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Analysis of Daily Life, Spiritual Comfort, and Fall Safety Care Needs of Elderly People in Urban and Rural Areas

Fang Zheng*, Xiaojing Tang, Xinyue Zhang

Tangshan Vocational & Technical College, Tangshan 063000, Hebei Province, China

*Corresponding author: Fang Zheng, 1149380200@qq.com

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Abstract: *Objective:* To examine the daily life care, spiritual comfort, and fall safety care needs of the elderly in urban and rural areas of Tangshan, along with their influencing factors. *Methods:* From August 2022 to April 2023, an investigation was conducted among urban and rural elderly individuals aged over 75 years in Tangshan City using the Activities of Daily Living Scale, the Revised Community Elderly Fall Risk Assessment Tool, and the Loneliness Scale. *Results:* The study included 750 urban and 740 rural elderly individuals aged over 75 years. Matrix analysis revealed a significant proportion of fall safety care needs across various daily life and spiritual care requirements. Multiple factor analysis indicated that advanced age, lower education levels, a greater number of chronic diseases, and lower levels of family and social support were associated with higher care demands among the elderly in both urban and rural areas. These differences were statistically significant ($P < 0.05$). *Conclusion:* The elderly in urban and rural areas demonstrate a high demand for fall safety care. Particular attention should be given to individuals with lower education levels, those who are widowed, those with multiple chronic diseases, and those with low levels of family and social support to better meet the diverse care needs of this population.

Keywords: Elderly people; Daily life care needs; Spiritual comfort needs; Fall safety care needs; Matrix analysis

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1. Introduction

In 2019, the population of elderly individuals aged 65 years and above in China reached 176 million^[1], with the size of this demographic exhibiting sustained and rapid growth. Aging contributes to an increase in the number of disabled and semi-disabled individuals^[2], a decline in skeletal muscle endurance and physical flexibility, and a rise in sensory disorders, anxiety, depression, loneliness, and other psychological challenges^[3]. These factors underscore the growing need for comprehensive care.

Current research, both domestically and internationally, primarily focuses on the care needs of elderly

individuals in community settings, with limited attention to rural elderly populations, particularly middle-aged and elderly individuals. Therefore, this study seeks to investigate the three primary types of care needs among middle-aged and elderly populations in urban and rural areas, along with the factors influencing these needs.

2. Materials and methods

2.1. General information

From August 2022 to March 2023, surveys were conducted among middle-aged and elderly individuals aged 75 years and older in urban and rural areas of the Tuanjie Building and Youyili communities in Tangshan City, as well as Xiaoji Town in Fengnan District, Tangshan City.

Inclusion criteria: Individuals aged 75 years and above; residing in the area for more than one year; having no significant communication barriers; and willing to participate and cooperate in the survey.

Exclusion criteria: Individuals with severe mental illnesses and those who were absent during the investigation period.

A total of 1,498 survey questionnaires were distributed, and 1,490 valid questionnaires were collected, resulting in an effective response rate of 99.47%.

2.2. Methods

All questionnaires were administered by uniformly trained investigators during household surveys, and the questionnaires were collected on-site. The survey included the following components:

- (1) General information: This section included data on gender, age, marital status, and educational level.
- (2) Daily Living Ability Scale ^[4]:
 - (a) A total of 14 items.
 - (b) The total score ranges from 14 to 56 points.
 - (c) A score of 14 indicates complete functionality and no need for assistance.
 - (d) Scores between 14 and 22 indicate low demand due to varying degrees of functional decline.
 - (e) Scores above 22 signify significant functional impairment and are classified as high demand.
- (3) Revised Community Elderly Fall Risk Assessment Tool ^[5]:
 - (a) Comprising 13 items, the total scale score ranges from 0 to 45 points.
 - (b) A score of 0 indicates no risk of falling and is categorized as no need.
 - (c) Scores between 0 and 12 reflect a low risk of falling, categorized as low demand.
 - (d) Scores greater than 12 indicate a high risk of falling and are categorized as high demand.
- (4) Loneliness Scale ^[6]:
 - (a) Consisting of 20 items, it uses a four-level frequency rating system.
 - (b) The total score ranges from 20 to 80 points, with higher scores indicating greater loneliness.
 - (c) Scores between 20 and 34 indicate low levels of loneliness, categorized as low need.
 - (d) Scores between 35 and 49 reflect moderate loneliness, categorized as moderate need.
 - (e) Scores above 50 represent high levels of loneliness, categorized as high need.
- (5) Family Support Scale (PSS Fa) ^[7]:
 - (a) Comprising 15 items, the total score is 15 points.
 - (b) Higher scores indicate better family support.

- (c) A score of 10 or above signifies high levels of family support, while scores below 10 indicate low levels of family support.
- (6) Social Support Rating Scale (SSRS) ^[7]:
- (a) This scale includes 11 items.
 - (b) Higher scores correspond to better levels of social support.
 - (c) Scores below 22 are classified as low, scores between 22 and 44 are considered moderate, and scores above 44 are categorized as high.

3. Result

3.1. General information of the research subjects

The general characteristics of the research subjects include 750 elderly individuals residing in urban areas (50.3%) and 740 in rural areas (49.7%). The sample consisted of 735 males (49.3%) and 755 females (50.7%), with an age range of 75–100 years and an average age of 79.30 ± 5.024 years.

3.2. Matrix analysis of care needs for elderly people in urban and rural areas

The three levels of daily care needs, initially classified as “high,” “low,” and “none,” were redefined as “high,” “medium,” and “low,” respectively. Similarly, the three levels of safety care needs were redefined using the same terminology, while the classifications for mental care needs remained unchanged. A total of 27 combinations were derived from the intersections of mental care needs (UCLA), safety care needs (FROP), and daily living care needs (ADL). The results demonstrated a significant proportion of moderate to high safety care needs across various combinations of daily life and mental care needs, as shown in **Table 4**.

3.3. Univariate analysis of care needs for elderly people in urban and rural areas

The care needs of elderly individuals aged 75 and above in urban and rural areas exhibited statistically significant differences based on gender, region, age, educational level, marital status, family support, and social support (all $P < 0.05$). Relevant data are presented in **Tables 2–9**.

Table 1. Distribution of three types of care needs combination matrices for elderly people in urban and rural areas

Project category		Mental care needs [<i>n</i> (%)]								
		High			Medium			Low		
		Security care needs			Security care needs			Security care needs		
		High	Medium	Low	High	Medium	Low	High	Medium	Low
Daily life care	High	160 (5.8)	40 (1.4)	0 (0.0)	145 (5.2)	73 (2.6)	0 (0.0)	40 (1.4)	33 (1.2)	0 (0.0)
	Medium	34 (1.2)	105 (3.8)	4 (0.1)	73 (2.6)	218 (7.8)	1 (0.0)	37 (1.3)	141 (5.1)	2 (0.1)
	Low	16 (0.6)	145 (5.2)	19 (0.7)	63 (2.3)	542 (19.5)	66 (2.4)	38 (1.4)	484 (17.4)	50 (1.8)

Table 2. Gender distribution of total care demand combination for elderly people in urban and rural areas

Gender	n	Care groups and categories [n (%)]									
		1	2	3	4	5	6	7	8	9	10
Male	735	25 (1.7)	158 (10.6)	10 (0.7)	124 (8.3)	16 (1.1)	157 (10.5)	21 (1.4)	90 (6.0)	53 (3.6)	81 (5.4)
Female	755	3 (0.2)	115 (7.7)	7 (0.5)	120 (8.1)	39 (2.6)	138 (9.3)	22 (1.5)	131 (8.8)	91 (6.1)	89 (6.0)

Note: The χ^2 value is 53.270, and the P -value is 0.000.

Table 3. Age distribution of total care demand combination for elderly people in urban and rural areas

Age (years)	n	Care groups and categories [n (%)]									
		1	2	3	4	5	6	7	8	9	10
75–79	831	18 (1.2)	204 (13.7)	11 (0.7)	168 (11.3)	39 (2.6)	185 (12.4)	23 (1.5)	101 (6.8)	48 (3.2)	34 (2.3)
80–84	396	6 (0.4)	52 (3.5)	4 (0.3)	58 (3.9)	7 (0.5)	76 (5.1)	9 (0.6)	69 (4.6)	43 (2.9)	72 (4.8)
85–100	263	4 (0.3)	17 (1.1)	2 (0.1)	18 (1.2)	9 (0.6)	34 (2.3)	11 (0.7)	51 (3.4)	53 (3.6)	64 (4.3)

Note: The χ^2 value is 231.562, and the P -value is 0.000.

Table 4. Urban and rural distribution of total care demand combination for elderly people in urban and rural areas

Area	n	Care groups and categories [n (%)]									
		1	2	3	4	5	6	7	8	9	10
Urban	740	2 (0.1)	148 (9.9)	1 (0.1)	150 (10.1)	39 (2.6)	118 (7.9)	31 (2.1)	104 (7.0)	69 (4.6)	78 (5.2)
Rural	750	26 (1.7)	125 (8.4)	16 (1.1)	94 (6.3)	16 (1.1)	177 (11.9)	12 (0.8)	117 (7.9)	75 (5.0)	92 (6.2)

Note: The χ^2 value is 80.515, and the P -value is 0.000.

Table 5. Distribution of marital status of total care demand combination for elderly people in urban and rural areas

Marital status	n	Care groups and categories [n (%)]									
		1	2	3	4	5	6	7	8	9	10
Married	516	3 (0.2)	131 (8.8)	1 (0.1)	117 (7.9)	31 (2.1)	88 (5.9)	15 (1.0)	61 (4.1)	35 (2.3)	34 (2.3)
Widowed	510	8 (0.5)	56 (3.8)	5 (0.3)	60 (4.0)	12 (0.8)	84 (5.6)	16 (1.1)	106 (7.1)	75 (5.0)	88 (5.9)
Single or divorced	464	17 (1.1)	86 (5.8)	11 (0.7)	67 (4.5)	12 (0.8)	123 (8.3)	12 (0.8)	54 (3.6)	34 (2.3)	48 (3.2)

Note: The χ^2 value is 164.704, and the P -value is 0.000.

Table 6. Distribution of educational level of total care demand combination for elderly people in urban and rural areas

Education degree	n	Care groups and categories [n (%)]									
		1	2	3	4	5	6	7	8	9	10
Illiterate	346	1 (0.1)	30 (2.0)	1 (0.1)	43 (2.9)	14 (0.9)	58 (3.9)	14 (0.9)	63 (4.2)	50 (3.4)	72 (4.8)
Primary	628	8 (0.5)	120 (8.1)	5 (0.3)	92 (6.2)	25 (1.7)	133 (8.9)	23 (1.5)	100 (6.7)	63 (4.2)	59 (4.0)
Middle	343	10 (0.7)	77 (5.2)	8 (0.5)	74 (5.0)	14 (0.9)	65 (4.4)	5 (0.3)	40 (2.7)	20 (1.3)	30 (2.0)
High school and above	173	9 (0.6)	46 (3.1)	3 (0.2)	35 (2.3)	2 (0.1)	39 (2.6)	1 (0.1)	18 (1.2)	11 (0.7)	9 (0.6)

Note: The χ^2 value is 139.696, and the P -value is 0.000.

Table 7. Distribution of the number of chronic diseases in the total care demand combination for elderly people in urban and rural areas

Chronic diseases	<i>n</i>	Care groups and categories [<i>n</i> (%)]									
		1	2	3	4	5	6	7	8	9	10
0	435	16 (1.1)	117 (7.9)	5 (0.3)	80 (5.4)	18 (1.2)	85 (5.7)	11 (0.7)	50 (3.4)	30 (2.0)	23 (1.5)
1–2	752	8 (0.5)	128 (8.6)	10 (0.7)	111 (7.4)	27 (1.8)	150 (10.1)	20 (1.3)	126 (8.5)	82 (5.5)	90 (6.0)
≥ 3	303	4 (0.3)	28 (1.9)	2 (0.1)	53 (3.6)	10 (0.7)	60 (4.0)	12 (0.8)	45 (3.0)	32 (2.1)	57 (3.8)

Note: The χ^2 value is 86.829, and the *P*-value is 0.000.

Table 8. Distribution of family support of the total care demand combination for elderly people in urban and rural areas

Family support	<i>n</i>	Care groups and categories [<i>n</i> (%)]									
		1	2	3	4	5	6	7	8	9	10
Low	1,095	14 (0.9)	128 (8.6)	14 (0.9)	166 (11.1)	40 (2.7)	243 (16.3)	30 (2.0)	188 (12.6)	123 (8.3)	149 (10.0)
High	395	14 (0.9)	145 (9.7)	3 (0.2)	78 (5.2)	15 (1.0)	52 (3.5)	13 (0.9)	33 (2.2)	21 (1.4)	21 (1.4)

Note: The χ^2 value is 166.999, and the *P*-value is 0.000.

Table 9. Distribution of social support of the total care demand combination for elderly people in urban and rural areas

Social support	<i>n</i>	Care groups and categories [<i>n</i> (%)]									
		1	2	3	4	5	6	7	8	9	10
Low	85	0 (0.0)	1 (0.1)	0 (0.0)	3 (0.2)	1 (0.1)	21 (1.4)	1 (0.1)	19 (1.3)	13 (0.9)	26 (1.7)
Medium	1,365	28 (1.9)	251 (16.8)	17 (1.1)	229 (15.4)	53 (3.6)	270 (18.1)	41 (2.8)	202 (13.6)	130 (8.7)	144 (10.0)
High	40	0 (0.0)	21 (1.4)	0 (0.0)	12 (0.8)	1 (0.1)	4 (0.3)	1 (0.1)	0 (0.0)	1 (0.1)	0 (0.0)

Note: The χ^2 value is 109.131, and the *P*-value is 0.000.

3.4. Multivariate analysis of care needs for elderly people in urban and rural areas

The 10 subtypes of dependent variable care needs were categorized into two levels, with subtypes 1–5 classified as low needs and subtypes 6–10 as high needs. Variables that showed statistically significant differences in the univariate analysis were included as independent variables in a binary logistic regression analysis. The findings indicated that elderly individuals aged 75 and above in urban and rural areas who were older, resided in rural regions, were widowed, had lower education levels, suffered from more chronic diseases, and reported lower levels of family and social support exhibited significantly higher care needs ($P < 0.05$). Detailed results are presented in **Table 10**.

Table 10. Multivariate analysis of care needs for elderly people in urban and rural areas

Item	β	Sx	Wald χ^2	P	OR	95% CI
Age	0.648	0.090	51.644	0.000	1.912	1.602–2.281
Area	-0.462	0.204	5.136	0.023	0.630	0.422–0.939
Marital status	0.258	0.115	5.059	0.024	1.294	1.034–1.620
Education degree	-0.364	0.071	25.989	0.000	0.695	0.604–0.799
Chronic diseases	0.448	0.090	24.901	0.000	1.565	1.312–1.865
Family support	-1.037	0.135	59.301	0.000	0.354	0.272–0.461
Social support	-1.888	0.327	33.334	0.000	0.151	0.080–0.287

4. Discussion

The findings of this study indicate a significant proportion of moderate to high fall safety care needs across various levels of daily life and mental care requirements. This suggests that middle-aged and elderly individuals in both urban and rural areas exhibit the greatest demand for fall safety care. Greater emphasis should therefore be placed on addressing fall safety care for this demographic.

The results reveal that care needs among elderly individuals in urban communities are higher than those in rural areas, differing from the findings of Zhai *et al.* ^[8]. Many elderly individuals in rural areas remain actively engaged in labor, maintain relatively good physical health, and experience greater ease in moving about compared to their urban counterparts. Additionally, rural elderly individuals often prefer outdoor activities and tend to interact more frequently with neighbors.

The study also indicates that older individuals have higher caregiving needs, aligning with the research findings of Chen *et al.* ^[9]. With advancing age, the ability of elderly individuals to perform daily activities diminishes. Physical limitations further restrict their engagement in outdoor activities, leading to a higher susceptibility to psychological issues such as anxiety and depression. Additionally, aging reduces skeletal muscle endurance and reaction time, thereby increasing the risk of falls and elevating the need for care.

Widowed elderly individuals demonstrate higher caregiving needs, consistent with Lima-Costa *et al.*'s findings ^[10]. Without the companionship of a spouse, widowed individuals often lack emotional support and assistance in addressing challenges, thereby increasing their care requirements.

Higher educational attainment among the elderly is associated with lower caregiving needs, as supported by Xu *et al.*'s research ^[11]. Elderly individuals with greater educational backgrounds are more likely to read health-related materials, adopt healthier lifestyles, and seek timely medical intervention, thereby mitigating disease progression and reducing care needs.

The results further highlight that elderly individuals with a greater number of chronic diseases exhibit higher care needs, consistent with the findings of Kong *et al.* ^[12]. A higher prevalence of chronic illnesses often correlates with poor physical health and increased medication use. Given the reduced metabolic capacity of elderly individuals, the side effects of medications—such as dizziness, impaired consciousness, and decreased balance—heighten the risk of falls and amplify their need for care.

