

care competencies ^[1]. Currently, geriatric medical education predominantly relies on classroom lectures, leading to issues such as disconnect between theory and practice, low student engagement, and insufficient cultivation of clinical reasoning. Li Yongyong and colleagues compared the effectiveness of traditional lectures versus the BOPPPS combined with CBL teaching methods in geriatric clinical education ^[2]. They found that while traditional methods enhance knowledge retention, they weaken students' ability to apply knowledge, failing to meet clinical demands. Scenario simulation is an emerging teaching approach that uses clinical case scenarios to enable students to practice diagnostic procedures and decision-making in simulated environments. Clinical practice demonstrates that this method helps address the shortcomings of traditional teaching, enhancing students' clinical skills and critical thinking. Li Nan and colleagues found that applying scenario simulation in standardized residency training effectively improves residents' clinical knowledge, practical abilities, doctor-patient communication skills, and proactive learning attitudes ^[3]. This study attempts to deeply integrate scenario simulation with standardized patients, employing specially trained standardized patients in realistic clinical scenario simulations. Trainees engage in practical exploration based on accurately grasping simulated patients' symptoms, signs, and medical histories, analyzing the application value of this integrated teaching method in geriatric medicine education.

2. Materials and methods

2.1. General data

The study included 65 clinical physicians from other departments of our hospital who rotated through the Geriatrics Department for training between August 2024 and July 2025.

2.1.1. Inclusion criteria

- (1) Active clinical physicians from departments such as General Practice, Endocrinology, and Cardiology within our hospital
- (2) Comprehensive competency assessment scores meeting the hospital's rotation training requirements
- (3) Voluntary participation in this study with signed informed consent

2.1.2. Exclusion criteria

- (1) Prior participation in standardized patient scenario simulation training
- (2) Training interruption exceeding one month for any reason (e.g., sick leave, maternity leave, resignation)
- (3) Physicians with prior specialized training in geriatrics or long-term (over 6 months) work experience in geriatrics.

Participants were randomly assigned using a random number table to a control group (n = 32) and an observation group (n = 33). The control group received traditional centralized theoretical instruction combined with faculty-led clinical mentoring, while the observation group underwent standardized patient scenario simulation training. Comparisons of general characteristics (gender, age, medical theory exam scores upon admission) between groups showed no statistically significant differences ($p > 0.05$), indicating comparability (Table 1).

Table 1. Comparison of general characteristics between groups

Group	Gender [n (%)]		Age ($\bar{X} \pm s$, years)	Entrance theoretical score ($\bar{X} \pm s$, points)
	Male	Female		
Control group (n = 32)	13	19	22.51 \pm 0.93	79.67 \pm 5.23
Observation group (n = 33)	15	18	22.53 \pm 0.87	78.89 \pm 5.35
χ^2/t	0.155		0.089	0.594
<i>p</i>	0.694		0.929	0.554

2.2. Methods

Both groups were led by the Director of Geriatric Medicine and Associate Chief Physicians, with each group receiving 45 teaching hours.

2.2.1. Control group

Employed traditional teaching methods combining concentrated theoretical lectures with instructor-led clinical supervision. For instance, after lectures, instructors systematically explained the etiology, pathology, clinical manifestations, and treatment principles of common geriatric diseases based on the department's syllabus. They then organized discussions on typical cases, guiding trainees to analyze conditions and propose diagnostic and therapeutic approaches. Subsequently, trainees were led to participate in daily ward activities within the geriatric medicine department, interacting with actual patients. Instructors demonstrated physical examination techniques on-site and explained key points for clinical observation and doctor-patient communication.

2.2.2. Observation group

Standardized patient scenario simulation teaching method, with the following implementation plan:

(1) Standardized patient training

Recruit standardized patients from retired hospital staff and medical volunteers, providing a 4-week intensive training program. Training covers typical clinical manifestations of common geriatric diseases (e.g., Alzheimer's disease, geriatric syndromes, multimorbidity), unique psychosocial characteristics of elderly patients, and communication approaches.

(2) Scenario design

Developed teaching scenarios based on the curriculum, including "Management of Elderly Patients with Multiple Coexisting Conditions," "Patient-Physician Communication with Elderly Patients," and "Resuscitation of Critically Ill Elderly Patients." Each scenario specified clear learning objectives and assessment criteria, requiring trainees to independently complete medical history taking, physical examination, analysis of auxiliary test results, and formulation of appropriate multi-disease collaborative treatment plans.

(3) Scenario simulation implementation

The teaching cycle spans 4 weeks, with two 90-minute scenario simulation sessions per week. The teaching process is divided into three phases: Phase 1 (first 10 minutes): Instructors briefly introduce the case background and learning objectives. Phase 2 (60 minutes): Trainees interact with standardized patients in small groups to complete history-taking, physical examination, and preliminary diagnosis, while instructors observe and record. Phase 3 (final 20 minutes): Standardized patients provide feedback,

followed by instructor summarization and evaluation. After each simulation, trainees submit reflection reports to reinforce learning.

(4) Multi-level feedback

Establish a multi-level feedback mechanism: Standardized patients primarily evaluate trainees' communication skills and compassionate care abilities; instructors focus on clinical reasoning, knowledge mastery, and procedural competence; peers assess teamwork and mutual learning capabilities. Trainees gain comprehensive insights into their strengths and areas for improvement through diverse feedback.

2.3. Observation indicators

2.3.1. Final examination scores (assessment method)

(1) Theoretical knowledge assessment

Administered via written exam covering four domains: pathogenesis of common geriatric diseases, diagnostic and treatment protocols for common geriatric conditions, principles of rational medication use, and geriatric medicine guidelines/consensus statements. Each domain is worth 10 points, totaling 40 points.

(2) Clinical diagnostic and therapeutic competency

Assessed through simulated case scenarios evaluating five competencies, including history-taking ability, standardized physical examination, interpretation of ancillary tests, diagnostic and differential diagnostic skills, and rational treatment planning. Each competency is worth 12 points, with a maximum of 60 points. The combined score of theoretical knowledge and clinical competency constitutes the final score.

2.3.2 Teaching acceptance (survey method)

A self-designed questionnaire assessed trainees' acceptance of teaching methods. The questionnaire included six items: whether teaching methods enhance learning interest, improve self-directed learning ability, boost comprehensive clinical problem-solving skills, strengthen patient communication skills, enhance teamwork capabilities, and improve research conceptualization abilities. Trainees selected "Yes" or "No" based on their genuine perceptions. A total of 65 questionnaires were distributed, with 65 valid responses collected, achieving a 100% valid response rate.

2.4. Statistical methods

Data analysis was performed using SPSS 26.0 software. Quantitative data were expressed as mean \pm standard deviation ($\bar{x} \pm s$), with intergroup comparisons conducted using *t*-tests. Qualitative data were presented as rates (%), with intergroup comparisons using chi-square (χ^2) tests. "Example count (%)" indicated intergroup comparisons using chi-square (χ^2) tests. $p < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of final examination scores between groups

At the end of the course, the observation group demonstrated significantly higher scores than the control group in all assessments of theoretical knowledge and clinical diagnostic and therapeutic capabilities, with statistically significant differences ($p < 0.05$), as shown in **Table 2**.

Table 2. Comparison of final examination scores between groups ($\bar{x} \pm s$, points)

Group	Theoretical knowledge				Clinical diagnostic and therapeutic skills					Total score
	Pathogenesis of common geriatric diseases	Diagnosis and treatment guidelines for common geriatric diseases	Principles of rational drug use	Geriatric medicine guidelines and consensus statements	Medical history taking skills	Standardized physical examination	Analytical skills for auxiliary tests	Diagnostic and differential diagnostic skills	Rationality of treatment plans	
Control group (n = 32)	7.32 \pm 0.23	8.21 \pm 0.19	8.09 \pm 0.25	7.55 \pm 0.36	9.67 \pm 0.45	9.33 \pm 0.95	10.02 \pm 0.39	10.77 \pm 0.24	9.21 \pm 0.23	80.17 \pm 3.29
Observation group (n = 33)	8.76 \pm 0.17	9.02 \pm 0.04	8.78 \pm 0.12	8.34 \pm 0.15	10.75 \pm 0.45	10.31 \pm 0.44	10.65 \pm 0.78	11.02 \pm 0.36	10.72 \pm 0.53	88.37 \pm 3.04
<i>t</i>	28.767	23.954	14.254	11.612	9.674	5.363	4.099	3.284	14.818	10.441
<i>p</i>	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001

3.2. Comparison of teaching method approval between groups

Trainees in the observation group demonstrated significantly higher agreement than the control group regarding the teaching methods' effectiveness in enhancing learning interest, improving self-directed learning abilities, boosting comprehensive clinical problem-solving skills, strengthening patient communication skills, enhancing teamwork capabilities, and improving research conceptualization abilities. These differences were statistically significant ($p < 0.05$), as shown in **Table 3**.

Table 3. Comparison of teaching method approval between groups (trainees) [n(%)]

Group	Enhancing Learning Interest	Enhancing Self-Directed Learning Ability	Enhancing comprehensive ability to address clinical issues	Enhancing patient communication skills	Enhance teamwork skills	Enhance the ability to develop research concepts
Control group (n = 32)	21 (65.63)	22 (68.75)	23 (71.88)	24 (75.00)	22 (68.75)	23 (71.88)
Observation group (n = 33)	30 (90.91)	32 (96.97)	31 (93.94)	32 (96.97)	31 (93.94)	32 (96.97)
χ^2	6.146	9.202	5.626	4.861	6.848	6.049
<i>p</i>	0.013	0.002	0.018	0.028	0.008	0.014

4. Discussion

From a pathophysiological perspective, the degenerative changes in organ function among the elderly are often accompanied by multiple chronic conditions such as hypertension, diabetes, and coronary heart disease. These various diseases interact with one another, and their treatment plans constrain each other^[4]. This further complicates diagnosis and treatment, requiring geriatric clinicians not only to possess solid expertise in geriatric medicine but also strong clinical reasoning skills and comprehensive management capabilities for multiple coexisting conditions. This enables rapid identification of atypical symptoms in elderly patients and precise diagnosis through multi-system assessment^[5].

Currently, clinical teaching in geriatrics predominantly relies on traditional models centered on concentrated theoretical lectures, where instructors unilaterally deliver knowledge and trainees passively receive it. Under this teaching approach, which disconnects theory from clinical practice, trainees may grasp fundamental disease knowledge points. However, due to the lack of systematic cultivation of communication skills and teamwork abilities, trainees struggle to apply this knowledge flexibly in clinical practice. There is an urgent need to explore more efficient teaching methods ^[6]. Standardized patient scenario simulation teaching represents an innovative approach that deeply integrates standardized patients with scenario-based simulation. This method involves systematically training standardized patients to accurately simulate the typical clinical manifestations, psychological characteristics, and communication patterns of common geriatric diseases. Trainees then interact with these standardized patients in small groups to complete the entire clinical process, including history taking, physical examination, and treatment plan formulation, thereby effectively enhancing their clinical practice skills and clinical reasoning ^[7].

The study findings indicate that the observation group demonstrated significantly higher scores than the control group in both theoretical knowledge and clinical diagnostic/therapeutic competency assessments at the end of the course ($p < 0.05$). Furthermore, the observation group exhibited significantly higher levels of agreement than the control group regarding the teaching method's effectiveness in enhancing learning interest, independent learning ability, comprehensive clinical problem-solving skills, patient communication skills, teamwork capabilities, and research conceptualization abilities ($p < 0.05$). These findings confirm the effectiveness and applicability of this teaching method in geriatric medical education. First, the standardized patient scenario simulation method transforms abstract theoretical knowledge into concrete practical operations through highly realistic clinical scenarios. Through interactions with standardized patients, trainees deepen their understanding of disease fundamentals by integrating geriatric knowledge. During simulated consultations, physical examinations, and clinical decision-making, they not only reinforce foundational concepts but also achieve synergistic enhancement of theoretical internalization and practical skills through repeated practice ^[8]. Second, by creating a highly simulated and interactive feedback-rich learning environment, this method compels trainees to engage in dynamic “integration-differentiation-decision-making” thinking when confronting simulated patients. This approach trains them to comprehensively consider the coexistence of multiple conditions and the interplay of pathophysiology in geriatric patients, enabling differential diagnosis from complex symptoms and signs, thereby directly honing their clinical reasoning skills ^[9]. Finally, standardized patients not only simulate symptoms but also provide feedback from the “patient’s” perspective on trainees’ diagnostic and communication effectiveness. This enables trainees to develop more systematic and rigorous clinical thinking patterns through continuous reflection and adjustment of their diagnostic strategies and communication approaches ^[10].

5. Conclusion

In summary, the application of standardized patient scenario simulation teaching in geriatric medicine education demonstrates significant effectiveness, systematically enhancing trainees’ comprehensive competencies. To deepen educational reform, it is recommended to vigorously promote this model in subsequent work, expand its application scope, and thereby fully unlock its pedagogical potential to support the cultivation of high-caliber medical professionals.

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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

The Predictive Value of Combined Synthetic MRI Features and PSAD for Clinically Significant Prostate Cancer

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Abstract: *Objective:* To investigate the diagnostic and predictive value of MRI features combined with clinical indicators for prostate cancer (PCa) and clinically significant prostate cancer (csPCa), and to establish a non-invasive combined model. *Methods:* A total of 36 patients with pathologically confirmed benign lesions (44 foci) and 23 patients with PCa (49 foci), including 25 foci of csPCa and 68 foci of non-csPCa, were included. SyMRI quantitative maps and clinical indicators were collected, and 224 imaging features were extracted. The intra- and inter-group correlation coefficients (ICC) for each feature were calculated using intra- and inter-group correlation analysis, and features with an ICC > 0.75 were selected as stable features that could be reproducibly extracted. Independent predictors were screened using logistic regression to construct single and combined models, and the performance was evaluated using ROC curves. *Results:* Age, PSAD, PD map contrast, and T2 map joint entropy were significantly higher in the PCa group compared to the benign group, while the median ADC was significantly lower ($p < 0.05$). The above-mentioned indicators were significantly correlated with PCa and csPCa, and the diagnostic performance of the combined model was superior to that of a single MRI or clinical model. *Conclusion:* MRI features combined with PSAD can effectively differentiate PCa and predict csPCa, providing a non-invasive quantitative diagnostic basis for clinical practice.

Keywords: Prostate cancer; Prostate-specific antigen; Synthetic magnetic resonance imaging; Predictive value

Online publication: Dec 31, 2025

1. Introduction

Prostate cancer (PCa) is the second most common type of cancer among men worldwide. In 2020, over 1.4 million new cases of prostate cancer were reported, and it remains the fifth leading cause of cancer-related deaths in men^[1]. The monitoring and treatment approaches for PCa are closely related to the Gleason Grade Group (GG) classification. Clinically, prostate-specific antigen (PSA) screening has traditionally been used for prostate cancer

detection^[2]. Guidelines recommend PSA-based prostate cancer screening for men aged 50 and above, or those aged 45 and above with a family history of prostate cancer, after fully informing them of the screening risks^[3]. PSA is a glycoprotein expressed by prostate tissue. However, due to the relatively low sensitivity and specificity of PSA in detecting early-stage prostate cancer, pathology remains the gold standard for diagnosing PCa. To reduce unnecessary biopsies and overtreatment of low-grade prostate cancer, there is an urgent need for a non-invasive, rapid diagnostic approach.

Clinically, prostate cancer (PCa) with a Gleason Score (GS) of $\geq 3 + 4$, a tumor volume of $\geq 0.5 \text{ cm}^3$, or extracapsular extension is defined as clinically significant prostate cancer (csPCa)^[4]. csPCa is an aggressive and highly malignant tumor that requires a combination of multiple treatment modalities in clinical practice to improve patient survival rates. In contrast, clinically insignificant prostate cancer (CIPC), due to its slow growth rate and low malignancy, is recommended for active surveillance without the need for treatment in clinical settings^[5]. Early and accurate diagnosis of csPCa holds significant guiding importance for formulating treatment plans and predicting patient outcomes.

The Prostate Imaging Reporting and Data System (PI-RADS) is a standardized system for prostate MRI imaging and interpretation^[6,7]. However, the evaluation methods in PI-RADS are predominantly subjective, lacking objective quantitative indicators, and suffer from issues such as low positive predictive value, high false-positive rates, and poor reproducibility. Currently, the commonly used T1 mapping and T2 mapping sequence scans are time-consuming and prone to patient movement issues, making it difficult to promote their clinical application^[8].

In recent years, synthetic magnetic resonance imaging (synthetic MRI, SyMRI) technology has been introduced and applied in clinical settings. This technique enables the acquisition of multiple contrast images, such as T1 and T2, as well as absolute quantitative maps, through a single scan. Furthermore, the quantitative maps generated by this technology demonstrate good consistency with conventional quantitative relaxation techniques^[8]. Arita et al. also found that for clinically significant cancer and PI-RADS category 3 lesions, there were no significant differences in diagnostic performance between synthetic MRI and both biparametric MRI (bpMRI) and dynamic contrast-enhanced MRI (DCE-MRI) ($p = 0.11\text{--}0.79$)^[9]. Texture analysis involves studying the local characteristics, patterns of change, and distribution modes of pixel gray-level values by analyzing the grayscale information in digital images, thereby quantifying the heterogeneity of lesions. Using SyMRI quantitative maps for texture analysis holds promise in addressing the issue of weak reproducibility among different researchers and contributes to establishing diagnostic criteria for quantitatively predicting clinically significant prostate cancer (csPCa). This study aims to explore the diagnostic and predictive value of synthetic MRI texture features combined with PSA-related indicators, such as prostate-specific antigen density (PSAD), for prostate cancer and csPCa. The goal is to establish a non-invasive, quantitative combined predictive model that provides a more accurate basis for clinical diagnosis and treatment.

2. Materials and methods

2.1. General information

This study was approved by the Ethics Committee of the Third Affiliated Hospital of Anhui Medical University (Hefei First People's Hospital). Case data of patients who underwent prostate MRI examinations and obtained pathological results via surgery or biopsy from April 2024 to October 2025 were collected. The inclusion and exclusion criteria were as follows: corresponding pathological results were obtained after the MRI examination with an interval of no more than 3 months; all patients had preoperative serum PSA levels; none of them had

received radiotherapy, chemotherapy, endocrine therapy, or other relevant treatments prior to the MRI examination, nor had they undergone prostate biopsy within 6 weeks.

2.2. Instruments and methods

A GE SIGNA Architect 3.0 T magnetic resonance scanner was used, equipped with a 28-channel phased-array abdominal coil. The scanning sequences included axial, coronal, and sagittal T2-weighted imaging, axial T1-weighted imaging, axial DWI with b-values of 50 and 1400 s/mm², and axial SyMRI. SyMRI utilized a multi-dynamic multi-echo (MDME) sequence for imaging, which consisted of 2 echo times and 4 delay times, generating a total of 8 raw images. The scanning parameters are detailed in the following table. ADC maps were automatically generated from the DWI images on the scanner console. Post-processing of the MDME raw images was performed using software to generate quantitative maps of T1, T2, and PD (refer **Table 1**).

Table 1. The detailed acquisition parameters of the MRI sequences.

Parameters	T1WI	T2WI	DWI	Synthetic MRI
Sequence	Fast spin echo	Fast spin echo	spin-echo echo-planar	QRAPMASTER
Imaging plane	Axial	Axial, coronal, sagittal	Axial	Axial
Repetition time (msec)	7	4100,4200,5700	6400	4000
Echo time (msec)	7	88,92,102	80	14/92
Inversion time (msec)	-	-	120	170/670/1840/3840
Flip angle (degrees)	111	111,110,110	90	90
Slice thickness/gap (mm)	4/1	4/1,4/1,4/1	4/1	4/1
Field of view (mm)	300 × 300	240 × 240,280 × 280,240 × 240	240 × 240	300 × 300
Matrix (frequency × phase)	320 × 256	320 × 256,352 × 352,320 × 256	96 × 128	320 × 256
Number of excitation	1	2, 2, 2	12	1
Echo train length	4	20,18,30	-	16
Bandwidth (kHz)	83.33	83.33,41.67,62.5	250	50
b values (s/mm ²)	-	-	50/1400	-
Acceleration factor	2	2	2	2
Acquisition time (min: s)	01:39	02:05,02:15,01:57	04:10	04:32

T1WI: T1 weighted imaging; T2WI: T2 weighted imaging; DWI: diffusion weighted imaging; MRI: magnetic resonance imaging; QRAPMASTER: quantification of relaxation times and proton density by multi-echo acquisition of a saturation-recovery using turbo spin-echo readout

2.3. Image analysis

Post-process the raw images scanned by the SyMRI sequence on the host computer to generate quantitative maps of T1, T2, and PD. Based on the puncture site, manually delineate the region of interest (ROI) on the SyMRI quantitative images using ITK-SNAP software, and then register the SyMRI and DWI images. Copy the ROI to the registered DWI and ADC maps. Texture features are extracted from histograms, shape features, and gray-level co-occurrence matrices (GLCM), with a total of 224 features extracted.

2.4. Statistical method design

Statistical analysis is conducted using IBM SPSS 26.0 software. Measurement data are first evaluated for normality distribution using the Kolmogorov–Smirnov test: data conforming to a normal distribution are expressed as “mean \pm standard deviation”, and comparisons between groups are made using the independent samples *t*-test; data not conforming to a normal distribution are expressed as “median (interquartile range)”, and comparisons between groups are made using the Mann Whitney U test. Compare the characteristic differences between benign and malignant prostate lesions, as well as between csPCa and non-csPCa (including imaging features such as T1map_mean and T2map_mean, as well as clinical indicators such as age and PSAD).

Logistic regression analysis was employed, with the aforementioned 230 features (224 imaging features and 6 clinical indicators) serving as independent variables, and “whether it is prostate cancer” or “whether it is csPCa” acting as the dependent variables. Variables significantly correlated with the dependent variables were screened out, and independent predictors with statistical significance were retained. Based on the above analysis results, a combined predictive model integrating “MR features + clinical indicators” was constructed, alongside single MR feature and single clinical indicator models for comparison. Receiver Operating Characteristic (ROC) curve analysis was used to evaluate the diagnostic performance of each model, calculating the Area Under the Curve (AUC), 95% Confidence Interval (CI), sensitivity, specificity, and optimal diagnostic threshold. The DeLong test was utilized to compare differences in AUC among different models, with $p < 0.05$ indicating statistical significance.

3. Results

A total of 36 benign patients and 23 prostate cancer patients were ultimately included. Counting by lesions, there were 44 lesions in the benign prostate lesion group and 49 in the malignant group; based on whether it was csPCa, they were further divided into 25 lesions in the csPCa group and 68 in the non-csPCa group. All included cases were pathologically confirmed. The mean age was 68.52 ± 6.31 years in the benign group and 73.89 ± 8.15 years in the prostate cancer group, with a significant increase in age observed in the prostate cancer group. In addition, PSAD, PDmap_original_glcM_Contrast, and T2map_original_glcM_JointEntropy in the prostate cancer group were also significantly higher than those in the benign group, while ADC_original_firstorder_Median showed a significant decrease (**Table 2**).

Table 2. Comparison of baseline data between the two groups of patients

Variable	Benign group (n = 44)	Prostate cancer (n = 49)	<i>p</i> -value
Age (years)	68.52 ± 6.31	73.89 ± 8.15	0.021
PSAD (ng/mL ²)	0.18 ± 0.07	0.39 ± 0.15	< 0.001
ADC_original_firstorder_Median ($\times 10^{-3}$ mm ² /s)	1.42 ± 0.23	0.98 ± 0.19	< 0.001
PDmap_original_glcM_Contrast	12.35 ± 4.12	18.67 ± 5.83	0.003
T2map_original_glcM_JointEntropy	2.15 ± 0.68	3.42 ± 0.95	< 0.001

Among the 224 extracted imaging features, logistic regression analysis revealed that ADC_original_firstorder_Median exhibited an inverse trend with the occurrence of PCA. A decrease in its value suggested restricted diffusion of water molecules, consistent with the pathological characteristic of increased cellular density in cancerous lesions. Conversely, PSAD, PDmap_original_glcM_Contrast, and T2map_original_glcM_JointEntropy were

positively correlated with the occurrence of PCA. For clinically significant prostate cancer, we similarly found that Age, PDmap_original_glcM_Contrast, and T2map_original_glcM_JointEntropy were positively correlated with its occurrence, while ADC_original_firstorder_Median demonstrated an inverse trend (**Table 3**). This study has evaluated the predictive capabilities of these indicators using ROC curves and found that the predictive power of a single MRI indicator or clinical indicator was lower than that of the combined MRI model, and even lower than the combination of clinical and MRI indicators. This trend was consistent in diagnosing benign conditions versus PCA and determining whether the prostate cancer was clinically significant (**Figure 1**).

Table 3. Association analysis of key indicators with clinical subtypes

Group	Variables	OR	95%CI	p
Benign vs malignant differentiation	PSAD	1.46	1.00–1.74	0.041
	ADC_original_firstorder_Median	0.0008	0.00–0.39	0.037
	PDmap_original_glcM_Contrast	1.04	1.02–1.07	0.004
	T2map_original_glcM_JointEntropy	6.52	1.16–52.58	0.049
Clinical vs non-clinical subtype differentiation	Age	1.18	1.04–1.39	0.016
	ADC_original_firstorder_Median	2.09×10^{-6}	0.00–0.01	0.005
	PDmap_original_glcM_Contrast	1.05	1.02–1.10	0.006
	T2map_original_glcM_JointEntropy	1573.3	23.06–2006221.70	0.008

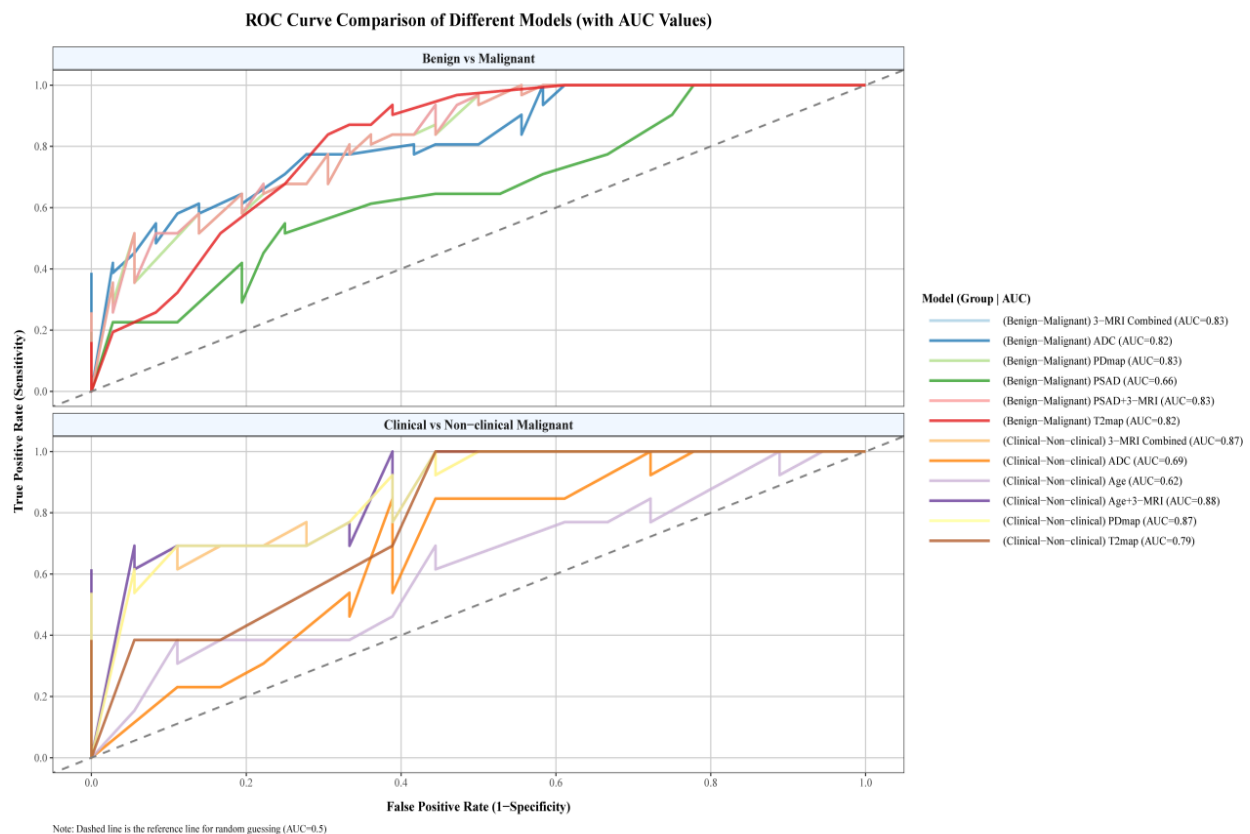


Figure 1. ROC curve comparison of different model (with AUC values).

4. Discussion

Prostate cancer is one of the most common malignant tumors in the male urinary system, with its epidemiology exhibiting significant characteristics of “age dependency” and “regional heterogeneity”^[10]. Globally, prostate cancer ranks second in incidence among male malignant tumors and rises exponentially with age, with a notable increase in incidence among men over 60 years old, reaching its peak in the 70–80 age group^[11]. The stratification of clinical significance in prostate cancer is one of the core focuses of current diagnostic and treatment decision-making, given its distinct epidemiological characteristics and biological behaviors. Clinically significant prostate cancer (CSPC) typically refers to cancerous lesions with a risk of clinical progression (such as a Gleason score ≥ 7 , large tumor volume, or capsular invasion), whereas non-clinically significant prostate cancer (non-CSPC) often presents as indolent lesions. These two types of prostate cancer differ fundamentally in terms of diagnostic and treatment strategies as well as prognosis^[12,13]. This study included 36 patients with pathologically confirmed benign prostatic lesions and 23 patients with prostate cancer. In terms of lesion distribution, benign lesions predominantly occurred in the transition zone, while malignant lesions were more common in the peripheral zone. This finding aligns perfectly with the epidemiological characteristic of prostate cancer being “predominantly peripheral zone-originating” and the pathological distribution characteristic of benign hyperplasia being “primarily transition zone-based”, providing a pathological basis for the rationality of lesion localization in subsequent radiomics analysis^[14–16]. From a clinical perspective, patients in the prostate cancer group were significantly older than those in the benign group, aligning with the epidemiological pattern of prostate cancer’s “age dependency”. As age increases, the risk of gene mutations in prostate epithelial cells accumulates, leading to a significantly higher likelihood of cancerous lesions. This further confirms the clinical significance of age as a risk factor for prostate cancer^[17].

