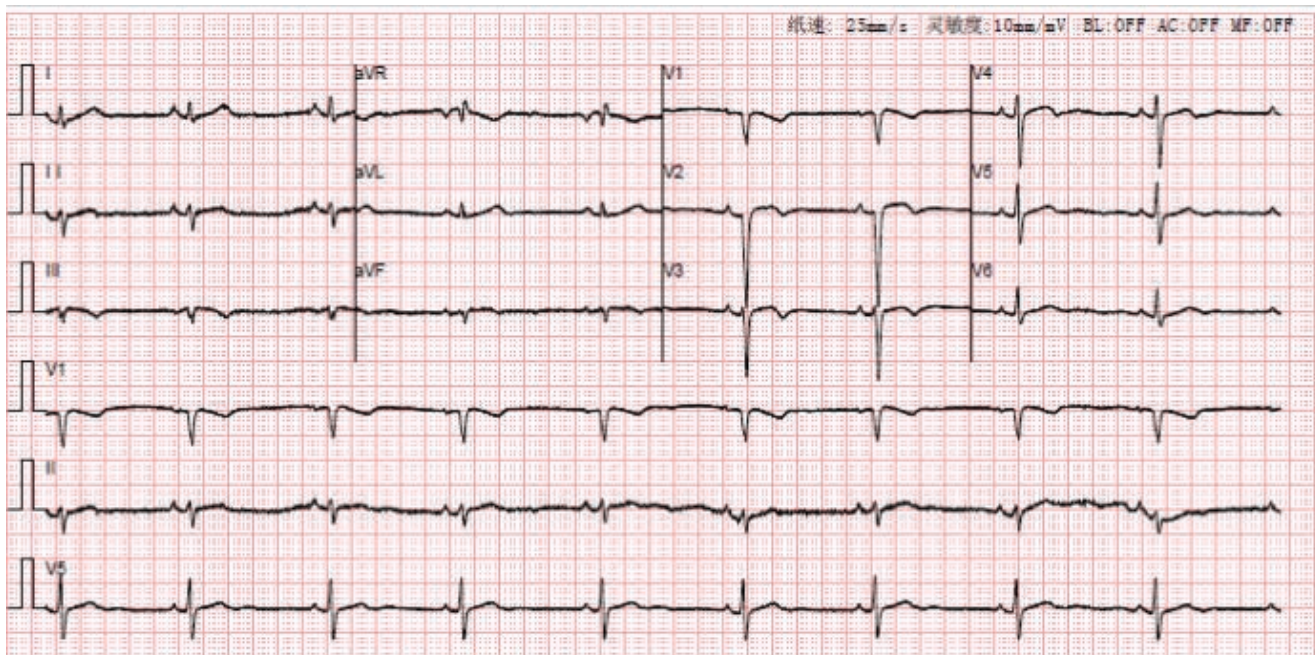


Figure 2. Pre-discharge ECG: ST segment elevation of 0.1–0.2 mv in leads V2, V4, and pathological Q waves in leads III, aVF

3. Discussion

Fulminant myocarditis is myocardial injury caused by pathogen infection, immune factors, chemical drugs, etc.^[9]. It has an acute onset and severe condition, and can rapidly progress to heart failure or shock in a short period. Myocardial injury indicators such as troponin and CK-MB are elevated. Acute phase is characterized by focal or diffuse myocardial tissue injury with massive inflammatory cell infiltration. Cardiac MRI may show characteristic myocardial changes such as edema, hyperemia, necrosis, and fibrosis. Endomyocardial biopsy provides an important basis for early diagnosis^[10–12]. Differential diagnosis of myocarditis needs to exclude myocardial injury caused by acute coronary syndrome, sepsis, etc. After confirmation, treatment includes bed rest, nutritional support, anti-infection, glucocorticoids, intravenous immunoglobulin, and IABP or ECMO if necessary. IABP should be used as early as possible when hemodynamics is unstable. If cardiogenic shock persists despite IABP use, with cardiac index (CI) < 2.0 L/min/m² and blood lactic acid > 2 mmol/L, extracorporeal membrane oxygenation (ECMO) treatment can be used^[13–15].

Characteristics of this case: The patient had an acute onset with prodromal respiratory tract infection symptoms, chest tightness, shortness of breath, hypotension, generalized ST segment elevation on ECG, elevated lactic acid, BNP and troponin. Coronary CTA showed no coronary stenosis, excluding acute myocardial infarction, and fulminant myocarditis was considered. However, echocardiography was normal, and cardiac MRI showed no typical manifestations of myocarditis such as myocardial edema, hyperemia, or fibrosis, so myocardial biopsy was necessary to confirm the diagnosis. The patient had hypotension, and right heart catheterization was performed under IABP support to maintain hemodynamic stability. Meanwhile, endomyocardial biopsy confirmed the diagnosis of myocarditis. Timely treatment with hormones and immunoglobulin resulted in a good prognosis. The patient's right heart catheterization showed CI: 1.80 L/min/

m², CO: 2.4 L/min, and blood lactic acid: 2.3 mmol/L. The patient had decreased cardiac output and elevated lactic acid, which indicated the possibility of ECMO placement. However, after IABP insertion, the patient's blood pressure recovered, circulation gradually improved, and blood lactic acid gradually decreased to 1.0 mmol/L, so ECMO was not ultimately used. After obtaining pathological specimens by myocardial biopsy, viral gene detection such as PCR, reverse transcription PCR, and nested PCR can be used to help identify pathogens. However, this examination has not been carried out in our hospital, which is a limitation of the diagnosis in this case.

4. Conclusion

This case demonstrates the critical role of timely endomyocardial biopsy in diagnosing fulminant myocarditis when imaging findings are inconclusive. Early mechanical circulatory support (IABP), combined with immunomodulatory therapy, effectively stabilized hemodynamics and led to a favorable outcome. Comprehensive evaluation including biomarkers, imaging, and histopathology is essential for accurate diagnosis and management of this potentially life-threatening condition.

Disclosure statement

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