Additionally, elderly individuals with higher levels of family support exhibit lower caregiving needs, corroborating the findings of Hong and Lu ^[13]. A supportive family environment enables timely assistance with physical and mental health issues. Close communication between family members and elderly individuals provides both material and emotional support, preventing issues such as disease exacerbation, anxiety, and depression, thereby reducing care requirements.

Similarly, higher levels of social support are associated with lower caregiving needs, consistent with Chen *et al.*'s findings ^[7]. Active social engagement among the elderly, including participation in outdoor activities and frequent interactions with neighbors, promotes physical fitness, alleviates negative emotions, and lowers the incidence of anxiety and depression, ultimately reducing care needs.

5. Conclusion

In conclusion, middle-aged and elderly individuals in both urban and rural areas demonstrate a high demand for fall safety care. Greater attention should be directed toward this issue, and appropriate measures should be implemented to address their care needs effectively.

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Effect of Comprehensive Nursing Intervention on the Maternal and Infant Outcomes of Pregnant Women with Gestational Diabetes Mellitus

Mingwan Zhou*, Wilfredo D. Quijencio, Wenjian Zhao

Institute of Health Sciences and Nursing, Far Eastern University, Sampaloc, Manila 1015, Philippines

*Corresponding author: Mingwan Zhou, zhoumingwan@gmail.com

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Abstract: *Objective:* To examine the effects of comprehensive nursing interventions on maternal and infant outcomes in pregnant women diagnosed with gestational diabetes mellitus (GDM). *Methods:* A quasi-experimental design was employed, involving 60 pregnant women with GDM who were purposively selected and randomly allocated into experimental and control groups, each comprising 30 participants. The experimental group received comprehensive nursing interventions and pregnancy monitoring, while the control group received standard nursing care. Data collection was conducted using demographic questionnaires, pregnancy indicators, and maternal-infant outcome measurement tools. The collected data were analyzed using Microsoft Excel and the Statistical Package for Social Sciences (SPSS). *Results:* The findings indicated significant improvements in fasting blood glucose, postprandial blood glucose, amniotic fluid index, and neonatal birth weight in the experimental group compared to the control group. However, no statistically significant differences were observed in body mass index (BMI) or pregnancy weight gain. Comprehensive nursing interventions were associated with a significant reduction in maternal complications, including polyhydramnios, postpartum hemorrhage, and preeclampsia, as well as neonatal complications such as neonatal pneumonia, macrosomia, and hypoglycemia. *Conclusion:* Comprehensive nursing interventions have a positive impact on maternal and neonatal outcomes in pregnant women with GDM.

Keywords: Comprehensive nursing interventions; Gestational diabetes mellitus (GDM); Maternal outcomes; Neonatal outcomes; Glycemic control

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1. Introduction

Gestational diabetes mellitus (GDM), the most prevalent metabolic disorder during pregnancy, induces varying degrees of maternal hyperglycemia and poses significant pregnancy-related risks^[1]. It presents substantial health challenges for both mothers and infants, including complications such as preeclampsia, macrosomia, preterm birth,

and long-term metabolic disorders. The rising global prevalence of GDM highlights the urgent need for effective management strategies to mitigate adverse maternal and neonatal outcomes. Comprehensive nursing interventions have emerged as a holistic approach to addressing the multifaceted needs of pregnant women with GDM. These interventions typically include personalized education, dietary counseling, glucose monitoring, psychological support, and prenatal care, all aimed at optimizing maternal glycemic control and improving neonatal health outcomes. Unlike conventional care models, comprehensive nursing interventions empower patients with the knowledge and tools necessary to actively engage in their care, enhancing compliance with treatment protocols ^[2].

In China, the incidence of gestational diabetes ranges between 1% and 5%. GDM refers to the onset or detection of varying degrees of abnormal glucose metabolism during pregnancy and is one of the most common medical complications associated with pregnancy ^[3]. In recent years, improved living standards and increased attention to prenatal nutrition have led to excessive nutritional supplementation and reduced physical activity among some pregnant women, resulting in a rising prevalence of over-nutrition and GDM ^[4].

For neonates, poorly managed maternal blood glucose levels pose significant risks. Complications such as neonatal pneumonia, which impairs respiratory function, macrosomia, which increases the likelihood of birth trauma, and hypoglycemia shortly after birth are prevalent. Severe cases may result in sudden neonatal death. Additionally, long-term health risks include predispositions to obesity, type 2 diabetes, and metabolic disorders later in life. These outcomes underscore the importance of maintaining optimal blood glucose levels during pregnancy through timely and effective interventions. Comprehensive nursing interventions are critical in mitigating these risks by delivering tailored care, education, and support to ensure favorable maternal and neonatal outcomes ^[5,6].

Statistical data highlight the gravity of GDM-related complications. The incidence of polyhydramnios in pregnant women with GDM can reach 20% ^[7], while postpartum hemorrhage, a severe complication, accounts for 21.1% of maternal deaths. Furthermore, urinary tract infections affect approximately 29.7% of women with GD, and preeclampsia impacts 9–14% of pregnancies in China ^[8]. For neonates, 68.7% of neonatal respiratory diseases are attributed to neonatal pneumonia ^[9]. The prevalence of macrosomia among GDM patients ranges from 12.3% to 24.15%, while hypoglycemia and neonatal asphyxia affect 1–5% and approximately 5% of cases, respectively ^[10,11]. These statistics emphasize the urgent need for effective nursing interventions to address the health risks associated with GDM.

The nursing care of pregnant women with GDM has garnered significant attention both domestically and internationally, leading to numerous studies ^[12]. However, research in China has predominantly focused on isolated interventions, such as health education, dietary management, physical activity guidance, or psychological support, and their individual impacts on maternal and pregnancy outcomes. Comprehensive nursing approaches that integrate these elements into cohesive, continuous interventions remain underexplored ^[11].

Comprehensive nursing interventions involve a holistic model combining health education, medication management, dietary counseling, exercise therapy, psychological support, and continuous monitoring throughout pregnancy. This model leverages multi-dimensional strategies to optimize outcomes ^[13]. Evidence suggests that high-quality comprehensive nursing interventions effectively control blood glucose levels, reducing the incidence of adverse pregnancy outcomes in GDM ^[14]. Despite this, limited research has focused specifically on the impact of such interventions on maternal and neonatal outcomes in GDM patients.

This gap underscores the significance of the present study. By evaluating the effects of comprehensive nursing interventions on maternal and neonatal outcomes in pregnant women with GDM, the research aims to provide robust evidence supporting the adoption of comprehensive care models in clinical practice. The findings could serve as a foundation for improving the quality of nursing care, optimizing pregnancy outcomes, and addressing

the unique challenges posed by GDM ^[15].

2. Materials and methods

2.1. General information

This study included 60 pregnant women diagnosed with gestational diabetes mellitus (GDM) who were treated in a hospital in Shandong Province.

Inclusion criteria for maternal participants: (1) Age range: 20–35 years; (2) Single fetus; (3) Gestational age: 26–28 weeks; (4) Diagnosed with GDM; (5) Natural pregnancy with no pre-existing diabetes; (7) Availability of complete clinical data.

Exclusion criteria for maternal participants: (1) History of type 1 or type 2 diabetes before pregnancy; (2) Presence of high blood pressure, heart disease, or neurological disorders; (3) Gestational age > 40 weeks; (4) Uterine fibroids, malformation, or dysplasia; (5) Ovarian cysts, polycystic ovary syndrome, or similar diseases; (6) Complications such as infections, blood disorders, placenta previa, fetal intrauterine growth retardation, trauma, burns, or surgical diseases; (7) No history of previous abortions.

The study employed a purposive sampling method, focusing on pregnant women with GDM who met the eligibility criteria. A total of 60 participants were selected according to these criteria and randomly assigned to two groups: the control group and the experimental group.

2.2. Method

2.2.1. Control group

Participants in the control group received routine nursing care, which included:

- (1) Regular prenatal check-ups as recommended by outpatient physicians.
- (2) Basic health education, such as guidance on self-monitoring of blood glucose levels and precautions.
- (3) Distribution of the Gestational Diabetes Handbook for detailed management guidance.
- (4) Emotional well-being monitoring and addressing patient concerns during hospital visits.

2.2.2. Experimental group

This group received a structured, holistic, and comprehensive nursing intervention. Nurses provided personalized care plans addressing both physiological and psychological needs to promote better glycemic control and overall pregnancy management.

The comprehensive nursing intervention was implemented in three stages, based on gestational age:

- (1) Stage 1 (26–28 weeks):
 - (a) Psychological intervention: Weekly telephone follow-ups and WeChat group chats provided education on GDM management and emotional support to reduce anxiety and stress.
 - (b) Health Education: Distribution of a Health Education Handbook and daily WeChat group discussions with experienced nurses.
- (2) Stage 2 (28–36 weeks):
 - (a) Dietary intervention: Low-glycemic diet plans, nutritional education, and weekly dietary monitoring through telephone follow-ups.
 - (b) Exercise intervention: Guidance on safe exercises such as yoga and walking, with encouragement for

- gradual increases in physical activity.
- (c) Monitoring during pregnancy: Training on prenatal monitoring methods (e.g., blood sugar levels, fetal heart rate) through daily WeChat updates and weekly follow-ups.
- (3) Stage 3 (36–40 weeks):
- (a) Psychological intervention: Face-to-face counseling sessions to alleviate prenatal anxiety and stress related to hospitalization.
- (b) Postpartum complication prevention: Education on hygiene, infection prevention, and postpartum care, with instructions provided to both patients and their family members.

2.3. Research instruments

- (1) Demographic questionnaire: Collected data on age, education level, occupation, marital status, place of residence, economic status, mode of birth, and presence of comorbidities.
- (2) Pregnancy indicators collection table: Designed by the researcher, this instrument recorded gestational indicators such as fasting glucose levels, two-hour postprandial glucose levels, amniotic fluid index, BMI, pregnancy weight gain, and neonatal birth weight.
- (3) Maternal and infant outcomes collection table: This instrument consisted of two sections: maternal outcomes after delivery and neonatal outcomes, including complications or health conditions of infants born to mothers with GDM.

2.4. Data analysis

The collected data were organized and analyzed using the Statistical Package for Social Sciences (SPSS). To ensure data security, it was stored on a computer with restricted access and used exclusively for this experimental study. *T*-tests were conducted to compare pregnancy indicators between the experimental and control groups before and after the intervention. χ^2 tests were employed to analyze differences in categorical maternal and infant outcomes. This method ensured rigorous statistical evaluation and confidentiality throughout the study.

3. Result

This analysis evaluates the effectiveness of comprehensive nursing interventions on maternal and neonatal outcomes in pregnancies complicated by GDM by comparing the experimental and control groups.

Table 1. Significant differences in pregnancy indices between the experimental and control groups after comprehensive nursing intervention

Pregnancy index	Group	M \pm SD	<i>t</i>	<i>P</i>	Interpretation	Decision
Fasting plasma glucose	Experimental	4.97 \pm 0.15	-11.58	0.00	Significant	Reject H0
	Control	5.57 \pm 0.24				
Postprandial blood glucose	Experimental	5.95 \pm 0.28	-10.11	0.00	Significant	Reject H0
	Control	6.94 \pm 0.46				
Amniotic fluid index	Experimental	17.69 \pm 1.66	-2.33	0.02	Significant	Reject H0
	Control	18.74 \pm 1.84				

Table 1 (Continued)

Pregnancy index	Group	M ± SD	<i>t</i>	<i>P</i>	Interpretation	Decision
Body mass index	Experimental	21.88 ± 1.38	-1.79	0.08	Not significant	Accept H0
	Control	22.50 ± 1.31				
Pregnancy weight gain	Experimental	2.25 ± 0.83	-1.27	0.21	Not significant	Accept H0
	Control	2.01 ± 0.63				
Birth weight	Experimental	3.21 ± 0.46	-2.63	0.02	Significant	Reject H0
	Control	3.53 ± 0.58				

Table 1 summarizes the mean (M) and standard deviation (SD) of pregnancy indices and the results of statistical tests comparing the experimental and control groups. Comprehensive nursing interventions demonstrated significant effects on fasting plasma glucose, postprandial blood glucose, amniotic fluid index, and birth weight, emphasizing their effectiveness in managing GDM.

The findings provide compelling evidence supporting the success of comprehensive nursing interventions in improving maternal outcomes. Significant reductions in fasting and postprandial glucose levels highlight the impact of dietary education, exercise, and glucose monitoring. These results align with prior research, which underscores the role of holistic care in minimizing GDM-related complications ^[13].

Reductions in amniotic fluid index and birth weight further underscore the benefits of comprehensive care, as these improvements lower risks associated with preterm labor, fetal distress, and delivery complications such as cesarean sections or birth injuries ^[16]. Although no significant differences were observed in BMI or pregnancy weight gain, trends indicate better weight management in the experimental group, highlighting the importance of balanced nutrition and physical activity.

Table 2. Number of maternal complications in the experimental and control groups

Complications	Experimental (<i>n</i>)	Control (<i>n</i>)
None	22	5
Polyhydramnios	4	9
Postpartum hemorrhage	1	4
Urinary tract infection	2	8
Preeclampsia	1	4

Table 2 reveals a significant reduction in maternal complications in the experimental group compared to the control group, demonstrating the efficacy of comprehensive nursing interventions. By improving glycemic control, psychological well-being, and preventive care, these interventions significantly reduce risks associated with GDM.

Table 3. Number of neonatal complications in the experimental and control groups

Complications	Experimental (<i>n</i>)	Control (<i>n</i>)
None	26	13
Neonatal pneumonia	0	2
Macrosomia	2	6
Neonatal hypoglycemia	0	5
Neonatal asphyxia	2	4

Table 3 demonstrates the significant benefits of comprehensive nursing interventions in reducing neonatal complications, including neonatal pneumonia, macrosomia, and neonatal hypoglycemia. These results underscore the importance of maternal glycemic control, fetal monitoring, and psychological support in promoting neonatal health.

The results of this study demonstrate that comprehensive nursing interventions are highly effective in reducing neonatal complications in pregnancies affected by gestational diabetes mellitus (GDM). Addressing critical aspects such as maternal glycemic control, fetal monitoring, and psychological support fosters a favorable environment for neonatal health. The findings emphasize the necessity for healthcare systems to integrate comprehensive nursing care into routine maternal care practices. Future research should prioritize the exploration of the long-term benefits of these interventions on neonatal development and their scalability in diverse clinical settings. Such research will further establish the pivotal role of comprehensive nursing interventions in enhancing maternal and neonatal outcomes in GDM pregnancies ^[17].

Table 4. Difference in pregnancy and neonatal outcomes between experimental and control groups

Complications	Statistics	Values	Interpretation	Decision
Pregnancy outcomes	χ^2	19.827	Significant	Reject H0
	df	4		
	P	0.001		
Neonatal outcomes	χ^2	14.000	Significant	Reject H0
	df	4		
	P	0.007		

The significant differences in neonatal outcomes between the experimental and control groups (**Table 4**) underscore the effectiveness of comprehensive nursing interventions in managing pregnancies complicated by GDM. By addressing the physiological, psychological, and educational needs of pregnant women, these interventions foster a supportive environment that promotes healthier outcomes for both mothers and their infants. The findings highlight the importance of adopting holistic care models within healthcare systems to ensure that pregnant women with GDM receive the necessary comprehensive support to achieve optimal health outcomes.

The χ^2 values and corresponding *P*-values in this study provide robust evidence for the critical role of comprehensive nursing interventions in improving neonatal outcomes. These findings form a strong basis for advocating the integration of such interventions into routine prenatal care, ultimately contributing to improved health outcomes for both mothers and their children.

4. Discussion

Comprehensive nursing interventions constitute a multifaceted approach that integrates health education, dietary management, psychological support, and prenatal monitoring. These interventions address the physiological and psychological needs of pregnant women, forming a foundation for improved maternal and neonatal outcomes. The significant improvements in neonatal outcomes observed in this study highlight the effectiveness of this holistic approach, as it targets the complex interplay of factors influencing maternal and fetal health.

Health education is pivotal in empowering pregnant women to manage their condition effectively. By providing tailored information about GDM, nurses enable women to make informed decisions regarding their health, thereby enhancing adherence to dietary plans and glucose monitoring protocols. Dietary interventions, in particular, play a critical role in regulating maternal blood glucose levels and mitigating risks associated with hyperglycemia. Psychological support further contributes by helping women manage stress, which positively influences both maternal and fetal outcomes. Prenatal monitoring facilitates the timely identification and management of potential complications, thereby enhancing the overall effectiveness of the intervention.