In terms of imaging and derived omics parameters, the prostate cancer group exhibited significantly higher values of PSAD, PDmap_original_glcM_Contrast, and T2map_original_glcM_JointEntropy compared to the benign group, while ADC_original_firstorder_Median was notably lower. Among these, the increase in PSAD reflects the heightened antigen secretion due to abnormal proliferation of cancer cells, serving as a crucial derived indicator for breaking through the PSA diagnostic gray zone. The decrease in ADC values is directly related to restricted water molecule diffusion caused by high cellular density and narrow extracellular spaces in cancerous lesions, providing a core quantitative basis for diagnosing prostate cancer using magnetic resonance diffusion-weighted imaging (DWI)^[18]. The elevation in PDmap contrast and T2 map joint entropy essentially represents the microscopic structural characteristics of uneven cell proliferation within cancerous lesions, with a mixture of necrotic and proliferative areas, as reflected in the imaging texture features. This reveals the heterogeneity of tumor tissue from the perspective of texture omics. From the perspective of diagnostic performance, Receiver Operating Characteristic (ROC) curve analysis revealed that the model combining clinical indicators with multimodal MRI features had a significantly higher Area Under the Curve (AUC) compared to models based solely on a single MRI modality or purely clinical indicators. This result underscores the value of multidimensional integration of “clinical-radiomics”, clinical indicators provide risk stratification at the population level, while MRI diffusion and texture features enable precise localization and characterization at the microstructural level of the lesion. The combination of these two approaches effectively compensates for the information limitations of single modalities, offering more comprehensive decision support for the “early identification and risk stratification” of prostate cancer^[19].

5. Conclusion

In summary, through multidimensional analysis encompassing clinical, imaging, and radiomic data, this study not only validated the independent value of age, Prostate-Specific Antigen Density (PSAD), Apparent Diffusion Coefficient (ADC), and texture radiomic parameters in differentiating benign from malignant prostate lesions but also demonstrated, through a multi-model fusion strategy, the advantages of integrating “clinical-radiomics” for precise diagnosis of prostate cancer. This provides evidence-based support for optimizing the clinical diagnosis and treatment pathways for prostate cancer.

Disclosure statement

The authors declare no conflict of interest.

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Perioperative Nursing Experience of a Case with Intrauterine Device Ectopia to the Stomach

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Abstract: *Objective:* To summarize the perioperative nursing strategies of a patient undergoing laparoscopic retrieval and partial gastrectomy because of the gastric migration of an intrauterine device. *Methods:* The following individualized care strategies were implemented: preoperative psychological optimization using cognitive-behavioral counseling, modified bowel preparation, accelerated postoperative recovery through early ambulation and stepwise nutritional advancement, strict condition monitoring of the patient, multimodal step analgesia, early tube removal, integration of medical and nursing checkups, and nursing measures using traditional Chinese medicine. *Results:* The patient was discharged from the hospital smoothly after 8 days. A follow-up visit was conducted one-week post-discharge, during which the patient's general condition was assessed as good, and no complications were reported. *Conclusion:* The use of individualized nursing strategies has aided in the smooth postoperative recovery of patients with ectopic intrauterine devices while improving the quality and safety of nursing.

Keywords: Intrauterine device migration; Partial gastrectomy; Laparoscopic surgical procedures; Perioperative nursing

Online publication: Dec 30, 2025

1. Introduction

The intrauterine device (IUD) is a long-acting and highly effective contraceptive method, serving as one of the primary choices for women of reproductive age ^[1]. IUD migration refers to the displacement of the device from its normal position within the uterine cavity, with partial or complete embedding into the myometrium, or ectopic migration to the abdominal cavity, broad ligament, or other locations. Its incidence is approximately 1 in 2,500 cases ^[2]. Most patients with IUD migration are asymptomatic; however, some may present with pelvic pain, infection, intestinal obstruction, or urinary symptoms ^[3]. When the IUD migrates into the stomach, it may even lead to severe complications such as gastrointestinal bleeding.

In June 2025, our hospital admitted a patient with IUD migration into the stomach. The patient underwent laparoscopic gastrotomy for foreign body removal combined with partial gastrectomy. She was discharged after 8 days of hospitalization and demonstrated satisfactory recovery during a follow-up visit one week later. The perioperative nursing experience for this case is summarized as follows.

2. Case presentation

2.1. General information

The patient was a 37-year-old woman with a body mass index (BMI) of 19.65 kg/m². Her past medical history was unremarkable, with no known major illnesses. On June 29, 2025, she presented to the outpatient department of our hospital with a complaint of mild abdominal pain and distension for three days. An X-ray of the abdomen showed complete displacement of the intrauterine device. Transvaginal three-dimensional color Doppler ultrasound revealed a uterus of normal size, no IUD echogenicity within the uterine cavity, and a small amount of fluid in the Douglas pouch. Abdominal CT showed a dense T-shaped shadow in the middle abdomen, one end of which pierced the greater curvature of the gastric antrum into the gastric lumen, with slight fluid in both the uterine and pelvic cavity. A diagnosis of IUD migration was made. The patient was then admitted under the diagnosis of “displaced intrauterine device”.

All routine laboratory tests, including complete blood count, coagulation profile and serum human chorionic gonadotropin, were within normal limits. Bowel and bladder functions were normal since the beginning of symptoms; there was no abnormal bleeding from the vagina, menstruation was regular with a moderate flow, and there was no dysmenorrhea. Her last menstrual period was on June 15, 2025. The personal history revealed two prior cesarean sections in 2010 and 2016 performed at external hospitals, and insertion of a T-shaped IUD at a local facility in 2017, with no regular postoperative follow-up thereafter.

2.2. Treatment and outcome

On July 2, the patient underwent laparoscopic retrieval of the intra-gastric foreign body and partial gastrectomy under general anesthesia. Intraoperative exploration revealed no ascites, and a cesarean section scar was visible on the uterine surface. The IUD was found to have completely migrated: one end had penetrated the greater curvature of the stomach into the gastric cavity, while the other end was encapsulated by the omentum with granuloma formation. A portion of the dark IUD tail filament was freely suspended within the abdominal cavity. An ultrasonic scalpel was used to dissect and excise the omental and granulomatous tissues surrounding the IUD during surgery and to free the device. A gastrotomy was then performed with ultrasonic assistance for the retrieval of the IUD, which was confirmed to be intact upon retrieval. The gastric incision was stapled with a 60 mm linear stapler and further reinforced by continuous seromuscular suturing with 3–0 absorbable sutures. One abdominal drainage tube was placed adjacent to the gastrotomy site. Postoperative prophylactic antibiotics, fluid resuscitation, and nutritional support were given.

The patient’s vital signs had been stable since the operation. About 100 mL light reddish serosanguineous fluid had been drained from the abdominal tube; the wound dressing was clean and dry, and there was no bleeding from it. There was no abdominal pain, distension, or abnormal vaginal bleeding. On July 7 (the fifth day after the operation), the body temperature was normal, intestinal function had returned to normal, the incision showed primary healing, and thus all discharge criteria had been met. On July 14, one week after discharge, follow-up

through telephone communication revealed that diet, activity, and bowel and bladder functions were normal with no discomfort.

3. Nursing care

3.1. Psychological nursing

Due to the particularity of this condition, patients often feel a great psychological burden and a sense of stigma ^[4]. On admission, the patient's psychological status was evaluated by the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS); scores were 58 and 52 points, respectively, indicating mild anxiety and depression. Accordingly, a professionally trained "Sunshine Angel" psychological nursing team was assigned to intervene. Employing narrative nursing techniques, the patient was encouraged to express her inner concerns. The main stressors identified included a lack of understanding regarding the gastric migration of the IUD and fear of postoperative fertility impairment.

According to the findings, disease education and emotional support were given through individualized psychological intervention, as well as family-assisted "dual synchronized" counseling sessions. Moreover, the patient was guided into the MBSR exercises to decrease anxiety. On postoperative day 3, reassessment showed that there was a marked improvement in psychology; SAS and SDS dropped to 42 and 45, respectively, indicating that anxiety and depressive symptoms had been relieved.

3.2. Preoperative preparation

On the night before the operation, instruct the patient to take sodium phosphate powder orally for bowel preparation. Fasting was started six hours before the operation. Give the patient 400 mL of a 12.5% carbohydrate beverage 2–3 hours before the operation, which will facilitate the emptying of the small intestine and avoid jejunal content reflux into the abdominal cavity, thus reducing postoperative complications. Insert a routine nasogastric tube on the day of surgery and perform vaginal irrigation with 0.5% povidone-iodine solution. The skin preparation of the surgical site should be performed strictly, including shaving of abdominal hair and disinfection of the skin surface to prevent inadvertent injury of the skin and minimize the infection rate at the incision site.

3.3. Postoperative nursing care

3.3.1. Vital signs and condition monitoring

After arrival at the ward, there was a complete handover from the operating room to the ward nurses concerning vital signs, intraoperative medication, estimated blood loss, anesthesia status, and incision condition. Continuous electrocardiographic monitoring was maintained during the postoperative period to observe blood pressure, heart rate, respiration, and oxygen saturation until the stabilization of the patient. The abdominal dressing was closely watched for bleeding or seepage; symptoms such as abdominal pain, distension, nausea, or vomiting were monitored. The time of the first passage of flatus and defecation was noted to assess intestinal recovery, while vaginal bleeding was also observed. Abnormal findings should be promptly reported to the physician for immediate management.

3.3.2. Pain management

Intraoperative injection of liposomal bupivacaine to the incision site was performed at the end of surgery in order

to relieve postoperative wound pain. After surgery, a stepwise analgesic treatment regimen was followed; basic analgesia with intravenous flurbiprofen axetil 50 mg was administered every 12 hours. Additional medication included 50 mg of tramadol for breakthrough pain. In addition, dynamic pain assessments were performed by the nurses who recorded, every 4 hours, the degree of pain according to the Numerical Rating Scale, especially during physical activity. The aim was to keep the NRS score at ≤ 3 within the first 24 h after surgery.

3.3.3. Drainage tube management

The use of drainage tubes should be subjected to the principle of early removal to facilitate recovery. Intraoperatively, the nasogastric tube was removed before leaving the operating room. After returning to the ward, one urinary catheter and one abdominal drainage tube were retained. These should be fixed securely and correctly labeled to ensure their patency and prevent dislodgment. Observe and document drainage characteristics carefully, such as colors, volumes, and nature. According to the progress in recovery, when the patient regained full consciousness, the urinary catheter should be removed to restore spontaneous urination. The abdominal drainage produced approximately 100 mL of light blood-tinged fluid over the first three postoperative days, without signs of ongoing bleeding, intra-abdominal infection, or intestinal leakage; thus, the drainage tube was removed on postoperative day 3 ^[5].

3.3.4. Positioning, early ambulation, and rehabilitation exercises

Due to pneumoperitoneum during laparoscopic procedures, patients are prone to postoperative abdominal distension and transient ileus. Early mobilization facilitates the expulsion of residual intra-abdominal gas, relieves bloating, enhances gastrointestinal motility, promotes wound healing, and prevents complications such as deep vein thrombosis. Four hours after surgery, the patient's bed head was elevated to 30–45° and the foot end to 10–15°. After a 30-minute adaptation period, the position was adjusted to a semi-recumbent posture. The patient was encouraged to sit up and engage in mild activity that same evening for at least two hours. Beginning on postoperative day 1, under nursing supervision, the patient performed ankle pump exercises and ambulated four times daily for 15–20 minutes per session, with gradual increases based on tolerance. Respiratory exercises, including pursed-lip breathing, were scheduled three times daily, each consisting of ten repetitions ^[5].

3.3.5. Dietary care

Approximately 30 minutes after surgery, the patient was instructed to chew xylitol gum every two hours, three times daily, for about 15 minutes each time. Chewing mimics the act of eating, stimulating oral receptors and salivation, thereby promoting the recovery of gastrointestinal motility ^[6]. Once the patient regained full consciousness, small sips of water (about 10 mL) were permitted. In the absence of abdominal distension, pain, nausea, or vomiting, the diet was gradually advanced to normal food intake ^[7].

3.3.6. Application of traditional Chinese medicine nursing techniques

Traditional Chinese medicine (TCM) therapies were introduced postoperatively to enhance functional recovery. Acupressure on the Neiguan point (located two cun above the transverse wrist crease on the forearm) was performed at 0.5, 2, and 4 hours after surgery, each session lasting 15 minutes with tolerable pressure. Starting from postoperative day 2, Neiguan stimulation was performed three times daily. This approach facilitates meridian flow, harmonizes Qi and blood, and promotes intestinal peristalsis via neuro-reflex regulation ^[8].

Additionally, acupressure on the Taichong point (located at the depression anterior to the junction of the first and second metatarsal bones) was applied for 10 minutes twice daily for three consecutive days, effectively alleviating postoperative pain ^[9]. Herbal umbilical application was also employed by placing medicinal paste on the Shenque acupoint (navel), which stimulates meridian Qi flow and aids in preventing nausea, vomiting, and constipation, thereby facilitating gastrointestinal recovery ^[10].

3.3.7. Integrated physician–nurse ward round model

During hospitalization, an integrated physician–nurse ward round model was employed. In daily rounds, the primary nurse reported on the patient's vital signs, nursing diagnoses, assessments of his condition, and care needs to the attending physician. Based on this, the physician devised a daily treatment plan, while the nurse carried out targeted interventions: monitoring the condition, managing drainage, psychological support, and health education. This approach enhanced communication among medical staff, nursing personnel, and the patient, therefore making recovery more coordinated and effective ^[11].

4. Conclusion

The migration of an IUD into the stomach cavity is extremely rare in clinical practice ^[12]. In this case, the IUD likely perforated through the cesarean scar and gradually migrated into the gastric cavity. This study has performed laparoscopic minimally invasive surgery to remove the ectopic IUD foreign body and implemented a personalized perioperative nursing plan. This approach effectively ensured patient safety during the perioperative period, facilitated postoperative recovery, and reduced the risk of related complications.

According to relevant clinical guidelines, patients who have undergone IUD placement should be followed up at the time of their first menstrual period or within 3–6 weeks after insertion to promptly identify potential complications such as uterine perforation or device migration ^[13]. In clinical nursing practice, health education for women with IUDs should be strengthened, and they should be guided to attend regular follow-up examinations to enhance the safety and effectiveness of contraceptive use.

Disclosure statement

The authors declare no conflict of interest.

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Research on the Application of Humanized Nursing in Clinical Obstetrics and Gynecology Nursing

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Abstract: Clinical nursing in obstetrics and gynecology is far more than mere disease treatment and technical operations; it also carries profound humanistic care connotations. Through clinical practice analysis, this study systematically elaborates on the risks existing in clinical obstetrics and gynecology nursing, analyzes the importance of humanized nursing, and proposes corresponding application countermeasures. It is found that the application of the humanized nursing model in clinical obstetrics and gynecology nursing can effectively meet the physical, psychological, and social needs of patients, establish a harmonious nurse-patient relationship, and have positive clinical value in promoting the physical and mental rehabilitation of patients. It is worthy of extensive promotion and application in clinical practice.

Keywords: Humanized nursing; Clinical obstetrics and gynecology nursing; Application

Online publication: Dec 31, 2025

1. Introduction

With the progress of society and the improvement of people's health awareness, the requirements for clinical obstetrics and gynecology nursing are increasingly high. The concept of humanized nursing is gradually becoming an important means to improve the quality of obstetrics and gynecology nursing and enhance patient experience. It not only focuses on patients' physical needs but also pays attention to their psychological, emotional, and social needs, striving to provide patients with comprehensive and personalized high-quality nursing services^[1]. In the process of clinical obstetrics and gynecology nursing, there are many risk factors. These risks may not only affect the treatment effect and rehabilitation process of patients but also trigger nurse-patient disputes, causing negative impacts on the hospital's reputation and image. Therefore, in-depth exploration of the application countermeasures of humanized nursing in clinical obstetrics and gynecology nursing is of great significance.

2. Risks existing in clinical obstetrics and gynecology nursing

2.1. Risks in medical order implementation

In clinical obstetrics and gynecology nursing, the link of medical order implementation is high-risk. Some nursing staff are insufficiently prepared before executing medical orders, have an inadequate understanding of the content of medical orders, and even rush to operate without a solid grasp of the usage, dosage, and precautions of new drugs, which is likely to lay hidden dangers for treatment. For example, for some new obstetrics and gynecology drugs with complex mechanisms of action, if nurses use them for patients without sufficient learning, adverse reactions may occur, affecting the treatment effect. Delayed execution of medical orders is also a common problem. The condition of obstetrics and gynecology patients changes rapidly, especially in the process of maternal delivery, which may have sudden emergencies. If nurses fail to execute medical orders in a timely manner due to busyness, negligence, etc., such as failing to conduct necessary inspections or use oxytocin for mothers on time, it is very easy to delay the condition and threaten the lives of mothers and fetuses.

2.2. Medication risks

Drug storage is an important link in medication safety. In practical work, there are often problems of improper drug placement. Similar drugs (with similar names, packaging, dosage forms, etc.) are placed adjacent to each other, and special drugs are mixed with ordinary drugs, oral drugs with external drugs, which violates drug management regulations and increases the risk of medication errors. There are many hidden dangers in the process of liquid preparation. Some nurses fail to strictly abide by the three checks and seven verifications principle when preparing drugs, leading to problems such as incorrect dosage and wrong types; preparing too many drugs at one time for critically ill patients will cause waste when the condition changes suddenly. The dangers during infusion cannot be underestimated^[2]. If nurses do not make rounds in a timely manner, they cannot promptly find problems such as loose connection between the infusion tube and the needle, improper fixation of the needle, which will lead to drug leakage, local pain, and even tissue necrosis; inaccurate recording of execution time, wrong or missing signatures on infusion cards affect the completeness of medical records and condition tracking; incorrect patient identification leading to wrong infusion, and failure to take protective measures for light-sensitive drugs leading to failure, etc., will adversely affect the treatment.

2.3. Risks to patients and neonates

The professional level and sense of responsibility of nursing staff are directly related to the safety of patients and neonates. Some nursing staff lack professional knowledge and are unskilled in operations. When caring for mothers and neonates, they cannot detect abnormalities in a timely manner. For example, missing the diagnosis of congenital diseases during neonatal examinations, delayed handling when encountering emergencies such as neonatal asphyxia, unskilled rescue techniques, and insufficient preparation of equipment and drugs will seriously threaten the lives of neonates. Patients' own factors can also bring risks^[3]. Postpartum mothers are weak and inconvenient to move. If the ward floor is slippery, there are no anti-slip facilities, or there are no guardrails beside the bed, they are prone to accidents such as falls and bed falls. Some mothers may experience psychological problems such as depression after childbirth. If not guided in a timely manner, they may cause harm to themselves or their neonates. In addition, mothers and their families lack knowledge and experience in neonatal feeding and nursing. For example, incorrect feeding postures lead to neonatal choking and suffocation, and improper nursing methods cause skin damage and infection.

3. Importance of the application of humanized nursing in clinical obstetrics and gynecology nursing

3.1. Related to the life safety of mothers and children

In the clinical nursing work of obstetrics and gynecology, the life safety of mothers and neonates has always been the top priority, and humanized nursing plays an indispensable role in this key field. In the surgical link, humanized nursing is particularly important. Taking cesarean section as an example, nursing staff will carefully verify maternal information before the operation to ensure accuracy; strictly check and disinfect surgical instruments to ensure sterility^[4]. At the same time, they pay close attention to the maternal psychological state, understand their worries through gentle communication, detailed introduce the surgical process, anesthesia method, and postoperative precautions to reduce psychological burden; accompany them at all times during the operation, provide spiritual support and encouragement, make the mother feel warm and at ease, and provide guarantee for the smooth progress of the operation. In daily nursing operations, humanized nursing is also crucial. In terms of neonatal care, nursing staff must have a high degree of professional quality and sense of responsibility, patiently guide new mothers to adopt correct feeding postures to avoid choking; strictly control the water temperature when bathing neonates, move gently, and dry and keep warm in a timely manner after bathing. At the same time, closely observe the neonate's facial color, breathing, mental state, etc., and handle abnormalities in a timely manner to fully ensure the neonate's life safety.

3.2. Increasing awareness of rights protection in recent years

With the development of society and the enhancement of people's legal awareness, patients' awareness of rights protection is also constantly improving, which is particularly obvious in the field of obstetrics and gynecology. In this context, humanized nursing is crucial for reducing nurse-patient disputes. Respecting patients' rights and interests are the important embodiment of humanized nursing^[5]. Patients have the right to know about their condition, treatment plans, nursing measures, etc. Nursing staff should take the initiative to timely and detailed introduce relevant information to patients and their families, such as delivery methods, risks and coping measures, drug names, effects, usage, adverse reactions, etc., to ensure informed consent. At the same time, respect patients' right to privacy, pay attention to protecting private parts during nursing operations, such as pulling up the bed curtain during gynecological examinations, creating a private space, and making patients feel respected.

3.3. Improve nursing service quality and patient satisfaction

By comparing conventional nursing and humanized nursing, this study can clearly see the significant advantages of humanized nursing in improving nursing service quality and patient satisfaction. Conventional nursing focuses on completing basic nursing tasks and pays less attention to patients' psychological and emotional needs; while humanized nursing is patient-centered, taking into account physical, psychological, and social needs, and providing comprehensive and personalized services^[6]. In obstetrics and gynecology wards, nursing staff will formulate personalized plans according to the mother's situation. For example, primiparas lack childbirth experience and are under great pressure, so they are given more psychological support and childbirth knowledge guidance; for mothers with pregnancy complications, closely monitor the changes in their condition, strengthen nursing measures, and adjust treatment plans in a timely manner. In postpartum care, attention is paid not only to the mother's physical recovery but also to mental health, and problems such as postpartum depression are detected and handled in a timely manner.

4. Application countermeasures of humanized nursing in clinical obstetrics and gynecology nursing

4.1. Strengthen psychological nursing and care for physical and mental changes of mothers

In the prenatal stage, mothers often feel nervous and anxious due to the unknown of childbirth and worries about the health of the fetus. Therefore, nursing staff should establish close communication with them, understand their psychological worries, explain professional childbirth knowledge, and introduce some successful cases to enhance their confidence in childbirth. Nursing staff can carry out prenatal knowledge lectures, display childbirth scenes with pictures or videos, teach mothers breathing methods during childbirth, and reduce their fear; pay attention to listening to mothers' questions, provide emotional support for them, and let them cope with childbirth with a good attitude^[7]. In the postpartum stage, mothers have great physical and mental changes and are prone to psychological problems such as depression. Nursing staff should pay more attention to the changes in mothers' emotions, communicate with them more, timely guide mothers with depression, and suggest that their families seek help from professional psychologists if necessary. At the same time, encourage families to accompany mothers more and take care of the neonate together with them, reduce the burden on mothers, and allow them to recover their physical and mental health as soon as possible^[8].

4.2. Conduct emotional communication and convey warm care

In the process of communicating with mothers and their families, nursing staff should maintain a good attitude, answer their questions with a smile and a gentle tone, and make them feel warm care from the hospital. First, nursing staff should carefully listen to their voices. When mothers are admitted to the hospital, they should detailed introduce the ward environment and explain the hospital rules; accompany them in a timely manner during childbirth to provide sufficient spiritual support; take the initiative to ask about their diet and rest after childbirth, and try their best to meet their needs to establish a good nurse-patient relationship^[9]. Second, nursing staff should hold regular forums, distribute questionnaires to mothers and their families to collect their opinions and suggestions, and timely improve the problems that arise. Such good interaction can continuously optimize nursing work and improve the level of nursing services.

4.3. Provide scientific postpartum guidance to ensure the health of mothers and infants

Nursing staff should provide mothers with scientific postpartum guidance, focusing on different areas. First, strengthen guidance on physical recovery. Nursing staff should guide mothers to carry out scientific rehabilitation, such as postpartum yoga and pelvic floor muscle exercises, so that they can recover their physical functions as soon as possible. Postpartum yoga can relieve mothers' emotions, improve their flexibility and endurance, and promote recovery. Pelvic floor muscle exercises can also improve and prevent postpartum pelvic floor dysfunction, such as urinary incontinence and prolapse. Therefore, mothers should be detailed introduced to the methods, precautions, and frequency of postpartum exercises to ensure that they correctly perform postpartum exercises^[10]. At the same time, pay more attention to the wound healing of mothers, guide them to care for the wound correctly, clean and disinfect the wound scientifically, and prevent wound dehiscence; formulate a balanced diet plan for mothers and provide personalized suggestions according to their situation to promote their physical health. Second, provide scientific breastfeeding guidance. Nursing staff should guide mothers to adopt correct breastfeeding postures, encourage them to feed on demand, and improve the success rate of breastfeeding; for mothers with insufficient milk secretion, provide some massage methods and dietary conditioning methods to promote milk

secretion ^[11]. Third, provide neonatal care guidance. Nursing staff should teach some neonatal care knowledge, including breastfeeding knowledge, sleeping postures, touching methods, bathing knowledge, and umbilical cord care knowledge. For example, guide parents to correctly choose bottles for preparation, and tell them the relevant precautions when using bottle feeding; create a good sleeping environment for the child and guide the neonate to sleep regularly. Show parents the correct bathing posture, tell them the water temperature and sequence to pay attention to when bathing; inform parents that after disinfecting the baby's umbilicus, it should be kept clean and dry to prevent infection ^[12].

4.4. Conduct targeted health promotion to improve mothers' self-management ability

For mothers in different pregnancy stages, nursing staff should carry out different promotions. For mothers in the first trimester, promote physical changes and precautions, let them pay attention to rest and reasonably adjust their diet; for mothers in the second trimester, promote fetal development and precautions for fetal movement monitoring, let them pay more attention to observing fetal movement changes and choose appropriate coping methods; for mothers in the third trimester, promote delivery preparation and precautions for childbirth, let them make preparations for labor and postpartum ^[13]. For mothers with pregnancy complications, nursing staff should carry out special promotions to inform them of the hazards and treatment and control methods of different diseases. Provide guidance on food intake, reasonable exercise methods, and blood glucose monitoring methods for mothers with gestational diabetes, and teach them to correctly use drugs such as insulin to exert the therapeutic effect; for mothers with gestational hypertension, provide guidance on blood pressure monitoring, lifestyle adjustments, and dietary structure adjustments to avoid serious complications such as eclampsia. Targeted health education can improve mothers' understanding of diseases and their own regulation ability, ensuring the physical health of mothers and infants ^[14].

4.5. Optimize environmental management and provide a comfortable recovery environment

In terms of ward layout, nursing staff should focus on creating a comfortable ward environment to make mothers feel at home. For example, place green plants to add vitality to the ward; use soft lighting to avoid stimulation from strong light; post lovely posters related to mothers and infants, provide soft and comfortable pillows, and set up a special accompanying area for families, so that mothers can rest in a comfortable environment. In terms of ward environment management, strictly control the temperature and humidity in the ward, keeping the temperature constant at 22–24 °C and the humidity at 50–60%, which can provide a comfortable feeling for mothers and neonates and help their physical and mental health development. Nursing staff should regularly detect temperature and humidity indicators, and timely adjust them with air conditioning equipment and humidifiers to make the indoor temperature and humidity as close to the ideal range as possible. Also, ensure the safety of furniture and utensils. For example, regularly check the safety of hospital beds, tables and chairs, toilets, and toilets to ensure they can work normally without potential safety hazards. The guardrails of hospital beds should be firm to prevent mothers from falling, and chairs should be placed properly without blocking the passage; non-slip mats and handrails should be laid in toilets to prevent falls ^[15]. In addition, regularly maintain and maintain air conditioning facilities, televisions, water heaters, and other equipment to avoid electric shock accidents. Set prompt signs in prominent positions to advise mothers and their families to pay attention to safety.

5. Conclusion

In summary, humanized nursing plays a significant role in clinical obstetrics and gynecology nursing. In response to nursing risks such as medical order implementation, medication, and risks to patients and neonates, nursing staff should take measures such as psychological nursing, emotional communication, postpartum guidance, targeted health promotion, and environmental management to effectively reduce risks and improve nursing quality. Clinical obstetrics and gynecology nursing is related to the life safety of mothers and infants, meets patients' emotional needs, enhances nurse-patient trust, reduces nurse-patient disputes against the background of increasing awareness of rights protection, and significantly improves patient satisfaction. In subsequent work, nursing staff should continue to promote and improve humanized nursing, focus on improving their own professional quality and humanistic care ability, and promote the health of mothers and infants.

Disclosure statement

The author declares no conflict of interest.

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Research on the Implementation Strategies of Curriculum Ideological and Political Teaching Reform in Higher Vocational Gerontological Nursing Under the Background of Educational Digitalization

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Abstract: In recent years, with the advent of the era of educational digitalization, the curriculum ideological and political teaching of gerontological nursing in higher vocational colleges has ushered in new development opportunities. Under the background of educational digitalization, in addition to teaching students' professional knowledge and skills of gerontological nursing, teachers should also focus on improving their ideological and moral literacy, guiding students to establish correct values in their hearts, promoting their all-round development in a true sense, and thus cultivating them into gerontological nursing talents with exquisite medical skills and noble medical ethics. This will better meet the social demand for professional gerontological nursing talents and inject inexhaustible motivation into the development of the elderly care industry. In this regard, this paper first elaborates on the value implication of the curriculum ideological and political teaching reform of higher vocational gerontological nursing under the background of educational digitalization, and then puts forward effective implementation strategies for teaching reform, aiming to provide certain reference for relevant researchers and better improve the effectiveness of curriculum ideological and political education in higher vocational gerontological nursing teaching.

Keywords: Educational digitalization; Higher vocational education; Gerontological nursing; Curriculum ideological and political education; Teaching reform

Online publication: Dec 31, 2025

1. Introduction

With the advancement of educational digitalization, the integration of ideological and political education into the Gerontological Nursing curriculum in higher vocational colleges has gained renewed significance. This approach not only focuses on equipping students with professional knowledge and skills but also emphasizes the cultivation

of moral integrity and core socialist values. By fostering well-rounded development, it aims to produce nursing professionals who possess both technical excellence and ethical awareness, thereby addressing the growing societal demand for high-quality elderly care and supporting the sustainable development of the eldercare industry. This article explores the value of such curricular reforms under digitalization and proposes practical implementation strategies, offering insights for enhancing the effectiveness of ideological and political education in gerontological nursing instruction.

2. Value implication of curriculum ideological and political teaching reform in higher vocational gerontological nursing under the background of educational digitalization

2.1. Conducive to providing opportunities for teaching method innovation

Affected by traditional educational concepts, the teaching methods adopted by teachers are relatively single, resulting in students being in a passive learning state. With the application of educational digitalization technologies and means, teaching methods will be more diverse and flexible. For example, teachers can use virtual simulation technology to create scenarios of caring for Alzheimer's patients, which not only ignites students' learning enthusiasm but also allows them to experience real elderly care scenarios immersively, effectively enhancing their practical nursing abilities. At the same time, teachers will use big data analysis technology to collect and analyze students' learning data, accurately grasp the learning characteristics, progress, and needs of each student, and formulate personalized learning plans for them based on the analysis results, thereby helping students better understand and master gerontological nursing knowledge and effectively improve their elderly care skills^[1].

2.2. Conducive to the construction of digital curriculum resources

Under the background of educational digitalization, teachers will take the initiative to establish online teaching resource libraries, uploading elaborately produced teaching videos, courseware, case analyses, and other materials to the resource library. Students can learn at any time according to their own learning needs and time arrangements. These resources not only include theoretical knowledge explanations but also cover a large number of practical operation demonstrations, such as standardized processes of gerontological nursing skills and key points of nursing for common senile diseases, allowing students to learn gerontological nursing knowledge in an all-round way. At the same time, teachers will dynamically update curriculum resources. With the continuous development of the field of gerontological nursing and the continuous emergence of research results, the curriculum content needs to be updated in a timely manner. Through digital means, teachers can quickly integrate the latest industry information and research results into the curriculum resources, ensuring the timeliness and cutting-edge nature of the knowledge learned by students^[2].

2.3. Conducive to optimizing the teaching evaluation system

In the curriculum ideological and political teaching evaluation link of gerontological nursing, teachers can use educational digitalization technology to track and analyze students' learning processes and performances in real time and comprehensively. For example, through online learning platforms, teachers conduct in-depth analysis of students' online learning duration, online test scores, learning progress, etc., to accurately evaluate students' efforts and learning outcomes. In addition, teachers can use digital means to collect and analyze students' specific

performances in activities such as case analysis and group cooperation, comprehensively evaluating their problem-solving abilities and team collaboration abilities. At the same time, teachers will enrich the evaluation subjects, organizing students to conduct self-evaluation and group mutual evaluation through online learning platforms. Self-evaluation helps students reflect on and summarize their own shortcomings and gains, while group mutual evaluation can effectively develop students' critical thinking and self-management abilities^[3].

3. Implementation strategies of curriculum ideological and political teaching reform in higher vocational gerontological nursing under the background of educational digitalization

3.1. Innovate teaching methods and achieve informatization upgrade

Currently, the innovation of teaching methods and the informatization upgrade of teaching scenarios are the top priorities of the curriculum ideological and political teaching reform of gerontological nursing, as follows: First, apply VR and AR technologies. Teachers use VR technology to create virtual scenarios such as hospital elderly care wards and nursing homes, allowing students to personally carry out elderly rehabilitation training, daily care, etc., in the virtual scenarios. The VR system will also provide students with corresponding guidance and evaluation feedback in a timely manner, helping students improve their nursing skills and enhance their sense of humanistic care. AR technology can superimpose virtual nursing operation steps and related knowledge in real scenarios. When students perform practical operations wearing AR devices, they can see prompts such as precautions and nursing operation processes, continuously enhancing their learning experience^[4]. Second, use big data technology. Teachers use big data technology to collect learning data such as exam scores, homework completion quality, and academic progress, conduct in-depth analysis of students' learning needs and characteristics, formulate personalized learning plans suitable for them, and identify their existing deficiencies and problems based on their previous learning data, adjusting the curriculum ideological and political teaching plan of gerontological nursing in a targeted manner to improve teaching effectiveness. Third, introduce a blended teaching model. In the online teaching link, students independently learn theoretical knowledge of gerontological nursing through high-quality online teaching resources; in the offline teaching link, students internalize the mastered theoretical knowledge through case analysis and practical operations to improve their practical operation level. Moreover, in this process, teachers should also carry out ideological and political education, guiding students to learn to put themselves in others' shoes, enhancing their empathy, and leading them to establish correct professional ethics, thereby fundamentally improving the effectiveness of curriculum ideological and political education^[5].

3.2. Deepen school-enterprise cooperation and build digital curriculum resources

Higher vocational colleges should develop high-quality online open courses focusing on educational digitalization, take the initiative to establish in-depth cooperative relationships with elderly care institutions, geriatric hospitals, etc., and jointly develop digital gerontological nursing curriculum resources. These resources mainly consist of video resources, text resources, virtual simulation training project resources, etc. Among them, text resources include curriculum standards, teaching plans, courseware, teaching cases, and policy documents such as the "Vocational Skill Level Standards for Elderly Care" and the "Vocational Skill Level Standards for Dementia Elderly Care". Video resources mainly refer to micro-courses and online high-quality courses on gerontological nursing; virtual simulation training project resources mainly include daily care for disabled elderly, fall prevention

and first aid, cognitive function assessment and training for dementia elderly, etc. In addition, in terms of the construction of curriculum ideological and political resources, higher vocational colleges should not only deeply explore ideological and political education elements from three perspectives, family and country feelings, professional literacy, and humanistic literacy, in combination with the curriculum modules of gerontological nursing, and infiltrate them into the entire process of gerontological nursing teaching. At the same time, considering the limited classroom teaching time, relying on the construction of high-quality online open courses, independently design curriculum ideological and political resources for teachers and students to communicate and learn, regularly update, supplement, and improve the curriculum ideological and political resources to keep ideological and political education in line with the times. The ideological and political materials are close to national elderly care-related policies, the development of pilot cities for the long-term care insurance system in the province, elderly care enterprise culture, deeds of outstanding elderly care figures, etc., promoting the close integration of ideological and political education with gerontological nursing teaching, reflecting the breadth and depth of the course, cutting-edge disciplinary content, corresponding to teaching objectives, and continuously improving the effectiveness of gerontological nursing teaching^[6].

3.3. Build a virtual-real combined practice platform to enhance students' practical abilities

To better integrate curriculum ideological and political education into gerontological nursing teaching, teachers should take the initiative to establish a virtual-real combined practice platform, which consists of a virtual simulation laboratory and a clinical internship base. Among them, students can use the latest simulation technology in the virtual simulation laboratory to truly experience various work processes of elderly care. In the clinical training base, teachers need to guide students to think about how to integrate modern nursing concepts into elderly care work and how to provide high-quality services to patients. Specific measures are as follows: First, establish a virtual simulation system. Teachers can create a highly realistic virtual elderly care environment, allowing students to personally experience the gerontological nursing process in the virtual reality environment. This can not only enhance students' practical abilities but also continuously improve their professional ethics and judgment abilities^[7]. Second, construct a "VR training module for ethical decision-making in elderly care". Teachers use virtual reality technology to simulate moral decision-making dilemmas that may arise in the process of elderly care, such as 12 common scenarios including patients' resistance to acupuncture treatment. Students need to make decisions in each scenario, thereby exercising their understanding of moral and ethical issues and communication abilities. Third, set up clinical practice bases for elderly care. Establish physical practice bases for elderly care equipped with advanced nursing equipment and instruments. Students can perform actual operations in the bases, transforming theoretical knowledge into practical abilities. Fourth, jointly build "benevolent care stations" with communities. Through cooperation with communities and nursing homes, schools build "benevolent care stations", where students can work as volunteers to provide services such as moxibustion health care and medication advice. This not only improves students' practical abilities but also allows them to fully understand the great love of medical staff in practice.

3.4. Optimize the teaching evaluation system to accurately evaluate students' performance

Based on the background of educational informatization, teachers can optimize the teaching evaluation system from the following aspects: First, introduce diversified evaluation indicators. On the basis of the theoretical exam scores of gerontological nursing, introduce evaluation indicators such as team collaboration ability, the

development of professional ethics, and practical ability. For example, in the indicator of the development of professional ethics, conduct a comprehensive evaluation through students' performance in internship bases and patient feedback; in the practical ability indicator, in addition to evaluating whether students can skillfully operate various nursing skills, comprehensively evaluate their ability to flexibly respond to various emergencies. Second, introduce process evaluation. Teachers need to regularly evaluate students' participation in group discussions, homework completion quality, classroom performance, etc., and sort out and summarize students' online discussion activity, online learning duration, frequency of watching high-quality courses, etc., through online learning platforms, thereby systematically and accurately grasping students' learning performance. Moreover, it should be combined with final reports and final exams to ensure the effectiveness and comprehensiveness of evaluation results^[8]. Third, introduce diversified evaluation subjects. Self-evaluation can help students conduct in-depth reflection on their own growth and learning process, clarifying their shortcomings and advantages; group mutual evaluation can promote mutual learning and communication among students, encouraging them to actively learn from others' strengths. Teachers can also invite enterprise experts to participate in the evaluation. Enterprise experts can evaluate students' abilities and qualities from a professional perspective and put forward professional suggestions. In this way, by optimizing the teaching evaluation system, students can be evaluated more objectively and comprehensively, ensuring that they receive a more fair and impartial evaluation.

3.5. Strengthen the construction of teachers' teams and improve teachers' comprehensive literacy

First, higher vocational colleges should develop educational digitalization training courses according to their actual conditions. The training content mainly includes the application of data analysis tools, digital resource production skills, and the use of online teaching platforms. For example, develop training courses on micro-course teaching video production, facilitating teachers to produce micro-course videos of key knowledge points of gerontological nursing courses to fully mobilize students' learning enthusiasm; training on data analysis software can also be conducted to enable teachers to understand students' learning needs and problems by analyzing their learning data, thereby adjusting teaching strategies. Second, to improve the effect of the curriculum ideological and political teaching reform of gerontological nursing, teachers need to fully understand and personally practice the concept of curriculum ideological and political education, which requires them to thoroughly grasp this educational concept and clarify how to effectively implement the task of curriculum ideological and political construction in the teaching process of gerontological nursing. In this regard, higher vocational colleges should adopt diversified strategies to improve teachers' level of curriculum ideological and political education, such as seminars, workshops, and thematic symposia, enabling them to develop a deeper understanding of the connotation of curriculum ideological and political education, and thus better infiltrate curriculum ideological and political education into gerontological nursing teaching^[9]. Third, construct a sound incentive mechanism to encourage teachers to continuously strengthen their own abilities. Provide material rewards and commendations to teachers who excel in classroom innovation, scientific research innovation, and gerontological nursing clinical practice, such as issuing teaching innovation awards and providing promotion opportunities. At the same time, higher vocational colleges can set up special teaching reform funds to support teachers in actively promoting educational digitalization teaching reform projects, fully stimulating their enthusiasm and innovation. Through these measures, the overall level of teachers can be improved, and a team of teachers with innovative spirit and practical experience can be built, providing sufficient guarantee for the improvement of the quality of the curriculum ideological and

political teaching reform of gerontological nursing.

4. Conclusion

In summary, under the wave of educational digitalization, the curriculum ideological and political teaching reform of higher vocational gerontological nursing is an inevitable requirement of the times and a key measure to cultivate high-quality gerontological nursing talents. In this regard, higher vocational colleges can start with strategies such as innovating teaching methods to achieve informatization upgrade, deepening school-enterprise cooperation to build digital curriculum resources, building a virtual-real combined practice platform to enhance students' practical abilities, optimizing the teaching evaluation system to accurately evaluate students' performance, and strengthening the construction of teachers' teams to improve teachers' comprehensive literacy. Thus, the curriculum ideological and political teaching reform of gerontological nursing is bound to achieve more remarkable results, cultivating more moral and talented professional talents for China's elderly care industry.

Disclosure statement

The authors declare no conflict of interest.

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Exploration and Practice of the “Dual-Teacher Linkage” Collaborative Teaching Model in Internal Medicine Nursing Teaching

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Abstract: *Objective:* To address the problems of disconnection between teaching and practice, weak clinical thinking, and poor post adaptability of students in traditional internal medicine nursing teaching, explore the “dual-teacher linkage” collaborative teaching path, and improve teaching quality and students’ post adaptability. *Methods:* Two classes of nursing majors in Grade 2023 of our college were selected as research objects. The experimental group (100 students) adopted the “dual-teacher linkage” model (on-campus teachers + clinical experts) to build a “pre-class co-research–in-class co-guidance–post-class co-evaluation” system; the control group (98 students) adopted traditional teaching. Comparisons were made after one semester of practice. *Results:* The average score of the comprehensive assessment in the experimental group was 85.6 points (76.3 points in the control group, $p < 0.05$). The clinical decision-making ability, program improvement ability, and post competence evaluation of the experimental group were all superior to those of the control group, and 93.3% of students were satisfied with this model. *Conclusion:* The “dual-teacher linkage” model can organically unify knowledge transmission and ability training, and is an effective and innovative practice to deepen the reform of internal medicine nursing teaching and cultivate high-quality skilled nursing talents.

Keywords: Dual-teacher linkage; Internal medicine nursing; Teaching reform; Collaborative teaching; Nursing education

Online publication: Dec 31, 2025

1. Introduction

Internal medicine nursing, as a core course for nursing majors, covers nursing knowledge of multiple system diseases such as respiratory, circulatory, and digestive systems, and has both theoretical and practical characteristics. Its teaching quality is directly related to whether nursing students can possess solid professional abilities to meet the needs of clinical nursing positions. However, the current traditional internal medicine nursing teaching model faces many challenges, with prominent disconnection between teaching and practice, which seriously affects the quality of talent training^[1]. In traditional teaching, although on-campus full-time teachers

are familiar with the teaching syllabus and theoretical knowledge system, their clinical practice experience and clinical thinking are difficult to effectively form. During the teaching process, most teaching cases rely on textbooks, which have gaps with actual clinical scenarios; students passively accept theoretical knowledge in class, lacking experience in analyzing and handling real clinical cases. As a result, when entering clinical internships, facing complex and changing patient conditions and diverse nursing needs, they often feel at a loss, have a long post adaptation period, and are difficult to quickly competent in nursing work^[2]. With the deepening of nursing education reform, the “dual-qualified” teaching concept has gradually attracted attention^[3]. The “dual-teacher linkage” collaborative teaching model breaks the barrier between on-campus full-time teachers and clinical experts, organically combines their advantages, and provides new ideas for solving the pain points of traditional teaching^[4]. This study takes nursing students of our college as the research object to explore the application of the “dual-teacher linkage” collaborative teaching model in internal medicine nursing teaching, aiming to improve teaching quality and cultivate high-quality skilled nursing talents meeting clinical needs.

2. Construction and practice of the “dual-teacher linkage” collaborative teaching model

2.1. Establish a professional “dual-teacher” teaching team

To ensure the effective implementation of the “dual-teacher linkage” model, a professional teaching team was first established. On-campus full-time teachers were selected who have more than 5 years of internal medicine nursing teaching experience, are familiar with the laws of nursing vocational education, and have good communication and coordination abilities; clinical nursing experts were selected from cooperative Grade A tertiary hospitals, requiring more than 10 years of internal medicine clinical nursing work experience, intermediate or above professional titles, certain expertise in the field of clinical nursing, love nursing education, and be proficient in teaching methods such as case teaching and scenario simulation.

After the team was established, special training and exchange activities were carried out. Organize on-campus teachers to conduct clinical practice learning in cooperative hospitals to update clinical knowledge and skills; invite clinical experts to participate in on-campus teaching seminars to familiarize themselves with the nursing professional talent training program, teaching syllabus, and teaching schedule, ensuring that the “dual teachers” reach a consensus on teaching goals and teaching content, laying a foundation for subsequent collaborative teaching^[5].

2.2. Build a three-dimensional teaching system of “pre-class co-research–in-class co-guidance–post-class co-evaluation”

2.2.1. Pre-class co-research: Clarify teaching goals and integrate teaching resources

Before the teaching of each chapter, on-campus full-time teachers and clinical nursing experts jointly carry out teaching and research activities. First, based on the nursing professional talent training goals, internal medicine nursing teaching syllabus, and combined with clinical post needs, clarify the knowledge goals, ability goals, and quality goals of the chapter. For example, in the teaching of the chapter “Nursing of Patients with Heart Failure”, the knowledge goal is set to master the etiology, clinical manifestations, and nursing measures of heart failure, the ability goal is set to be able to conduct condition assessment and nursing operations for patients with heart failure, and the quality goal is set to cultivate students’ humanistic care spirit and teamwork awareness.

Second, jointly integrate teaching resources. On-campus teachers provide theoretical teaching materials such as textbooks and courseware, while clinical experts share real clinical cases (such as emergency nursing cases of patients with acute left heart failure, long-term nursing cases of patients with chronic heart failure), clinical nursing operation videos (such as intravenous infusion, use of electrocardiographic monitors, etc.), and the latest nursing standards (such as updated content on heart failure nursing in the Clinical Nursing Practice Guidelines). These resources are integrated to form case libraries, courseware, and practical training manuals that meet the needs of “dual-teacher linkage” teaching, ensuring that teaching content is closely connected with clinical practice.

2.2.2. In-class co-guidance: Realize “classroom as ward, teaching as practice”

In the classroom teaching process, on-campus full-time teachers and clinical nursing experts carry out teaching activities collaboratively in accordance with the pre-determined teaching plan, realizing the in-depth integration of “classroom as ward, teaching as practice”.

In the theoretical knowledge explanation link, on-campus teachers build a systematic theoretical framework based on textbooks, and clearly explain the etiology, pathogenesis, clinical manifestations, and nursing diagnosis of internal medicine diseases combined with multimedia courseware. During the explanation, clinical experts intervene at the right time to share real cases based on their own clinical experience. For example, when explaining “Nursing of Patients with Myocardial Infarction”, clinical experts talk about emergency rescue cases of patients with acute myocardial infarction encountered in the hospital, describing the patient’s symptoms, the doctor’s diagnosis process, and the cooperation of the nursing team, allowing students to intuitively feel the actual clinical scenario and deepen their understanding of theoretical knowledge.

In the practical teaching link, a combination of scenario simulation and case analysis is adopted. Use on-campus simulated wards and simulated equipment (such as electrocardiographic monitors, defibrillators, etc.) to create clinical scenarios, such as “emergency nursing scenario for patients with upper gastrointestinal bleeding” and “rescue scenario for patients with diabetic ketoacidosis”. Clinical experts play the roles of patient family members or doctors, on-campus teachers play the role of nursing preceptors, and students are divided into groups to play nurses for nursing operations and condition disposal. During students’ operations, the “dual teachers” provide joint guidance: on-campus teachers focus on the standardization and accuracy of students’ operations, such as the technique of intravenous puncture and the process of aseptic operation; clinical experts focus on students’ clinical thinking and emergency response capabilities, such as whether students can adjust nursing measures in a timely manner according to changes in the patient’s condition, and whether they can quickly respond and take correct rescue measures when encountering emergencies (such as the patient going into shock).

2.2.3. Post-class co-evaluation: Diversified evaluation to promote teaching improvement and student development

Post-class evaluation is an important link of the “dual-teacher linkage” collaborative teaching model. Through diversified evaluation methods, it comprehensively assesses students’ learning effects, reflects on the teaching process, and promotes teaching improvement.

In terms of student evaluation, a combination of process evaluation and summative evaluation is adopted. Process evaluation includes students’ classroom performance (such as enthusiasm in participating in case discussions, performance in scenario simulation operations) and completion of after-class assignments (such as nursing case analysis reports, nursing plan design); summative evaluation is the final comprehensive assessment,

which is divided into theoretical assessment and skill assessment. The theoretical assessment is jointly set by the “dual teachers”, focusing on assessing students’ mastery of internal medicine nursing theoretical knowledge and knowledge application ability, with question types including multiple-choice questions, short-answer questions, and case analysis questions; the skill assessment adopts the scenario simulation assessment method, with the “dual teachers” serving as examiners to comprehensively score students based on the standardization of operations, clinical thinking ability, communication ability, etc.

In terms of teaching reflection and improvement, the “dual teachers” jointly summarize and reflect on the teaching process. Analyze problems existing in the pre-class co-research and in-class co-guidance links, such as whether the connection of teaching content is smooth, whether the teaching methods are suitable for students, and whether the cooperation between the “dual teachers” is tacit; adjust the teaching plan and teaching resources according to the student evaluation results and feedback opinions, such as updating the case library, optimizing teaching methods, and strengthening the collaborative cooperation between the “dual teachers” in classroom teaching, to continuously improve teaching quality.

3. Results

Two classes of nursing majors in Grade 2022 of our college were selected as research objects. The experimental group (100 students) adopted the “dual-teacher linkage” collaborative teaching model, and the control group (98 students) adopted the traditional teaching model for one semester of internal medicine nursing teaching practice. After the practice, the teaching effect was evaluated through comprehensive assessment, questionnaire survey, etc., and the specific results are as follows.

3.1. Significant improvement in students’ comprehensive assessment scores

The final comprehensive assessment scores (average of theoretical assessment scores and skill assessment scores) of students in the experimental group were significantly higher than those in the control group. The average comprehensive assessment score of the experimental group was 85.6 points, and that of the control group was 76.3 points, with a statistically significant difference ($p < 0.05$). In terms of assessment content, students in the experimental group performed particularly well in case analysis questions and scenario simulation skill assessments, being able to proficiently use theoretical knowledge to analyze clinical problems, formulate scientific and reasonable nursing plans, and perform nursing operations standardizedly with certain clinical thinking ability. However, students in the control group performed relatively weakly in these aspects, and some students were unable to effectively combine theoretical knowledge with clinical practice.

3.2. Improvement in students’ clinical decision-making ability, critical thinking, and post competence

Through questionnaire surveys and evaluation of clinical internship performance, it was found that students’ clinical decision-making ability, critical thinking, and post competence in the experimental group were significantly improved. In terms of clinical decision-making ability, 85.3% of students in the experimental group could quickly make correct nursing decisions when the patient’s condition changed, compared with only 56.7% in the control group; in terms of critical thinking, 78.9% of students in the experimental group could put forward reasonable improvement suggestions for clinical nursing plans, compared with 42.2% in the control group;

in terms of post competence, the evaluation of students in the experimental group by hospital preceptors was significantly higher than that of the control group, believing that students in the experimental group could adapt to clinical nursing work faster, independently complete nursing operations, and have stronger communication and collaboration abilities with patients and medical staff.

3.3. High student satisfaction with the teaching model

A satisfaction survey on the “dual-teacher linkage” teaching model was conducted among students in the experimental group. The results showed that 98.3% of students were satisfied or very satisfied with this teaching model. Students reported that the “dual-teacher linkage” model made classroom teaching more vivid and interesting. The real cases and practical experience shared by clinical experts helped them better understand theoretical knowledge and experience clinical work scenarios in advance; teaching methods such as scenario simulation and group discussions improved their learning enthusiasm and practical ability, laying a good foundation for subsequent clinical internships and employment.

4. Discussion

4.1. Advantages of the “dual-teacher linkage” model

Solve the problem of disconnection between “teaching” and “practice” in traditional teaching. In traditional internal medicine nursing teaching, on-campus teachers are disconnected from clinical practice, leading to inconsistency between teaching content and clinical needs. The “dual-teacher linkage” model integrates real clinical cases, the latest nursing standards, and cutting-edge technologies into the teaching process through the collaborative cooperation between on-campus teachers and clinical experts, realizing the in-depth integration of theoretical teaching and clinical practice. Students can be exposed to actual clinical content in class, effectively solving the problem of disconnection between “teaching” and “practice” and shortening the adaptation period of students from school to clinical practice^[6].

Improve students’ comprehensive abilities. In the process of “dual-teacher linkage” teaching, through various teaching methods such as case teaching, scenario simulation, and group discussions, as well as the joint guidance and evaluation of the “dual teachers”, students not only master solid internal medicine nursing theoretical knowledge and operational skills but also cultivate their clinical thinking ability, critical thinking ability, emergency response ability, and teamwork ability, comprehensively improving students’ comprehensive quality and post competence, which meets the needs of nursing professional talent training^[7].

Promote teachers’ professional development. For on-campus full-time teachers, through cooperation and communication with clinical experts, they can timely understand the latest trends and development trends in the field of clinical nursing, update their clinical knowledge and skills, and improve their practical teaching ability; for clinical nursing experts, participating in the teaching process helps them summarize clinical experience, transform practical experience into teaching resources, and improve their teaching ability and scientific research ability. The “dual teachers” learn from each other and make progress together in the process of collaborative teaching, realizing a win-win situation in teachers’ professional development^[8].

4.2. Problems and improvement directions in the practice process

In the practice process of the “dual-teacher linkage” collaborative teaching model, some problems have also

been found. First, due to busy work, some clinical experts have difficulty ensuring time for pre-class co-research and post-class co-evaluation, affecting the collaboration efficiency of the teaching team; second, the collaborative cooperation between the “dual teachers” in classroom teaching needs to be further strengthened, and some classrooms have problems such as inconsistent teaching rhythm and unsmooth connection of teaching content; third, the teaching evaluation system needs to be further improved. In process evaluation, the evaluation indicators for students’ clinical thinking and professional literacy are not detailed enough, making it difficult to comprehensively and accurately assess students’ comprehensive abilities ^[9].

To address the above problems, improvements will be made in the following aspects in the future: first, establish a more perfect cooperation mechanism with cooperative hospitals, reasonably arrange the teaching time of clinical experts, and provide guarantees for their participation in teaching activities; second, strengthen the communication and collaboration between the “dual teachers” in the teaching process, unify teaching rhythm and teaching ideas through regular teaching seminars and collective lesson preparation activities, and improve the collaborative effect of classroom teaching; third, further optimize the teaching evaluation system, refine process evaluation indicators, and introduce diversified evaluation subjects (such as students, hospital preceptors, etc.) to ensure the comprehensiveness and accuracy of evaluation results ^[10].

5. Conclusion

The “dual-teacher linkage” collaborative teaching model realizes the complementary advantages of on-campus full-time teachers and clinical nursing experts by building a three-dimensional teaching system of “pre-class co-research–in-class co-guidance–post-class co-evaluation”. It effectively solves the problem of disconnection between “teaching” and “practice” in traditional internal medicine nursing teaching, significantly improves students’ clinical decision-making ability, critical thinking, and post competence, and has been highly recognized by students. This model organically unifies knowledge transmission and ability training, provides an effective path for deepening the reform of internal medicine nursing teaching and cultivating high-quality skilled nursing talents, and has important popularization and application value. In the future nursing education and teaching, the application of the “dual-teacher linkage” model in other nursing professional courses can be further explored, and the model content and implementation strategies can be continuously improved to promote the high-quality development of nursing vocational education.

Funding

“Research on Improving Clinical Thinking Practice of Higher Vocational Nursing Students in Internal Medicine Nursing Through Digital Narrative Education from the Perspective of New Quality Productive Forces” (Project No.: Y202507)

Disclosure statement

The authors declare no conflict of interest.

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Teaching Practice of Integrating Craftsmanship Spirit into “Comprehensive Nursing Training” for Higher Vocational Nursing Students

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Abstract: With social development, people have increasingly high requirements for the quality and demand of medical and health care, which requires medical colleges to continuously improve the training quality of medical and nursing talents to meet social needs. Nursing education is a key link in cultivating nursing professionals and craftsmanship spirit is a very important aspect of nursing education, reflecting nursing staff's love for work and pursuit of excellence. This study explores integrating craftsmanship spirit into the teaching of “Comprehensive Nursing Training” for higher vocational nursing students, aiming to drive overall improvement, cultivate students' professional abilities, professional literacy, and core competitiveness, and contribute to cultivating high-quality skilled talents.

Keywords: Craftsmanship spirit; Higher vocational nursing students; Teaching practice

Online publication: Dec 31, 2025

1. Introduction

As a key component of professional spirit, craftsmanship spirit emphasizes qualities such as pursuit of excellence, dedication, innovation, and creativity ^[1,2]. By cultivating craftsmanship spirit, nursing students can enhance their sense of innovation and practical ability, providing better support and services for future nursing work. Therefore, this study have formed and strengthened the “craftsmanship spirit” in the preparation and competition process of vocational college skills competitions, and at the same time, taken the “Comprehensive Nursing Training” course as a carrier to pass on the craftsmanship spirit to every ordinary student in daily education and learning, cultivating excellent successors for the nursing cause.

2. Current situation of integrating craftsmanship spirit into higher vocational “comprehensive nursing training” teaching

2.1. Lack of standardization and systematicness in craftsmanship spirit learning

Relevant studies have found that some teachers have a biased understanding of the training goals of nursing

professionals. In the teaching of “Comprehensive Nursing Training”, they focus on skill operations. In activities such as virtual simulation, operation demonstrations, and skill training carried out for learning, they emphasize the application of knowledge and skills, but lack clear requirements for the cultivation of professional spirit and moral literacy, as well as standardized and systematic teaching methods. There is a lack of collective research on standardized lesson preparation and integration methods for craftsmanship spirit.