The findings of this study align with the research conducted by Long ^[18], which demonstrated that structured prenatal care reduces maternal complications such as postpartum hemorrhage and preeclampsia. Similarly, Liu and Zhu ^[19] observed that effective maternal glucose control enhances fetal development and reduces the risks of neonatal hypoglycemia and respiratory conditions. These parallels reinforce the importance of incorporating comprehensive nursing interventions into routine prenatal care, as they address both immediate and long-term challenges associated with GDM.

From a clinical perspective, the results of this study advocate for the widespread adoption of comprehensive nursing interventions in managing pregnancies complicated by GDM. Training healthcare providers in the implementation of these interventions can lead to improved maternal and neonatal health outcomes while reducing the burden of complications associated with GDM. Additionally, these findings underscore the need for healthcare systems to allocate resources, including training programs and digital tools, to support the implementation of holistic care models.

The significant improvements observed in neonatal outcomes also carry implications for healthcare policy. Policymakers are encouraged to integrate comprehensive nursing interventions into national maternal care guidelines, particularly for high-risk pregnancies. Such an approach not only enhances health outcomes but also reduces healthcare costs associated with the management of complications. By prioritizing holistic care, policymakers can establish a framework that supports improved outcomes for mothers and their infants.

While this study provides compelling evidence for the effectiveness of comprehensive nursing interventions, further research is necessary to explore their scalability and long-term benefits. Future studies should examine the implementation of these interventions in diverse healthcare settings, including low-resource environments, to evaluate their adaptability and impact. Additionally, longitudinal research could assess the long-term effects of improved maternal glycemic control on child health, including the risks of obesity and type 2 diabetes.

The significant differences in neonatal outcomes between the experimental and control groups underscore the effectiveness of comprehensive nursing interventions in managing pregnancies complicated by GDM. By addressing the physiological, psychological, and educational needs of pregnant women, these interventions create a supportive environment conducive to healthier outcomes for both mothers and their infants. The findings highlight the necessity for healthcare systems to adopt holistic care models, ensuring that pregnant women with GDM receive the comprehensive support required to achieve optimal health outcomes. Future research should

continue to expand on these findings, exploring innovative strategies to enhance the effectiveness and accessibility of comprehensive nursing interventions.

5. Conclusions

Comprehensive nursing interventions have demonstrated effectiveness in supporting pregnant women with GDM in managing pregnancy indicators, such as blood glucose levels and weight gain while reducing adverse maternal and neonatal outcomes.

By addressing the physiological and psychological needs of pregnant women with GDM, phased and comprehensive nursing interventions—including health education, dietary management, exercise routines, psychological support, and prenatal monitoring—have contributed to improved maternal and neonatal health outcomes.

These interventions significantly reduced maternal complications, such as preeclampsia and postpartum hemorrhage, as well as neonatal complications, including macrosomia and neonatal hypoglycemia. These findings underscore the critical importance of a multifaceted approach to GDM care.

Disclosure statement

The authors declare that they have no conflict of interest.

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Knowledge and Attitudes About Hepatitis B (HBV) Infection Among Women of Reproductive Age in China

Xue Han*, Jeffrey A. Lucero

Institute of Health Sciences and Nursing, Far Eastern University, Sampaloc, Manila, Philippines 1015

*Corresponding author: Xue Han, hanxue.971126@gmail.com

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Abstract: *Objective:* To assess the knowledge and attitudes about hepatitis B (HBV) infection among women of reproductive age in China, exploring the factors that influence their understanding of the disease and their perceptions toward individuals infected with HBV. *Methods:* A descriptive-correlational research design was employed, using purposive sampling to select 114 women of reproductive age from a community in Shandong Province, China. Data were collected through two structured questionnaires: one assessing HBV knowledge and the other measuring attitudes toward HBV. Descriptive and inferential statistical analyses, including chi-squared tests and Spearman correlation analysis, were used to examine relationships between demographic characteristics, knowledge, and attitudes. *Results:* The majority of participants demonstrated low knowledge about Hepatitis B, with 99.1% scoring within the low knowledge range. However, respondents exhibited generally positive attitudes toward prevention and inclusion. Significant associations were found between vaccination history and better knowledge scores, as well as between familial exposure and increased knowledge and positive attitudes. A weak inverse relationship between knowledge and attitudes was observed, suggesting that higher knowledge did not necessarily correlate with more favorable attitudes. *Conclusion:* The study highlights significant gaps in knowledge about Hepatitis B among women of reproductive age, despite positive attitudes toward prevention and social inclusion. Vaccination history and familial exposure were key factors associated with better knowledge and more supportive attitudes. These findings suggest the need for targeted health education strategies that address both knowledge gaps and emotional factors to improve attitudes and enhance preventive behaviors.

Keywords: Hepatitis B (HBV); Women of reproductive age; Health knowledge; Health attitudes; Vaccination and prevention

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1. Introduction

Hepatitis B virus (HBV) infection represents a significant global public health challenge, with its widespread

prevalence and profound impact necessitating urgent attention. According to estimates by the World Health Organization, approximately 2 billion individuals worldwide have been infected with HBV, of whom 257 million have become chronic carriers. In 2019, the number of chronic hepatitis B patients reached 296 million, with 1.5 million new infections annually and approximately 820,000 deaths attributed primarily to cirrhosis and primary liver cancer ^[1]. The geographic distribution of HBV is heterogeneous, with a particularly high prevalence of chronic HBV infection among women of reproductive age in China, estimated at 5.2% to 6.7%, underscoring the need for targeted, in-depth research on this population ^[2].

Mother-to-child transmission (MTCT) constitutes a significant route of HBV transmission, posing severe risks to the health of women of reproductive age and their fetuses ^[3]. Consequently, interrupting MTCT has become a key strategy in efforts to eliminate HBV. While current interventions, including the administration of hepatitis B immune globulin (HBIG) and delivery room prophylaxis, effectively reduce the risk of MTCT ^[4], the extent of knowledge and attitudinal tendencies among women of reproductive age regarding HBV infection critically influences the adoption of preventive behaviors.

Pregnant women are particularly susceptible to HBV infection due to physiological changes during pregnancy, such as diminished immunity and increased liver burden. Additionally, emotional stress, including anxiety and depression related to concerns about fetal health, further exacerbates the challenges faced by this population ^[5]. These factors highlight the importance of examining knowledge and attitudes toward HBV infection in pregnant women.

Hepatitis B remains a pressing global health issue, and the limited research on knowledge and attitudes toward HBV infection, particularly among women of reproductive age, underscores the necessity for further investigation ^[6]. Given the pivotal role of women of reproductive age within families and society, enhancing their knowledge of HBV and fostering positive attitudes toward affected individuals are essential.

The present study seeks to evaluate the understanding of HBV and attitudes toward those infected among women of reproductive age, addressing gaps in the existing literature and adopting a multidimensional research perspective. The study's core objectives include establishing a comprehensive HBV knowledge framework for women of reproductive age, improving their preventive capabilities, assessing their attitudes toward infected individuals, promoting social acceptance of hepatitis B patients, and mitigating stigma. By advancing HBV education and guiding attitudes, this study aims to contribute to the improvement of women's health outcomes.

2. Materials and methods

2.1. Research methods

This study employed descriptive-correlational research methods, summarized as follows. It was conducted in a non-interventionist manner, without altering or manipulating the study variables and without collecting marker data that could influence the study objectives, ensuring observations were made under natural conditions. Descriptive analysis was utilized to characterize the knowledge level of hepatitis B infection and the current status of hepatitis B-related health issues among Chinese women of reproductive age, providing foundational data for future analyses. Correlation analysis was conducted to quantify the strength of relationships between variables and to identify potential causal links between knowledge and attitudes, offering a theoretical basis for public health education strategies. Overall, the descriptive-correlational approach allowed for both the observation of the current situation and the exploration of potential statistical correlations among variables, thereby providing robust data and

theoretical guidance for future research and health intervention efforts.

2.2. Purposive sampling

This study targeted 114 women of reproductive age from a specific community in Shandong Province, China. The community was selected based on its geographical proximity, which facilitated efficient fieldwork and enabled timely responses to changes, as well as the researcher's in-depth understanding of its demographics and social structure, enhancing the study's relevance and effectiveness. A purposive sampling method was employed to select participants who met predefined criteria, ensuring the collected data directly addressed the research objectives and hypotheses. This approach improved internal validity by focusing on a specific group, enabling a detailed and meaningful analysis of the target population.

2.3. Research instrument

The first research instrument collected basic demographic characteristics of the respondents, essential for analyzing the distribution of hepatitis B knowledge and attitudes across social groups. This section of the questionnaire gathered information such as age, education level, and other relevant details to identify patterns and contextualize the findings.

To evaluate hepatitis B knowledge among women of reproductive age, the "Participants' Hepatitis B Knowledge Assessment Questionnaire (PBKQ)" was developed. This questionnaire included four dimensions, each comprising three questions, covering critical aspects of hepatitis B knowledge for a total of 12 items. Each correct response earned one point, resulting in a maximum score of 12, providing a quantitative measure of the respondents' knowledge. The instrument's reliability was confirmed using Cronbach's Alpha, which yielded a score of 0.92, indicating excellent internal consistency according to Nunnally's criteria^[7].

To assess attitudes toward hepatitis B, the study utilized the "Participants' Attitude Measurement Questionnaire for Hepatitis B (PAMHB)," designed using the Likert Scale model. Respondents rated their agreement with items related to knowledge, fear levels, social acceptance, and behavioral tendencies, with scores ranging from 4 to 1 per item. The scale comprised 12 items, yielding a maximum score of 48 and capturing the overall intensity of respondents' attitudes. The instrument's reliability was validated with a Cronbach's Alpha of 0.95, indicating excellent consistency and robustness.

2.4. Data analysis

The data collected was systematically recorded and analyzed using SPSS statistical methods. To ensure data security, all information was stored on a computer with strict confidentiality measures and used exclusively for this study. Descriptive statistics, including frequencies, percentages, mean scores, and standard deviations, were employed to summarize the data. Additionally, inferential statistical methods, such as χ^2 tests and Spearman correlation analysis, were used to examine relationships and associations between variables, providing deeper insights into the study's findings.

3. Results

In 2024, a survey was conducted to assess knowledge of and attitudes toward hepatitis B among 114 women of reproductive age from a community in Yantai, China. The results are presented below:

Table 1. Profile characteristics of respondents

Item	Frequency (f)	Percentage (%)
Age group		
19–29 years old	91	79.8
30–39 years old	16	14.0
40–49 years old	4	3.5
50–59 years old	3	2.6
Education level		
Junior high school	1	0.9
High school	30	26.3
Baccalaureate	71	62.3
Masterate	9	7.9
Doctorate	3	2.6
Vaccination history		
No	111	97.4
Yes	3	2.6
Familial exposure		
No	95	83.3
Yes	19	16.7
History of surgery		
No	78	68.4
Yes	36	31.6

Table 1 shows that the majority of respondents (79.8%) were aged 19–29 years, with smaller proportions in older age groups: 30–39 years (14.0%), 40–49 years (3.5%), and 50–59 years (2.6%). This indicates a predominantly young demographic, which may influence perceptions and experiences related to health. Most respondents had attained a baccalaureate degree (62.3%), followed by those with a high school education (26.3%). A smaller proportion had completed a master’s degree (7.9%) or a doctorate (2.6%), while only 0.9% had finished junior high school. This study revealed that 97.4% of participants had no history of hepatitis B vaccination, with only 2.6% reporting vaccination. This finding highlights a significant gap in preventive healthcare practices. Approximately 16.7% of respondents reported familial exposure to hepatitis B, while 83.3% had no such exposure. This relatively low rate of familial exposure may suggest limited direct contact with infected individuals within their immediate circles. Around 31.6% of respondents reported a history of surgery, while 68.4% did not. Surgical procedures may pose a risk of exposure to bloodborne infections, emphasizing the importance of stringent preventive measures.

Table 2. Knowledge score summary

Knowledge score	Frequency (f)	Percentage (%)
0–8 (low knowledge)	113	99.1
9–12 (high knowledge)	1	0.9
Total	114	100.0

Among the 114 respondents, 113 (99.1%) were classified as having low knowledge of Hepatitis B (scores 0–8),

while only 1 respondent (0.9%) demonstrated high knowledge (scores 9–12), as shown in **Table 2**. This finding underscores a significant gap in understanding Hepatitis B, including its transmission, symptoms, and treatment. The prevalence of low knowledge highlights the inadequacy of current health education initiatives.

Table 3. Attitudes towards hepatitis B

Attitudes towards hepatitis B	Mean (M)	Standard deviation (SD)	Verbal interpretation (VI)
Overall mean score	3.95	0.24	Strongly agree

The overall mean score of 3.95 (SD = 0.24, **Table 3**) reflects a high degree of consensus among respondents regarding positive attitudes toward Hepatitis B prevention, social inclusion, and advocacy.

Table 4. Relationship between demographic characteristics and knowledge of hepatitis B

Demographic characteristics	χ^2	Degrees of freedom (df)	P	Interpretation
Age	0.255	3	0.968	No significant relationship was observed.
Education	0.611	4	0.962	No significant relationship was observed.
History of vaccination	37.33	1	< 0.001	Significant relationship identified.
Familial exposure	5.04	1	0.025	Significant relationship identified.
History of surgery	2.19	1	0.139	No significant relationship was observed.

Chi-squared tests were conducted to assess the relationships between demographic factors (age, education, vaccination history, familial exposure, and surgical history) and knowledge levels (**Table 4**). No significant relationship was found between age and knowledge ($\chi^2 = 0.255$, $P = 0.968$) or education and knowledge ($\chi^2 = 0.611$, $P = 0.962$). A significant relationship was observed between vaccination history and knowledge ($\chi^2 = 37.33$, $P < 0.001$). Similarly, familial exposure to hepatitis B was significantly associated with higher knowledge levels ($\chi^2 = 5.04$, $P = 0.025$). No significant relationship was observed between surgical history and knowledge ($\chi^2 = 2.19$, $P = 0.139$).

Table 5. Relationship between demographic characteristics and attitudes toward hepatitis B

Demographic characteristics	χ^2	Degrees of freedom (df)	P	Interpretation
Age	16.029	15	0.380	No significant relationship was observed.
Education	7.533	20	0.995	No significant relationship was observed.
History of vaccination	61.964	5	< 0.001	Significant relationship identified.
Familial exposure	32.952	5	< 0.001	Significant relationship identified.
History of surgery	10.637	5	0.059	Marginal significance was observed.

The analysis of demographic characteristics and attitudes revealed significant relationships between vaccination history and familial exposure (**Table 5**). No significant relationship was found between age and attitudes ($\chi^2 = 16.029$, $P = 0.380$) or education and attitudes ($\chi^2 = 7.533$, $P = 0.995$). Vaccination history showed a significant association with more positive attitudes ($\chi^2 = 61.964$, $P < 0.001$), as did familial exposure ($\chi^2 = 32.952$, $P < 0.001$). Marginal significance was observed for surgical history ($\chi^2 = 10.637$, $P = 0.059$), suggesting potential

influence from frequent healthcare interactions.

Table 6. Relationship between knowledge score and attitude score

Correlation	ρ	P	Interpretation
Knowledge and attitude	-0.258	0.006	Weak inverse relationship; statistically significant.

The study identified a weak but statistically significant inverse relationship ($\rho = -0.258$, $P = 0.006$) between knowledge and attitudes toward hepatitis B (**Table 6**). Higher knowledge scores were associated with slightly less positive attitudes. This finding suggests that factors beyond knowledge, such as cultural norms, emotional influences, or personal experiences, may play a more substantial role in shaping attitudes.

The predominance of low knowledge levels among participants (99.1%) limited the ability to examine the effects of high knowledge on attitudes. These findings underscore the need for targeted educational campaigns that address not only factual knowledge but also emotional and social factors. Incorporating patient stories, peer support, and efforts to dispel misconceptions and stigma through clear communication could enhance supportive attitudes toward hepatitis B.

4. Discussion

The findings underscore critical knowledge gaps and persistent misconceptions regarding hepatitis B among respondents, highlighting deficiencies in health literacy despite relatively high levels of educational attainment. These results align with previous studies suggesting that formal education alone does not ensure a comprehensive understanding of health issues. For instance, prior research demonstrated that tertiary education correlates with improved knowledge of hepatitis B; however, significant gaps remain concerning transmission modes and treatment^[8]. Similarly, another study found that higher education levels were associated with increased vaccination uptake, yet deeper misconceptions about the disease were not adequately addressed^[9]. Limited familial exposure to hepatitis B may contribute to an underestimation of personal risk, thereby reducing awareness and the adoption of preventive behaviors. The findings of the World Health Organization also emphasize that populations exposed to comprehensive health communication programs exhibit significantly better awareness, highlighting the need for robust public health education initiatives aimed at improving knowledge and encouraging timely diagnosis and treatment^[10].