2.2. Superficial understanding of craftsmanship spirit

Most scholars believe that craftsmanship spirit is a kind of professional spirit, a professional value orientation and behavioral performance of practitioners, embodying professional ethics, professional abilities, and professional qualities ^[3]. Some teachers in higher vocational colleges fail to fully analyze it in combination with specific professional and curriculum content, directly applying the connotation of craftsmanship spirit determined from a macro perspective. This leads to both the integration of craftsmanship spirit and students’ understanding of it remaining superficial and rigid, resulting in low acceptance and internalization among students.

2.3. Imperfect curriculum teaching evaluation system

At present, the evaluation of curriculum teaching, especially the practical module, is difficult to quantify, with non-standard evaluation criteria and distorted assessment methods for practical teaching. In most cases, the assessment of practical teaching is conducted by teachers through summative evaluation at the end of the semester, and the results are taken as the final assessment scores for students’ various operations. This assessment focuses on the proficiency of students’ operations, fails to connect with clinical positions, cannot fully and truly reflect students’ application of theoretical knowledge, actual level of various operations, and comprehensive professional quality, and is even less able to guide students to pursue excellence in operational skills ^[4].

3. Necessity of integrating craftsmanship spirit into higher vocational “comprehensive nursing training” teaching

Vocational colleges shoulder the responsibility of cultivating high-quality technical and skilled talents, and should pay attention to the cultivation of craftsmanship spirit throughout the education process ^[5]. The curriculum design of “Comprehensive Nursing Training” adheres to an employment-oriented and ability-based approach, closely centers on the training goals of nursing talents, and organically integrates courses according to professional characteristics, forming a curriculum system with the characteristics of vocational and technical talent training and adapting to nursing majors. Teaching practice has found that vocational nursing students have a low awareness and understanding of craftsmanship spirit, and even less understanding of the relationship between craftsmanship spirit and nursing services. At the same time, students’ learning autonomy and consciousness are low. Some students’ learning motivation is mainly to obtain academic qualifications, with low professional interest and recognition ^[6]. They lack the patience and perseverance to repeatedly practice detailed nursing operations, as well as teamwork spirit, service awareness, and innovative spirit. This indicates that integrating craftsmanship spirit into nursing teaching is extremely urgent. With the development of modern medical models, nursing practice has put forward higher requirements for nursing talents. Nursing services have gradually shifted to diversified health services. To adapt to the new nursing service model and meet the market demand for nursing talents in modern society ^[7].

4. Exploration of paths for integrating craftsmanship spirit into higher vocational “comprehensive nursing training” teaching

4.1. Pre-class: Stimulate internal motivation and lay a cognitive foundation

4.1.1. Carefully design teaching goals and clarify the direction of craftsmanship spirit cultivation

When formulating practical teaching goals, this study does not only focus on skill mastery (such as venipuncture, aseptic technology, etc.) but also integrate core elements of craftsmanship spirit such as rigor, meticulousness, responsibility first, and continuous improvement. This study required students to meet the standards of skills competitions, clarifying that practical training is not only technical training but also a process of shaping professional attitudes and values.

4.1.2. Introduce model education and stimulate professional identity

Before class, through videos, cases, lectures, and other forms, introduce the deeds of excellent nurses and Nightingale Award winners to students, guiding them to think: What makes a truly good nurse? Stimulate students' reverence and sense of mission for the nursing profession. Invite outstanding graduates of the school to share their personal insights on engaging in the nursing profession before class, helping students establish a correct professional outlook.

4.1.3. Preview on the Xuexitong platform to cultivate independent learning and rigorous attitudes

With the development of science and technology, digital teaching models have emerged as the times require. By integrating multimedia resources, online course platforms, and virtual simulation technology, they have brought unprecedented flexibility and richness to nursing education ^[8]. Relevant operations have been uploaded to the Xuexitong platform in the form of cases before class, including operation standards, videos, cases, preview task lists, etc., to help students clarify classroom tasks and cultivate their learning attitudes of active exploration and pursuit of accuracy, which is the foundation of craftsmanship spirit.

4.2. In-class: Multi-dimensional penetration and cultivation of craftsmanship spirit in practice

4.2.1. Strengthen standard awareness and pursue operational accuracy

Relevant operation standards have been issued to each student before class. Group leaders lead team members to supervise each other, strictly requiring students to perform every operation in accordance with clinical operation specifications and competition standards, emphasizing “doing it right once and doing it well every time”. Every detail in the operation (such as hand hygiene, sterile area management, patient position, etc.) is required to be pursued to excellence, cultivating students' professional attitude of “zero errors”. Students can combine theoretical knowledge with practical operations, master basic nursing skills, and form correct professional attitudes and values ^[9].

4.2.2. Implement “process evaluation + reflection and improvement” to cultivate the awareness of continuous improvement

Teaching evaluation is a key link in teaching reform ^[10]. In class, a combination of “teacher evaluation + peer evaluation + self-evaluation + clinical instructor evaluation” is adopted. It not only focuses on the operation results but also reflects humanistic care through attitudes, behaviors, and language expressions, making patients feel respected and valued, thereby realizing value guidance for students ^[11]. Objective scoring standards are used

instead of subjective ones for evaluation. Timely comments are given after operations, encouraging students to reflect after operations: Where can I do better? Have I truly put the patient at the center? Through continuous “summary—reflection—improvement—retraining”, both skills and literacy are enhanced.

4.2.3. Construct scenarios with the combination of virtual and real to strengthen sense of responsibility

The construction of real resources should not stay in the idea of a “skill operation field” but should shift to the functional goal of a “post scenario simulation center”^[12]. Based on the virtual simulation experimental teaching platform, an experimental teaching system of “real-person practice + model assistance + virtual solidification” has been created, forming a diversified practical teaching model. It improves the interactivity, situationally, and immersion of experimental teaching, which is conducive to cultivating students’ practical ability, hands-on ability, and innovative ability. Practical training scenarios close to clinical reality (such as first aid, intensive care, geriatric care, etc.) are set up in advance before class, allowing students to exercise calm, meticulous, and responsible professional qualities in complex scenarios. Standardized patients are trained before class, taking turns to be patients, and real scenario simulations are conducted in class to guide students to think from the patient’s perspective, enhancing their sense of responsibility and empathy.

4.2.4. Teachers’ demonstration and guidance to convey craftsmanship attitude

Teachers impart not only skills but also the craftsmanship spirit of responsibility, perseverance, patience, dedication, and pursuit of excellence, which inspires countless dreamers to forge ahead^[13]. In the demonstration session, guided by the standards of skills competitions, we strive for precision and standardization. From the standardized holding of instruments to the precise control of details, the entire process is clearly demonstrated and carefully disassembled, allowing students to intuitively feel the “standard scale”. Teachers integrate rigorous and meticulous professional attitudes and the spirit of striving for excellence into every link, and integrate humanistic care into practical scenarios in a subtle way, fully demonstrating the temperature and professionalism of the nursing profession. Taking themselves as examples, teachers become perceptible and learnable “craftsman models” in students’ hearts with standardized skills, rigorous work style, dedicated original aspirations, and humanistic care, not only imparting professional skills but also conveying professional beliefs, guiding students to cultivate craftsmanship spirit in a subtle way.

4.3. Post-class: Consolidation and expansion to deepen the internalization of craftsmanship spirit

4.3.1. Review, summarize, and retrain to pursue excellence

Based on classroom feedback, each student identifies their own problems. Students are encouraged to repeatedly practice items that need improvement after class, using simulators, virtual simulation platforms, etc., for independent training. Students can book training rooms online, upload practice videos through the Xuexitong platform, and teachers comment in the background to help students improve their operational skills and cultivate their quality of not giving up easily and pursuing excellence.

4.3.2. Replace traditional assessment with diversified assessment

Traditional assessment focuses on operations and is confined to final results. After the curriculum reform,

the assessment consists of three parts: usual performance (class attitude, attendance rate, homework quality, etc.), group performance (independently choosing presentation forms such as lectures, PPT, videos, on-site performances, etc.), and personal assessment results (OSCE). Through the assessment, students generally report that their abilities in expression, cooperation, organization, etc., have been improved. The OSCE assessment focuses on core nursing abilities, setting up a three-station assessment covering the entire process of “assessment—operation—health education”. The first station introduces standardized patients (SP) to simulate real chief complaints, testing students’ communication skills and condition observation abilities. The second station requires SP to give immediate feedback on communication effects based on students’ performance, strengthening the “patient-centered” service concept. The third station uses intelligent simulators to provide real-time feedback on operation data, improving assessment accuracy, and perfectly integrating craftsmanship spirit into every class.

4.3.3. Take the skills festival as an opportunity to encourage students to learn through competition

Closely following the core learning content of each grade, the college regularly builds a hierarchical nursing skills competition matrix, from basic nursing operation competitions to comprehensive case nursing competitions. It conducts strict assessments and evaluations in accordance with professional competition standards, building a competitive stage for students to pursue excellence. In the competition and exchange on the field, and in the ultimate refinement of skills, students deeply understand the professional core of striving for excellence; in the full display of style and the peak duel of strength, they continuously ignite professional confidence and cultivate professional honor, allowing craftsmanship spirit to take root in their hearts!

5. Teaching practice achievements of integrating craftsmanship spirit into higher vocational “comprehensive nursing training”

5.1. Refined operation standards

Deeply aligned with the requirements of vocational college skills competitions, detailed specifications with both professionalism and practicality have been formed by decomposing key links and quantifying operational details. These specifications have been fully promoted and applied in on-campus practical teaching, providing students with clear and actionable operation guidelines for skill practice, helping them accurately grasp technical key points and lay a solid professional foundation.

5.2. Improved skill accuracy

The one-time pass rate of students’ core nursing operations such as intravenous infusion, intradermal injection, and subcutaneous injection has soared from 82.3% to 96%, and their ability to judge and handle complex comprehensive cases has been comprehensively upgraded. In operations, students can more accurately balance technical specifications and humanistic care, actively pay attention to patients’ subjective feelings, and provide personalized care in a timely manner, achieving dual improvement of “precision nursing” and “humanistic care”.

5.3. Prominent results of school-enterprise collaborative education

As a core empowering course for nursing students before internship, “Comprehensive Nursing Training” strengthens the cultivation of clinical thinking and post-adaptation training with craftsmanship spirit as the core, helping students smoothly connect to internship scenarios. The satisfaction of many cooperative hospitals with

students' comprehensive performance has increased significantly, especially in the accuracy of nursing operations and the effectiveness of nurse-patient communication. Some students have received handwritten thank-you letters from patients for their professional and rigorous services and warm and thoughtful care, which has become a vivid demonstration of integrating craftsmanship spirit into practical teaching.

By integrating craftsmanship spirit into the “Comprehensive Nursing Training” course, this study guides students to form correct worldviews, outlooks on life, values, and professional outlooks, improve their learning initiative and professional identity, and cultivate their teamwork spirit, service awareness, communication skills, etc. Integrating craftsmanship spirit into the daily teaching of “Comprehensive Nursing Training”, extracting integration points, taking skills competitions as the starting point, exploring educational paths in the process of competition preparation and training, forming a replicable and referable competition training template, and materializing competition results to apply in daily teaching, so that the achievements of competitions benefit more students, cultivate the “craftsmanship spirit” of overall nursing students, improve their comprehensive quality, and better adapt to social development and needs.

6. Conclusion

In summary, integrating the craftsmanship spirit into the “Comprehensive Nursing Training” curriculum is essential for cultivating nursing professionals who meet the evolving demands of healthcare. This approach not only enhances students' practical skills and professional literacy but also fosters their dedication to excellence, thereby strengthening their core competitiveness. Ultimately, it contributes significantly to the development of high-quality, skilled nursing talents for society.

Disclosure statement

The author declares no conflict of interest.

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Integration Paths of Curriculum Ideological and Political Education and Obstetrics and Gynecology Nursing Teaching in the New Era

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Abstract: In the new era, curriculum ideological and political education has become one of the core approaches for higher education to implement the fundamental task of moral education. Obstetrics and gynecology nursing is a professional basic course for medical nursing majors, featuring professionalism, humanism, and sociality, which has a natural fit with the integration of curriculum ideological and political education. Based on the professional characteristics of obstetrics and gynecology nursing teaching, this paper constructs a “six-in-one” integration path from six dimensions: integration goals, element excavation, content penetration, method innovation, evaluation system, and teacher team construction. It provides a reference for cultivating obstetrics and gynecology nursing talents with both exquisite professional skills and noble professional literacy.

Keywords: New era; Curriculum ideological and political education; Obstetrics and gynecology nursing; Integration paths; Moral education

Online publication: Dec 31, 2025

1. Introduction

To implement the basic requirements for talent training in the new era and comprehensively strengthen the fundamental task of moral education in colleges and universities, integrating curriculum ideological and political education with obstetrics and gynecology nursing teaching aims to enhance students' medical ethics and moral literacy, realizing the organic unity of ideological and political education and professional education^[1]. Under the general ideological and political education pattern, teachers should not only take the initiative to integrate ideological and political content into teaching but also present it vividly and naturally to make it easily acceptable to students. This will create a new education ecosystem of full-process curriculum ideological and political education for “Obstetrics and Gynecology Nursing” and achieve the all-round development of obstetrics and gynecology nursing talents.

2. Clarify the core goals of integrating curriculum ideological and political education with obstetrics and gynecology nursing teaching

The integration of curriculum ideological and political education with obstetrics and gynecology nursing teaching should take “value guidance, ability-oriented, and literacy-focused” as the core, establish three-dimensional integration goals, and realize the unity of knowledge transmission, ability training, and value shaping ^[2].

2.1. Value guidance goals

(1) Strengthen medical ethics

Cultivate students’ professional initial aspiration of respecting life and caring for mothers and infants, establish a “patient-centered” service concept, and adhere to the integrity bottom line and professional ethics of the medical industry.

(2) Cultivate family and country feelings

Combined with the background of the Healthy China strategy and the three-child policy, guide students to recognize the important role of obstetrics and gynecology nursing in population health and family happiness, and enhance their sense of industry mission and social responsibility.

(3) Shape humanistic spirit

Cultivate students’ humanistic literacy of respecting women’s privacy and understanding the psychological needs of pregnant and lying-in women, enabling them to provide nursing services with empathy and build a harmonious doctor-patient relationship.

2.2. Professional literacy goals

(1) Solidify professional foundation

Under the guidance of ideological and political education, strengthen students’ mastery of core knowledge of obstetrics and gynecology nursing (such as pregnancy physiology, labor mechanism, and gynecological disease nursing) to ensure the accuracy and systematicness of professional knowledge.

(2) Improve practical ability

Integrate a sense of responsibility and teamwork into nursing operation training, and cultivate students’ emergency response ability and teamwork ability in obstetric first aid and gynecological intensive care.

(3) Foster legal thinking

Guide students to be familiar with relevant laws and regulations such as the “Maternal and Child Health Care Law” and the “Regulations on Nurses”, and establish the professional awareness of practicing in accordance with the law and standardized operation.

2.3. Social adaptation goals

(1) Adapt to industry development

Combine new technologies and new norms in the field of obstetrics and gynecology nursing (such as the promotion of painless childbirth and enhanced recovery after obstetric surgery), and cultivate students’ lifelong learning ability and innovative thinking.

(2) Inherit excellent culture

Explore the traditional wisdom in traditional Chinese medicine obstetrics and gynecology nursing (such as postnatal rehabilitation diet therapy and acupoint massage) and integrate it into teaching to enhance

students' cultural confidence and cultural inheritance awareness.

3. Systematically excavate ideological and political elements in obstetrics and gynecology nursing courses

The excavation of ideological and political elements is the foundation of integration. It is necessary to base on the curriculum content, industry characteristics, and era needs of obstetrics and gynecology nursing to achieve accurate docking between ideological and political elements and professional content ^[3].

3.1. Value elements of “life first”

Centering on core content such as pregnancy, childbirth, and postnatal rehabilitation, excavate elements such as “the sanctity of life gestation” and “the primacy of maternal and infant safety”. Strengthen students' reverence for life through cases of neonatal rescue and stories of premature infant care.

Combined with obstetrics and gynecology emergency and critical care (such as postpartum hemorrhage and amniotic fluid embolism first aid), highlight the professional spirit of “racing against time to save lives” and cultivate students' sense of responsibility.

3.2. Professional elements of ethical norms

Target scenarios such as the privacy protection of gynecological cancer patients and the right to independent choice of pregnant and lying-in women (such as the choice of delivery method), excavate medical ethical elements, and guide students to correctly handle ethical issues such as “informed consent” and “privacy confidentiality”.

Combined with cases of doctor-nurse communication and nurse-patient communication, excavate professional ethics of “respect, integrity, and justice”, and cultivate students' communication skills and professional ethics ^[4].

3.3. Emotional elements of humanistic care

Pay attention to the psychological needs of pregnant and lying-in women (such as pregnancy anxiety and postpartum depression), excavate elements such as “empathy” and “care and tolerance”, and guide students to focus on psychological counseling and emotional support in the nursing process.

For special groups such as elderly pregnant and lying-in women and mothers of left-behind children, excavate elements of “social responsibility” and “humanistic care”, and cultivate students' social empathy and public welfare spirit.

3.4. Normative elements of legal compliance

Combine relevant laws and regulations such as the “Maternal and Child Health Care Law” and the “Women's Rights and Interests Protection Law”, excavate elements of “practicing in accordance with the law” and “standardized operation”, and strengthen students' legal awareness through warnings from medical dispute cases.

Centering on standardized processes such as nursing document writing and medical waste disposal, excavate the craftsman spirit of “rigor and meticulousness, striving for excellence”, and cultivate students' sense of professional norms ^[5].

3.5. Mission elements of era development

Combine era issues such as the demand for obstetric care under the three-child policy and the nursing of

gynecological geriatric diseases under the background of aging population, excavate elements of “serving national strategies” and “adapting to industry development”, and enhance students’ sense of era mission.

Share the deeds of obstetrics and gynecology medical staff who stick to their posts at night and support the front line, excavate elements of “family and country feelings” and “dedication spirit”, and stimulate students’ sense of professional honor.

4. Construct a teaching content integration system of “full-link penetration”

The integration of curriculum ideological and political education with obstetrics and gynecology nursing teaching needs to break the dilemma of “separation between ideological and political education and professional content”, and organically integrate ideological and political elements into all links such as theoretical teaching, practical teaching, and after-class expansion.

4.1. Ideological and political penetration in theoretical teaching

(1) Chapter introduction link

Start each chapter with ideological and political cases. For example, when explaining “normal childbirth”, introduce the deeds of “great power craftsmen” in obstetric nursing to emphasize the responsibility and care in childbirth nursing; when explaining “gynecological tumor nursing”, start with stories of anti-cancer star patients and nurses to convey the power of life.

(2) Knowledge point explanation link

Deeply bind ideological and political elements with professional knowledge points. For example, when explaining “prenatal monitoring”, emphasize that “rigor and meticulousness are the guarantee of maternal and infant safety” and integrate warning cases of nursing errors; when explaining “postpartum rehabilitation nursing”, integrate traditional Chinese medicine dietary culture to infiltrate confidence in traditional culture.

(3) Chapter summary link

Summarize ideological and political key points at the end of each chapter. For example, summarize the professional concept of “life first, prevention first” in the “pregnancy nursing” chapter, and summarize the service principle of “respecting privacy and humanistic care” in the “gynecological surgery nursing” chapter.

4.2. Ideological and political integration in practical teaching

(1) Simulated training teaching

When conducting training in simulated delivery rooms and gynecological nursing laboratories, set up ideological and political scenarios, such as “psychological counseling for pregnant and lying-in women with sudden anxiety” and “teamwork in neonatal asphyxia first aid”. Require students to reflect humanistic care and a sense of responsibility in operations, and teachers comment on ideological and political performance on site.

(2) Clinical probation teaching

During the hospital probation link, arrange students to follow excellent nurse instructors, observe the instructors’ nurse-patient communication methods and emergency response attitudes, and internalize

professional spirit through “on-the-job learning + reflection and summary”.

(3) Community practice teaching

Organize students to go deep into communities to carry out maternal and child health publicity, postnatal follow-up, and gynecological disease screening for the elderly, strengthening their sense of social responsibility and humanistic care ability in serving the masses ^[6].

4.3. Ideological and political extension in after-class expansion

(1) Assign ideological and political after-class tasks

Such as writing essays on “The Obstetrics and Gynecology Nurse in My Heart”, collecting “positive energy cases of obstetrics and gynecology nursing”, and making “maternal and child health science popularization short videos” to guide students to take the initiative to excavate ideological and political elements.

(2) Carry out online ideological and political learning

Use platforms such as Xuexitong and MOOCs to push resources such as deeds of advanced figures in the field of obstetrics and gynecology, special lectures on medical ethics, and interpretations of laws and regulations to expand the breadth and depth of ideological and political learning.

(3) Organize thematic discussion activities

Conduct group discussions around themes such as “nursing ethics for patients with postpartum depression” and “challenges and responsibilities of obstetric nursing under the three-child policy” to cultivate students’ critical thinking and value judgment ability.

5. Innovate the teaching method integration model of “unity of knowledge and practice”

Combine the professional characteristics of obstetrics and gynecology nursing and the laws of ideological and political education, innovate teaching methods, and realize the coordinated promotion of “professional skill training” and “ideological and political value guidance”.

5.1. Case teaching method: Strengthen value identification

(1) Select positive and negative cases

Positive cases include “medical teams sticking to obstetrics during the epidemic” and “maternal and child health workers rooted at the grassroots”; negative cases include “medical disputes caused by non-standard operations” and “violations of patient privacy”. Through case analysis and group discussions, guide students to distinguish right from wrong and adhere to professional bottom lines.

(2) Design “case + ideological and political” dual-oriented teaching

Each case includes both professional knowledge points (such as nursing diagnosis and nursing measures) and embedded ideological and political key points (such as sense of responsibility and humanistic care). Require students to elaborate on ideological and political insights while analyzing professional issues.

5.2. Scenario simulation method: improve practical literacy

(1) Construct high-simulation ideological and political scenarios

Such as “pregnant and lying-in women refusing to cooperate with nursing due to fear of childbirth”, “gynecological cancer patients collapsing emotionally after learning their condition”, and “multi-disciplinary team collaboration in obstetric first aid”. Let students play roles such as nurses, patients, and family members to exercise their communication skills, emergency response capabilities, and humanistic literacy in simulated practice.

(2) Introduce standardized patients (SP)

Invite standardized patients to play different types of pregnant and lying-in women or patients, set up complex communication scenarios and ethical dilemmas, and strengthen students’ sense of professional ethics and humanistic care ability through “role-playing + teacher comments + review and reflection”^[7].

5.3. Model demonstration method: Stimulate professional pursuit

(1) Invite advanced figures in the industry to enter the campus

Invite “Most Beautiful Nurses” and “Excellent Obstetricians” to give special lectures, sharing their professional experiences, service concepts, and touching stories to inspire students’ sense of professional honor with the power of role models.

(2) Give play to the role of teachers’ words and deeds

Teachers should pay attention to their own words and deeds in the teaching process, such as emphasizing standardization and rigor in training operations and reflecting respect and tolerance in communication with students. Infect students with personality charm to achieve “silent” ideological and political guidance.

5.4. Project-based teaching method: Strengthen sense of responsibility

(1) Design “maternal and child health service projects”

Such as “community pregnancy health education program design”, “postpartum rehabilitation guidance manual compilation”, and “gynecological disease prevention science popularization project for the elderly”. Let students complete project planning, implementation, and summary in groups, cultivating their teamwork ability, innovation ability, and social responsibility in project advancement^[8].

(2) Incorporate ideological and political evaluation indicators

In project evaluation, not only assess the scientificity and feasibility of professional programs but also evaluate students’ sense of responsibility, communication and collaboration performance, and embodiment of humanistic care in the project.

6. Establish a “diversified and three-dimensional” teaching evaluation integration system

To ensure the effect of curriculum ideological and political integration, it is necessary to break the single professional skill evaluation model and establish a diversified evaluation system of “professional ability + ideological and political literacy” to realize “promoting integration through evaluation and promoting improvement through evaluation”^[9].

6.1. Diversification of evaluation dimensions

(1) Professional ability dimension

Assess students’ mastery of obstetrics and gynecology nursing knowledge, standardization of nursing

operations, and accuracy of emergency response, accounting for 60%.

(2) Ideological and political literacy dimension

Includes four sub-dimensions: professional ethics (20%), humanistic care (10%), sense of responsibility (5%), and legal awareness (5%). Specific evaluation indicators include “whether to respect patient privacy”, “whether to reflect empathy in communication”, “whether to be rigorous and standardized in operations”, and “whether to abide by laws and regulations”.

6.2. Diversification of evaluation subjects

(1) Teacher evaluation (60%)

Teachers conduct comprehensive scoring of students’ professional ability and ideological and political literacy based on classroom performance, training operations, case analysis, and project results.

(2) Student mutual evaluation (20%)

In group discussions, scenario simulations, and project practices, students evaluate each other’s ideological and political performance such as teamwork spirit, communication ability, and sense of responsibility.

(3) Practice unit evaluation (15%)

During hospital probation and community practice, instructors and internship units evaluate students’ professional attitude, work performance, and nurse-patient communication.

(4) Self-reflection evaluation (5%)

Require students to write learning reflection reports, summarize their progress and deficiencies in professional learning and ideological and political literacy, and conduct self-scoring.

6.3. Process orientation of evaluation methods

(1) Process evaluation (70%)

Real-time track students’ learning process and the development of ideological and political literacy through classroom questioning, homework completion, training operation performance, group discussion speeches, and practice logs, avoiding “one exam determining everything”.

(2) Summative evaluation (30%)

The final exam adopts question types of “professional knowledge + ideological and political case analysis”, such as setting discussion questions like “how to reflect sense of responsibility and humanistic care in obstetric first aid cases”, to assess students’ understanding and application of ideological and political elements.

7. Strengthen the construction of “dual-qualified” teacher teams

Teachers are the key subjects in the integration of curriculum ideological and political education with obstetrics and gynecology nursing teaching. It is necessary to build a “dual-qualified” teacher team with both solid professional foundation and strong ideological and political teaching ability.

7.1. Strengthen ideological and political literacy training

Regularly organize teachers to participate in special training on ideological and political teaching, medical ethics

seminars, and legal knowledge courses to improve their theoretical level of ideological and political education and policy understanding ability.

Encourage teachers to participate in “curriculum ideological and political teaching ability improvement” training programs, learn advanced ideological and political teaching methods and integration experiences, and broaden their teaching horizons ^[10].

7.2. Build teaching and research exchange platforms

Establish a curriculum ideological and political teaching and research group, and regularly carry out thematic teaching and research activities such as “excavation of ideological and political elements”, “innovation of teaching methods”, and “construction of evaluation systems” to promote experience exchange and cooperation among teachers.

Organize curriculum ideological and political teaching competitions, lesson plan design evaluations, and model class demonstrations to stimulate teachers’ teaching innovation enthusiasm and create ideological and political teaching benchmarks.

8. Conclusion

In summary, under the background of the new era, the integration of curriculum ideological and political education with obstetrics and gynecology nursing teaching is an inevitable requirement for implementing the fundamental task of moral education and a key path for cultivating high-quality obstetrics and gynecology nursing talents. Through the “six-in-one” path of clarifying integration goals, excavating ideological and political elements, penetrating teaching content, innovating teaching methods, improving evaluation systems, and strengthening teacher team construction, the organic unity of professional skill training and ideological and political value guidance can be realized. In the future, it is necessary to continuously deepen teaching reform and optimize integration paths, so that curriculum ideological and political education can truly integrate into the “blood” of obstetrics and gynecology nursing teaching. This will cultivate new-era obstetrics and gynecology nursing talents who are proficient in professional skills, have temperature, abide by norms, and have a sense of responsibility, providing solid talent support for the implementation of the Healthy China strategy.

Disclosure statement

The authors declare no conflict of interest.

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Analysis of Clinical Characteristics of *Mycoplasma Pneumoniae* Pneumonia in Children Under Two Years of Age

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Abstract: *Objective:* To analyse the clinical characteristics of *Mycoplasma pneumoniae* pneumonia (MPP) in children under two years of age. *Methods:* A retrospective analysis was conducted on 112 paediatric cases of MPP admitted to our hospital between January 2022 and December 2023. Clinical data including symptoms, signs, imaging findings, and prognosis were collected. *Results:* Analysis of clinical symptom distribution revealed coughing in 100.0% of cases, comprising both paroxysmal dry cough and productive cough. Fever was present in 61.61% of cases, with additional manifestations including wheezing, vomiting, diarrhoea, and respiratory distress. Pulmonary rales were the most prevalent finding at 75.89%, alongside other signs such as diminished breath sounds. Imaging analysis of all 112 pneumonia cases revealed bronchopneumonia accounted for 70.54% of cases, representing a relatively high proportion. Treatment involved macrolide antibiotics, including azithromycin, with bronchodilators and corticosteroids added for significant wheezing. The overall treatment efficacy rate was 90.18%. *Conclusion:* Analysis of *Mycoplasma pneumoniae* characteristics in children under 2 years indicates that MPP in infants and young children under 2 presents with mild symptoms, pronounced signs, and relatively mild overall inflammation, resulting in a comparatively high overall cure rate.

Keywords: *Mycoplasma pneumoniae* in children; Clinical characteristics; Analysis

Online publication: Dec 31, 2025

1. Introduction

Mycoplasma pneumoniae (MP), a primary pathogen in community-acquired pneumonia among children, typically affects school-aged children. Epidemiological data indicates increasing incidence of MPP in infants and young children, making it a current paediatric focus ^[1]. In this age group, the immature immune system and narrower airways result in clinical manifestations differing from those in older children, leading to a higher risk of misdiagnosis or missed diagnosis. Furthermore, laboratory tests and imaging characteristics for MPP in infants

and young children exhibit distinct features. Inadequate awareness among clinicians may compromise treatment decisions^[2]. Research on MPP in children under two years of age remains limited. This study analyses data from 112 paediatric MPP cases under two years old, identifying pathological patterns and diagnostic/therapeutic key points to inform early clinical symptom recognition^[3].

2. Materials and methods

2.1. General data

A total of 112 paediatric MPP cases admitted to our hospital between January 2022 and December 2023 were statistically analysed. The inclusion criteria are as follows:

- (1) Children aged under 24 months;
- (2) Meeting the MPP diagnostic criteria outlined in the ‘Diagnostic and Treatment Guidelines for Community-Acquired Pneumonia in Children’;
- (3) Complete clinical records.

The exclusion criteria are as follows:

- (1) Concurrent bacterial, viral, or other pathogen infections;
- (2) Underlying conditions such as congenital heart disease;
- (3) Patients with incomplete follow-up data.

2.2. Methods

A retrospective analysis was conducted to collect clinical data, specifically including:

- (1) General information: Gender, age, onset time;
- (2) Clinical symptoms: Cough, fever, wheezing, dyspnoea, and diarrhoea;
- (3) Physical findings: Pulmonary rales, diminished breath sounds, pleural friction rub, cyanosis;
- (4) Imaging studies: Chest X-ray and CT findings, jointly interpreted by radiologists;
- (5) Treatment and prognosis: Therapeutic outcomes^[4].

2.3. Data processing

SPSS statistical software (Version 22.0) was employed. Quantitative indicators were analysed using t-tests. Statistical significance was defined as $P < 0.05$ for comparable indicators before and after intervention.

3. Results

3.1. Clinical data

Among 112 paediatric MPP cases, the male-to-female ratio was 65:47. The mean age was 15.30 ± 6.42 months. Autumn was the most prevalent season, accounting for 47.32% of cases.

3.2. Clinical symptoms

Analysis of symptom distribution across both groups revealed coughing present in 100.0% of cases, comprising paroxysmal dry cough, productive cough, and wheezing. Fever was reported in 61.61% of cases. Additional symptoms included vomiting, diarrhoea, and dyspnoea (**Table 1**).

Table 1. Distribution of clinical symptoms in 112 paediatric patients

Symptom	Number of cases (n)	Proportion (%)
Cough	112	100.00
Paroxysmal dry cough	68	60.71
Productive cough	44	39.29
Wheezing	77	68.75
Fever	69	61.61
Low-grade fever (37.3–38°C)	28	25.00
Moderate fever (38.1–38.9°C)	19	16.96
High fever ($\geq 39^\circ\text{C}$)	14	12.50
Vomiting	16	14.29
Diarrhoea	12	10.71
Shortness of breath	21	18.75
Lethargy	8	7.14

3.3. Clinical signs

Analysis of clinical sign distribution among 112 paediatric patients revealed pulmonary rales as the most prevalent finding at 75.89%, alongside other manifestations, including diminished breath sounds (**Table 2**).

Table 2. Distribution of clinical characteristics in 112 paediatric patients

Signs	Number of cases (n)	Proportion (%)
Lung crackles	85	75.89
Diminished breath sounds	25	22.32
Pleural friction rub	2	1.79
Cyanosis	7	6.25
No positive physical findings	3	2.68

3.4. Imaging findings and distribution of pneumonia types

Analysis of imaging findings in 112 cases of pneumonia revealed that bronchopneumonia accounted for 70.54% of these cases, representing a relatively high proportion (**Table 3**).

Table 3. Radiographic manifestations in 12 cases of pneumonia

Imaging findings	Number of cases (n)	Proportion (%)
Bronchopneumonia	79	70.54
Lobar pneumonia	28	25.00
Interstitial pneumonia	5	4.46
With small amounts of pleural effusion	3	2.68

3.5. Treatment and prognosis

Treatment of 112 paediatric pneumonia cases primarily involved macrolide antibiotics for infection control, including azithromycin. Bronchodilators and corticosteroids were added for patients exhibiting significant wheezing. The overall treatment efficacy rate was 90.18% (**Table 4**).

Table 4. Treatment and prognosis of 12 paediatric pneumonia cases

Therapeutic efficacy	Number of cases (n)	Proportion (%)
Cured	82	73.21
Improved	19	16.96
No effect	11	9.82
Overall response rate	101	90.18

4. Discussion

MP is a common pathogen widely prevalent in human populations. MPP constitutes a community-acquired pneumonia, accounting for 10% to 40% of all pneumonia cases. In recent years, the widespread use of antibiotics has led to an increasing prevalence of drug-resistant strains of MPP, presenting new challenges for clinical management ^[5]. Moreover, the pathogenesis of MPP remains incompletely understood, involving pathogen adhesion, cytotoxicity, cellular immunity, and humoral immunity. Consequently, an in-depth investigation into the clinical management of MPP holds significant importance. As a prevalent disease at present, MP frequently affects the skin, gastrointestinal tract, and cardiovascular system. Laboratory investigations should incorporate pathogen detection, yielding favourable overall outcomes ^[6].

MPP, a prevalent respiratory infection, is particularly common among children and adolescents. MPP primarily spreads via droplet transmission, presenting with symptoms including dyspnoea, cough, and fever. Severe cases may lead to complications such as pleurisy and pneumonia. The widespread use of antibiotics has resulted in increased resistance strains of MPP, posing significant challenges ^[7].

This study indicates that children under two years old are particularly susceptible to MPP. This is primarily due to the gradual waning of maternal immunity during this age period, coinciding with the establishment of their own immune systems. Concurrently, their increased mobility and exposure to environmental pathogens contribute to susceptibility. The disease exhibits seasonal prevalence, with autumn being the peak season. This correlates with the transmission characteristics of MP, which spreads via airborne transmission. Consequently, respiratory mucosa is significantly influenced by environmental factors, heightening susceptibility to infection.

Clinical features of MPP in children under two exhibit distinct characteristics. The core symptom is coughing, manifesting as either dry or productive coughs, primarily due to infants' limited mucus clearance capacity and abundant airway secretions. The overall incidence of wheezing generally reaches 68.75%. MP infection readily induces increased secretions, mucosal oedema, and wheezing episodes in affected children ^[8].

Among febrile patients, low-grade fever predominates, with high fever being relatively uncommon. Systemic toxic symptoms are mild, largely due to the relatively mild nature of MP reactions. Additionally, some children present with diarrhoea and vomiting, necessitating clinical differentiation from intestinal infections. On examination, pulmonary auscultation reveals predominantly moist rales, differing from the pleural involvement seen in older children. This relates to the immature development of the pleura in infants and young children,

necessitating differentiation from intestinal infections^[9].

Typical radiological features of MPP in infants and young children are bronchopneumonia, differing from the lobar pneumonia presentation seen in older children with MPP. Bronchopneumonia is primarily associated with the airway structure in infants and young children, while lobar pneumonia generally indicates a more severe overall condition and is prone to complications. Interstitial pneumonia requires differentiation from other infections^[10]. Macrolide antibiotics are the first-line treatment, with azithromycin and erythromycin generally yielding favourable overall outcomes. For unresponsive cases, further investigation and adjustment should incorporate pathogen-specific testing. MPP in children under two years presents distinct clinical features, predominantly occurring in autumn, characterised by wheezing, high fever, and inflammatory responses. Imaging findings predominantly reveal bronchopneumonia, with macrolide antibiotics demonstrating effective treatment outcomes. Early diagnosis and intervention are crucial for improving prognosis^[11].

5. Conclusion

In summary, this study of 112 pediatric patients under two years of age confirms that MPP presents with distinct clinical features in this young population. The most prominent symptom was cough, present in all cases, while wheezing and fever were also common. Imaging findings predominantly indicated bronchopneumonia. Treatment with macrolide antibiotics, primarily azithromycin, supplemented with bronchodilators and corticosteroids for severe cases, yielded a favorable overall response rate of 90.18%. These findings underscore that while MPP in infants and toddlers often manifests with mild systemic symptoms, respiratory signs are pronounced, and the inflammatory response is generally moderate, leading to a high cure rate with timely and appropriate management. Early recognition of these age-specific characteristics is crucial for accurate diagnosis and effective treatment, thereby improving clinical outcomes in this vulnerable group.

Disclosure statement

The author declares no conflict of interest.

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Prediction Models for Postoperative Deep Vein Thrombosis in Elderly Hip Fracture Patients: A Systematic Review

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Abstract: *Objective:* To systematically evaluate prediction models for postoperative deep vein thrombosis (DVT) in elderly hip fracture patients and assess their methodological quality and predictive performance. *Methods:* Following PRISMA guidelines, we searched eight databases (PubMed, Embase, Cochrane Library, Web of Science, CINAHL, CNKI, Wanfang, VIP) from inception to May 2025. Studies developing or validating DVT prediction models in elderly hip fracture patients were included. Two reviewers independently screened studies, extracted data, and assessed risk of bias and applicability using the PROBAST tool. *Results:* Eleven studies were included, all conducted in China between 2021 and 2025. Sample sizes ranged from 101 to 504 patients (total $n = 3,286$). Models incorporated 3 to 9 predictors, with D-dimer, age, and time from injury to surgery being most common. All 11 studies (100%) were rated as high risk of bias, primarily due to small sample sizes, lack of validation, and inadequate missing data handling. Applicability concerns were low in 8 studies (72.7%). AUC values ranged from 0.648 to 0.967, with 10 studies (90.9%) reporting $AUC > 0.7$. Meta-analysis identified time from injury to surgery ($OR = 4.63$, 95% CI: 2.58–6.68), age ($OR = 1.99$), D-dimer ($OR = 1.51$), and Caprini score ($OR = 1.75$) as significant predictors. *Conclusion:* Current DVT prediction models for elderly hip fracture patients demonstrate acceptable discrimination but are limited by high risk of bias and lack of external validation. Prospective, multicenter studies with rigorous validation are needed to develop clinically applicable models.

Keywords: Hip fracture; Deep vein thrombosis; Prediction model; Risk assessment; Systematic review

Online publication: Dec 31, 2025

1. Introduction

With global population aging, hip fractures in the elderly have become a major public health challenge, associated with significant morbidity and mortality ^[1]. Deep vein thrombosis (DVT) is one of the most serious postoperative complications in this population. Due to surgical trauma, prolonged immobilization, and hypercoagulable states, DVT incidence ranges from 8% to 34.9% despite standard thromboprophylaxis ^[2]. Untreated DVT can progress to

fatal pulmonary embolism and chronic post-thrombotic syndrome, significantly compromising patient outcomes.

Early risk stratification and targeted prophylaxis are critical for optimizing outcomes. However, widely-used generic prediction models such as the Caprini, Padua, and Wells scores were not specifically designed for elderly hip fracture patients and may lack adequate sensitivity or specificity. Consequently, several prediction models tailored specifically for this population have been recently developed, but they demonstrate considerable heterogeneity in methodology and performance.

Systematic evaluation of these models using standardized methodological assessment tools remains limited. This systematic review aims to comprehensively evaluate DVT prediction models for elderly hip fracture patients using the Prediction model Risk of Bias Assessment Tool (PROBAST), providing evidence-based guidance for clinical decision-making and DVT prevention in this high-risk population.

2. Methods

2.1. Study design and registration

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement.

2.2. Eligibility criteria

Studies were included if they developed or validated prediction models for postoperative DVT risk in elderly patients aged ≥ 60 years with hip fractures who underwent hip surgery. Eligible study designs included case-control, cohort, or retrospective studies that reported model performance metrics such as AUC, C-statistic, or calibration measures. Studies were excluded if they only analyzed risk factors without developing a prediction model, included non-hip fractures, or were duplicate publications.

2.3. Information sources and search strategy

A comprehensive literature search was conducted across eight electronic databases (PubMed, Embase, Web of Science, Cochrane Library, CINAHL, CNKI, Wanfang, and VIP) from inception to May 31, 2025. Search terms included “hip fracture”, “deep vein thrombosis”, “DVT”, “prediction model”, “risk model”, and “nomogram”, combined using Boolean operators. No language restrictions were applied. Reference lists of included studies and relevant systematic reviews were manually searched to identify additional eligible studies.

2.4. Study selection and data extraction

Two reviewers independently screened titles and abstracts, followed by full-text assessment of potentially relevant studies. Disagreements were resolved through discussion or consultation with a third reviewer. Data extraction was performed using a standardized form, capturing study characteristics (author, year, country, design, sample size, DVT events), model characteristics (modeling method, number and type of predictors, presentation format), model performance (AUC, calibration), outcome definition (DVT diagnostic criteria), and missing data handling methods.

2.5. Risk of bias and applicability assessment

Two reviewers independently assessed methodological quality using the Prediction model Risk of Bias Assessment Tool (PROBAST), which evaluates risk of bias and applicability across four domains: participants, predictors,

outcome, and statistical analysis. Risk of bias was rated as high if at least one domain was rated as high risk, low if all four domains were rated as low risk, and unclear otherwise. Applicability was assessed across three domains (participants, predictors, outcome) and rated as high concern if at least one domain raised high concerns, low concern if all domains raised low concerns, and unclear otherwise. Disagreements were resolved through discussion or third-party adjudication.

2.6. Data synthesis and statistical analysis

For predictors reported in at least three studies, meta-analysis was conducted using R software (version 4.3.0) with odds ratios and 95% confidence intervals as effect measures. Heterogeneity was assessed using the I^2 statistic and Cochran's Q test. Fixed-effects models were applied when $I^2 < 50\%$ or $p > 0.10$, while random-effects models were used when $I^2 \geq 50\%$ or $p \leq 0.10$. Publication bias was assessed using funnel plots and Egger's test when at least 10 studies were available. Statistical significance was set at $p < 0.05$. Model performance metrics were summarized descriptively due to expected methodological heterogeneity, and meta-analysis of performance metrics was not conducted due to insufficient comparable data.

3. Results

3.1. Study selection

The database search identified 856 potentially relevant articles. After removing 312 duplicates, 544 records underwent title and abstract screening, followed by full-text review of 28 articles. Ultimately, 11 studies met the inclusion criteria and were included in this systematic review ^[3–13].

3.2. Study characteristics

All 11 included studies were published between 2021 and 2025 and conducted in China. Seven studies employed retrospective cohort designs, and four used case-control designs. Sample sizes ranged from 101 to 504 patients, with a total of 3,286 participants. All studies focused on elderly patients aged ≥ 60 years who underwent hip surgery for hip fractures. Modeling methods included logistic regression ($n = 9$), LASSO regression ($n = 1$), and mixed methods ($n = 1$). The number of predictors in final models ranged from 3 to 9 variables. DVT was diagnosed by lower limb venous Doppler ultrasonography in all studies. Only one study (9.1%) reported internal validation, and none performed external validation.

3.3. Model performance

The area under the receiver operating characteristic curve (AUC) for development cohorts ranged from 0.648 to 0.967, with 10 studies (90.9%) reporting AUC values > 0.7 , indicating acceptable to good discrimination. Nine studies (81.8%) assessed calibration using the Hosmer-Lemeshow goodness-of-fit test, with all demonstrating adequate calibration ($p > 0.05$).

3.4. Risk of bias and applicability

According to PROBAST assessment, all 11 studies (100%) were rated as high risk of bias. The most common source of bias was in the Analysis domain (100% high risk), primarily due to small sample sizes relative to the number of candidate predictors, failure to report missing data handling, and lack of validation. Overall applicability was judged as low concern in 8 studies (72.7%) and unclear concern in 3 studies (27.3%), suggesting

that the predictors and outcomes assessed are clinically relevant to the target population.

3.5. Meta-analysis of common predictors

Eight predictor variables reported in at least three studies were eligible for meta-analysis. Random-effects or fixed-effects models were applied based on heterogeneity assessment. The pooled effect estimates for common predictors are presented in **Table 1**. Time from injury to surgery emerged as the strongest predictor (OR = 4.63, 95% CI: 2.58–6.68, $p < 0.001$) with negligible heterogeneity ($I^2 = 0.0\%$). Other significant predictors included age (OR = 1.99, 95% CI: 1.06–2.92, $p < 0.001$), Caprini score (OR = 1.75, 95% CI: 0.74–2.75, $p < 0.001$), D-dimer (OR = 1.51, 95% CI: 1.09–1.94, $p < 0.001$), duration of bed rest (OR = 1.66, 95% CI: 0.89–2.42, $p < 0.001$), time from injury to admission (OR = 1.16, 95% CI: 0.93–1.39, $p < 0.001$), and systemic immune-inflammation index (SII) (OR = 1.02, 95% CI: 0.99–1.04, $p < 0.001$). Diabetes mellitus showed a non-significant trend (OR = 5.12, 95% CI: -0.58–10.83, $p = 0.078$). As shown in **Table 1**, substantial heterogeneity ($I^2 \geq 50\%$) was observed for Caprini score, SII, time from injury to admission, diabetes mellitus, and duration of bed rest, necessitating random-effects models. Low heterogeneity was found for D-dimer, age, and time from injury to surgery.

Table 1. Meta-analysis of common predictors for postoperative DVT in elderly hip fracture patients

Predictor	OR	95% CI	Z value	p value	I ² (%)	Heterogeneity p value
Caprini score	1.75	0.74–2.75	3.40	< 0.001	78.3	< 0.001
D-dimer	1.51	1.09–1.94	6.96	< 0.001	49.2	0.08
SII	1.02	0.99–1.04	72.76	<0.001	94.0	<0.001
Age	1.99	1.06–2.92	4.20	< 0.001	0.0	0.47
Time from injury to admission	1.16	0.93–1.39	9.90	< 0.001	59.2	0.06
Time from injury to surgery	4.63	2.58–6.68	4.43	< 0.001	0.0	0.84
Diabetes mellitus	5.12	-0.58–10.83	1.76	0.078	54.0	0.07
Duration of bed rest	1.66	0.89–2.42	4.26	< 0.001	84.6	0.01

Abbreviations: OR = odds ratio; CI = confidence interval; SII = systemic immune-inflammation index; DVT = deep vein thrombosis.

Notes: Random-effects models were applied when $I^2 \geq 50\%$ or heterogeneity $p \leq 0.10$; fixed-effects models were used when $I^2 < 50\%$ and heterogeneity $p > 0.10$.

4. Discussion

4.1. DVT prediction models for elderly hip fracture patients remain in early developmental stages

With the global aging population, developing reliable DVT risk prediction models for elderly hip fracture patients is increasingly critical. However, this field remains in its early stages, as all 11 included studies were published within the past four years (2021–2025), conducted exclusively in single-center settings in China with sample sizes of 101–504 patients. This geographic homogeneity limits generalizability to other populations and healthcare settings.

Methodological limitations were evident across studies. Only one study employed advanced techniques such as LASSO regression, while others used traditional logistic regression. Critically, only one study reported internal validation, and none conducted external validation. Without rigorous validation, reported performance metrics may

be overly optimistic and fail to reflect real-world utility. Future studies should adhere to the TRIPOD statement and leverage multicenter collaborations to develop more robust models.

4.2. Key predictors demonstrate clinical relevance

Time from injury to surgery emerged as the strongest predictor (OR = 4.63, 95% CI: 2.58–6.68, $p < 0.001$) with negligible heterogeneity ($I^2 = 0.0\%$). Prolonged preoperative delays contribute to DVT risk through venous stasis, inflammatory activation, and muscle atrophy, underscoring the importance of early surgical intervention. Age (OR = 1.99) and D-dimer levels (OR = 1.51) demonstrated consistent associations with low heterogeneity, reflecting their biological relevance. The Caprini score (OR = 1.75) showed clinical utility but with high heterogeneity ($I^2 = 78.3\%$), suggesting variability in scoring protocols.

The systemic immune-inflammation index (SII) demonstrated statistical significance (OR = 1.02) but very high heterogeneity ($I^2 = 94.0\%$), limiting its clinical applicability. Diabetes mellitus showed a strong effect size (OR = 5.12) but did not reach statistical significance ($p = 0.078$), possibly due to small sample sizes and failure to account for disease severity. Larger studies with stratified analyses are needed to clarify its independent contribution.

4.3. Methodological quality limits clinical translation

PROBAST assessment revealed that all 11 studies had high risk of bias, predominantly in the Analysis domain. Key concerns included inadequate sample sizes (most studies had < 10 events per variable, below the recommended 20), no reporting of missing data handling, and lack of validation. Most studies relied on univariate screening before multivariable modeling, which fails to account for confounding. These deficiencies substantially limit clinical applicability despite promising discrimination performance (AUC > 0.7 in 90.9% of studies). Applicability concerns were low (72.7%), suggesting clinically relevant predictors and outcomes.

4.4. Implications and future directions

While most models demonstrated acceptable discrimination, their high risk of bias precludes immediate clinical implementation. Clinicians should rely on established risk assessment tools while prioritizing modifiable risk factors such as minimizing surgical delay. Future research should prioritize prospective, multicenter studies with adequate sample sizes, standardized predictor definitions, and rigorous validation including calibration and decision curve analysis. Machine learning algorithms should be explored to capture complex predictor interactions. Development of user-friendly implementation tools and real-world impact studies would facilitate clinical translation.

4.5. Limitations

This systematic review is limited by the small number of single-center studies from China, restricting geographic diversity. Retrospective designs preclude causal inference. Substantial heterogeneity in predictor definitions limited comprehensive meta-analyses. Publication bias could not be assessed due to insufficient studies per predictor.

5. Conclusion

Based on the current evidence, this review concludes that existing DVT prediction models for elderly hip fracture patients, while demonstrating acceptable discrimination, are significantly limited by high risk of bias and insufficient external validation. Therefore, the development of clinically robust and widely applicable models

requires future large-scale, multicenter prospective studies employing rigorous methodology and validation.

Disclosure statement

The authors declare no conflict of interest.

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Analyzing the Efficacy of Combining Meridian Flow Low-Frequency Therapy Instrument with Chinese Herbal Enema for the Treatment of Acute and Chronic Pelvic Inflammatory Disease

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Abstract: *Objective:* To study the clinical efficacy of applying the Meridian Flow Low-Frequency Therapy Device combined with Chinese herbal enema for patients with acute and chronic pelvic inflammatory disease (PID). *Methods:* Sixty-two patients with acute and chronic PID admitted from January 2024 to October 2025 were selected and randomly divided into a standard group ($n = 31$) and an experimental group ($n = 31$). The standard group received conventional medication + Chinese herbal enema treatment. The experimental group received the Meridian Flow Low-Frequency Therapy Device in addition to the standard group's treatment. The clinical efficacy, changes in inflammatory markers, and pelvic improvement were compared between the two groups. *Results:* The excellent-good rate of treatment in the experimental group was higher than that in the standard group ($p < 0.05$). The levels of various inflammatory factors in the experimental group were lower than those in the standard group (all $p < 0.05$). The improvement in pelvic mass diameter and pelvic effusion depth in the experimental group was superior to that in the standard group (both $p < 0.05$). *Conclusion:* The Meridian Flow Low-Frequency Therapy Device combined with Chinese herbal enema has a definite curative effect in treating pelvic inflammatory disease. It can effectively alleviate clinical symptoms, reduce inflammatory response, and promote the improvement of the pelvic environment.

Keywords: Acute and chronic pelvic inflammatory disease; Meridian flow low-frequency therapy device; Chinese herbal enema

Online publication: Dec 31, 2025

1. Introduction

Pelvic inflammatory disease (PID) is an infectious disease of the female upper reproductive tract. If not completely cured during the acute phase, it can progress to a chronic state, leading to sequelae such as chronic pelvic pain, fallopian tube adhesions, and infertility^[1]. Conventional symptomatic treatment primarily involves broad-spectrum

antibiotics, but it carries risks such as drug resistance, high recurrence rates, and numerous sequelae^[2]. Traditional Chinese Medicine (TCM) demonstrates unique advantages through comprehensive approaches like “clearing heat and detoxifying, promoting blood circulation and removing stasis, promoting diuresis and dispersing nodules”. In recent years, the Meridian Flow Low-Frequency Therapy Device, which combines the TCM time medicine concept of “Zi Wu Liu Zhu” (Midnight-noon Ebb-Flow) with modern electrostimulation technology, aims to “unblock meridians, regulate Qi, remove stasis, and relieve pain” by selecting acupoints according to the time of day and applying low-frequency electrical pulse stimulation. Chinese herbal enema allows drugs to act directly on the affected area, increases local drug concentration, and synergistically enhances efficacy. Currently, research on the combination of the Meridian Flow Low-Frequency Therapy Device and Chinese herbal enema therapy for treating PID remains relatively limited. This study aims to explore the application effect of this combined regimen in the clinical treatment of acute and chronic PID, with the goal of providing evidence-based support for optimizing comprehensive treatment plans.

2. Materials and methods

2.1. General information

A total of 62 patients with acute and chronic pelvic inflammatory disease admitted from January 2024 to October 2025 were selected and randomly divided into a standard group (n = 31 cases) and an experimental group (n = 31 cases).

2.1.1. Inclusion criteria

- (1) Meeting the diagnostic criteria for acute and chronic pelvic inflammatory disease in “Gynecology”^[3]
- (2) Patients providing informed consent for this study
- (3) The research having been approved by the hospital’s ethics review department

2.1.2. Exclusion criteria

- (1) Pregnancy or lactation
- (2) Concomitant gynecological malignancies or tuberculous pelvic inflammatory disease
- (3) Allergy to electrode patches or enema medications

2.2. Methods

The standard group received conventional medication combined with traditional Chinese medicine enema therapy.

(1) Conventional medication

Cefuroxime sodium for injection (approval number: National Medical Products Administration Approval No. H20063772; manufacturer: Shijiazhuang Zhongnuo Pharmaceutical Co., Ltd., a subsidiary of CSPC Pharmaceutical Group) 1.5 g was added to 100 mL of normal saline for intravenous drip, twice daily.

(2) Traditional Chinese medicine enema

A self-formulated heat-clearing and blood-stasis-resolving enema prescription was used, consisting of *Sargentodoxae Caulis*, *Patriniae Herba*, *Commelinae Herba*, *Violae Herba*, and *Taraxaci Herba*, each at 30 g.

(3) Preparation method

The above herbs were added with 500 mL of water and boiled down to 100 mL, then packaged for later use. Enema procedure: Before treatment, the patient was instructed to empty their bladder and bowels and assume a left lateral position. A disposable rectal tube was inserted into the anus to a depth of 15–20 cm, and 100 mL of the herbal decoction was slowly injected. After the enema, the patient was instructed to maintain the position for more than 1 hour. The enema time was chosen to be during the Mao hour (5:00–7:00, when the Large Intestine Meridian is dominant) according to the theory of the circadian flow of Qi and blood, once daily.

The experimental group was additionally treated with a Ziwu Liuzhu low-frequency therapeutic device on the basis of the standard group: the SM-021 low-frequency therapeutic device (manufacturer: Shenzhen Ximentec Biomedical Technology Co., Ltd.) was used, and treatment was administered during two time periods, namely the Chen period (7:00–9:00, when the Stomach Meridian is in charge) and the You period (17:00–19:00, when the Kidney Meridian is in charge), in accordance with the Ziwu Liuzhu theory. Treatment method: Patients were placed in a comfortable lying position, and electrode pads were fixed at the Guanyuan, Zigong, and Sanyinjiao acupoint locations. A specialized prescription for pelvic inflammatory disease was selected, with the frequency set at 50 Hz and the intensity adjusted to the patient's tolerance level. Each treatment session lasted for 30 minutes and was administered twice daily. Both groups received continuous treatment for 14 days.

2.3. Observation indicators

2.3.1. Clinical efficacy

Assessed after 14 days of treatment, with the following evaluation criteria: “Excellent” efficacy refers to the complete disappearance of discomfort such as lower abdominal pain and lumbosacral distension, normalization of vaginal discharge, and the absence of uterine appendage tenderness or pelvic masses as confirmed by gynecological and B-ultrasound examinations; “Good” efficacy indicates varying degrees of improvement in clinical symptoms, signs, and examination results; “Poor” efficacy denotes no improvement or worsening of the condition. For statistical purposes, both “excellent” and “good” cases were counted as effective, and the overall excellent and good rate was calculated.

2.3.2. Inflammatory indicators

Fasting venous blood samples were collected before treatment and 14 days after treatment. After centrifugation, TNF- α , CRP, and IL-6 levels were detected using the enzyme-linked immunosorbent assay.

2.3.3. Pelvic conditions

The diameters of pelvic masses and the depths of pelvic effusion were examined via B-ultrasound before and after treatment.

2.4. Statistical methods

Data processing and analysis were conducted using SPSS 23.0 statistical software. Count data were presented in the form of frequency (composition ratio), and differences between groups were determined using the chi-square test. If measurement data conformed to the characteristics of a normal distribution, they were expressed as mean \pm standard deviation, and independent sample *t*-tests were applied for inter-group comparisons. When the *p*-value was below 0.05, the difference was considered statistically significant.

3. Results

3.1. Comparison of data between the two groups

All data in the two groups were comparable (all $p > 0.05$). See **Table 1**.

Table 1. General baseline data of patients in the two groups

Group	n	Reproductive history (n)		Mean age ($\bar{x} \pm s$, years)	Mean duration ($\bar{x} \pm s$, years)
		None	Previous		
Standard	31	5	26	45.29 \pm 5.50	1.45 \pm 0.57
Test	31	4	27	45.12 \pm 5.61	1.42 \pm 0.45
Statistic (χ^2/t)	-	0.130		0.120	0.230
<i>p</i> -value	-	0.718		0.905	0.819

3.2. Comparison of clinical efficacy between the two groups

The excellent and good treatment rate in the experimental group was higher than that in the standard group ($p < 0.05$). See **Table 2**.

Table 2. Comparison of clinical efficacy between the two groups [n(%)]

Group	n	Excellent	Good	Poor	Excellent-good rate
Standard group (n = 31)	31	15 (48.39)	12 (38.71)	4 (12.90)	27 (87.10)
Test group (n = 31)	31	18 (58.06)	13 (41.94)	0 (0.00)	31 (100.00)
χ^2 -value	-	-	-	-	4.276
<i>p</i> -value	-	-	-	-	0.039

3.3. Comparison of inflammatory indicators between the two groups

After treatment, the levels of various inflammatory factors in the experimental group were lower than those in the standard group (all $p < 0.05$). See **Table 3**.