Despite significant knowledge deficits, respondents demonstrated progressive attitudes toward prevention and advocacy, consistent with the WHO's emphasis on the role of anti-stigma campaigns and educational efforts in fostering inclusion. These positive attitudes represent an opportunity to address knowledge gaps and promote effective public health interventions through targeted educational programs and community engagement initiatives^[11].

The analysis of the study reveals a complex interplay between demographic factors, knowledge, and attitudes toward hepatitis B, offering valuable insights that align with related research. Vaccination history and familial exposure were found to be significantly associated with higher knowledge levels and more supportive attitudes, underscoring the importance of personal experiences and health education in fostering awareness and empathy^[12]. Conversely, no significant associations were observed between knowledge and factors such as age, education, or surgical history, though other studies have reported positive correlations linked to healthcare interactions.

The weak inverse relationship identified between knowledge and attitudes highlights the necessity for

holistic educational strategies that integrate factual information with emotional and social elements. Empathy-driven interventions, including patient narratives and community engagement, have the potential to bridge the gap between knowledge and attitudes, address stigma, and promote inclusivity^[13]. These findings emphasize the need for public health campaigns that extend beyond mere knowledge dissemination, aiming instead to cultivate deeper understanding and drive behavior change.

5. Conclusion

The analysis identified no significant relationships between most demographic characteristics, including age and education, and attitudes toward Hepatitis B, highlighting the predominant influence of cultural and societal norms on health-related perceptions. A significant positive correlation between vaccination history and supportive attitudes suggests that vaccination programs may play a dual role in promoting both preventive behaviors and empathetic perspectives. Conversely, the weak inverse correlation observed between knowledge and attitudes reflects a complex dynamic in which increased knowledge does not consistently lead to improved attitudes. This finding underscores the need for a more nuanced approach to health education, incorporating both factual information and strategies that address emotional, cultural, and societal dimensions to effectively foster understanding and supportive attitudes.

Disclosure statement

The authors declare no conflict of interest.

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Study on the Efficacy of Radiofrequency and Laser Ablation in the Treatment of Superficial Varicose Veins in the Lower Extremities

Qingshan Wang*

Department of Vascular Surgery, The First Affiliated Hospital of Guangzhou Medical University, Guangzhou 510120, Guangdong Province, China

*Corresponding author: Qingshan Wang, qingshan19840510@126.com

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Abstract: *Objective:* To evaluate the efficacy of endovenous radiofrequency ablation (RFA) and laser ablation (EVLA) in the treatment of superficial varicose veins of the lower extremities. *Methods:* Seventy-eight patients with superficial varicose veins treated at a hospital between April 2022 and May 2023 were selected and divided into a radiofrequency ablation group (RFA group; 39 cases) and a laser ablation group (EVLA group; 39 cases) based on the treatment method. Operation time, postoperative recovery duration, venous clinical severity score (VCSS) changes, complication rates, closure rates, and recurrence rates were compared between the groups at 1 month, 3 months, and 12 months postoperatively. The postoperative therapeutic outcomes were comprehensively evaluated. *Results:* No significant differences in age, gender, disease grade, or disease course were observed between the groups ($P > 0.05$). The superficial varicose vein closure rate was 100% in both groups at 1 and 3 months postoperatively. At 12 months, the closure rate was 94.87% in the RFA group and 97.43% in the EVLA group, with no statistically significant difference ($P > 0.05$). No significant differences were observed in VCSS changes or complication incidence between the groups ($P > 0.05$). *Conclusion:* Radiofrequency ablation and laser ablation demonstrate comparable efficacy and safety in the treatment of superficial varicose veins of the lower extremities.

Keywords: Radiofrequency ablation; Laser ablation; Superficial varicose veins; Closure rate; Complications

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1. Introduction

Varicose veins of the lower extremities represent a prevalent vascular condition that significantly impacts patients' quality of life. This condition can be categorized into primary and secondary varicose veins based on its etiology^[1]. The primary cause is elevated venous pressure, resulting from superficial and deep venous reflux disorders due to congenital weakness of the superficial venous walls and structural abnormalities in venous valves.

According to the latest guidelines, treatment for lower extremity varicose veins is determined by the Clinical-

Etiology-Anatomy-Pathophysiology (CEAP) classification ^[2,3]. For patients classified as C0, who exhibit no symptoms or indications for surgical intervention, the primary goal is to improve their lifestyle and work habits. The use of compression stockings and oral medications effectively alleviates discomfort.

However, for patients presenting with discomfort, lower limb edema, pruritus, eczema, or severe cases of venous leg ulcers (CEAP C2-C6), which substantially affect their quality of life, surgical intervention is typically required.

In recent years, minimally invasive procedures such as radiofrequency ablation (RFA) and endovenous laser ablation (EVLA) have gained widespread application for the treatment of superficial varicose veins due to their minimal invasiveness and rapid recovery times ^[4,5]. RFA and EVLA offer effective solutions for managing reflux disorders by sealing the affected veins, thus restoring proper venous function ^[6-8].

This study aims to investigate and compare the efficacy and safety of RFA and EVLA in the treatment of superficial varicose veins, providing further insight into the advantages and limitations of these minimally invasive techniques.

2. Materials and methods

2.1. General information

A total of 78 patients with superficial varicose veins of the lower extremities and 46 patients with small saphenous varicose veins, treated at the hospital between April 2022 and May 2023, were included in the study. The 78 patients with superficial varicose veins were randomly divided into the RFA group ($n = 39$) and the EVLA group ($n = 39$). The RFA group included 17 males and 22 females, while the EVLA group included 16 males and 23 females.

Inclusion criteria: (1) Patients aged 20–75 years; (2) Availability of complete medical records; (3) Diagnosis of primary superficial varicose veins confirmed through clinical symptoms, signs, and imaging examinations; (4) Patients with normal consciousness who could cooperate during procedures and assessments, with no severe mental illness or contraindications; (5) CEAP classification grades C1–C4; (6) Patients who had signed informed consent.

Exclusion criteria: (1) Patients with severe diseases of vital organs; (2) Presence of iliac vein compression; (3) Post-thrombotic syndrome; (4) Severe allergic constitution; (5) Pregnant or lactating women; (6) Patients with contraindications for surgery; (7) Loss to follow-up.

No statistically significant differences were observed in general characteristics between the two groups ($P > 0.05$), as shown in **Table 1**.

Table 1. Comparison of general characteristics of patients with superficial varicose veins of the lower extremities ($n = 39$, mean \pm SD)

Indicators	RFA group	EVLA group	t / χ^2	P
Gender (male/female, cases)	17/22	16/23	0.052	0.820
Affected sides (left/right, cases)	19/20	22/17	0.457	0.499
C1–2	9	10	0.623	0.891
C3	15	14		
C4a	9	7		
C4b	6	8		
Age (years)	56.1 \pm 8.9	56.3 \pm 8.6	0.103	0.918
Duration of disease (years)	4.6 \pm 2.1	4.7 \pm 2.0	0.465	0.783

2.2. Treatment methods

2.2.1. Instruments

- (1) RFA group: The ClosureRFG Radiofrequency Generator (Medtronic Inc.) and the ClosureFast catheter were used, along with an introduction sheath (Terumo Corporation, Japan).
- (2) EVLA group: The Halo Diode Laser System (Micro-Energy Medical Technology Co., Ltd.) and Halo-R-0.40-2.5 and Halo-R-0.60-2.5 fibers were used.

2.2.2. Procedures

On the treatment day, venous positions in the affected leg were mapped using ultrasound. Mild intravenous sedation was administered using propofol or midazolam under anesthesiologist supervision. For great saphenous vein (GSV) treatment, ablation began 2 cm distal to the saphenofemoral junction (SFJ) and avoided the area below the knee. Small saphenous vein (SSV) ablation was initiated 2 cm distal to the saphenopopliteal junction. Patients were positioned at a 30-degree head-down tilt during ablation. Wet gauze was used to compress the skin around the laser fiber to minimize heat damage, and the lower limb was bandaged with elastic bandages.

A tumescent anesthetic solution was prepared by mixing 500 mL of Hartmann's solution with 20 mL of 2% lidocaine. Under intraoperative ultrasound guidance, perivenous infiltration ensured a minimum vein-skin distance of 10 mm.

RFA group: RFA was performed using a ClosureFast catheter with a 7F sheath. The GSV was punctured to establish vascular access, and ablation was performed with two cycles for the proximal segment and a single cycle for subsequent segments. Manual pressure was applied throughout the procedure.

EVLA group: EVLA was conducted using a vascular needle to establish access, and a laser fiber connected to a 1470 nm laser system was inserted into the vein via a vascular sheath. Treatment parameters adhered to the "Guidelines for the Diagnosis and Treatment of Common Venous Diseases (2022 edition)." For GSV, a 600 μm fiber was used, with laser power set at 6–8 W and LEED at 40–50 J/cm. For SSV, a 400 μm fiber was used, with laser power set at 4–5 W and LEED at 35–40 J/cm.

2.2.3. Postoperative management

Branch varices, reticular veins, and telangiectasia were treated with venectomy or sclerotherapy at the surgeon's discretion. Patients were encouraged to mobilize 4–8 hours postoperatively and were discharged the same day. Oral non-steroidal anti-inflammatory drugs were prescribed for three days, without thromboprophylaxis. Patients wore gradient compression stockings (20–30 mmHg) at thigh level during the day for two weeks. Numerical rating scale (NRS) scores were recorded at 6 hours, 1 day, 10 days, and 30 days postoperatively.

2.3. Observation indicators

- (1) Telephone follow-ups were conducted one week after treatment to evaluate return-to-normal activity days. Short-term (baseline, 1 month, 3 months) and long-term (12 months) venous closure rates were compared between groups. Changes in venous clinical severity scores (VCSS) before and after treatment were analyzed.
- (2) Complications, including deep vein thrombosis (DVT), heat-induced thrombosis (EHIT), surgical site ecchymosis, paresthesia, postoperative edema, burns, and superficial phlebitis, were assessed during the one-month follow-up.

2.4. Statistical analysis

Data analysis was conducted using statistical software. Measurement data were expressed as mean \pm standard deviation (SD), with comparisons between groups performed using *t*-tests. Count data were expressed as rates (%), with group comparisons analyzed using χ^2 tests. A value of $P < 0.05$ was considered statistically significant.

3. Results

3.1. Short-term and long-term postoperative closure rates

Immediately after the procedure (0 time), the vein closure rate was 100% in both groups. At 1 month, 3 months, and 12 months postoperatively, the closure rates decreased slightly in both groups. However, no statistically significant difference was observed between the two groups at any time point ($P > 0.05$) (**Table 2**).

Table 2. Comparison of surgical closure rates between the two groups for superficial varicose veins of the lower extremities [$n = 39$, n (%)]

Groups	At 0 time*	1 month*	3 months*	12 months*
RFA group	39 (100%)	39 (100%)	39 (100%)	37 (94.87)
EVLA group	39 (100%)	39 (100%)	39 (100%)	38 (97.43%)
χ^2				0.010
<i>P</i>				> 0.999

Note: * indicates the time immediately after surgery.

3.2. Days of postoperative return to activity

Table 3 shows that the average recovery time for returning to normal activities was 2.92 ± 1.08 days in the RFA group and 2.82 ± 1.14 days in the EVLA group. The difference was not statistically significant ($P > 0.05$).

Table 3. Comparison of days of return to activity after surgery between the two groups ($n = 39$, mean \pm SD)

Groups	Cases	Days of return to activity after surgery
RFA group	39	2.92 ± 1.08
EVLA group	39	2.82 ± 1.14
<i>t</i>		0.406
<i>P</i>		0.686

3.3. Venous clinical severity scores

Before surgery, there was no statistically significant difference in VCSS scores between the two groups ($t = 0.082$, $P > 0.05$). Postoperatively, both groups showed significantly improved VCSS scores at 1 month, 3 months, and 12 months compared to preoperative scores (RFA group, $t = 24.07$, $P < 0.0001$; EVLA group, $t = 24.73$, $P < 0.0001$). However, no significant difference in VCSS scores was observed between the groups at any postoperative time point ($P > 0.05$), as shown in **Table 4**.

Table 4. Comparison of VCSS scores for superficial varicose veins of the lower extremities in both groups ($n = 39$, mean \pm SD)

Groups	Pre-operation	1 month*	3 months*	12 months*	<i>t</i>	<i>P</i>
RFA group	10.20 \pm 4.18	1.59 \pm 0.75	2.07 \pm 0.90	4.02 \pm 1.71	8.543	< 0.001
EVLA group	10.48 \pm 4.30	1.56 \pm 0.72	2.02 \pm 0.96	4.00 \pm 1.61	8.820	< 0.0001
<i>t</i>	0.294	0.154	0.243	0.068		
<i>P</i>	0.767	0.878	0.808	0.946		

Note: * indicates the time immediately after surgery.

3.4. Incidence of complications

No significant differences were found in the incidence of complications, including deep vein thrombosis (DVT), heat-induced thrombosis (EHIT), surgical site ecchymosis, postoperative paresthesia (numbness), postoperative edema, burns, or superficial phlebitis, between the two groups ($P > 0.05$), as shown in **Table 5**.

Table 5. Comparison of the incidence of surgical complications between the two groups [$n = 39$, n (%)]

Groups	DVT	EHIT	Ecchymosis at the surgical site	Postoperative paresthesia (numbness)	Postoperative edema	Burns	Superficial phlebitis	Incidence of surgical complications
RFA group	0	0	7 (17.95%)	2 (5.12%)	1 (2.86%)	0	0	10 (25.64%)
EVLA group	0	0	6 (15.38%)	1 (2.56%)	0	0	0	7 (17.95%)
χ^2								0.909
<i>P</i>								0.635

4. Discussion

The treatment of varicose veins has undergone significant advancements over the years. The increasing adoption of minimally invasive procedures such as EVLA, RFA, ultrasound-guided foam sclerotherapy, and cryopexy has resulted in excellent therapeutic outcomes ^[9-11]. Most patients undergoing these minimally invasive treatments report high levels of satisfaction with the results. Radiofrequency ablation utilizes radiofrequency energy to shrink the collagen in the venous wall and close the lumen, while laser ablation employs thermal energy from the laser to achieve the same outcome. Both RFA and EVLA are intraluminal procedures, eliminating the need for vein extraction, which shortens the operation time and reduces intraoperative blood loss. The efficacy of these techniques is influenced by factors such as precision in execution, appropriate energy settings, and adherence to standardized postoperative care protocols. The Society for Vascular Surgery and the American Venous Forum endorses thermal ablation techniques (EVLA or RFA) as safe and effective methods for treating incompetent saphenous veins ^[12].

In this study, both EVLA and RFA were utilized to treat superficial varicose veins of the lower extremities. The findings indicated that both methods produced satisfactory therapeutic outcomes, aligning with previous research ^[9-12]. No statistically significant differences were observed between the two groups regarding vein closure rate, symptom improvement, or complication rates. The closure rate was 100% in both groups immediately after surgery (time 0). Although the closure rate decreased slightly over time, there was no significant difference

between the two groups.

Similarly, the two groups exhibited comparable results in terms of the number of days required to resume normal activities after surgery and improvements in Venous Clinical Severity Scores (VCSS). Regarding safety, the incidence of adverse events was low and did not differ significantly between the two techniques, indicating comparable safety profiles during treatment.

Radiofrequency ablation achieves vein closure by constricting the collagen in the venous wall using radiofrequency energy, while EVLA utilizes laser-induced thermal energy for the same purpose. The effectiveness of both techniques appears to depend on factors such as precise operation, optimal energy settings, and standardized postoperative care.

5. Limitations

This study has several limitations. The relatively small sample size and limited follow-up duration may affect the accuracy and generalizability of the findings. Future research involving larger sample sizes, multi-center studies, and extended follow-up periods is necessary to comprehensively evaluate the efficacy and safety of these two laser devices.

6. Conclusions

In conclusion, both radiofrequency ablation and laser ablation are safe and effective treatment options for superficial varicose veins of the lower extremities. No statistically significant differences were observed between the two methods in terms of closure rates, postoperative recovery times, improvements in VCSS scores, or the incidence of adverse events. Clinicians may choose either procedure based on the specific clinical context and patient needs.

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Disclosure statement

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Clinical Application of Patient Participation Health Model in the Health Management of Patients with Type 2 Diabetes

Xiyu Jiang*

The Second Affiliated Hospital of Guilin Medical College, Guilin 541199, Guangxi Province, China

*Corresponding author: Xiyu Jiang, 15078993550@163.com

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Abstract: *Objective:* To analyze the clinical effects of the patient participation health model in the health management of type 2 diabetes mellitus. *Methods:* A total of 124 patients with type 2 diabetes admitted to the hospital from June 2023 to June 2024 were randomly assigned to either the control group (64 patients) or the intervention group (60 patients). Patients in the control group received routine health management, while those in the intervention group were managed using a patient-participation health model with progressive, stage-based interventions. Outcomes were assessed based on blood glucose control, disease awareness, and self-management behaviors. Adverse reactions during health management were closely monitored in both groups. *Results:* Patients in the intervention group showed significantly better outcomes in blood glucose control, disease awareness, and self-management behaviors compared to the control group. *Conclusion:* The patient participation health model demonstrated significant clinical value, effectively enhancing self-management abilities, improving glycemic control, and increasing disease awareness. This model is recommended for widespread adoption in the health management of type 2 diabetes to achieve better therapeutic outcomes and improve patient quality of life.