Table 3. Comparison of inflammatory indicators between the two groups ($\bar{x} \pm s$)

Group	n	TNF- α (ng/L)		CRP (mg/L)		IL-6 (ng/L)	
		Before	After	Before	After	Before	After
Standard	31	55.34 \pm 6.45	38.45 \pm 5.32*	15.23 \pm 3.25	7.85 \pm 1.67*	30.67 \pm 5.04	17.78 \pm 3.42*
Test	31	54.87 \pm 6.72	30.16 \pm 5.23*	15.56 \pm 3.47	5.12 \pm 1.25*	30.12 \pm 5.58	13.23 \pm 3.45*
<i>t</i> -value	-	0.281	6.187	0.386	7.287	0.407	5.215
<i>p</i> -value	-	0.780	< 0.001	0.701	< 0.001	0.685	< 0.001

Note: Compared with the same group before treatment, * $p < 0.05$.

3.4. Comparison of pelvic conditions between the two groups

After treatment, the improvement in the diameter of pelvic masses and the depth of pelvic effusion in the experimental group was superior to that in the standard group (both $p < 0.05$). See **Table 4**.

Table 4. Comparison of pelvic conditions between the two groups [$(\bar{x} \pm s)$, cm]

Group	n	TNF- α (ng/L)		CRP (mg/L)	
		Before	After	Before	After
Standard	31	55.34 \pm 6.45	38.45 \pm 5.32*	15.23 \pm 3.25	7.85 \pm 1.67*
Test	31	54.87 \pm 6.72	30.16 \pm 5.23*	15.56 \pm 3.47	5.12 \pm 1.25*
<i>t</i> -value	-	0.281	6.187	0.386	7.287
<i>p</i> -value	-	0.780	< 0.001	0.701	< 0.001

Note: Compared with the same group before treatment, * $p < 0.05$.

4. Discussion

If pelvic inflammatory disease is not treated promptly and properly, prolonged illness can lead to various long-term complications, such as chronic pelvic pain, tubal infertility, and ectopic pregnancy, seriously impairing the reproductive health and quality of life of women of childbearing age^[4]. Antibiotic therapy is primarily used clinically to treat pelvic inflammatory disease. While it can effectively control acute infections, its efficacy in treating chronic pelvic inflammatory disease and its sequelae is limited, and long-term use can easily lead to issues such as dysbacteriosis and increased drug resistance^[5]. In recent years, traditional Chinese medicine (TCM) has demonstrated unique advantages in the treatment of pelvic inflammatory disease (PID), particularly herbal enema therapy, which allows drugs to be directly absorbed through the rectal mucosa, reaching the affected area directly, bypassing the first-pass effect of the liver, and increasing local drug concentration. The Ziwu Lizhu theory, a precious concept of chronomedicine in TCM, originates from the “Huangdi Neijing” (The Yellow Emperor’s Classic of Internal Medicine). Based on the theory of “harmony between humans and nature”, it posits that the flow of Qi and blood in the human body follows a certain rhythm in the meridians over time, exhibiting patterns of waxing and waning^[6]. As a physical therapy modality, low-frequency therapeutic devices can improve local pelvic blood circulation through low-frequency pulsed electrical stimulation, promote inflammation absorption, and alleviate pain symptoms. Their adjuvant role in PID treatment has been clinically validated^[7]. Utilizing low-frequency therapy for chronic PID under the guidance of the Ziwu Lizhu theory allows for selecting the most appropriate timing for treatment based on the patterns of Qi and blood flow and the opening and closing of acupoint meridians, thereby enhancing therapeutic efficacy. The combined therapy of the Ziwu Lizhu low-frequency therapeutic device and herbal enema fully leverages the advantages of TCM chronomedicine and the integration of internal and external treatments, providing new insights and methods for PID treatment.

The Ziwu Lizhu low-frequency therapeutic device regulates meridian Qi and blood and improves local pelvic microcirculation through acupoint electrical stimulation at specific times. Modern research indicates that low-frequency electrical stimulation can promote tissue metabolism, accelerate inflammation absorption, relieve muscle spasms, and alleviate pain^[8]. In this study, the Chenshi period (when the Stomach Meridian is in command) and the Youshi period (when the Kidney Meridian is in command) were selected for treatment. During the Chenshi period, Qi and blood flow into the Stomach Meridian, and treatment at this time can strengthen the spleen and stomach and resolve phlegm-dampness; during the Youshi period, Qi and blood flow into the Kidney Meridian, and treatment at this time can nourish kidney Qi and regulate the Chong and Ren Meridians. The combined application of these two periods can synergistically regulate the functions of the Zang-fu organs and

enhance the therapeutic effect. Herbal enema is an important external treatment method in traditional Chinese medicine for pelvic inflammatory disease. In this study, a self-formulated herbal enema prescription for clearing heat and resolving blood stasis was used. In this prescription, *Sargentodoxae Caulis* acts as the vanguard, guiding the herbs downward and promoting blood circulation; *Patriniae Herba*, *Taraxaci Herba*, and *Viola Herba* are used to attack the core issues, focusing on clearing heat, detoxifying, and resolving abscesses and dispersing masses; *Commelinae Herba* is used as a supporting herb to promote diuresis and allow the pathogenic factors to exit the body. The five herbs in the entire prescription have specific and powerful effects and are precisely combined to collectively exert comprehensive effects of clearing heat, detoxifying, promoting blood circulation to resolve blood stasis, and promoting diuresis to drain pus, highly aligning with the core pathogenesis of “damp-heat and blood stasis” in pelvic inflammatory disease. Modern pharmacological studies have shown that both *Sargentodoxae Caulis* and *Patriniae Herba* have broad-spectrum antibacterial effects, effectively inhibiting the growth of various Gram-positive and Gram-negative bacteria and significantly reducing the levels of inflammatory factors such as TNF- α and IL-6; *Commelinae Herba*, *Viola Herba*, and *Taraxaci Herba* also possess broad-spectrum antibacterial and anti-inflammatory activities. When used in combination, these herbs can inhibit pathogens and alleviate inflammatory responses through multiple pathways, thereby promoting the repair of pelvic tissues. The combination of the Ziwu Liuzhu theory and traditional Chinese medicine enema therapy, with enema treatment administered during the Mao time period (when the Large Intestine Meridian is dominant), is employed because, at this time, Qi and blood flow through the Large Intestine Meridian, the conduction function of the large intestine is robust, and the absorption capacity of the rectal mucosa is enhanced, facilitating the full expression of the medicinal effects. Consequently, the results of this study show that the excellent and good treatment rate in the experimental group was higher than that in the standard group ($p < 0.05$). After treatment, the levels of various inflammatory factors in the experimental group were all lower than those in the standard group (all $p < 0.05$). Analysis of the reasons may be related to the following mechanisms:

- (1) The Ziwu Liuzhu low-frequency therapeutic instrument stimulates and improves pelvic blood circulation, promoting drug distribution and absorption;
- (2) Traditional Chinese medicine enema directly acts on pelvic tissues, inhibiting pathogen growth and reducing inflammatory exudation;
- (3) Timed treatment with the Ziwu Liuzhu theory enhances the body's sensitivity to drugs and physical therapy, creating a synergistic effect. Additionally, after treatment, the improvement in pelvic mass diameter and pelvic effusion depth in the experimental group was superior to that in the standard group (both $p < 0.05$), suggesting that the combined treatment can more effectively promote the recovery of pelvic pathological changes.

Research by Yang Liqing et al. has shown that pelvic floor therapeutic devices combined with traditional Chinese medicine can improve pelvic hemodynamics, promote inflammation absorption, and facilitate tissue repair^[9]. Zheng Yongxia's study indicated that the Ziwu Liuzhu low-frequency therapeutic instrument can significantly alleviate pain and improve the pelvic environment in patients with chronic pelvic inflammatory disease^[10]. These reports collectively support the conclusions of this study.

5. Conclusion

In summary, the combination of the Ziwu Liuzhu theory-based low-frequency therapeutic instrument and

traditional Chinese medicine enema therapy for treating pelvic inflammatory disease has proven effective, effectively alleviating clinical symptoms, reducing inflammatory responses, and promoting improvement in the pelvic environment.

Disclosure statement

The authors declare no conflict of interest.

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A Randomized Controlled Study of Combined Spinal-Epidural Analgesia Using a 25G Fine Needle Single Puncture in Children

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Abstract: *Objective:* To investigate the efficacy and safety of combined spinal-epidural (CSE) anesthesia using a 25G spinal fine needle via a single puncture for lower limb surgery in children. *Methods:* Sixty pediatric patients scheduled for surgery were randomly divided into two groups, with 30 patients in each. The control group received subarachnoid anesthesia with 2–2.5 mL of 0.33% ropivacaine. The experimental group received the same ropivacaine dose, followed by withdrawal of the needle to the epidural space and administration of 0.1 mg hydromorphone diluted to 5 mL. The anesthetic and analgesic effects, incidence of complications, and postoperative family satisfaction were observed in both groups. *Results:* Compared with the control group, the experimental group showed a higher anesthesia success rate, a shorter onset time, and a longer maintenance time of anesthesia ($p < 0.05$). Postoperative analgesia at various time points was significantly better in the experimental group ($p < 0.05$). The total incidence of complications was lower in the experimental group, though the difference was not statistically significant ($p > 0.05$). Family satisfaction was significantly higher in the experimental group ($p < 0.05$). *Conclusion:* CSE anesthesia using a 25G fine needle via a single puncture for pediatric lower limb surgery is safe and effective. It can significantly improve surgical outcomes and is worthy of clinical promotion.

Keywords: 25G fine needle single puncture; Children; Combined spinal-epidural anesthesia; Hydromorphone

Online publication: Dec 31, 2025

1. Introduction

The management of anesthesia for pediatric surgery has always been a critical focus in clinical practice. Currently, in clinical practice in China, fine needle spinal anesthesia is commonly used for lower limb surgeries in children, with postoperative analgesia often relying on intravenous methods^[1]. However, intravenous analgesia is often unsatisfactory, presenting issues such as unstable analgesic effects, suboptimal alertness, and incomplete pain relief. The combined spinal-epidural (CSE) anesthesia approach integrates the rapid onset of spinal anesthesia

with the advantage of epidural anesthesia for postoperative pain management. However, the traditional “needle-through-needle” technique requires initial puncture of the epidural space with a larger Tuohy needle, which has significant drawbacks including greater puncture trauma, risk of post-dural puncture headache, and a higher risk of catheter misplacement into the subarachnoid space^[2].

In recent years, both domestic and international research has explored improved implementation methods. Among these, the technique using a 25G fine needle for a single puncture to simultaneously achieve intrathecal drug administration and epidural catheter placement shows promising prospects. This technique significantly reduces complication risks associated with traditional methods through a minimally invasive approach while perfectly retaining the flexibility for continuous postoperative epidural analgesia, providing an ideal solution for postoperative pain management^[3]. Therefore, how to effectively achieve ideal anesthetic effects and practically solve postoperative pain problems has become an important issue urgently needing to be addressed. This study aims to use a 25G fine needle single puncture technique to achieve CSE anesthesia in children and evaluate its clinical efficacy and safety.

2. Materials and methods

2.1. General information

Sixty pediatric patients scheduled for surgery in our hospital from June 2024 to December 2025 were selected as subjects. The 60 patients were randomly divided into two groups using a random number table, with 30 patients in each group. The study was approved by the hospital ethics committee (Ethics Approval No.: 2025-KY-18).

2.1.1. Inclusion criteria

- (1) Age 3–14 years, weight 10–40 kg
- (2) Scheduled for lower limb surgery (e.g., lower limb fracture reduction and fixation, circumcision, etc.)
- (3) Indicated for CSE anesthesia, ASA physical status I–II
- (4) Informed consent obtained from the family and informed consent form signed

2.1.2. Exclusion criteria

- (1) Cardiac diseases (e.g., congenital heart disease with cardiac dysfunction, acute myocarditis), liver diseases (e.g., cirrhosis, cholestatic liver disease), kidney diseases (e.g., chronic kidney insufficiency, acute kidney injury), neurological diseases (e.g., status epilepticus, spinal cord lesions)
- (2) Allergy to ropivacaine or hydromorphone
- (3) Contraindications to lumbar puncture (e.g., lumbar deformity, infection at puncture site, coagulation disorders)
- (4) Concurrent systemic/local infectious diseases, or inability to cooperate with positioning (Blinding method to be added)

2.2. Methods

2.2.1. Preoperative preparation

Ten minutes preoperatively, children received an intravenous injection of dexmedetomidine (0.35 µg/kg) based on body weight (reference common pediatric preoperative sedation dose 0.5–1 µg/kg, providing sedation for anxiety

reduction and mild analgesia). Upon entering the operating room, a peripheral intravenous line was established, and the patient was connected to a multi-function monitor for continuous monitoring of heart rate, blood pressure, oxygen saturation, and respiratory rate.

2.2.2. Intraoperative procedure and management

(1) Positioning and puncture preparation

Assist the child into the lateral decubitus position with the lumbar intervertebral spaces fully opened. Using the L3–4 interspace as the puncture point, perform routine disinfection and drape with a sterile aperture drape, adhering strictly to aseptic technique.

(2) Puncture and group-specific drug administration

Puncture the subarachnoid space with a 25G fine needle. After observing clear cerebrospinal fluid (CSF) reflux, administer drugs: ① Control group: Inject 2–2.5 mL of isobaric 0.33% ropivacaine (2 mg/mL) (reference pediatric spinal anesthesia dose from the International Guidelines for Pediatric Regional Anesthesia*). ② Experimental group: First inject the same dose of ropivacaine. Then, after withdrawing the needle to the epidural space confirmed by “loss of resistance + aspiration negative for CSF/blood”, inject 0.1 mg of hydromorphone (conforming to the pediatric safe dose range of 0.002–0.005 mg/kg), diluted with normal saline to 5 mL, administered in 3 aliquots over 5–8 minutes. This procedure was performed by attending physicians or higher.

(3) Monitoring and complication management

Record vital signs every 5 minutes. Manage complications as follows: ① Respiratory depression ($RR < 12$ breaths/min or $SpO_2 < 90\%$): Administer oxygen/manual assisted ventilation, intubate if necessary; ② Hypotension: Administer fluid bolus 10–15 mL/kg, use ephedrine 0.1–0.2 mg/kg if ineffective; ③ Agitation: After excluding pain, administer additional dexmedetomidine 0.1–0.15 μ g/kg, maintaining Ramsay sedation score 2–3.

2.2.3. Postoperative handover

Monitor vital signs for 30 minutes to 1 hour postoperatively. After confirming the child is awake (responsive to stimuli) and free of acute complications, transfer to the post-anesthesia care unit with a full handover.

2.3. Observation indicators

2.3.1. Assessment of anesthetic effects

Including: Anesthesia success rate (proportion of children meeting all criteria post-puncture)

- (1) Aspiration of clear CSF
- (2) Surgery completed without requiring additional intravenous/local anesthetics
- (3) Vital sign fluctuations $< 20\%$ of preoperative baseline, no surgery interruption due to inadequate anesthesia)

Anesthesia onset time (time from completion of intrathecal drug injection to the appearance of either:

- (1) Loss of pain sensation in the surgical area of the lower limb
- (2) Motor blockade in the lower limb.

Anesthesia maintenance time (time from anesthesia onset until effect wanes requiring supplemental medication).

2.3.2. Assessment of analgesic effects

Using the Faces Pain Scale-Revised (FPS-R) to evaluate pain intensity at 1 h, 4 h, 8 h, 12 h, and 24 h postoperatively, where 0 indicates no pain and 10 indicates worst pain ^[4].

2.3.3. Assessment of safety

Recording the incidence of intraoperative apnea, hypotension, postoperative headache, urinary retention, and puncture-related complications.

2.3.4. Evaluation of family satisfaction

Using a self-designed nursing satisfaction questionnaire on a 100-point scale, categorized as very satisfied (> 90 points), satisfied (75–90 points), and dissatisfied (< 75 points). Total satisfaction is the sum of very satisfied and satisfied cases ^[5].

2.4. Statistical methods

All data were processed using SPSS 23.0 software. Measurement data conforming to normal distribution are described as mean \pm standard deviation, with intergroup comparisons using independent samples t-tests. Count data are presented as frequency and percentage, with differences tested using Chi-square (χ^2) analysis. The significance level was set at $p < 0.05$.

3. Results

3.1. Comparison of general data

As shown in **Table 1**, there were no significant differences in general patient data between the groups ($p > 0.05$).

Table 1. Comparison of general data between groups [n (%) / ($\bar{x} \pm s$)]

Group	No.	Sex (M/F)	Age (years)	Height (cm)	Weight (kg)	Pre anesthesia SBP (mmHg)	Pre anesthesia DBP (mmHg)	Pre anesthesia heart rate (beats/min)	Pre anesthesia respiratory rate (breaths/ min)
Experimental group	30	16/14	7.64 \pm 2.75	120.89 \pm 15.23	26.57 \pm 6.41	94.87 \pm 8.02	57.93 \pm 6.11	81.92 \pm 10.15	18.45 \pm 2.43
Control group	30	17/13	7.92 \pm 2.61	122.56 \pm 14.95	27.23 \pm 6.34	95.76 \pm 7.78	58.65 \pm 5.89	83.67 \pm 9.58	18.88 \pm 2.31
<i>t</i> value			0.405	0.429	0.401	0.436	0.465	0.687	0.702
<i>p</i> value			0.687	0.670	0.690	0.664	0.644	0.495	0.485

M/F: Male/Female; SBP: Systolic blood pressure; DBP: Diastolic blood pressure

3.2. Comparison of anesthetic effects

As shown in **Table 2**, the experimental group showed a higher anesthesia success rate, a shorter anesthesia onset time, and a longer anesthesia maintenance time compared to the control group ($p < 0.05$).

Table 2. Comparison of anesthetic effects between groups [n (%) / ($\bar{x} \pm s$)]

Group	Number of cases (n)	Anesthesia success rate (n, %)	Anesthesia onset time (min)	Anesthesia maintenance time (min)
Experimental group	30	30 (100.00)	5.78 ± 0.25	98.22 ± 4.23
Control group	30	26 (86.67)	7.24 ± 0.24	78.81 ± 4.42
χ^2/t value	-	4.286	23.075	17.377
<i>p</i> value	-	0.038	0.001	0.001

3.3. Comparison of postoperative analgesic effects

As shown in **Table 3**, the experimental group showed significantly better analgesic effects at all postoperative time points compared to the control group ($p < 0.05$).

Table 3. Comparison of postoperative analgesic effects between groups [$(\bar{x} \pm s)$ / points]

Group	n	1h	4h	8h	12h	24h
Experimental group	30	1.22 ± 0.13	1.79 ± 0.17	2.23 ± 0.22	2.45 ± 0.15	3.37 ± 0.16
Control group	30	2.23 ± 0.14	2.52 ± 0.15	3.24 ± 0.27	3.67 ± 0.13	4.54 ± 0.19
<i>t</i> -value	-	28.956	17.636	15.884	33.665	25.799
<i>p</i> -value	-	0.001	0.001	0.001	0.001	0.001

3.4. Comparison of complications

As shown in **Table 4**, the total incidence of complications post-intervention was lower in the experimental group, but the difference between groups was not statistically significant ($p > 0.05$).

Table 4. Comparison of postoperative complications between groups [n (%)]

Group	n	Apnea	Hypo-tension	Urinary retention	Headache	Puncture-related complications	Total incidence
Experimental group	30	0 (0.00)	0 (0.00)	0 (0.00)	1 (3.33)	0 (0.00)	1 (3.33)
Control group	30	0 (0.00)	1 (3.33)	1 (3.33)	1 (3.33)	1 (3.33)	4 (13.32)
χ^2	-	-	-	-	-	-	1.964
<i>p</i>	-	-	-	-	-	-	0.161

3.5. Comparison of family satisfaction

As shown in **Table 5**, family satisfaction post-intervention was significantly higher in the experimental group ($p < 0.05$).

Table 5. Comparison of family satisfaction between groups [n (%)]

Group	Number of cases (n)	Very satisfied	Satisfied	Dissatisfied	Overall satisfaction
Experimental group	30	18 (60.00)	11 (36.67)	1 (3.33)	29 (96.67)
Control group	30	13 (43.33)	11 (36.67)	6 (20.00)	24 (80.00)
χ^2	-	-	-	-	4.043
<i>p</i>	-	-	-	-	0.044

4. Discussion

In pediatric surgery, the choice of anesthesia regimen is directly linked to surgical safety and postoperative recovery quality. Children's physiological functions are not yet fully developed, and their metabolic capacity for anesthetic drugs, pain tolerance, and sensitivity to adverse reactions differ significantly from adults. Therefore, ensuring anesthetic efficacy while minimizing trauma and complication risks remains a core direction in clinical anesthesia research ^[6]. In recent years, fine needle neuraxial anesthesia techniques have gained attention due to their minimally invasive advantages. In this study, CSE anesthesia was achieved using a 25G fine needle single puncture, breaking through the limitations of traditional techniques and demonstrating significant clinical value. The core innovation of this study lies in the 25G fine needle single puncture technique, which overcomes the traditional "needle-through-needle" two-puncture model. Its feasibility can be verified from two aspects: First, regarding technical safety, the diameter of the 25G needle is only 0.5mm, causing less damage compared to the traditional Tuohy needle ^[7]. Second, regarding epidural space localization, the dual judgment method of "loss of resistance + aspiration test" was used, sudden loss of resistance upon needle withdrawal combined with aspiration negative for CSF or blood, alongside the operator's experience, preventing the risk of drug misplacement ^[8].

In this study, the selection of ropivacaine strictly followed evidence-based guidelines and pediatric physiological characteristics: 0.33% isobaric ropivacaine at a dose of 2 mg/mL was chosen based on the following rationale: According to guidelines, for pediatric epidural regional anesthesia, the ropivacaine dose should be controlled at 2 mg/mL, with a maximum dose of 2.5 mg/kg, and a concentration of 0.25–0.5% is appropriate ^[9]. The 0.33% concentration falls within this range, ensuring adequate block strength while avoiding prolonged motor block due to high concentration and preventing insufficient analgesia from low concentration. Compared to relevant foreign studies, which used 0.33% ropivacaine 0.7 mg/kg for simple spinal anesthesia in pediatric lower limb surgery with an anesthesia maintenance time of about 75 minutes, the experimental group in this study, due to the combination with hydromorphone, had an extended maintenance time to (98.22 ± 4.23) minutes, indicating that combined medication can prolong analgesic duration ^[10]. Additionally, the faster onset time in the experimental group is speculated to be related to the synergistic effect of hydromorphone on the local anesthetic, as hydromorphone can inhibit pain signal transmission in the spinal dorsal horn, enhancing the blocking effect of ropivacaine.

Furthermore, the FPS-R scores in the experimental group from 1 to 24 hours postoperatively ranged from (1.22 ± 0.13) to (3.37 ± 0.16) points), all lower than those in the control group (2.23 ± 0.14) to (4.54 ± 0.19) points). The primary reason is the continuous inhibitory effect of hydromorphone on spinal pain signals, compensating for the duration limitation of simple spinal anesthesia. In the safety assessment, the total complication incidence in the experimental group was 3.33%, with only one case of headache. The control group had an incidence of 13.32%, including one case each of hypotension and urinary retention, showing some advantage over traditional techniques. Regarding puncture-related complications, traditional large-bore needles have an incidence of 3–5%; in this study, only the control group had one case of mild redness/swelling, which subsided within 24 hours. Regarding circulatory and respiratory aspects, neither group experienced apnea. The control group had one case of hypotension, which normalized after fluid administration, while the experimental group had no hypotension, indicating that preoperative dexmedetomidine and hydromorphone have low cardiovascular depressive effects, jointly ensuring safety ^[11]. Additionally, family satisfaction, as an important indicator of medical service quality, reached 96.67% in the experimental group, significantly higher than the 80.00% in the control group. In pediatric medical care, the emotional state and cooperation level of family members indirectly impact treatment outcomes.

A positive anesthesia experience helps alleviate family anxiety and improves the efficiency of doctor-patient communication.

5. Conclusion

In summary, CSE anesthesia using a 25G fine needle single puncture (ropivacaine + hydromorphone) for pediatric lower limb surgery demonstrates high success rate, prolonged analgesia, good safety, and possesses clinical promotion value. However, this study has certain limitations: First, the single-center sample size of 60 cases is small, and the lack of double-blinding may introduce bias. Second, follow-up was only 24 hours, not addressing long-term complications. Third, it was limited to the L3–4 interspace and ASA I-II children, not covering populations such as those with obesity or lumbar deformities. Fourth, ultrasound guidance was not used, which might affect puncture accuracy in children with unclear anatomy. Future research could involve multicenter, large-sample double-blind studies; extend follow-up to 72 hours and expand to special populations; combine ultrasound guidance to optimize the procedure and explore hydromorphone dose gradients; and establish standardized protocols to promote grassroots implementation.

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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

Research on the Polymorphism of Folate Metabolism Genes and Its Correlation with Pregnancy-Induced Hypertension in Women of Childbearing Age in the Neijiang Region

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Abstract: *Objective:* To explore the polymorphism of folate metabolism genes and its correlation with pregnancy-induced hypertension (PIH) in women of childbearing age in the Neijiang region. *Methods:* Forty-five pregnant women with hypertension disorders who received prenatal care at the Maternal and Child Health Hospital in the Neijiang region from May 2023 to April 2025 were selected for the study and designated as the case group. Additionally, 45 healthy pregnant women during the same period were selected as the control group. Venous blood samples were collected from both groups for folate metabolism gene testing, and the correlation with PIH was analyzed. *Results:* There were statistically significant differences in BMI index, systolic blood pressure, diastolic blood pressure, serum folate levels, Hcy levels, and vitamin B12 levels between the case group and the control group ($p < 0.05$). The proportions of MTHFR-wild type and MTRR-wild type in the case group were lower than those in the control group, while the proportions of MTHFR-heterozygous mutant type and MTRR-heterozygous mutant type were higher in the case group ($p < 0.05$). The Logistic regression model showed that overweight/obesity, abnormal folate levels, abnormal Hcy levels, abnormal vitamin B12 levels, MTHFR-heterozygous mutant type, and (repeated entry corrected to another relevant factor if necessary, but assuming it's a typo and should be another mutant type or omitted for clarity, here kept as is for direct translation) MTHFR-heterozygous mutant type (note: this repetition should likely be corrected in the original text, e.g., to MTRR-heterozygous mutant type or another relevant factor) were independent risk factors for the occurrence of HDP ($p < 0.05$), while MTHFR-wild type and MTRR-wild type were protective factors against HDP ($p < 0.05$). *Conclusion:* The polymorphism distribution of key genes involved in folate metabolism among women of childbearing age in Neijiang is significantly associated with the occurrence of Hypertensive Disorders of Pregnancy (HDP). Mutant genotypes of MTHFR and MTRR serve as independent risk factors for HDP, while the wild-type acts as a protective factor. Additionally, overweight/obesity, reduced serum folate levels, hyperhomocysteinemia, and vitamin B12 deficiency are also important risk indicators for the onset of HDP.

Keywords: Women of childbearing age; Polymorphism of folate metabolism genes; Hypertensive disorders of pregnancy (HDP); Correlation

Online publication: Dec 31, 2025

1. Introduction

Hypertensive Disorders of Pregnancy (HDP) represent a unique and common complication during pregnancy, with a complex pathogenesis. Current clinical research suggests that it results from the combined effects of multiple factors, including genetics, immunity, and environment. Folate, as a crucial B-vitamin, plays a vital role in its metabolic pathway for maintaining normal homocysteine (Hcy) levels, DNA synthesis, and methylation, particularly in pregnant women ^[1]. Impaired folate metabolism can lead to the accumulation of Hcy in the body, resulting in hyperhomocysteinemia (HHcy). Based on existing clinical studies, HHcy has been confirmed as an independent risk factor for cardiovascular diseases and is closely associated with the onset of HDP ^[2]. However, the efficiency of the folate metabolic pathway is regulated by a series of key enzymes, and polymorphisms in the genes encoding these enzymes may affect enzyme activity, thereby altering an individual's folate metabolic status and disease susceptibility. Currently, no international authoritative obstetrics and gynecology organization has issued explicit guidelines recommending routine folic acid metabolism gene testing for all high-risk pregnant women to prevent pregnancy-induced hypertension (PIH) ^[3]. Given this, more clinical studies are still needed to confirm the polymorphism of folic acid metabolism genes and their correlation with PIH, in order to provide evidence-based support for transforming this into standardized clinical screening and personalized intervention strategies.

2. Materials and methods

2.1. General information

Forty-five pregnant women with hypertension disorders during pregnancy who received prenatal care at the Maternal and Child Health Hospital in Neijiang from May 2023 to April 2024 were selected for inclusion in the study and designated as the case group. Additionally, 45 healthy pregnant women from the same period were selected as the control group. All participants in this trial provided informed consent, and the study has been approved by the ethics committee.

2.1.1. Inclusion criteria

- (1) Pregnant women aged between 20 and 35 years
- (2) The case group met the diagnostic criteria for HDP ^[4]
- (3) Participation in this trial was voluntary, and informed consent forms were signed

2.1.2. Exclusion criteria

- (1) Patients with thalassemia or iron-deficiency anemia
- (2) Patients with uncontrolled endocrine or kidney diseases

2.2. Methods

Peripheral blood samples were collected from women in different groups using vacuum blood collection tubes. Simultaneously, 3 mL of venous blood was drawn from pregnant women, centrifuged at 3000 r/min for 10 minutes to separate the serum, and stored in a refrigerator at -20 °C. The stored serum samples were subjected to folate metabolism gene testing. Based on the gene testing results, the folate metabolism gene polymorphisms of each woman enrolled in the trial were analyzed.