Keywords: Type 2 diabetes; Health management; Patient participation health model; Clinical application

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1. Introduction

The increasing prevalence of diabetes, driven by social and economic development and lifestyle changes, has become a significant global public health concern. Type 2 diabetes, the most common form of the disease, poses a substantial burden on patients' quality of life. Traditional health management approaches have primarily focused on medication and physician guidance, often neglecting the active role of patients in managing their condition.

In recent years, the patient-participation health model has emerged as a novel approach to health management. This model emphasizes the active involvement of patients in disease management, empowering them to take on a central role in their health care. By promoting education and self-management, this approach aims to improve

treatment outcomes and overall quality of life.

This study seeks to evaluate the effectiveness of the patient participation health model in the management of type 2 diabetes. By comparing traditional health management practices with the patient participation model, this research assesses improvements in blood glucose control, disease awareness, and self-management behaviors. The findings aim to provide a scientific foundation for advancing health management strategies for patients with type 2 diabetes and to propose innovative approaches for clinical practice.

2. Materials and methods

2.1. General information

A total of 124 patients with type 2 diabetes admitted to the hospital from June 2023 to June 2024 were selected as study participants using the convenience sampling method.

Inclusion criteria: (1) Aged between 18 and 75 years; (2) Meeting the diagnostic criteria for type 2 diabetes; (3) Capable of understanding and voluntarily participating in the study; (4) Proficient in using the WeChat application.

Exclusion criteria: (1) Presence of other serious chronic diseases or mental illnesses; (2) Cognitive impairment or communication difficulties; (3) Participation in other clinical trials; (4) Severe liver or kidney dysfunction, malignancy, or other severe conditions; (5) Use of medications significantly affecting blood sugar, such as hormone drugs or immunosuppressants.

All participants provided written informed consent before enrollment. To minimize inter-group contamination, the 124 patients were divided into two groups based on their admission sequence. Patients admitted between June and December 2023 (64 patients) formed the control group, while those admitted between January and June 2024 (60 patients) formed the intervention group ^[4]. The control group comprised 38 male and 26 female patients, and the intervention group included 32 male and 28 female patients. The mean ages of the two groups were 58.3 and 57.9 years, respectively, aligning with the inclusion criteria. In terms of educational attainment, 40% of patients in the control group and 45% in the intervention group had university-level education or higher, indicating comparability in educational background. Baseline data, including height, weight, blood pressure, blood glucose levels, disease cognition, and self-management behaviors, were collected from all patients before enrollment. No statistically significant differences were found between the two groups ($P > 0.05$).

2.2. Methods

2.2.1. Control group

Patients received conventional health management, including health education during their visits. This covered fundamental topics such as dietary control, exercise guidance, blood glucose monitoring, and medication adherence. Regular follow-up visits were conducted to ensure compliance with medical advice.

2.2.2. Intervention group

In addition to conventional health management, patients in this group were introduced to the patient participation health model ^[1]. The intervention was phased and progressive, as outlined below:

2.2.2.1. From dim awareness to understanding

(1) Characteristics: Focused on improving patients' awareness of type 2 diabetes and establishing correct

disease concepts ^[2].

- (2) Cognitive level: Patients' understanding of the disease and current self-management practices was assessed through questionnaires to provide targeted guidance for subsequent education ^[3].
- (3) Behavioral level: One-on-one consultations educated patients on diet and exercise planning and emphasized the importance of blood glucose monitoring. Health education courses, including lectures, interactive Q&A sessions, and case analysis, were conducted to enhance disease understanding and promote self-management habits ^[4].

2.2.2.2. From understanding to compliance

- (1) Characteristics: Aimed at encouraging active participation in health management, overcoming compliance barriers, and fostering adherence behaviors ^[5].
- (2) Cognitive level: Regular health education sessions deepened patients' understanding. Quizzes and multimedia tools such as videos and animations were employed to simplify complex concepts ^[6].
- (3) Behavioral level: Interactive activities such as role-play and scenario simulations allowed patients to practice healthy behaviors. A social platform was provided for sharing experiences and mutual encouragement ^[7].

2.2.2.3. From compliance to a well-being plan

- (1) Characteristics: Patients were empowered to participate in health decision-making, adapt to the health management model, and maintain healthy behaviors ^[8].
- (2) Cognitive level: Patients were guided to design their own health management strategies, with scientific support to strengthen adherence and disease management ^[9].
- (3) Behavioral level: Efforts were made to reinforce drug therapy practices, self-care, and extended care ^[10]. Multimedia tools and personalized consultations facilitated a deeper understanding and retention of diabetes management principles.

2.3. Observational measures and evaluation tools

- (1) Disease cognition: A customized questionnaire assessed patients' knowledge across four dimensions: basic knowledge, dietary management, exercise management, and complications. Scores ranged from 0 to 100, with higher scores indicating better disease cognition ^[11].
- (2) Blood glucose control: Baseline measurements of fasting blood glucose (FBG) and hemoglobin A1c (HbA1c) levels were collected. These were monitored every three months during the intervention period. The impact of the health model on blood glucose control was assessed by comparing pre- and post-intervention data and hypoglycemic events.
- (3) Self-management behaviors: The Diabetes Self-Management Behavior Scale (DSMB) was used to evaluate changes in dietary management, exercise routines, blood glucose monitoring, foot care, and medication adherence. Assessments were conducted regularly to analyze behavioral changes and their correlation with blood glucose control ^[12].

2.4. Statistical methods

SPSS 20.0 software was used for data analysis. Measurement data, such as age and disease cognition, were

expressed as mean \pm standard deviation (SD). Frequencies and percentages were used for categorical variables like educational levels. A P -value of < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of disease cognitive levels

After the study, patients in the intervention group demonstrated significantly higher levels of disease cognition compared to those in the control group. Specifically, the average scores for the intervention group in the dimensions of basic knowledge, diet knowledge, exercise knowledge, and complication knowledge were 17.65, 17.60, 17.98, and 17.23 points, respectively. In contrast, the control group scored averages of 16.28, 15.97, 16.44, and 15.64 points in the same dimensions (**Table 1**). Statistical analysis revealed that the differences in disease cognition levels between the two groups were statistically significant ($P < 0.05$). These findings indicate that the intervention measures based on patient participation in the health model effectively enhanced patients' understanding of type 2 diabetes ^[13].

Table 1. Comparison of disease cognition levels between the two groups before and after the intervention

Group	<i>n</i>	Basic knowledge		Diet knowledge		Exercise knowledge		Complication knowledge		Total points	
		Before	After	Before	After	Before	After	Before	After	Before	After
Control	64	12.11 \pm 1.69	16.28 \pm 1.61*	12.58 \pm 2.38	15.97 \pm 1.44*	12.02 \pm 1.78	16.44 \pm 1.79*	11.64 \pm 1.83	15.64 \pm 1.27*	48.34 \pm 4.49	64.33 \pm 4.37*
Intervention	60	11.88 \pm 1.69	17.65 \pm 3.17* [#]	12.33 \pm 2.18	17.60 \pm 2.65* [#]	11.57 \pm 1.38	17.98 \pm 1.85* [#]	11.95 \pm 1.96	17.23 \pm 2.37* [#]	47.63 \pm 4.05	70.47 \pm 6.00* [#]

Note: * $P < 0.05$ as compared to pre-intervention, [#] $P < 0.05$ as compared to the control group.

3.2. Comparison of blood glucose control

The intervention group exhibited significantly better blood glucose control compared to the control group. Specifically, the fasting blood glucose (FBG) and glycosylated hemoglobin (HbA1c) levels in the intervention group decreased notably following the intervention, while the control group showed minimal changes in glycemic control. At the end of the intervention, the mean FBG level in the intervention group was 6.8 mmol/L, and the mean HbA1c level was 7.2%. In contrast, the control group had mean FBG and HbA1c levels of 7.5 mmol/L and 7.9%, respectively. Statistical analysis confirmed that the differences in glycemic control between the two groups were statistically significant ($P < 0.05$), demonstrating that the health model based on patient participation significantly improved blood glucose management ^[14].

3.3. Comparison of self-management behaviors

Significant improvements in self-management behaviors were observed among patients in the intervention group across all assessed dimensions. The intervention group achieved average scores of 18.2 for diet management, 18.5 for exercise management, 18.3 for blood glucose monitoring, 18.1 for foot care, and 18.4 for medication management. In comparison, the control group scored averages of 16.8, 16.9, 16.7, 16.5, and 16.8, respectively, in these dimensions. Statistical analysis showed that the differences in self-management behavior scores between the two groups were statistically significant ($P < 0.05$). These results indicate that the patient participation-based

health model interventions effectively enhanced the self-management capabilities of patients.

4. Discussion

This study, through a comparative analysis of conventional health management and health management based on the patient participation health model, confirmed that the latter offers significant advantages in enhancing disease cognition levels, improving glycemic control outcomes, and promoting self-management behaviors in patients with type 2 diabetes. Through phased and progressive interventions, the patient participation health model not only enhances patients' understanding of their condition but also fosters the development of effective self-management habits in daily life. These improvements contribute to better blood glucose control and a reduced risk of complications^[15]. Moreover, the model encourages active patient involvement in health management, thereby enhancing treatment outcomes and overall quality of life through education and self-management strategies.

In clinical practice, the successful application of the patient participation health model necessitates that medical professionals possess the requisite knowledge and skills to deliver personalized health education and guidance to patients. Concurrently, medical institutions should provide the necessary support infrastructure, such as establishing patient education platforms and offering comprehensive health education materials, to facilitate the effective implementation of this model. Furthermore, the widespread adoption of the patient-participation health model requires policy support and the efficient allocation of medical resources to ensure that patients have access to continuous and effective health management services.

5. Conclusion

In conclusion, the patient participation health model offers an innovative approach to the health management of patients with type 2 diabetes. By enhancing patients' self-management abilities and disease cognition levels, this model contributes to improved glycemic control and overall quality of life. With ongoing research and expanded practical applications, the patient participation health model is poised to become an integral component of the health management strategies for patients with type 2 diabetes.

Disclosure statement

The author declares no conflict of interest.

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A Study on the Beliefs and Attitudes of Nurses in Yunnan Province Towards Nurse Prescriptive Authority

Yulin Lu¹, Jian Chen^{2*}, Ying Li¹, Jun Yu², Yanyu Chen², Jiangyu Xue¹

¹Yunnan Medical Health College, Kunming 650000, Yunnan Province, China

²Yunnan Cancer Hospital, Kunming 650100, Yunnan Province, China

*Corresponding author: Jian Chen, 17697315@qq.com

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Abstract: *Objective:* To investigate the current beliefs and attitudes of nurses in Yunnan Province toward prescriptive authority, analyze the influencing factors, and provide evidence for future research and policy formulation to support the establishment of nurses' prescriptive authority in China. *Method:* A cross-sectional survey was conducted among 937 nurses in Yunnan Province using the Beliefs and Attitudes Scale on Nurses' Prescriptive Authority. The scale assessed four dimensions: perceived need, self-efficacy, perceived benefits, and perceived barriers. Multiple linear regression analysis was used to identify factors influencing the overall score and each dimension. *Results:* The total score of the Beliefs and Attitudes Scale was 89.17 ± 17.69 , indicating a moderate level of awareness and positive attitude among nurses. The highest-scoring dimension was perceived benefits (34.94 ± 8.04), while the lowest was perceived barriers (15.23 ± 3.5). Age was identified as a significant factor influencing the overall score and self-efficacy dimension ($P < 0.05$). Years of practice influenced the perceived benefits dimension ($P = 0.051$), while gender, age, and professional title were key factors affecting the perceived barriers dimension ($P < 0.05$). Male nurses and senior nurses demonstrated more caution toward potential risks associated with prescriptive authority. *Conclusion:* Nurses in Yunnan Province exhibit moderate levels of belief in and attitudes toward prescriptive authority, with age being the most significant influencing factor. Tailored training programs, policy promotion, and practical guidance are recommended to enhance nurses' understanding and support for prescriptive authority, thereby improving nursing practices and addressing regional healthcare challenges.

Keywords: Nurses' prescriptive authority; Beliefs and attitudes; Influencing factors; Yunnan Province; Nursing policy

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1. Introduction

Nurse prescriptive authority refers to the rights granted to nurses in clinical practice to prescribe medications and

order related tests ^[1]. The *International Council of Nurses Guidelines on Nurse Prescriptive Authority* ^[2,3] classifies nurse prescribing into categories such as medications, treatments, diagnostic tests, medical devices, instruments, dressings, and specific therapeutic diets. Facing challenges such as the increased disease burden brought by an aging population, imbalances in the supply and demand of medical resources, and growing demand for quality nursing care, many countries and regions have attempted to grant nurses prescriptive authority to improve the quality and efficiency of nursing care and to address the rising costs of healthcare. These efforts have yielded positive results ^[4]. Some domestic scholars have also advocated for granting nurses appropriate prescriptive authority to meet the current and future healthcare service needs of China ^[2-6].

As a border province in southwestern China with many mountainous areas and a shortage of healthcare resources and highly skilled health professionals, the establishment of nurse prescriptive authority in Yunnan Province could significantly alleviate medical challenges in the southwestern region. However, the successful implementation of nurse prescriptive authority depends on the awareness, acceptance, and support of nursing professionals. At present, there is a lack of detailed and in-depth research on this topic in China. This study aims to investigate the current beliefs and attitudes of nurses in Yunnan Province regarding nurse prescriptive authority, analyze the current state and influencing factors, and provide a basis for further research and policy formulation.

2. Materials and methods

2.1. Survey subjects

Using a convenience sampling method, a questionnaire survey was conducted from May to November 2024, targeting registered nurses in four regions of Yunnan Province: Central Yunnan, Western Yunnan, Eastern Yunnan, and Southern Yunnan. Inclusion criteria: (1) possession of a nursing license; (2) at least three years of clinical work experience; (3) willingness to participate in the survey. Exclusion criteria: (1) nurses on leave; (2) trainee nurses; (3) nurses not directly involved in clinical nursing work.

The sample size was determined based on 10-20 times the maximum number of items for the independent variables. This study included 42 independent variables (15 items in the general survey and 27 items in the scale dimensions). Considering a 15% questionnaire loss rate, the final sample size was set at 800 participants. All survey subjects provided informed consent and voluntarily participated in the study.

2.2. Research methods

2.2.1. Survey tools

2.2.1.1. General information questionnaire

The researchers designed a general information questionnaire, which included 15 items on sociodemographic information such as age, gender, professional title, position, years of practice, educational background, region, and type of workplace.

2.2.1.2. Beliefs and attitudes towards nurse prescriptive authority scale

Ling *et al.* ^[7] developed the scale by referencing the attitude questionnaire toward nurse prescriptive authority by and through literature review, localization, improvement, expert consultation, and a preliminary survey. The final scale consists of 27 items across four dimensions, with a total score ranging from 27 to 135. Higher scores indicate stronger beliefs and intentions regarding nurse prescriptive authority implementation.

The scale demonstrated good reliability and validity (correlation coefficients between the total scale and each dimension ranged from 0.62 to 0.83, the content validity index (S-CVI) was 0.921, test-retest reliability was 0.808, and Cronbach's α coefficient was 0.902). A 5-point Likert scoring method was used, with the questionnaire taking approximately 5–8 minutes to complete ^[8].

2.2.2. Survey methods

Before the survey, permission was obtained from relevant hospitals and departments. The questionnaire was distributed and collected by trained project team members. An online platform (Wenjuanxing) was used for distribution. Survey participants were informed about the confidentiality and anonymity of the questionnaire and were provided with instructions and precautions for completing it.

Upon completion, the surveyors reviewed the questionnaires on-site, addressing any omissions or errors immediately. Completion time was controlled between 10–15 minutes. To ensure completeness and accuracy, mandatory items, logical jumps, and time/attempt controls were applied.

A total of 950 questionnaires were distributed and collected, achieving a 100% response rate. However, seven questionnaires that took over 40 minutes to complete and six questionnaires where the same option was selected for all items were deemed invalid and excluded.

2.3. Statistical analysis

The collected questionnaires were verified by two individuals before statistical analysis using SPSS 26. For quantitative data, the mean \pm standard deviation (SD) was used if normally distributed; otherwise, non-parametric statistical methods were applied. Frequency and proportions were used for categorical data. Single-factor analysis was conducted to explore factors influencing beliefs and attitudes toward nurse prescriptive authority, and multiple linear regression analysis was performed for statistically significant factors identified in the single-factor analysis. The significance level was set at $\alpha = 0.05$.

3. Results

3.1. Basic characteristics of the study population

A total of 937 nurses from Yunnan Province participated in the survey, with their basic characteristics shown in **Table 1**. Chi-squared tests were used to analyze the basic characteristics of the study population. Significant statistical differences were found in gender, age composition, professional titles, years of practice, education level, region, type of institution, institution level, and department composition (all $P < 0.001$).

Table 1. Basic characteristics of the study population and univariate analysis of nurses' beliefs and attitudes toward nurse prescriptive authority ($n = 937$)

Characteristics	<i>n</i> (%)	Nurse prescriptive authority beliefs and attitudes score	<i>F</i>	<i>P</i>
Gender			0.055	0.814
Female	819 (87.4)	89.22 \pm 17.75		
Male	118 (12.6)	88.81 \pm 17.35		
Age			5.170	0.002
≤ 29 years	651 (69.5)	88.14 \pm 16.56		

Table 1 (Continued)

Characteristics	<i>n</i> (%)	Nurse prescriptive authority beliefs and attitudes score	<i>F</i>	<i>P</i>
30–39 years	179 (19.1)	89.44 ± 20.96		
40–49 years	76 (8.1)	93.66 ± 18.94		
50–59 years	31 (3.3)	98.26 ± 12.63		
Professional title			4.235	0.002
None	470 (50.2)	88.39 ± 15.53		
Junior	224 (23.9)	88.24 ± 18.73		
Intermediate	199 (21.2)	89.90 ± 21.22		
Associate Senior	32 (3.4)	97.25 ± 12.65		
Senior	12 (1.3)	103.75 ± 14.40		
Years of practice			4.465	0.012
3–5 years	618 (66.0)	88.61 ± 15.82		
5–10 years	190 (20.3)	88.11 ± 20.63		
> 10 years	129 (13.8)	93.45 ± 20.78		
Education level			1.078	0.366
Secondary school	55 (5.9)	89.93 ± 17.88		
College	592 (63.2)	88.43 ± 16.32		
Bachelor's	252 (26.9)	90.07 ± 20.76		
Master's	28 (3.0)	94.04 ± 14.64		
Doctoral	10 (1.1)	92.70 ± 18.33		
Region			0.547	0.650
Central Yunnan	453 (48.3)	89.42 ± 18.35		
Southern Yunnan	104 (11.1)	90.80 ± 16.55		
Western Yunnan	159 (17.0)	88.50 ± 17.22		
Eastern Yunnan	221 (23.6)	88.38 ± 17.21		
Type of institution			0.798	0.451
Private institution	107 (11.4)	89.19 ± 18.76		
Public institution	763 (81.4)	89.40 ± 17.54		
Public-private mixed	67 (7.2)	86.55 ± 17.74		
Institution level			0.842	0.431
Level 1	90 (9.6)	91.12 ± 17.12		
Level 2	473 (50.5)	88.59 ± 18.36		
Level 3	374 (39.9)	89.44 ± 16.95		
Department			2.524	0.014
Internal medicine	190 (20.3)	88.39 ± 18.33		
Surgery	181 (19.3)	90.55 ± 15.15		

Table 1 (Continued)

Characteristics	<i>n</i> (%)	Nurse prescriptive authority beliefs and attitudes score	<i>F</i>	<i>P</i>
Obstetrics and gynecology	93 (9.9)	88.26 ± 17.95		
Pediatrics	97 (10.4)	85.77 ± 20.84*		
Emergency department	119 (12.7)	89.06 ± 16.74		
ICU	20 (2.1)	98.20 ± 18.77*		
Other clinical departments	121 (12.9)	86.88 ± 18.31		
Medical technical departments	116 (12.4)	92.82 ± 16.51*		
Total	937 (100)	89.17 ± 17.69		

3.2. Current beliefs and attitudes of Yunnan nurses towards nurse prescriptive authority

The results are shown in **Table 2**. From **Table 2**, it can be seen that the total score of the Nurse Prescriptive Authority Beliefs and Attitudes Scale was (89.17 ± 17.69), indicating a moderate level. The highest-scoring dimension was the perceived benefits of nurse prescriptive authority, while the lowest was the perceived barriers to exercising nurse prescriptive authority.

Table 2. Total scores and scores of each dimension of the nurse prescriptive authority belief and attitude scales (*n* = 937)

Dimension	Score
Perceived need for nurses' prescriptive authority	17.42 ± 4.72
Self-efficacy in exercising prescriptive authority	19.91 ± 5.44
Perceived benefits of nurses' prescriptive authority	34.94 ± 8.04
Perceived barriers to exercising prescriptive authority	15.23 ± 3.50
Total score	89.17 ± 17.69

3.3. Univariate analysis of factors affecting nurses' beliefs and attitudes toward nurse prescriptive authority

The results are shown in **Table 1**. From **Table 1**, it can be observed that there were statistically significant differences in belief and attitude scores related to nurse prescriptive authority based on age, professional title, years of practice, and department (all *P* < 0.05). No significant differences were found based on gender, education level, region, type of institution, or institution level (all *P* > 0.05).

Analysis of variance was used to examine the scores of different characteristics of nurses on each dimension of the scale. Results indicated that there were statistical differences in the “perceived need for prescriptive authority” dimension based on age and professional title (*P* < 0.05). Nurses of different ages, professional titles, institution levels, and departments had significant differences in the “self-efficacy in exercising nurse prescriptive authority” dimension (all *P* < 0.05). Nurses with different years of practice showed significant differences in the “perceived benefits of nurse prescriptive authority” dimension (*P* = 0.050). Statistically significant differences were found in the “perceived barriers to exercising nurse prescriptive authority” dimension across different genders, ages, professional titles, types of institution, and institution levels (all *P* < 0.05), with male nurses scoring higher than female nurses (*F* = 10.725, *P* = 0.001).

3.4. Multivariate linear regression analysis of factors affecting scores on the nurse prescriptive authority beliefs and attitudes scale

Variables that showed statistical differences in the univariate analysis were included in the multivariate linear regression analysis using the enter method, as shown in **Table 3**. The model had a correlation coefficient $R = 0.124$, a coefficient of determination $R^2 = 0.015$, $F = 3.616$, $P < 0.05$, indicating that the regression model was statistically significant. Results showed that age was a significant factor influencing both the total score and the “self-efficacy” dimension of the scale (both $P < 0.05$). Clinical years of practice were a factor influencing the “perceived benefits” dimension ($P < 0.05$). Gender, age, and professional title were factors influencing the “perceived barriers” dimension (all $P < 0.05$).

Table 3. Multiple linear regression analysis of factors influencing scores on the beliefs and attitudes scale on nurses’ prescriptive authority

Outcome variable	Predictor variable	Partial regression coefficient	Standard error	Standardized coefficient	<i>t</i>	<i>P</i>
Total score	Constant	86.591	3.297		26.265	< 0.001
	Age	2.843	1.232	0.125	2.307	0.021
	Professional title	0.359	1.042	0.02	0.344	0.731
	Years of practice	-0.704	1.233	-0.029	-0.571	0.568
	Department	0.063	0.238	0.009	0.263	0.793
Perceived need	Constant	16.454	0.342		48.135	< 0.001
	Age	0.296	0.312	0.049	0.948	0.343
	Professional title	0.295	0.252	0.06	1.17	0.242
Self efficacy	Constant	19.059	0.811		23.487	< 0.001
	Age	0.794	0.361	0.114	2.203	0.028
	Professional title	-0.128	0.292	-0.023	-0.439	0.661
	Institution level	-0.135	0.28	-0.016	-0.48	0.631
	Department	0.06	0.073	0.027	0.817	0.414
Perceived benefits	Constant	32.47	1.287		25.237	< 0.001
	Years of practice	0.709	0.362	0.064	1.958	0.051
Perceived barriers	Constant	15.413	0.812		18.983	< 0.001
	Gender	1.064	0.343	0.101	3.098	0.002
	Age	-0.889	0.23	-0.198	-3.861	< 0.001
	Professional title	0.416	0.187	0.115	2.229	0.026
	Type of institution	-0.301	0.264	-0.037	-1.139	0.255
	Institution level	-0.112	0.179	-0.02	-0.625	0.532

4. Discussion

4.1. Current beliefs and attitudes of nurses in Yunnan Province toward prescriptive authority

According to the survey results, the total score of the Beliefs and Attitudes Scale on Nurses’ Prescriptive

Authority was 89.17 ± 17.69 , reflecting a moderate level. This indicates that, overall, nurses in Yunnan Province possess some awareness of and a positive attitude toward prescriptive authority, although there remains room for improvement. Among the dimensions, the highest-scoring one was the perceived benefits of nurses' prescriptive authority, while the lowest was the perceived barriers to exercising prescriptive authority. This finding suggests that while nurses recognize the benefits of prescriptive authority, they still face numerous challenges in practice, as also noted by Feng *et al.* ^[9], who highlighted legal regulations and education as major obstacles. Additionally, this study found significant heterogeneity in nurses' beliefs and attitudes based on gender, age, professional title, years of practice, educational background, region, institutional type, institutional level, and department. This highlights the importance of considering the specific needs of different groups when formulating relevant policies.

4.2. Factors influencing beliefs and attitudes toward nurses' prescriptive authority in Yunnan province

The results showed that age was a significant factor affecting the total score of beliefs and attitudes and the self-efficacy dimension. Years of clinical practice influenced the perceived benefits dimension, while gender, age, and professional title collectively impacted the perceived barriers dimension. These findings emphasize the critical role of age in shaping nurses' attitudes toward prescriptive authority. With increasing age, nurses tend to hold more positive beliefs and attitudes toward prescriptive authority. Older nurses are more inclined to view prescriptive authority as an opportunity to expand their career scope and enhance their professional skills. Their extensive clinical experience and skills instill confidence in acquiring prescriptive authority. Moreover, their broader social experiences lead them to value the positive clinical, social, and humanistic impacts of prescriptive authority.

Years of practice also play a pivotal role in nurses' understanding of prescriptive authority, as similarly observed by Zhong *et al.* ^[10], who reported that nurses with longer careers have a stronger desire to achieve higher professional value. Furthermore, this study revealed that age, gender, and professional title are important factors influencing the perceived barriers dimension. Nurses with more clinical experience may adopt a more cautious attitude toward new policies, concerned about potential increases in workload or disruptions to existing workflows. Older and higher-ranked nurses may also be more sensitive to potential risks, particularly regarding legal responsibilities and patient safety, leading to a more conservative stance toward new policies. Related studies have also noted that senior nurses with higher ranks demonstrate greater capability to identify prescription errors compared to their junior counterparts ^[11].

Male nurses scored higher than female nurses in the perceived barriers dimension, possibly reflecting a more cautious attitude toward potential risks. As noted by Blackley *et al.* ^[12], male nurses often face role conflicts and exclusion in the workplace, which may lead them to adopt more careful attitudes when addressing potential risks to avoid negative feedback and misunderstandings.

4.3. Practical implications and recommendations

This study highlights the current state of nurses' beliefs and attitudes toward prescriptive authority in Yunnan Province and the influencing factors, providing valuable data to support further optimization of nursing career development. Based on the findings, the following recommendations are proposed:

- (1) Design personalized training programs targeting nurses of different age groups, professional titles, and years of practice to help them better understand and accept prescriptive authority.
- (2) Promote the policy of nurses' prescriptive authority widely through various channels (e.g., social media,

professional journals, and internal newsletters), particularly among groups with higher perceived barriers, such as male nurses, to enhance overall awareness and support.

- (3) Provide practical guidance to nurses at all levels, especially on overcoming challenges encountered in exercising prescriptive authority. Establish dedicated consulting and support teams to promptly address issues nurses face in their work.
- (4) Conduct regular surveys to monitor changes in nurses' attitudes and adjust relevant policies and measures to ensure the successful implementation of prescriptive authority.

This study indicates that nurses in Yunnan Province exhibit moderate levels of belief in and attitudes toward prescriptive authority, with age being the most significant influencing factor. Targeted interventions can further enhance nurses' understanding and support of this right, thereby facilitating its implementation, promoting the comprehensive development of the nursing profession, and improving healthcare service quality.

Disclosure statement

The authors declare no conflict of interest.

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Study on the Construction of Whole-course Nursing Objective Management System for Patients with Type 2 Diabetes

Lei Wu*

The Second Affiliated Hospital of Guilin Medical College, Guilin 541199, China

*Corresponding author: Lei Wu, 15720593019@163.com

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Abstract: *Objective:* To explore the effect of a whole-course nursing objective management system on disease control and quality of life in patients with type 2 diabetes, and to propose strategies for constructing such a system for these patients. *Methods:* Ninety patients with type 2 diabetes admitted to the Department of Endocrinology of the hospital from January 2024 to June 2024 were selected. The control group ($n = 45$) received routine nursing care, while the observation group ($n = 45$) received whole-course nursing. Indicators such as glucose metabolism and compliance behavior were measured before and after care, and the health and quality of life of patients in both groups were evaluated. *Results:* A comparison of blood glucose levels and compliance behavior showed that the observation group had lower blood glucose levels than the control group ($P < 0.05$). Additionally, the compliance behavior score of the observation group was higher than that of the control group ($P < 0.05$). *Conclusion:* The holistic nursing model demonstrates significant nursing effects for patients with type 2 diabetes. This approach not only assists in blood sugar control, prevents disease progression, and reduces complications, but also enhances patients' knowledge of health management, aiding in their recovery.

Keywords: Patients with type 2 diabetes; Whole nursing; Management system by objectives; Construction path

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1. Introduction

Type 2 diabetes mellitus (T2DM) is a chronic condition characterized by abnormal insulin secretion and is classified as an endocrine and metabolic disease that requires lifelong treatment. The complexity of its treatment often results in patients struggling to manage their behavior during the home-care phase following discharge. The lack of professional nursing supervision and guidance during this stage frequently leads to elevated blood glucose levels and the development of complications, which significantly impact the health of patients with type 2 diabetes.

The whole-process nursing management model integrates in-hospital care with out-of-hospital home-based continuous care. This patient-centered approach emphasizes comprehensive guidance during both the admission

and discharge phases. It includes providing patients with essential health knowledge, daily exercise routines, and health monitoring advice, thereby forming an efficient and high-quality closed-loop nursing service system.

This study analyzes the effects of whole-course nursing within the care services provided to patients with type 2 diabetes. It also explores strategies for constructing a comprehensive nursing objective management system to further improve the whole-course nursing service model and assist patients in achieving better disease control.

2. Materials and methods

2.1. General information

Ninety patients with type 2 diabetes admitted to the Department of Endocrinology of the hospital from January 2024 to June 2024 were included in this study. All patients met the WHO diagnostic criteria for diabetes. The patients were divided into an observation group and a control group based on their admission dates. The observation group consisted of 45 patients (23 males and 22 females), with 6 patients experiencing complications such as diabetic foot and vision loss. The mean age of this group was 68.28 ± 8.23 years. The control group included 45 patients (15 males and 30 females), with an average age of 70.61 ± 6.08 years; 8 patients in this group experienced complications such as diabetic foot and hypertension. There were no statistically significant differences in age, gender, or condition between the two groups ($P > 0.05$).

2.2. Methods

Ninety patients with type 2 diabetes were divided into an observation group and a control group. The control group received routine nursing care, while the observation group was provided with whole-process nursing. Data on patients' blood glucose levels and health awareness were compared between admission and discharge to clarify the advantages of the whole-process nursing model and to construct a comprehensive whole-process nursing objective management system.

2.2.1. Routine nursing in the control group

The nursing staff in the endocrinology department conducted blood glucose tests for hospitalized patients and collected basic information, such as details of daily medication, disease duration, and common medication side effects. Patients were provided with explanations about the causes and mechanisms of type 2 diabetes, treatment methods, and daily precautions^[1]. Dietary guidance was also emphasized, with recommendations for a low-sugar, low-fat diet, adherence to the principle of eating small, frequent meals, and avoidance of spicy and stimulatory foods. Patients and their families were advised to regularly monitor blood glucose levels and incorporate appropriate exercise^[2].

2.2.2. Comprehensive nursing in the observation group

The whole-process nursing care was divided into two stages: in-hospital care and post-discharge care, with tailored interventions for each stage.

(1) In-hospital care

- (a) Psychological care: Nursing staff observed and inquired about patients' clinical symptoms, provided information on treatment methods and precautions, and emphasized dietary guidelines for type 2 diabetes. Attention was given to psychological and emotional changes, with counseling offered as needed^[3].