2.3. Observation indicators

When pregnant women consented to participate in the trial, their basic information, including age and education level, was collected through face-to-face interviews and questionnaires. For pregnant women enrolled in the trial, during each prenatal check-up, healthcare professionals provided advice and conducted relevant physical examinations based on the pregnant women's health status, including measurements of body mass index (BMI) and blood pressure. BMI was referenced against previous standards, with overweight pregnant women defined as those with a BMI of 24.0–27.9 kg/m², and obese pregnant women defined as those with a BMI \geq 28.0 kg/m² [5]. The reference ranges for folate levels in pregnant women during early, middle, and late pregnancy were 3.25–85.1 ng/mL, 7.42–44.49 ng/mL, and 6.69–38.92 ng/mL, respectively. The normal range for homocysteine (Hcy) was 4.60–12.44 μ mol/L, and the critical value for vitamin B12 levels was set at 150 pg/mL.

2.4. Statistical methods

Statistical analysis of the data was performed using the statistical software SPSS 19.0. The comparison of genotype distributions of gene loci between groups was conducted using the χ^2 test, while the comparison of serum markers between groups was performed using the independent samples *t*-test. Logistic regression analysis was employed to analyze the risk of gestational hypertension, with a significance level set at $p < 0.05$ indicating statistically significant differences.

3. Results

3.1. Comparison of general information between the two groups

There were statistically significant differences in BMI index, systolic blood pressure, diastolic blood pressure, serum folate levels, Hcy levels, and vitamin B12 levels between the case group and the control group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of general information of pregnant women between the two groups

General characteristics	Case group (n = 45)	Control group (n = 45)	<i>t</i> / χ^2	<i>p</i>
Age (years)	26.83 \pm 2.47	26.91 \pm 2.51	0.152	0.789
BMI (kg/m ²)	28.76 \pm 2.34	25.48 \pm 2.29	6.720	< 0.001
Systolic BP (mmHg)	148.36 \pm 8.47	116.82 \pm 7.93	18.235	< 0.001
Diastolic BP (mmHg)	96.28 \pm 6.51	75.41 \pm 6.02	16.198	< 0.001
Education level (n)			0.067	0.796
High school or below	10 (22.22)	9 (20.00)		
College or above	35 (77.78)	36 (80.00)		
Serum folate (nmol/L)	15.62 \pm 3.38	36.24 \pm 3.67	27.724	< 0.001
Hcy (μ mol/L)	14.28 \pm 2.74	8.47 \pm 1.69	12.107	< 0.001
Vitamin B12 (pg/mL)	305.73 \pm 46.82	341.86 \pm 49.31	3.564	0.001

3.2. Comparison of folate metabolism gene polymorphism distribution between the two groups

The proportions of MTHFR-wild type and MTRR-wild type in the case group were lower than those in the control group, while the proportions of MTHFR-heterozygous mutant type and MTRR-heterozygous mutant type were higher in the case group than in the control group ($p < 0.05$). See **Table 2** and **3**.

Table 2. Comparison of folate metabolism gene MTHFR polymorphism distribution between the two groups [n(%)]

Group	n	Wild type	Heterozygous mutation	Homozygous mutation
Case group	45	20 (44.44)	20 (44.44)	5 (11.11)
Control group	45	36 (80.00)	9 (20.00)	0 (0.00)
χ^2		12.101	6.156	-
p		0.001	0.013	0.056

Note: “-” indicates Fisher’s exact test.

Table 3. Comparison of folate metabolism gene MTRR polymorphism distribution between the two groups [n(%)]

Group	n	Wild type	Heterozygous mutation	Homozygous mutation
Case group	45	15 (33.33)	25 (55.56)	5 (11.11)
Control group	45	27 (60.00)	15 (33.33)	3 (6.67)
χ^2		6.429	4.500	0.137
p		0.011	0.034	0.711

3.3. Correlation between research indicators and HDP based on logistic regression analysis

The statistically significant indicators from **Table 1**, **Table 2**, and **Table 3** were incorporated into a binary logistic regression model for analysis. The results indicated that overweight/obesity, abnormal folate levels, abnormal Hcy levels, abnormal vitamin B12 levels, MTHFR-heterozygous mutation, and MTHFR-homozygous mutation were independent risk factors for the occurrence of HDP ($p < 0.05$). Conversely, MTHFR-wild type and MTRR-wild type were protective factors against HDP ($p < 0.05$). See **Table 4**.

Table 4. Binary logistic regression model analysis of factors influencing the occurrence of HDP

Influencing factor	β	SE	p	OR	95% CI
Overweight / Obesity	1.288	0.444	0.004	3.625	1.519–8.651
Abnormal folate	1.520	0.478	0.001	4.571	1.792–11.660
Abnormal Hcy	1.476	0.467	0.002	4.375	1.750–10.938
Abnormal Vitamin B12	1.342	0.477	0.005	3.826	1.501–9.752
MTHFR - Wild Type	-1.609	0.480	0.001	0.200	0.078–0.514
MTHFR - Heterozygous mutation	1.163	0.478	0.015	3.200	1.253–8.172
MTRR - Wild type	-1.100	0.438	0.012	0.333	0.141–0.786
MTRR - Heterozygous mutation	0.916	0.436	0.036	2.500	1.064–5.874

4. Discussion

HDP is one of the leading causes of morbidity and mortality among pregnant women and perinatal infants worldwide. In recent years, with the advancement of precision medicine, gene polymorphisms in the folate metabolic pathway have been recognized as significant genetic susceptibility factors for HDP [6]. Folate metabolism plays a crucial role in cell proliferation, DNA synthesis and repair, and the regulation of DNA methylation. Methylenetetrahydrofolate reductase (MTHFR) and methionine synthase reductase (MTRR), as key enzymes in this pathway, may have their activities affected by gene polymorphisms, thereby altering metabolite levels and increasing the risk of HDP.

In this study, it was observed that the proportions of MTHFR-wild type and MTRR-wild type in the case group were lower than those in the control group, while the proportions of MTHFR-heterozygous mutant type and MTRR-heterozygous mutant type were higher than those in the control group ($p < 0.05$). The reason for this lies in the fact that although the homozygous mutant type carries the highest risk, its absolute frequency in the population is far lower than that of the heterozygous type. Although the individual risk of the heterozygous type is lower than that of the homozygous mutant type, its absolute number may be the largest due to its large population base. Additionally, studies have shown that individuals carrying the MTHFR C677T heterozygous mutation have MTHFR enzyme activity approximately 65% to 70% of that of the wild type, and the MTRR A66G heterozygous mutation also leads to partial impairment of enzyme function [7]. Reduced enzyme activity results in decreased production of 5-methyltetrahydrofolate, which in turn elevates plasma homocysteine (Hcy) levels. Elevated Hcy can induce endothelial dysfunction, oxidative stress, vascular inflammation, and a propensity for thrombosis, potentially exacerbating placental vascular endothelial damage and blood pressure regulation imbalance during pregnancy, thereby increasing the risk of hypertension. Furthermore, homocysteine accumulation may also activate the renin-angiotensin system, further exacerbating vasoconstriction and renal damage [8].

Therefore, in this study, abnormal Hcy levels, MTHFR-heterozygous mutant type, and MTRR-heterozygous mutant type were identified as independent risk factors for the occurrence of hypertensive disorders of pregnancy (HDP). This study also observed that overweight/obesity, abnormal folate levels, and abnormal vitamin B12 levels are similarly risk factors for hypertensive disorders of pregnancy (HDP). Overweight/obesity can lead to adverse placental perfusion and oxidative damage to placental tissue, resulting in maternal arterial dysfunction and blood flow disorders, thereby increasing the risk of HDP. Furthermore, the inflammatory response, endothelial dysfunction, and oxidative stress caused by obesity itself can also exacerbate the risk of HDP [9]. Abnormal folate and vitamin B12 levels exacerbate homocysteine (Hcy) accumulation through one-carbon metabolism disorders, inducing oxidative stress and vascular dysfunction. Previous studies have similarly confirmed these factors as risk factors that exacerbate the risk of HDP, consistent with the findings of this study [10]. However, as a single-center study with a small sample size, this research is subject to selection bias, and thus the generalizability of its results remains to be validated through further multi-center, large-sample studies. Additionally, it must be noted that folate metabolism is also influenced by various factors such as dietary intake and supplement use. Although this study controlled for some confounding factors, it did not comprehensively collect and analyze all possible interfering information, which may have had an impact on the final results.

5. Conclusion

In summary, this study found that among women of childbearing age in the Neijiang region, MTHFR C677T and MTRR A66G gene polymorphisms are closely associated with the risk of developing hypertensive disorders

of pregnancy. Pregnant women carrying mutant genotypes, who concurrently exhibit abnormalities in folate metabolism-related indicators (low folate, high homocysteine (Hcy), and low vitamin B12) and are overweight/obese, face a significantly increased risk of developing hypertensive disorders of pregnancy (HDP). Therefore, for pregnant women with the aforementioned high-risk factors, conducting polymorphic screening of key genes in the folate metabolic pathway and performing risk assessments based on their metabolic status hold potential clinical value in formulating personalized folate intervention strategies and achieving early prevention of HDP.

Disclosure statement

The author declares no conflict of interest.

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Evaluation Value of Cardiac Color Doppler Echocardiography in Assessing Poor Prognosis in Patients with Coronary Atherosclerotic Heart Disease

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Abstract: *Objective:* To investigate the evaluation value of cardiac color Doppler echocardiography (CDE) in assessing poor prognosis in patients with coronary atherosclerotic heart disease (CAD). *Methods:* A retrospective review was conducted of 106 patients with coronary artery disease (CAD) who were treated in the hospital's cardiovascular department between January 2023 and June 2024. All participants received baseline comprehensive Doppler echocardiography (CDE) assessments. Based on whether they experienced a Major Adverse Cardiovascular Event (MACE) within one year of follow-up, the patients were categorized into either a MACE group or a non-MACE group. The study compared baseline clinical information and CDE parameters, specifically left ventricular ejection fraction (LVEF), wall motion score index (WMSI), and mitral annular E/e' ratio, between the two groups. Independent predictors of MACE were identified using multivariate logistic regression analysis. *Results:* A total of 29 out of the 106 patients experienced MACE during the one-year follow-up. Compared with the non-MACE group, the MACE group had a higher prevalence of diabetes mellitus. In terms of CDE parameters, the MACE group had a lower LVEF than the non-MACE group ($p < 0.05$), while WMSI, average E/e', pulmonary artery systolic pressure (PASP), and mitral regurgitation (MR) proportion were all higher in the MACE group than in the non-MACE group ($p < 0.05$). Multifactor logistic regression analysis revealed that after adjusting for confounding factors such as diabetes, WMSI (OR = 3.003, 95% CI: 1.226–7.356, $p = 0.016$) and mean E/e' (OR = 1.281, 95% CI: 1.006–1.539, $p = 0.008$) were independent predictors of the occurrence of major adverse cardiovascular events (MACE). *Conclusion:* WMSI and E/e' diagnosed by color Doppler echocardiography (CDE) hold significant and independent assessment value for predicting poor prognosis in patients with coronary artery disease (CAD).

Keywords: Coronary atherosclerotic heart disease; Color doppler echocardiography; Poor prognosis; Major adverse cardiovascular events; Ventricular function

Online publication: Dec 31, 2025

1. Introduction

Coronary atherosclerotic heart disease (CAD) is one of the leading causes of death and disability worldwide ^[1]. Despite significant advancements in percutaneous coronary intervention and pharmacological treatment techniques in recent years, patients with CAD still face a high risk of recurrence of major adverse cardiovascular events (MACE). Therefore, accurate risk stratification and prognostic assessment of patients with CAD are of great significance for optimizing subsequent individualized treatment strategies and improving long-term patient survival ^[2]. Currently, coronary angiography (CAG) and coronary computed tomography angiography (CCTA) are primarily used in clinical settings to assess coronary anatomical stenosis. However, CAG, as an invasive procedure, has significant limitations, while CCTA, although non-invasive, also carries risks of ionizing radiation and iodinated contrast agent toxicity. Moreover, the degree of stenosis may not fully correlate with myocardial injury and prognosis, potentially leading to unnecessary downstream functional tests ^[3,4]. In view of this, this study conducted a retrospective analysis of the clinical data of 106 patients with coronary artery disease (CAD) admitted to the cardiovascular department of our hospital from January 2023 to June 2024, aiming to explore the value of cardiac color Doppler echocardiography in evaluating poor prognosis in CAD patients, with a particular focus on the predictive value of indicators such as regional wall motion abnormality index (WMSI) and elevated left ventricular filling pressure (E/e') for major adverse cardiovascular events (MACE). The findings are reported as follows.

2. Materials and methods

2.1. General information

A retrospective review was performed on the medical records of 106 coronary artery disease (CAD) patients who were admitted to our hospital's cardiology department between January 2023 and June 2024. All patients included in the analysis underwent baseline cardiac Doppler echocardiography (CDE) upon admission and completed a one-year follow-up to collect prognostic information. This work was approved by our hospital's Medical Ethics Committee with a waiver of informed consent.

2.2. Inclusion criteria

- (1) Patients confirmed by imaging examination to have at least one major coronary artery with $\geq 50\%$ luminal stenosis
- (2) Aged 18 years or older
- (3) Complete baseline data and clear imaging data images

2.3. Exclusion criteria

- (1) Patients with severe primary valvular heart disease, congenital heart disease, restrictive cardiomyopathy, or other non-ischemic myocardial diseases
- (2) Patients with a history of heart valve replacement or coronary artery bypass grafting
- (3) Patients with persistent atrial fibrillation, frequent premature ventricular contractions, or other severe arrhythmias
- (4) Patients with severe infections or diseases in other organs
- (5) Patients with malignant tumors or autoimmune diseases

- (6) Patients with poor baseline CDE image quality that makes it impossible to accurately identify the endocardial border

2.4. Methods

A color Doppler ultrasound diagnostic apparatus (State Import Drug Registration No. 20193062262, model and specification: EPIQ 7C; State Import Drug Registration No. 20173060626, model and specification: Vivid E95) was used. The patient was placed in a left lateral recumbent position and connected to an electrocardiogram. The left ventricular ejection fraction (LVEF) was calculated using the biplane Simpson's method, and semi-quantitative scoring of the ventricular wall motion was performed to calculate the wall motion score index (WMSI). The early diastolic mitral flow velocity (E wave) was measured using pulse Doppler, and the myocardial tissue motion velocity (e wave) was measured in combination with tissue Doppler imaging to calculate the E/e' ratio. Continuous Doppler was used to measure the peak velocity of tricuspid regurgitation to estimate the pulmonary artery systolic pressure (PASP). The degree of mitral regurgitation (MR) was assessed using color Doppler.

2.5. Statistical methods

Data analysis was performed using SPSS 22.0 statistical software. After confirming normal distribution via the Shapiro-Wilk test, measurement data were expressed as mean \pm standard deviation ($\bar{x} \pm s$) and analyzed using the *t*-test. Count data were presented as percentages and analyzed using the χ^2 test or Fisher's exact test. Variables showing a univariate association with $p < 0.01$ were entered into a multivariate logistic regression model. Statistical significance was defined as a two-sided *p*-value of less than 0.05.

3. Results

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

Among the 106 CAD patients included in this study, 29 patients (27.36%) experienced MACE during a one-year follow-up, while 77 patients (72.64%) did not experience MACE. A review of baseline characteristics found no significant differences between the MACE and non-MACE groups in terms of age, sex, body mass index, history of hypertension, smoking status, or prevalence of multivessel disease. The only exception was comorbid diabetes, which was significantly more prevalent in the MACE group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of baseline data between the two groups of patients [$\bar{x} \pm s$, n(%)]

Variable	MACE group (n = 29)	Non-MACE group (n = 77)	Statistical value (χ^2/t)	<i>p</i> -value
Age (years)	65.12 \pm 9.42	63.88 \pm 10.15	0.571	0.569
Gender (Male, %)	20 (68.97)	55 (71.43)	0.062	0.804
BMI (kg/m ²)	25.05 \pm 3.14	24.66 \pm 2.98	0.592	0.555
Hypertension (%)	21 (72.41)	43 (55.84)	2.418	0.120
Diabetes (%)	15 (51.72)	19 (24.68)	7.074	0.008
Smoking history (%)	14 (48.28)	30 (38.96)	0.753	0.386
Multivessel disease (%)	18 (62.07)	32 (41.56)	3.556	0.059

3.2. Comparison of CDE diagnostic parameters between the two groups of patients

Patients who experienced MACE demonstrated significantly poorer cardiac function across multiple measures compared to the non-MACE group. This included impaired systolic function (lower LVEF and higher WMSI), diastolic dysfunction (higher average E/e'), and adverse hemodynamics (higher PASP and a greater proportion of MR). All differences were statistically significant ($p < 0.05$). See **Table 2**.

Table 2. Comparison of CDE diagnostic parameters between the two groups of patients [$\bar{x} \pm s$, n(%)]

Parameter	MACE group (n = 29)	Non-MACE group (n = 77)	Statistical value (χ^2/t)	p-value
Systolic function				
LVEF (%)	48.15 \pm 6.22	55.60 \pm 5.19	-6.233	< 0.001
WMSI	1.51 \pm 0.24	1.18 \pm 0.15	8.474	< 0.001
Diastolic function				
E/e' (average)	15.25 \pm 3.11	10.90 \pm 2.65	7.178	< 0.001
Hemodynamics				
PASP (mmHg)	42.10 \pm 8.16	33.50 \pm 6.97	5.400	< 0.001
Moderate-to-severe MR (%)	10 (34.48)	11 (14.29)	5.409	0.020

3.3. Multivariate logistic regression analysis of MACE occurrence

Diabetes, multivessel disease, LVEF, WMSI, E/e', PASP, and moderate to severe MR from the univariate analysis were included in the multivariate Logistic regression model for analysis. The results showed that diabetes, WMSI, and mean E/e' were independent predictors of MACE occurrence ($p < 0.05$). See **Table 3**.

Table 3. Multivariate logistic regression analysis of MACE occurrence

Variable	β	SE	Wald χ^2	p-value	OR	95% CI
Diabetes	0.851	0.399	4.545	0.033	2.341	1.071–5.117
LVEF (%)	-0.037	0.051	0.525	0.469	0.964	0.873–1.064
Multivessel disease	0.377	0.408	0.853	0.356	1.458	0.655–3.245
WMSI	1.100	0.457	5.788	0.016	3.003	1.226–7.356
E/e' (average)	0.248	0.094	6.979	0.008	1.281	1.006–1.539
PASP (mmHg)	0.045	0.036	1.528	0.216	1.046	0.974–1.123
Moderate-to-severe MR	0.484	0.547	0.785	0.376	1.623	0.556–4.738

4. Discussion

Coronary artery disease (CAD) has now emerged as a significant global public health challenge. Research data indicate that its incidence among individuals under 50 years old in China has increased by nearly 30% in the past three years, with a more pronounced trend towards younger age groups^[5]. Due to its non-invasive nature, lack of radiation exposure, high convenience, and strong reproducibility, Cardiac Doppler Echocardiography (CDE) has become the first-line choice for assessing cardiac structure and function. However, its risk assessment for CAD

patients largely relies on LVEF. Since LVEF is an indicator significantly influenced by preload and afterload conditions, it only reflects the overall ventricular pumping capacity. Even when patients may have already developed significant subclinical myocardial damage and diastolic dysfunction, LVEF may still remain within the normal range ^[6]. Therefore, this study primarily employs a multiparametric model integrating the Wall Motion Score Index (WMSI) and E/e' to explore the value of cardiac color Doppler ultrasound in predicting major adverse cardiac events (MACE) within one year in patients with coronary artery disease (CAD) from both ventricular wall mechanics and hemodynamic perspectives.

The findings of this study indicate that although the left ventricular ejection fraction (LVEF) in the MACE group is significantly lower than that in the non-MACE group, it does not demonstrate independent predictive value in the multivariate model. In contrast, WMSI is confirmed as an independent predictor of MACE occurrence. The reason for this is that when myocardial contraction in CAD patients weakens or even ceases due to ischemia, the myocardium in other regions supplied by normal coronary arteries can exhibit compensatory enhanced contraction through the Frank-Starling mechanism. Consequently, the calculated LVEF value cannot fully reflect the true ischemic burden ^[7]. In comparison, WMSI can precisely quantify the extent and severity of regional ventricular wall motion abnormalities caused by ischemia. This means that even if LVEF remains compensatorily normal, a high WMSI not only indicates a larger infarct size but also reflects a high risk of myocardial remodeling and arrhythmias ^[8]. In addition, this study also observed the value of the E/e' ratio in the prognostic evaluation of CAD. Myocardial ischemia and fibrosis caused by CAD will lead to impaired diastolic function and an increase in LVFP. The elevated LVFP further results in pulmonary congestion and heart failure, thereby triggering MACE. As an important non-invasive indicator for evaluating left ventricular filling pressure, E/e' plays a crucial measurement point in the process of CAD leading to heart failure ^[9]. In this study, the continuous elevation of E/e' in the MACE group suggests that the patients' left ventricles are in a highly stiff state, and the heart requires higher end-diastolic pressure to maintain filling. Over time, this can easily lead to the abnormal transmission of stress in the reverse direction to the pulmonary circulation, increasing the risk of pulmonary congestion and pulmonary arterial hypertension, which are also core factors triggering heart failure and MACE ^[10]. Park et al. found in their study that an E/e' ratio ≥ 15 was the strongest predictor of cardiac death in patients with acute myocardial infarction, which is consistent with the findings of this study ^[11]. Although PASP and MR in this study did not demonstrate statistical independence in the regression model, their significantly high levels in the MACE group to some extent indicate the downstream effects of cardiac dysfunction. The elevation of E/e' can be transmitted in the reverse direction, triggering left ventricular remodeling and pulmonary arterial hypertension, thereby leading to an increase in PASP. Its independence may be overshadowed by upstream indicators such as E/e' in clinical practice, but it should still be considered an important reference for the overall risk assessment of MACE.

5. Conclusion

In conclusion, the comprehensive CDE evaluation strategy incorporating WMSI and E/e' has high clinical value in assessing poor prognosis in CAD patients and can provide strong guidance for actively formulating and adjusting precise treatment strategies and follow-up plans in clinical practice.

Disclosure statement

The author declares no conflict of interest.

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Exploring the Mechanism of Wumei Pill in the Treatment of Autoimmune Hepatitis Based on Network Pharmacology and Molecular Docking

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Abstract: *Objective:* To explore the molecular mechanism and action pathways of Wumei Pill in the treatment of autoimmune hepatitis (AIH) using network pharmacology and molecular docking methods. *Methods:* The active components and targets of Wumei Pill, as well as AIH-related disease targets, were screened through the TCMS, GeneCards, OMIM, and Disgenet databases. Cytoscape 3.9.1 was used to construct a series of topological networks, followed by Kyoto Encyclopedia of Genes and Genomes (KEGG) pathway enrichment analysis and Gene Ontology (GO) enrichment analysis. Molecular docking and visualization were performed using AutoDockTools 1.5.7 and PyMOL 2.4.0. *Results:* A total of 124 active components of Wumei Pill, 877 drug targets, 1130 disease targets, and 64 overlapping targets were obtained. GO enrichment analysis yielded 82 biological processes, 4 cellular components, and 19 molecular functions. KEGG pathway enrichment analysis identified 21 signaling pathways. *Conclusion:* Wumei Pill can act on targets such as Tumor Necrosis Factor (TNF), Caspase 3 (CASP3), C-X-C Motif Chemokine Ligand 8 (CXCL8), Nuclear Factor Kappa B Subunit 1 (NFKB1), and Transforming Growth Factor Beta 1 (TGFB1) through active components including ginsenoside and (R)-tetrahydroberberine. It further regulates inflammation and apoptosis-related pathways such as tumor-related signaling pathways and Th17 cell differentiation pathway to treat AIH. This study provides a theoretical basis for in-depth research on the mechanism of Wumei Pill in the treatment of AIH and the development of therapeutic drugs.

Keywords: Wumei pill; Autoimmune hepatitis (AIH); Network pharmacology; Molecular docking technology

Online publication: Dec 31, 2025

1. Introduction

Autoimmune hepatitis (AIH) is a chronic inflammatory liver disease caused by immune abnormalities. Clinical manifestations vary among patients of different severity, mainly characterized by interface hepatitis in liver

histopathological examination, elevated serum gamma-glutamyl transpeptidase (GGT), immunoglobulin G (IgG), and positive autoantibodies such as antinuclear antibody (ANA) and anti-smooth muscle antibody (ASMA) ^[1]. Currently, the incidence of AIH is increasing year by year. Due to its strong concealment, it is difficult for patients to detect in the early stage, and it can easily progress to cirrhosis and liver failure if left untreated ^[2]. Therefore, strengthening early detection, timely medical intervention, and reducing inflammation levels are crucial to prevent disease deterioration.

After receiving AIH patients, Western medicine usually adopts the traditional treatment plan of combining glucocorticoids with immunosuppressants. This plan takes a long time, causes various adverse reactions during medication, and is prone to recurrence after drug withdrawal ^[3]. The therapeutic effect of this plan on AIH patients is not ideal, and long-term medication requires substantial financial resources, bringing a heavy economic burden to patients' families. Thus, exploring more effective, economical, and safe treatment plans is imperative ^[4].

Traditional Chinese medicine (TCM) is an important part of traditional medicine. Guided by the principles of holistic view and syndrome differentiation and treatment in clinical application, it has the advantages of fewer adverse reactions and cost-effectiveness, and has shown good efficacy in the treatment of liver diseases, providing conditions for improving AIH treatment outcomes. Wumei Pill is a TCM preparation derived from Zhang Zhongjing's Shanghan Lun (Treatise on Febrile Diseases). Its main components include 10 medicines such as *Mume Fructus*, *Asari Radix et Rhizoma*, *Zingiberis Rhizoma*, *Cinnamomi Ramulus*, *Ginseng Radix et Rhizoma*, *Angelicae Sinensis Radix*, *Phellodendri Chinensis Cortex*, *Coptis Chinensis Rhizoma*, and *Aconiti Radix Lateralis Preparata*. It has the main effects of warming the viscera to calm roundworms, soothing the liver and regulating the middle energizer, clearing heat from the upper and warming the lower, balancing pathogenic factors and healthy Qi, and treating both cold and heat syndromes. It is widely used in the treatment of multisystem diseases such as gastroenteritis and hepatorenal syndrome ^[5-8]. Pharmacological evidence-based research has shown that Wumei Pill can inhibit Th17 cell differentiation and regulate the NLRP3 inflammasome to improve inflammatory responses ^[9,10].

Network pharmacology and molecular docking technology adopt an interdisciplinary research approach, combining bioinformatics and computer technology to mine relevant network data around research topics and generate drug-disease mapping relationship networks, providing support for further analyzing the therapeutic effects of TCM on diseases. Using network pharmacology and molecular docking technology to explore the mechanism of Wumei Pill in the treatment of AIH helps enrich clinical diagnosis and treatment methods and improve the cure rate of this disease.

2. Materials and methods

2.1. Screening of active components, targets of Wumei Pill, and construction of overlapping targets with diseases

The names and 2D structures of components of Wumei Pill (*Mume Fructus*, *Asari Radix et Rhizoma*, *Zingiberis Rhizoma*, *Cinnamomi Ramulus*, *Ginseng Radix et Rhizoma*, *Angelicae Sinensis Radix*, *Phellodendri Chinensis Cortex*, *Coptis Chinensis Rhizoma*, *Aconiti Radix Lateralis Preparata*) were obtained from the TCMSP database. Active components with oral bioavailability (OB) $\geq 40\%$ and drug-likeness (DL) ≥ 0.18 were screened. The Swiss Target Prediction database was used to predict the targets of active components, and drug component genes were obtained. AIH-related disease targets were retrieved from the GeneCards, OMIM, and Disgenet databases using

“Autoimmune hepatitis” as the index. The overlapping targets between disease genes and drug component targets were obtained using Venny 2.1.0.

2.2. Construction of protein-protein interaction (PPI) network

The overlapping targets were input into the STRING 12.0 database, with the species set to “Homo sapiens” and confidence > 0.40. The potential targets were screened and imported into Cytoscape 3.9.1 software. CentiScaPe 2.2 was used to select parameters including Degree, Closeness, and Betweenness to obtain core targets and construct the PPI network diagram.

2.3. Construction of topological networks of TCM component-target and pathway-target

Information on drugs, active components, common targets, pathways, and targets was imported into Cytoscape 3.9.1 for network structure visualization. Node colors were set as follows: TCM component-target network: drugs–purple, active components–green, common targets–orange; pathway-target topological network: targets–green, pathways–red. Node sizes were set based on node degree (from small to large with increasing degree), resulting in the drug-component-target network diagram and pathway-target topological network diagram.

2.4. Kyoto encyclopedia of genes and genomes (KEGG) and gene ontology (GO) enrichment analysis

The common drug-disease targets were imported into the DAVID platform, and enrichment analysis was performed by selecting “OFFICIAL-GENE-SYMBOL”, Homo sapiens, and Gene List. Enriched biological processes (BP), cellular components (CC), and molecular functions (MF) were obtained (screened with $p < 0.05$). Microbioinformatics online mapping tools were used to draw bubble charts and bar charts for visualization of results.

2.5. Molecular docking

Based on the component-target network diagram, the top 10 active components with the highest degree values were selected, and their Mol2 structures were downloaded. Preprocessing was performed using PyMOL 2.4.0, and the pdbqt format was saved. Based on the PPI network, the top 5 targets with the highest degree values were selected as macromolecular receptor experimental objects. Crystal structures obtained by X-ray crystallography from “*Homo sapiens*” were selected from the PDB database. The crystal structures in pdb format were downloaded, and the proteins were preprocessed (e.g., water removal) using PyMOL 2.4.0, followed by hydrogenation in AutoDockTools 1.5.7 and saving in pdbqt format. Molecular docking was performed using AutoDockTools 1.5.7, and visualization was achieved using PyMOL 2.4.0.

3. Results

3.1. Screening of active components, targets, and overlapping targets

A total of 124 active components of Wumei Pill were screened from the TCMSP database. A total of 877 targets of active components of Wumei Pill were predicted through the Swiss Target Prediction website, with 51 active components obtained after screening and deduplication. AIH targets screened from the GeneCards, OMIM, and Disgenet databases were 808, 142, and 190, respectively. After data collation and deduplication, 1130 disease targets

were obtained. A total of 64 overlapping targets between Wumei Pill and AIH were obtained using Venny 2.1.0.