(2) Post-discharge care

- (a) Blood glucose monitoring and education: Before discharge, nursing staff conducted blood glucose tests, provided oral medication and insulin injection guidance, and distributed a type 2 diabetes home care manual. Follow-up questions regarding rehabilitation were also addressed.
- (b) Follow-up care: Nursing staff made telephone follow-ups one-month post-discharge to inquire about recent blood glucose tests, clinical symptoms, and medication adherence. Specific guidance was provided on oral hypoglycemic drugs and insulin administration ^[4].
- (c) Integration with community care: Patients were reminded to visit community hospitals for HbA1c and blood routine tests. A combination of community, discharge, and home-based nursing was emphasized to improve the whole-process nursing management system and help patients control their disease and enhance their quality of life ^[5].

2.3. Observation indicators

The compliance behavior and blood glucose changes of the 90 patients at admission and discharge were compared. This analysis aimed to identify differences between routine nursing and whole-process nursing, highlighting the importance of the latter in improving disease control, health awareness, mental well-being, and quality of life in patients with type 2 diabetes.

2.4. Statistical analysis

Data analysis was conducted using SPSS 22.0 software. The compliance behavior and blood glucose changes of the 90 patients were analyzed using *t* and χ^2 -tests. A *P*-value of < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of compliance behavior scores between the two groups at admission and discharge

The compliance behavior of patients in the control and observation groups was evaluated based on five parameters: dietary control as directed by the doctor, timely and quantitative eating, regular exercise, appropriate medication adherence, and self-monitoring of blood glucose. The data revealed that the quality of care in the whole-course nursing mode was significantly higher than that of the conventional nursing mode ($P < 0.05$), as presented in **Table 1**.

Table 1. Comparison of compliance behavior scores between the two groups [*n* (%)]

Items	Control group				Observation group			
	Upon admission	Upon discharge	χ^2	<i>P</i>	Upon admission	Upon discharge	χ^2	<i>P</i>
Control diet as directed by the doctor	28 (43.02)	31 (47.62)	0.279	> 0.05	29 (43.02)	61 (91.02)	34.392	< 0.01
Eat regularly and quantitatively	14 (21.54)	16 (20.35)	0.173	> 0.05	14 (20.91)	52 (76.02)	40.871	< 0.01
Exercise regularly	32 (48.23)	30 (52.13)	1.524	> 0.05	30 (47.72)	59 (88.02)	14.072	< 0.01
Take medication regularly and correctly	18 (46.69)	32 (49.02)	6.136	< 0.05	18 (26.87)	52 (86.35)	43.723	< 0.01
Self-monitor blood glucose	4 (6.15)	4 (11.27)	0.887	> 0.05	6 (8.96)	30 (44.72)	20.092	< 0.01

3.2. Comparison of blood glucose changes at admission and discharge between the two groups

The fasting and postprandial blood glucose levels of the two groups were compared at admission and discharge. The data indicated that the blood glucose levels of patients receiving whole-course nursing care were more stable, suggesting better disease control. The results are summarized in **Table 2**.

Table 2. Comparison of blood glucose changes at admission and discharge between the two groups [*n* (%)]

Groups	Number of cases	Upon admission	Upon discharge	χ^2	<i>P</i>
Control group	45	65 (100).	41 (63.05)	27.033	<0.01
Observation group	45	67 (100).	5 (7.56)	111.697	<0.01

4. Discussion

4.1. Strengthening diabetes health education during hospitalization and improving the whole-course nursing objective management system

Diabetes, as a chronic and incurable condition, requires long-term management. The prognosis depends on treatment effectiveness, and scientific and effective nursing guidance plays a crucial role in preventing or delaying complications. Early intervention has also shown significant benefits^[6]. Based on the treatment data of 90 patients with type 2 diabetes admitted to the Endocrinology Department of the hospital, it is evident that the whole-course nursing model significantly improves prognostic outcomes, home nursing, and case management. Thus, it is imperative to develop a comprehensive nursing objective management system that integrates admission, discharge, and home nursing guidance into a closed-loop nursing service to enhance disease control and patient recovery^[7].

Endocrinology nurses should focus on health education for patients with type 2 diabetes. This includes explaining the causes of diabetes, medication management, injection therapies, complications, and dietary precautions to patients and their families. Incorporating diabetes education into routine nursing care enhances health awareness, supports self-management, and helps patients better control their condition^[8]. Additionally, insulin administration techniques should be demonstrated and explained in detail, including injection methods, rotation of injection sites, dosage adjustments, and timing. Patients and their families should also be educated on blood glucose meter operation and encouraged to record fasting and postprandial blood glucose levels. This information aids in understanding the condition and informs subsequent clinical treatment.

4.2. Providing comprehensive discharge health guidance and encouraging adherence to medical advice

Nursing staff should offer detailed health guidance to patients upon discharge, including instructions on daily diabetes care, oral and injectable medications, and dietary precautions. Distributing blood glucose monitoring forms and urging patients to record their glucose levels at home can facilitate ongoing health management^[9].

Developing a diabetes health manual that systematically explains the disease, monitoring methods, glycated hemoglobin (HbA1c) values, medication precautions, and dietary guidelines can serve as an invaluable resource for patients post-discharge. For instance, the manual can include guidelines on recognizing and managing hypoglycemia, conducting self-monitoring of blood glucose, and adhering to a diet that emphasizes whole grains

such as whole wheat and buckwheat noodles while avoiding high-sugar fruits. This enhances patients' health awareness and supports disease management ^[10].

Personalized nursing services should also be provided, particularly for patients with severe conditions or complications. These services can include instructions on daily disinfection and care for diabetic foot ulcers, monitoring of blood lipids and blood pressure, and guidance on eye care. Such targeted care highlights the risks of complications and encourages consistent monitoring and timely hospital visits ^[11].

4.3. Implementing home nursing guidance and enhancing the quality of nursing services

The whole-course nursing objective management system encompasses admission, discharge, and home nursing guidance, requiring continuous follow-up to address patients' rehabilitation challenges and improve the quality of care ^[12]. Nursing staff should establish comprehensive nursing files for patients with type 2 diabetes to facilitate home care post-discharge. For instance, follow-up calls one month after discharge can inquire about recent blood glucose monitoring, dietary habits, exercise routines, and any new symptoms. Patients can also be encouraged to undergo HbA1c testing at nearby community hospitals to assess blood glucose control over the past three months ^[13].

Additionally, nursing staff can conduct health education sessions at community healthcare facilities. These sessions can cover the symptoms of type 2 diabetes, standard fasting and postprandial blood glucose values, medication and dietary guidelines, insulin administration techniques, and blood glucose monitoring procedures. Such initiatives not only address patient queries but also emphasize the importance of seeking timely medical intervention. These efforts collectively enhance nursing service quality and strengthen the whole-course nursing objective management system for type 2 diabetes patients ^[14].

5. Conclusion

In conclusion, the whole-course nursing model demonstrates significant efficacy in disease control, delaying complications, and improving self-management and health awareness in type 2 diabetes patients. Accordingly, nursing staff should actively develop and implement a comprehensive nursing objective management system that integrates admission, discharge, and home care. Addressing patient concerns promptly, promoting adherence to medical advice, and encouraging regular exercise and medication use can enhance patient outcomes, improve satisfaction with nursing services, and contribute to the broader goal of promoting public health and building a healthy nation ^[15].

Disclosure statement

The author declares no conflict of interest.

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Utilizing Machine Learning Techniques to Enhance Attention-Deficit Hyperactivity Disorder Diagnosis Using Resting-State EEG Data

Lina Han¹, Liyan Li¹, Yanyan Chen¹, Xiaohan Wu¹, Yang Yu¹, Xu Liu², Zihan Yang², Ling Li², Xinxian Peng^{1*}

¹Changchun Sixth Hospital, Changchun 130000, Jilin Province, China

²The School of Communication Engineering, Jilin University, Changchun 130000, Jilin Province, China

*Corresponding author: Xinxian Peng, peng18946617300@163.com

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Abstract: *Objective:* This study investigates the auxiliary role of resting-state electroencephalography (EEG) in the clinical diagnosis of attention-deficit hyperactivity disorder (ADHD) using machine learning techniques. *Methods:* Resting-state EEG recordings were obtained from 57 children, comprising 28 typically developing children and 29 children diagnosed with ADHD. The EEG signal data from both groups were analyzed. To ensure analytical accuracy, artifacts and noise in the EEG signals were removed using the EEGLAB toolbox within the MATLAB environment. Following preprocessing, a comparative analysis was conducted using various ensemble learning algorithms, including AdaBoost, GBM, LightGBM, RF, XGB, and CatBoost. Model performance was systematically evaluated and optimized, validating the superior efficacy of ensemble learning approaches in identifying ADHD. *Conclusion:* Applying machine learning techniques to extract features from resting-state EEG signals enabled the development of effective ensemble learning models. Differential entropy and energy features across multiple frequency bands proved particularly valuable for these models. This approach significantly enhances the detection rate of ADHD in children, demonstrating high diagnostic efficacy and sensitivity, and providing a promising tool for clinical application.

Keywords: Attention-deficit hyperactivity disorder; Machine learning; EEG signals; Feature extraction; Ensemble learning models; Diagnosis

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1. Introduction

Attention-Deficit Hyperactivity Disorder (ADHD), commonly referred to as hyperactivity disorder, is among the most prevalent neuropsychiatric disorders in childhood ^[1]. It is characterized by age-inappropriate inattention,

reduced attention span, excessive activity irrespective of context, emotional impulsivity, cognitive impairments, and learning difficulties, while intellectual capacity typically remains normal or near normal ^[2,3]. In recent years, ADHD has been widely recognized as a neurodevelopmental disorder with a biological basis and significant impairments in executive function ^[4]. Given its high prevalence and severe impacts, ADHD substantially affects children's academic performance and overall well-being ^[5].

Advancing the diagnosis and treatment of ADHD is of paramount importance. Current diagnostic methods rely heavily on subjective approaches, such as interviews, observations, and rating scales, which are often time-consuming, labor-intensive, and susceptible to bias ^[6]. To address these challenges, researchers have explored neurophysiological methods, particularly the utility of electroencephalography (EEG) in identifying ADHD. EEG has demonstrated high sensitivity and specificity, gaining approval from the U.S. Food and Drug Administration (FDA) for its use in ADHD diagnostics ^[7]. A notable feature of ADHD is the high prevalence of EEG abnormalities observed in affected individuals.

Technological advancements have driven substantial progress in EEG research, particularly in its medical applications. The integration of EEG signals into ADHD diagnosis, research, and treatment has become a shared focal point in these fields. However, studies focusing on resting-state EEG in ADHD patients remain limited. Leveraging artificial intelligence algorithms to analyze resting-state EEG signals holds both theoretical and practical value for advancing ADHD diagnostics.

As machine learning continues to evolve, it has been increasingly adopted in healthcare-related fields. Within psychiatric research, machine learning has shown promising results in the classification and diagnosis of various mental disorders. EEG signals, which first garnered researchers' attention in the early 20th century, have since undergone extensive algorithmic and theoretical development. These advancements have positioned EEG as a valuable tool for diagnosing brain-related disorders. By processing and analyzing EEG signals, researchers can extract rich physiological information, enabling precise and actionable conclusions.

2. Materials and methods

2.1. Study design and participants

2.1.1. Subjects

2.1.1.1. ADHD group

The ADHD group comprised 29 patients (17 boys and 12 girls, aged 4–13 years) who visited the outpatient clinic between 2022 and 2024. Diagnoses were made by attending physicians or specialists based on the criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) ^[8]. The diagnostic criteria included:

- (1) Developmentally inappropriate symptoms of hyperactivity/impulsivity and/or inattention persisting for at least six months;
- (2) Symptoms manifesting across multiple settings (e.g., home and school);
- (3) Significant impairment in daily functioning caused by the symptoms;
- (4) Initial onset of symptoms and associated impairments during early to middle childhood;
- (5) Symptoms not attributable to other medical or psychiatric conditions.

Patients who had been taking psychotropic medications or stimulants were excluded unless such medications had been discontinued for at least 48 hours prior to enrollment. The study was approved by the Ethics Committee

of Changchun Sixth Hospital (ethics number: 202203).

2.1.1.2. Control group

The control group included 28 healthy children (17 boys and 11 girls, aged 4–13 years) who underwent routine health checkups during the same period. Participants in the control group were matched with the ADHD group in terms of age, IQ, and gender. Structured interviews confirmed the absence of significant psychological or behavioral symptoms, severe physical illnesses, or psychiatric disorders.

Exclusion criteria for all participants encompassed physical illnesses, neurological disorders, genetic conditions, or a history of psychiatric disorders. Written informed consent was obtained from both children and their parents. The study protocol received approval from the ethics committee. General clinical data and resting-state EEG data were collected from all participants.

2.2. Data collection

Resting-state EEG recordings were obtained in a quiet environment, with participants awake and their eyes closed, using a 32-channel EEG system (Nicolet V32, Natus Medical Incorporated). Electrodes were positioned following the international 10–20 system, with conductive paste ensuring electrode-scalp resistance below 5 k Ω . The EEG data were preprocessed using the EEGLAB toolbox in MATLAB to remove artifacts caused by powerline noise, eye movements, muscle activity, and perspiration, yielding artifact-free EEG signals suitable for analysis.

2.3. Methods

2.3.1. Signal processing

EEG signals are inherently weaker and more random than other bioelectric signals, such as electrocardiograms (ECG) and electrooculograms (EOG). As a result, collected EEG data often contain components from EOG, ECG, and electromyographic (EMG) signals, which can interfere with subsequent analyses. To ensure the accuracy of results, preprocessing was performed using the EEGLAB toolbox in MATLAB. The following steps were undertaken:

- (1) Manual inspection and removal of noisy segments: Each channel's data were visually inspected, and segments exhibiting excessive signal fluctuations were manually excluded.
- (2) Electrode localization: Electrode positions were mapped to ensure accurate spatial alignment of the EEG data.
- (3) Exclusion of unnecessary channels: Channels not required for analysis, such as A1 and A2, were removed.
- (4) Bandpass filtering: A finite impulse response (FIR) bandpass filter was applied to retain signal frequencies within the range of 0.5 Hz to 45 Hz, relevant for analysis.
- (5) Resampling: Based on the Nyquist sampling theorem, a sampling rate exceeding 90 Hz was required to capture the target frequency range. For computational efficiency, the signals were resampled at 128 Hz.
- (6) Faulty channel detection and interpolation: Faulty channels were identified, and their signals were corrected using interpolation based on data from neighboring channels, preserving the original features of the EEG signals.
- (7) Independent Component Analysis (ICA): ICA was applied to decompose the EEG signals into independent components. The ICLabel algorithm was used to identify and remove artifacts such as EOG and ECG. This algorithm classified components into seven types: EEG, EMG, EOG, ECG, line noise, channel noise,

and others. Components classified as EEG with a probability of at least 80% were retained for further analysis.

2.3.2. Machine learning model

Ensemble learning combines multiple learners to solve a single problem. The core principle involves constructing and integrating multiple models to enhance prediction accuracy and stability^[9]. Unlike individual models, ensemble learning algorithms train multiple weak classifiers on different data subsets and aggregate their decisions. This approach effectively reduces bias and variance, improving generalization and providing robust resistance to noise, thus minimizing the risk of overfitting. Ensemble learning is particularly effective for high-dimensional, noisy real-world datasets^[10].

In this study, ensemble learning algorithms, including AdaBoost, GBM, LightGBM, RF, XGB, and CatBoost, were applied to the classification task. Systematic evaluation and optimization of these models demonstrated the superior effectiveness of ensemble learning algorithms in this context.

2.3.3. Differential entropy

Differential entropy, a key concept in information theory, measures the information content of continuous random variables^[11]. It generalizes the concept of discrete Shannon entropy, making it particularly suitable for analyzing continuous signals. Unlike Shannon entropy, which applies to discrete random variables, differential entropy accommodates variables with continuous value ranges. This property renders it highly applicable in fields such as signal processing, machine learning, and statistical analysis.

Differential entropy quantifies the average uncertainty of a random variable^[12]. Higher differential entropy typically indicates greater complexity or information content within a signal, which is especially relevant for analyzing natural signals such as EEG data. By computing differential entropy, it is possible to measure the complexity of a signal, which provides valuable insights for applications such as feature extraction and pattern recognition^[13]. The formula for calculating differential entropy is as follows:

$$H(X) = - \int_{-\infty}^{\infty} f(x) \log f(x) dx \quad (1)$$

Here, $H(X)$ represents the differential entropy, X is the continuous random variable, and $f(x)$ denotes the probability density function of X .

2.3.4. Wavelet packet decomposition for energy calculation

Wavelet packet decomposition (WPD) is a sophisticated signal processing technique that enables comprehensive frequency analysis by recursively dividing a signal into its frequency components^[14]. Unlike standard wavelet decomposition, which focuses on either low-frequency or high-frequency components, WPD subdivides both, allowing for a more detailed and adaptable representation of the signal's structure.