3.2. Core targets of PPI network

CentiScaPe 2.2 was used to screen 12 key targets with Degree > 5.388, Closeness > 0.008, and Betweenness > 89.469, resulting in 12 nodes and 33 edges. The greater the importance, the larger and brighter the circle; the higher the degree of connection, the thicker and darker the line. The results showed that the core targets included Tumor Necrosis Factor (TNF), Cytochrome P450 27B1 (CYP27B1), Transforming Growth Factor Beta 1 (TGFB1), etc. (Figure 1).

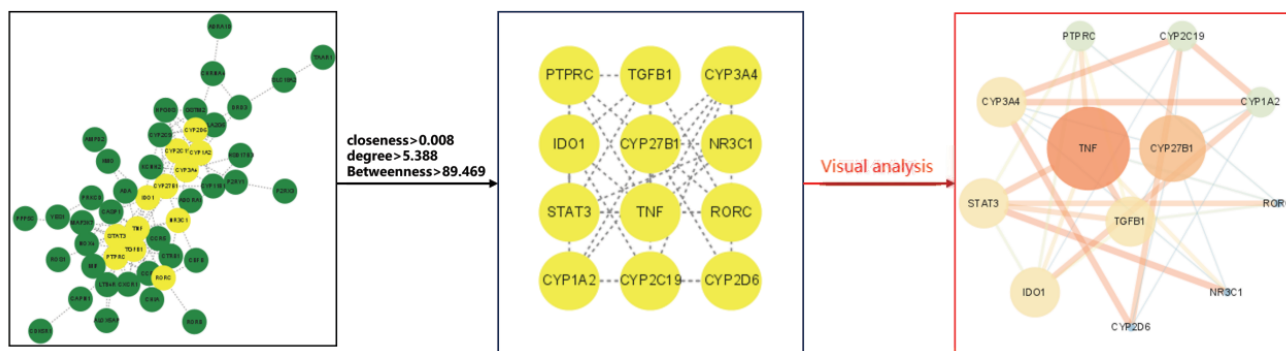


Figure 1. Protein-protein interaction (PPI) network diagram of overlapping targets between core targets of Wumei Pill and core targets of AIH.

3.3. Topological networks of drug-component-target and pathway-target

Cytoscape 3.9.1 was used for network structure visualization to obtain the drug-component-target network diagram (Figure 2) and pathway-target topological network diagram (Figure 3). The higher the degree value, the larger the node.

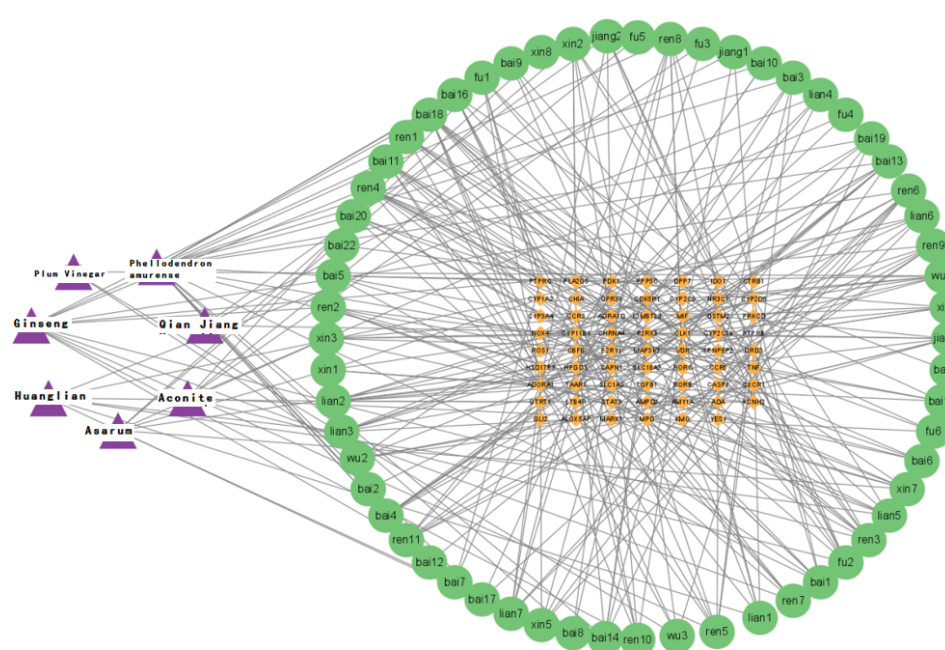


Figure 2. Drug-component-target network diagram.

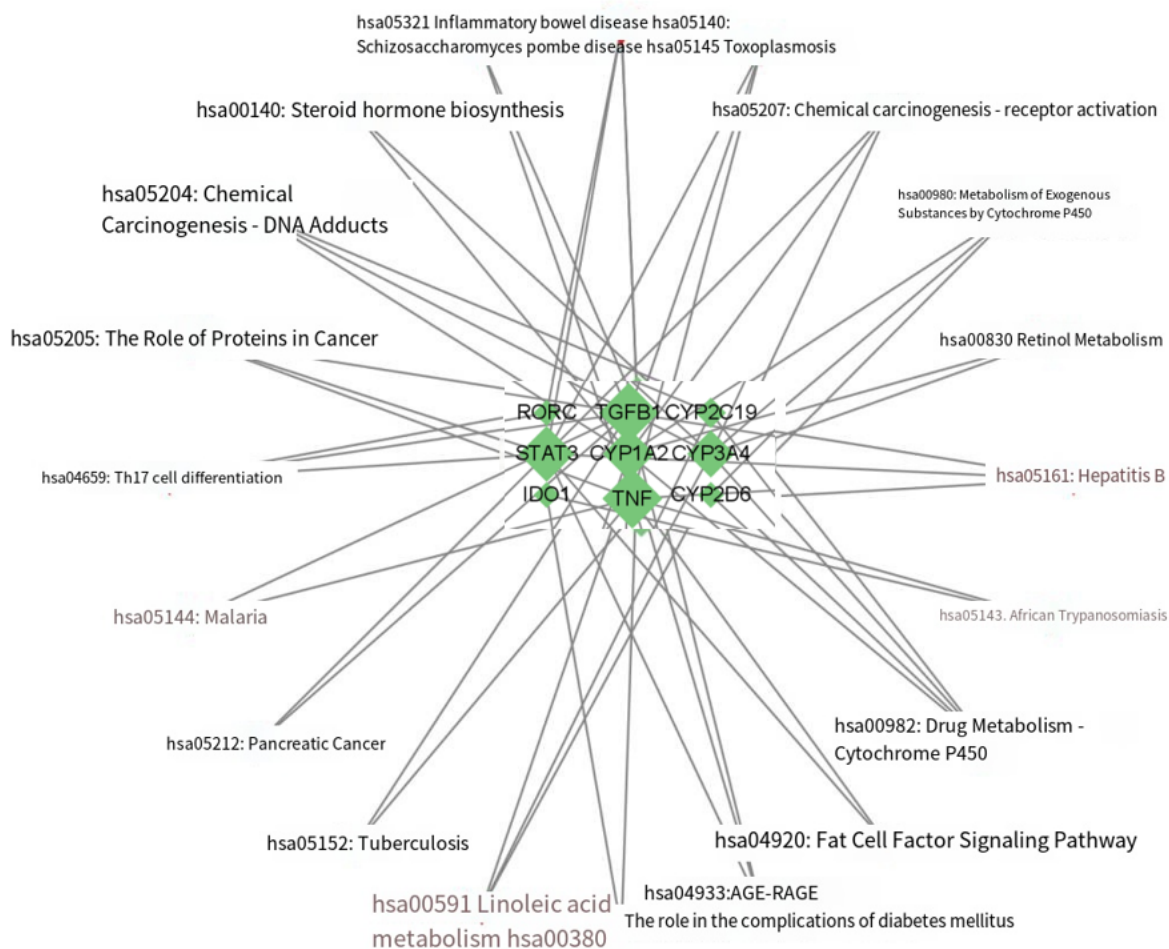


Figure 3. Pathway-target topological network diagram.

3.4. GO and KEGG enrichment analysis of core targets

GO enrichment analysis of 12 key target genes using the David database yielded 105 GO terms, including 82 biological processes (mainly involved in inflammatory response, positive regulation of transcription by RNA polymerase II, positive regulation of DNA-templated transcription, etc.), 4 cellular components (cytoplasm, intracellular membrane-bounded organelle, endoplasmic reticulum membrane, cell surface), and 19 molecular functions (involving genes related to African trypanosomiasis, chemical carcinogenesis-receptor activation, proteoglycans in cancer, etc.). KEGG enrichment analysis identified 20 signaling pathways, including linoleic acid metabolism, Th17 cell differentiation, drug metabolism-cytochrome P450, etc.

3.5. Molecular docking results

The top 5 targets (TNF, CASP3, CXCL8, NFKB1, TGFB1) with the highest degree values in the PPI network were selected for molecular docking simulation with the main components (girinimbine, calyachine, (R)-tetrahydroberberine, cavidine, (-)-isocorydine) (**Table 1**). The binding strength between compounds and ligands was judged based on binding energy. The lower the binding energy, the tighter the binding between the compound and the ligand. The results showed that all binding energies were less than 0 kcal/mol, indicating that the core

active components of Wumei Pill had good binding activity with AIH-related targets and high potential biological activity. Combinations with good binding ability and hydrogen bonds were selected for visualization analysis (Figure 4).

Table 1. Molecular docking binding energies

Target	Girinimbine	Calyachine	(R)-Tetrahydroberberine	Cavidine	(-)-Isocorydine
CASP3	-5.17	-4.73	-6.04	-4.52	-3.75
TNF	-6.11	-5.68	-5.47	-5.1	-3.84
NFKB1	-6.64	-5.1	-5.04	-5.3	-5.21
TGFB1	-5.04	-4.75	-4.37	-4.72	-3.73
CXCL8	-5.0	-5.0	-4.41	-5.36	-3.69

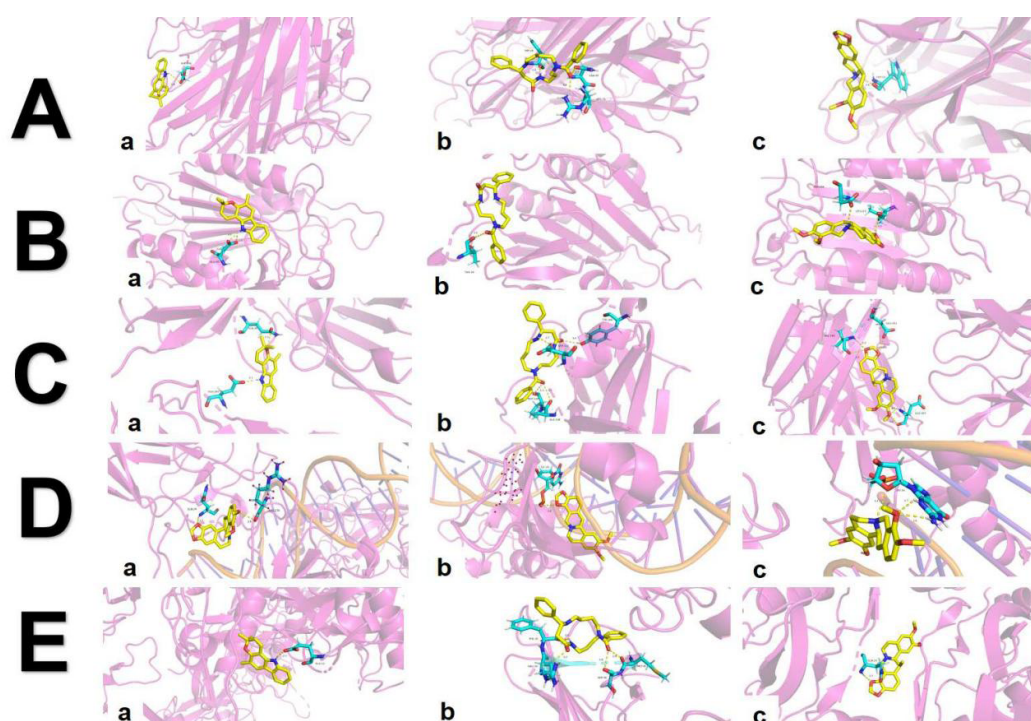


Figure 4. Molecular docking results 6A: a: TNF–Girinimbine; b: TNF–Calyachine; c: TNF–(R)-Tetrahydroberberine;6B: a: CASP3–Girinimbine; b: CASP3–Calyachine; c: CASP3–(R)-Tetrahydroberberine;6C: a: CXCL8–Girinimbine; b: CXCL8–Calyachine; c: CXCL8–Cavidine;6D: a: NFKB1–(R)-Tetrahydroberberine; b: NFKB1–Cavidine; c: NFKB1–(-)-Isocorydine;6E: a: TGFB1–Girinimbine; b: TGFB1–Calyachine; c: TGFB1–Cavidine.

4. Discussion

Autoimmune hepatitis is mainly caused by factors such as living environment, drug use, and viral invasion. During the immune system response, antibodies produced by hepatocytes and T cell-mediated immune responses lead to inflammatory reactions in the liver ^[11]. Since AIH was introduced in the clinical field, treatment methods have been relatively limited, and the main treatment goals are to slow down liver fibrosis and relieve liver inflammation ^[12]. Studies have found that Wumei Pill has the effects of reducing inflammation and enhancing immune function in the treatment of this disease ^[13].

In this study, a total of 124 main active components of Wumei Pill, corresponding to 877 targets, and 64 overlapping targets involved in the treatment of AIH were obtained. The main components such as girinimbine, calyachine, (R)-tetrahydroberberine, cavidine, and (-)-isocorydine were obtained by constructing the component-target network diagram. The top 5 core targets were screened through the PPI network, and it was concluded that the mechanism of Wumei Pill on AIH is mainly related to TNF, CASP3, CXCL8, NFKB1, and TGFB1. Molecular docking of the top 5 main active components with the 5 core targets showed that the core active components of Wumei Pill had good binding activity with AIH-related targets and high potential biological activity.

TNF is secreted by macrophages and T cells, and its main function is to regulate inflammatory immune responses. High doses of TNF can stimulate MAPK and NF- κ B signaling pathways, activate local inflammatory genes and mediate cell life activities, leading to inflammatory reactions^[14,15]. TNF plays an important role in multiple cellular functions such as immune regulation and inflammation. Relevant studies have shown that under the induction of TNF- α blockers, the human body is prone to drug-induced autoimmune hepatitis^[16,17]. CASP3 is a protease that can cause DNA cleavage and promote cell apoptosis. Based on bioinformatics and proteomic identification, CASP3 is one of the main types of liver-protective target proteins^[18]. In addition, studies have found that berberine hydrochloride can inhibit the CASP3 signaling pathway to alleviate liver injury caused by acute hypoxia exposure, and CASP3 can also participate in liver regeneration^[19,20], further confirming that CASP3 is related to liver injury diseases. During inflammation mediation, CXCL8 has the function of promoting the formation of Mallory-Denk bodies in the liver. Abnormal regulation of its receptors is related to many inflammation-mediated diseases, and its expression is significantly upregulated in various inflammatory liver diseases^[21]. NF- κ B subunits regulate innate and adaptive immunity, cell proliferation, stress response, and cell apoptosis. After the deletion of p105 and p50 of NFKB1, organ damage and inflammatory reactions will be aggravated^[22]. Studies have suggested that NFKB1 is related to rheumatoid arthritis, and TGF- β 1 is related to systemic lupus erythematosus, indicating that they may be related to autoimmune diseases^[23,24].

KEGG enrichment results indicated that the process of Wumei Pill in the treatment of AIH may be related to pathways such as inflammatory bowel disease, drug metabolism-cytochrome P450, linoleic acid metabolism, proteoglycans in cancer, and Th17 cell differentiation. Core targets are highly enriched in the above pathways, mainly related to processes such as inflammatory response, positive regulation of transcription by RNA polymerase II, and positive regulation of DNA-templated transcription. According to investigation and analysis, AIH has the risk of developing into hepatocellular carcinoma^[25]. Both drug metabolism-cytochrome P450 and proteoglycan-related pathways are closely related to hepatocellular carcinoma^[26,27]. According to the KEGG analysis of therapeutic targets, the number of targets enriched in drug metabolism-cytochrome P450 and proteoglycan-related signaling pathways is relatively high. Cell surface proteoglycans are important regulatory factors in inflammatory reactions and serve as attractive pharmacological targets in cancer for cancer immunotherapy, reflecting that the use of Wumei Pill is related to the clinical remission of AIH transformation to hepatocellular carcinoma^[28]. Linoleic acid is a major positive regulator of CD8⁺ T cell activity, enhancing anti-tumor ability by improving metabolic adaptability, so linoleic acid can be used as an enhancer for adoptive cell therapy in tumor treatment^[29]. In addition, linoleic acid can reduce apoptosis through NF- κ B^[30]. As a key mediator of inflammatory reactions, the transcription factor NF- κ B can regulate multiple aspects of immune function. Loss-of-function mutations in negative regulators of the NF- κ B pathway are also the cause of autoimmune or inflammatory diseases^[31]. The NF- κ B signaling pathway can not only promote hepatocyte survival in the liver but also control the expression of a series of growth factors and cytokines, participating in liver inflammatory reactions^[32]. Therefore, it can be

inferred that linoleic acid plays an important role in the treatment of AIH by regulating NF- κ B. Th17 cells are related to many inflammatory reactions and autoimmune diseases, and the increased differentiation of pathogenic T helper 17 cells plays an important role in the occurrence and development of AIH^[33]. Regulating Th17 cell balance provides a feasible treatment method for AIH patients^[34,35].

Analysis of molecular docking results showed that the main active components of Wumei Pill had good docking effects with key targets of autoimmune hepatitis, and all binding energies were < 0 kJ/mol, indicating that there is a stable interaction between them. Based on this finding, we have reason to speculate that Wumei Pill may have potential efficacy in the treatment of AIH.

5. Conclusion

In summary, this study predicted the active components and targets of Wumei Pill using network pharmacology methods, analyzed the protein PPI network interaction, cellular components, signaling pathways, and biological processes of the targets of Wumei Pill in the treatment of AIH, and initially clarified the mechanism of Wumei Pill in the treatment of AIH. Molecular docking technology was used to construct a docking model of the interaction between active components in Wumei Pill and key targets for the treatment of AIH, further verifying the results of network pharmacology analysis, providing a reference basis for subsequent experimental research and clinical application.

Funding

University-Level College Student Innovation and Entrepreneurship Training Program of Qiqihar Medical University; Exploring the Mechanism of Ganjiang Huangqin Huanglian Renshen Decoction on AIH Mice Based on Network Pharmacology and In Vivo Experiments (Project No.: X202311230039)

Disclosure statement

The authors declare no conflict of interest.

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Publisher's note

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

Exploring the Implementation Pathway for Point-of-Care Ultrasound-Guided Basic Clinical Puncture Procedures in Practical Teaching

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Abstract: The present study aims to explore the implementation pathway for practical teaching of basic clinical puncture procedures under the guidance of point-of-care ultrasound (POCUS). The goal of the study is twofold: firstly, to address the shortcomings of the current medical education model and, secondly, to enhance medical students' independent thinking abilities and clinical diagnostic skills. The study enrolled 87 clinical medicine interns rotating at Jiangning Hospital in Nanjing from January to December 2024, dividing them into an experimental group (receiving ultrasound-guided puncture procedure training) and a control group (receiving conventional puncture procedure training). It was evident that both groups had successfully completed the requisite two-hour comprehensive course training program. A subsequent analysis of the teaching outcomes was then conducted through intergroup comparison. The findings indicated that the experimental group exhibited lower DOPS assessment scores in comparison to the control group (4.91 ± 1.01 vs. 5.84 ± 1.22 , $p < 0.05$). However, the satisfaction levels of the experimental group with the teaching method reached 95.45%. This finding indicates that ultrasound-guided puncture techniques may offer a substantial advantage in terms of pedagogical approaches. However, it should be noted that students in the experimental group faced challenges such as high operational complexity and the need to pay attention to numerous details during actual procedures, leading to lower assessment scores. Conducting a systematic analysis of these issues can provide clear directions for the optimization of teaching methods in the future, thereby enhancing students' learning outcomes and clinical application capabilities.

Keywords: Point-of-care ultrasound; Puncture; Practical training

Online publication: Dec 31, 2025

1. Introduction

With the continuous improvement of material life, the average life expectancy and medical conditions have seen significant enhancements and improvements. However, this progress has been accompanied by a scarcity of

medical resources and an uneven distribution across regions. To cope with the dynamic and complex healthcare environment, medical education needs to intensify its efforts in cultivating medical students with strong comprehensive abilities. The “Guiding Opinions of the General Office of the State Council on Accelerating the Innovative Development of Medical Education”^[1] issued in 2020 explicitly proposed promoting the interdisciplinary integration of medical engineering, medical science, and medical humanities, and strengthening the cultivation of innovative and outstanding talents with a multidisciplinary background of “Medicine + X”. However, traditional medical education faces issues such as disciplinary barriers, fragmented knowledge, a disconnect between basic and clinical education, and outdated teaching methods. Therefore, curriculum system reform has become a crucial aspect of cultivating innovative and interdisciplinary medical talents.

As an interdisciplinary technology, ultrasound is widely applied in imaging diagnosis and clinical operations. For clinicians, ultrasound serves as a “visual stethoscope” and is increasingly utilized in multidisciplinary collaborations^[2]. Due to its advantages of no ionizing radiation, low cost, and non-invasiveness, ultrasound has become an attractive teaching tool for medical students. It can fully integrate basic medical knowledge with clinical applications, helping students deepen their understanding of foundational medical subjects such as systemic anatomy, physiology, pathology, and diagnostics, enhance their practical operational skills, and foster direct interaction between students, teachers, and patients^[3]. Furthermore, as a non-invasive and real-time examination tool, ultrasound plays a significant role in the clinical education system of Western countries. Early exposure to ultrasound technology training can promote the development of competency^[4-6].

The WFUMB (The World Federation of Ultrasound in Medicine and Biology) consensus on ultrasound education for medical students state that ultrasound is becoming a fundamental diagnostic tool in most medical specialties and an innovative tool for teaching anatomy, physiology, and pathophysiology to both undergraduate and postgraduate students^[7]. Extensive research on ultrasound instruction has been conducted worldwide, revealing significant diversity in training methods, equipment, and curriculum design. Opportunities for ultrasound education at both undergraduate and postgraduate levels continue to expand, with increasingly diverse project concepts and teaching formats^[8-10]. This study aims to explore the practical implementation path of ultrasound-guided clinical basic skills training during the medical student training phase, addressing deficiencies in the existing medical training model and enhancing medical students’ independent thinking and clinical diagnostic abilities.

Ultrasound has a wide range of clinical applications^[11]. In the 1990s, European medical schools began incorporating ultrasound into their teaching and recommended the development of undergraduate curricula. Subsequently, developed countries and regions successively applied ultrasound training to anatomy and physiology courses, integrated it into physical examinations and problem-based learning, and ultimately utilized it in clinical rotations^[12,13]. Germany began requiring the inclusion of point-of-care ultrasound courses in the undergraduate curriculum for all medical students in 2015^[14]. In contrast, China started relatively late, with most medical schools lacking professional ultrasound training courses at the undergraduate level. Currently, clinical specialists in China often receive professional ultrasound technology training only after encountering specific practical issues in their clinical work^[15]. Therefore, through this study, we aim to explore the implementation path of practical teaching for bedside ultrasound-guided basic clinical puncture procedures during the medical student training phase, with the goal of popularizing fundamental ultrasound knowledge and basic ultrasound skills.

2. Materials and methods

2.1. Research design

This study selected 87 clinical medicine interns rotating at Jiangning Hospital in Nanjing from January 2024 to December 2024 as the research subjects. The 87 students were randomly divided into an experimental group of 44 and a control group of 43. The experimental group consisted of 24 males and 20 females, while the control group had 24 males and 19 females, with no statistically significant difference in general demographic data between the two groups. The experimental group received ultrasound-guided puncture procedure training, while the control group underwent conventional puncture procedure training. After the teaching sessions, a unified clinical skills assessment (using the DOPS evaluation form) and a questionnaire survey (using the Likert scale) were conducted. Data entry and statistical analysis were performed using SPSS 23.0 statistical software to evaluate the effectiveness of the two different practical teaching implementation paths.

2.2. Teaching implementation

A teaching research group consisting of six instructors from clinical departments, the ultrasound department, and the skills center was established. An in-depth investigation was conducted into the learning abilities and practical needs of medical students. Taking into account the actual clinical requirements, the characteristics of ultrasound technology, and the feasibility of simulation-based teaching, a two-hour teaching content was determined that integrates basic procedures such as thoracentesis and deep venous catheterization with ultrasound technology.

2.2.1. First class hour: Theoretical knowledge explanation

(1) Basic principles of ultrasound (15 minutes)

Utilizing videos from the MOOC platform, PowerPoint presentations, and animated demonstrations, the fundamental concepts of ultrasound imaging and equipment structure are introduced. The PBL (Problem-Based Learning) teaching method is employed to present misdiagnosis cases, stimulating students' interest in learning about ultrasound principles.

(2) Traditional thoracentesis and internal jugular vein puncture procedures (45 minutes)

Employing the CBL (Case-Based Learning) teaching method, real clinical cases are introduced to provide a detailed explanation of indications, contraindications, and procedural steps. Live demonstrations using human models are conducted, emphasizing key precautions.

2.2.2. Second class hour: Video learning and discussion

Video Learning of Ultrasound-Guided Thoracentesis and Internal Jugular Vein Puncture (45 minutes): High-definition operation videos are played to demonstrate in detail the real-time application of ultrasound images during the puncture process. The video is paused at appropriate times to provide detailed explanations of key steps.

2.2.3. Group discussion and summary (15 minutes)

Organize students into groups for discussion, allowing them to share their insights, questions, and experiences. The teacher will summarize the key points of the course and re-emphasize the importance of ultrasound-guided puncture techniques.

3. Results

3.1. Student skill assessment results

After the course implementation, DOPS evaluation scales were collected from 87 interns. The experimental group scored 4.91 ± 1.01 , while the control group scored 5.84 ± 1.22 , with a statistically significant difference ($p < 0.001$), as shown in **Table 1**.

Table 1. Scores on the DOPS evaluation scale for the experimental and control groups

Group	Sample size	Excellent [n (Score)]	Qualified [n (Score)]	Failed [n (Score)]	Mean score	<i>p</i> -value
Experimental group	44	2 (7.65 ± 0.43)	37 (4.94 ± 0.54)	5 (3.58 ± 0.11)	4.91 ± 1.01	< 0.001
Control group	43	8 (7.69 ± 0.46)	33 (5.52 ± 0.85)	2 (3.85 ± 0.07)	5.84 ± 1.22	

3.2. Questionnaire survey results

The satisfaction survey on this course training covered five dimensions: teaching content, teaching methods, teacher performance, training effectiveness, and overall evaluation, with a total of 18 sub-items. A total of 44 questionnaires were distributed, and 44 valid questionnaires were collected, resulting in a 100% effective response rate. See **Table 2**.

Table 2. Overview of satisfaction ratings across dimensions in the experimental group

Survey dimension	Satisfied (Count)	Dissatisfied (Count)	Satisfaction rate	Dissatisfaction rate
Teaching content	38	6	86.36%	13.64%
Teaching methods	42	2	95.45%	4.55%
Instructor performance	35	9	79.55%	20.45%
Training effectiveness	32	12	72.73%	27.27%
Overall satisfaction & willingness to recommend	38	6	86.36%	13.64%

4. Discussion

The lower scores in the experimental group during the implementation of this teaching approach were primarily attributed to the inherent characteristics of ultrasound operation. Ultrasound operation requires students to master a wide range of skills, including the operation of ultrasound equipment, interpretation of ultrasound images, and real-time monitoring of puncture needles. Moreover, prolonged operation can easily lead to student fatigue, thereby increasing the likelihood of errors and affecting assessment scores. However, it cannot be denied that ultrasound-guided puncture technique has extensive clinical application scenarios and significant clinical value. In the future, it is necessary to further increase simulation training sessions and optimize assessment criteria. Meanwhile, we also need to strengthen teacher training to ensure that students receive more professional guidance.

This study has some limitations, such as a small sample size and a short research period, which failed to comprehensively evaluate the effectiveness of ultrasound-guided puncture technique in long-term clinical practice. The core challenge currently faced by ultrasound puncture teaching is the lack of a unified assessment system ^[16]. The design of the DOPS assessment form may not fully cover all the details of ultrasound operation, affecting the

comprehensiveness of the assessment results. Although medical educators are committed to optimizing ultrasound teaching procedures based on practical experience, there are still the following methodological disagreements: whether traditional experimental methods derived from biomedical research (such as randomized controlled trials) are suitable for evaluating ultrasound teaching processes that are highly context-dependent and multifactorial. Therefore, whether teaching interventions can be effectively validated and improved in the form of medical research remains an unresolved issue^[17].

5. Conclusion

This study explores a practical teaching implementation path for guiding basic clinical puncture procedures with bedside ultrasound, aiming to address issues such as the reliance on surface landmarks in traditional puncture teaching, the long learning curve for junior physicians, and the high incidence of complications^[18]. Although students in the experimental group scored lower in the DOPS assessment, they expressed higher satisfaction with the teaching methods and content. Through reasonable adjustments and improvements, this teaching path is expected to enhance students' learning outcomes in puncture procedures and enable ultrasound-guided puncture techniques to play a greater role in clinical teaching. In the future, students' clinical practical abilities can be further enhanced by increasing simulated training sessions, optimizing assessment criteria, and strengthening teacher training.

Funding

Education Foundation of Kangda College of Nanjing Medical University (Project No.: KDJYYJYB202332); Science Foundation of Kangda College of Nanjing Medical University (Project No.: KD2023KYJJ250)

Disclosure statement

The authors declare no conflict of interest.

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