The process of wavelet packet decomposition involves the iterative application of low-pass and high-pass filters, which split the signal into two sub-bands at each decomposition level: a low-frequency sub-band and a high-frequency sub-band^[15]. This recursive division generates a complete binary tree structure, offering enhanced resolution and flexibility for analyzing complex signals.

The mathematical framework of WPD can be expressed as follows:

$$\phi^{2k}(t) = \sqrt{2} \sum_n h(n) \phi^k(2t - n) \quad (2)$$

$$\phi^{2k+1}(t) = \sqrt{2} \sum_n g(n) \phi^k(2t - n) \quad (3)$$

Here, $h(n)$ and $g(n)$ are the low-pass and high-pass filters, $\phi^0(t)=\phi(t)$ is the scaling function, and $\phi^1(t)=\phi(t)$ is the wavelet function. The recursive decomposition of $x(t)$ the input signal into low-frequency and high-frequency components is described by:

$$x_{j+1,2k}(t) = \sum_m h(m - 2n) x_{j,k}(t) \quad (4)$$

$$x_{j+1,2k+1}(t) = \sum_m g(m - 2n) x_{j,k}(t) \quad (5)$$

where $x_{j,k}(t)$ represents the wavelet coefficients for the k sub-band at the j level. The signal can then be reconstructed as:

$$x(t) = \sum_{k=0}^{2^j-1} x_{j,k}(t) \quad (6)$$

Here, j and k denote the decomposition level and sub-band, respectively. Once the signal is decomposed into specific frequency bands, the energy of the wavelet packet coefficients is calculated to quantify the signal's intensity within each frequency band. The energy calculation formula is:

$$E_{j,k} = \sum_m |x_{j,k}(t)|^2 \quad (7)$$

The energy distribution across different frequency bands provides critical insights into the signal's characteristics, supporting advanced tasks such as feature extraction and pattern recognition. The flexibility and precision of WPD make it particularly effective for analyzing complex signals like EEG, where detailed frequency resolution is essential.

2.3.5. Evaluation metrics

For this binary classification problem, precision and recall were prioritized as key evaluation metrics. Precision measures the proportion of true positive predictions among all positive predictions, while recall evaluates the classifier's ability to identify all actual positive instances.

The Receiver Operating Characteristic (ROC) curve is a graphical representation that illustrates the trade-off between the true positive rate and the false positive rate across various thresholds. The area under the ROC curve (AUC) is a widely used metric for binary classification tasks, particularly in medical diagnostics.

AUC values range from 0 to 1, with higher values indicating better classification performance. An AUC value closer to 1 signifies superior classifier effectiveness, making this metric crucial for evaluating and comparing models in scenarios requiring high predictive accuracy, such as EEG-based diagnostic tasks.

4. Results

To evaluate the impact of feature extraction on the performance of machine learning models, raw EEG data (without feature extraction) were initially input into the models. The resulting accuracy and AUC values are summarized in **Table 1**, with the corresponding ROC curve illustrated in **Figure 1**.

After applying feature extraction, notable changes in model performance were observed. The updated results, including accuracy and AUC values, are presented in **Table 2**, with the corresponding ROC curve depicted in

Figure 2.

This comparative analysis highlights the importance of feature extraction in enhancing the predictive capabilities of machine learning models when applied to EEG data.

Table 1. Results obtained using raw EEG data

	AdaBoost	CatBoost	GBM	LightGBM	RF	XGB
Accuracy	0.76	0.81	0.79	0.82	0.79	0.81
AUC	0.84	0.88	0.86	0.89	0.84	0.88

Table 2. Results obtained after feature extraction

	AdaBoost	CatBoost	GBM	LightGBM	RF	XGB
Accuracy	0.80	0.96	0.87	0.94	0.93	0.93
AUC	0.89	0.99	0.94	0.99	0.98	0.98

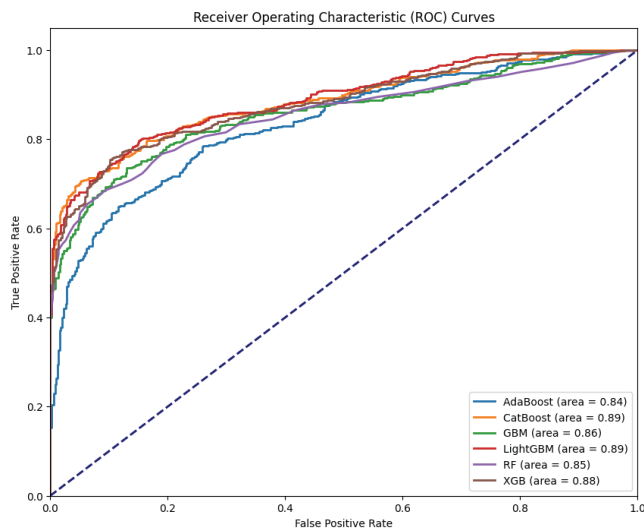


Figure 1. ROC curve obtained using raw EEG signals

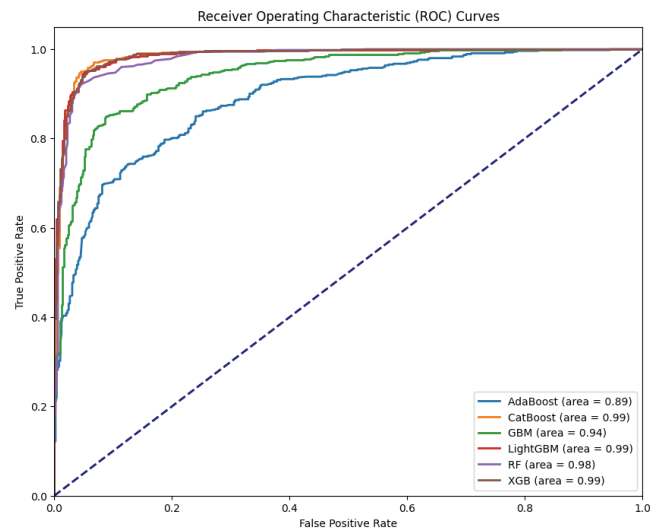


Figure 2. ROC curve obtained after feature extraction

5. Discussion

Efforts to identify objective diagnostic markers for ADHD have prompted numerous resting-state EEG studies. In this study, EEG signals were collected from 28 ADHD patients and 29 healthy controls. By extracting features from these EEG signals and applying ensemble learning models, the classification performance of features in a single modality was assessed. The results yielded promising data, facilitating the identification of objective differences linked to brain activity. The strong discriminatory ability of machine learning algorithms underscores their significant clinical potential and affirms the feasibility of using EEG signals for ADHD identification.

This study leveraged machine learning techniques and advancements in EEG signal analysis to develop more robust models. The results confirmed the effectiveness of the extracted features, such as differential entropy and energy characteristics across different frequency bands, for machine learning-based ADHD identification. However, several limitations should be addressed in future research:

- (1) Sample size limitations: ADHD is a highly specific condition. The dataset in this study, which included augmented EEG signal clips from the same individuals, differs considerably from larger datasets comprising signals from multiple individuals. Expanding the sample size is essential for drawing scientifically valid and objective conclusions, thereby reducing errors linked to data insufficiency.
- (2) Model generalizability: Future studies should prioritize adapting methods to ensure robust model performance across various datasets, thereby facilitating cross-dataset ADHD classification. Establishing a shared platform or database based on this study could help overcome challenges related to sample scarcity. This aligns with current trends toward scalable and generalizable technological solutions.
- (3) Clinical phenotype differentiation: This study did not account for the clinical phenotypes of ADHD. However, an accurate clinical diagnosis requires a clear identification of these phenotypes.
- (4) Differentiation from other psychiatric disorders: While this study excluded comorbid psychiatric disorders in the ADHD group, epidemiological studies and clinical experience suggest a high prevalence of comorbid conditions among ADHD patients.

These findings emphasize the importance of expanding sample sizes, developing a comprehensive ADHD database, integrating EEG data across different age groups, and incorporating comorbid psychiatric disorders into future research. Additionally, developing more stable models will further enhance the accuracy and applicability of machine-learning approaches in clinical practice.

6. Conclusion

This study analyzed EEG modality data from both patients and healthy control groups. Following the preprocessing of EEG signals from both groups, relevant features were extracted and classified using ensemble learning models in machine learning.

The results demonstrated that, even prior to feature extraction, the models achieved commendable performance, emphasizing the robust feature extraction capabilities of ensemble learning when applied to raw data. Importantly, feature extraction led to a significant improvement in model performance, validating the effectiveness of the extracted features, such as differential entropy and energy characteristics across various frequency bands, for machine learning tasks.

These findings provide a highly efficient approach for the diagnostic identification of ADHD, offering valuable support for its diagnosis, research, and treatment. Furthermore, this paves the way for more accurate and accessible diagnostic tools in clinical practice.

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Authors' contribution

Conceptualization: Xinxian Peng

Methodology: Xu Liu, Zihan Yang, Ling Li

Formal analysis: Liyan Li, Yanyan Chen, Xiaohan Wu, Yang Yu

Writing – original draft: Lina Han

Writing – review & editing: all authors

Disclosure statement

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Effect of Ultra-Early Hemoperfusion on Emergency Treatment Outcomes in Patients with Severe Organophosphate Pesticide Poisoning

Jianyu Yang*

Taizhou People's Hospital, Taizhou 225300, Jiangsu Province, China

*Corresponding author: Jianyu Yang, yjy1351515@163.com

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Abstract: *Objective:* To analyze the emergency treatment effect of ultra-early hemoperfusion (HP) in patients with severe organophosphate pesticide poisoning (SOPP). *Methods:* Sixty SOPP patients treated in the emergency department between January 2022 and January 2024 were randomly divided into two groups using a random number table. The observation group (30 cases) received ultra-early HP treatment, while the reference group (30 cases) received conventional HP treatment initiated 6 hours post-poisoning. The groups were compared in terms of overall emergency efficacy, clinical indicators, serological markers, inflammatory factors, and complication rates. *Results:* The observation group had a higher total efficacy rate than the reference group, superior clinical indicators, and a lower complication rate ($P < 0.05$). After 24 hours of emergency treatment, serological markers and inflammatory factor levels in the observation group were lower than those in the reference group ($P < 0.05$). *Conclusion:* Ultra-early HP treatment provides better emergency outcomes for SOPP patients by shortening treatment time, improving serological markers and inflammatory factor levels, and offering higher safety. It demonstrates significant advantages in emergency care.

Keywords: Ultra-early hemoperfusion; Severe organophosphate pesticide poisoning; Emergency treatment outcomes

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1. Introduction

Organophosphate pesticides are rich in phosphorus elements, effective for pest control, and widely used in agricultural production. These pesticides are highly volatile, and their components can enter the body via the respiratory tract or skin and mucous membranes, leading to poisoning symptoms. Severe organophosphate pesticide poisoning (SOPP) represents a critical condition with a high mortality rate, often accompanied by complications and poor prognosis^[1]. Gastric lavage, catharsis, and anti-infection therapy constitute the basic treatments, alleviating poisoning symptoms and slowing disease progression. Combined hemoperfusion (HP) can

clear blood toxins, reduce pesticide residues in the body, purify the blood, and prevent multiple organ damage. However, the optimal timing for initiating HP remains controversial. Many scholars suggest that ultra-early HP initiation improves emergency efficiency, prevents adverse events related to the disease, and enhances clinical outcomes. Therefore, this study selected 60 SOPP patients to evaluate the emergency treatment efficacy of ultra-early HP.

2. Materials and methods

2.1. General information

A total of 60 patients with severe organophosphate pesticide poisoning (SOPP) admitted to the emergency department between January 2022 and January 2024 were included. They were randomly divided into two groups using a random number table. The observation group (30 cases) consisted of 19 males and 11 females, aged 34–76 years, with an average age of 52.65 ± 3.79 years. The reference group (30 cases) included 18 males and 12 females, aged 32–78 years, with an average age of 52.79 ± 3.80 years. There were no significant differences in baseline data between the two groups ($P > 0.05$).

Inclusion criteria: Diagnosed with organophosphate pesticide poisoning based on Practical Internal Medicine ^[2]; classified as severe; met the indications for HP treatment; poisoning-to-treatment time < 24 hours; complete clinical data; fully cooperative with emergency treatment.

Exclusion criteria: Coexisting heart, liver, or kidney diseases; immune diseases; hemoglobin ≤ 60 g/L or diastolic blood pressure ≤ 70 mmHg after fluid resuscitation; vegetative state; voluntary withdrawal of treatment by the patient or family.

2.2. Methods

Both groups received the same basic treatments, including gastric lavage with warm water or clean water until the lavage fluid was clear and garlic odor-free. Skin and hair were washed with soap water. Patients were given 250 mL of 25% mannitol (produced by Guangdong Nanguo Pharmaceutical, National Drug Approval Number H20103532) orally for catharsis. Early, adequate administration of atropine (produced by Jilin Jibang Pharmaceutical, National Drug Approval Number H20053923) was initiated with a dose of 5–10 mg every 5–10 minutes. The dosage was reduced or stopped 6 hours after symptom relief. Patients with respiratory failure underwent tracheal intubation and mechanical ventilation, with ventilator parameters adjusted based on their condition. Symptomatic treatments, including anti-infection, fluid replacement, and correction of electrolyte imbalances, were administered. Pralidoxime iodide (produced by Shanghai Huaihai Pharmaceutical Factory, National Drug Approval Number H31021788) was intravenously infused at an initial dose of 1.2–1.6 g, with a maximum of 2 g per hour and < 10 g per 24 hours, at an infusion rate of 0.4 g/h. The dosage was reduced or stopped after 6 hours of symptom relief.

The reference group began HP treatment 6 hours after poisoning, while the observation group initiated HP immediately upon admission to the emergency department. A hemoperfusion machine (model JF-800A, produced by Jianfan Biological Technology, Zhuhai) and disposable hemoperfusion cartridges (model YTS-200, produced by Aier Medical Technology, Langfang) were used. The femoral vein was punctured, and the hemoperfusion machine and cartridge were connected, with a blood flow rate of 150–200 mL/min. Heparin sodium injection (produced by Shandong Lukang Chenyang Pharmaceutical, National Drug Approval Number H20043156) was

administered at an initial dose of 100 mL, followed by a maintenance dose of 6–8 mL per hour. Heparin sodium was discontinued 1 hour before the end of HP. Each HP session lasted 90–120 minutes, followed by a 12–24 hour pause, for a total treatment duration of 72 hours.

2.3. Observation indicators

- (1) Clinical indicators: Observations included atropine dosage, time to cholinesterase normalization, time to regain consciousness, and hospitalization duration.
- (2) Complications: The incidence of intermediate syndrome, pulmonary edema, respiratory failure, cerebral edema, and gastrointestinal bleeding was recorded.
- (3) Serological indicators: Venous blood samples (5 mL, fasting) were collected before emergency treatment and 24 hours afterward. Samples were centrifuged for 10 minutes at 3000 r/min, and an automatic biochemical analyzer (model Hitachi 3100, produced by Hitachi, Japan) was used to measure the following: (a) Alanine aminotransferase (ALT); (b) Amylase (AMS); (c) Cardiac troponin I (cTnI).
- (4) Inflammatory factors: Venous blood samples collected at the same time points were analyzed using enzyme-linked immunosorbent assays (ELISA) to measure the following: (a) Interleukin-6 (IL-6); (b) C-reactive protein (CRP); (c) Transforming growth factor-beta1 (TGF- β 1).

2.4. Criteria for efficacy evaluation

- (1) Significant efficacy: Chest X-rays show no exudation, lung consolidation, or fibrosis; uniform density; all blood indicators are normal.
- (2) Partial efficacy: Chest X-rays show lung interstitial changes; blood indicators are basically normal.
- (3) No efficacy: Chest X-rays show exudation, lung interstitial changes, and fibrosis; blood indicators are significantly abnormal.

2.5. Statistical analysis

Data were processed using SPSS 28.0. Measurement data were expressed as mean \pm standard deviation (SD) and analyzed using *t*-tests. Count data were expressed as numbers and percentages [*n* (%)] and analyzed using χ^2 tests. Statistical significance was set at $P < 0.05$.

3. Results

3.1. Comparison of overall emergency treatment efficacy

Table 1 shows that the overall emergency treatment efficacy in the observation group was significantly higher than that in the reference group ($P < 0.05$).

Table 1. Comparison of overall emergency treatment efficacy [*n* (%)]

Group	<i>n</i>	Significant efficacy	Partial efficacy	No efficacy	Total efficacy (%)
Observation group	30	14	13	3	27 (90.00%)
Reference group	30	9	10	11	19 (63.33%)
χ^2					5.963
<i>P</i>					0.015

3.2. Comparison of clinical indicators

The observation group showed significantly better clinical indicators, including lower atropine dosage, shorter time to cholinesterase normalization, time to regain consciousness, and hospitalization duration compared to the reference group ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of clinical indicators (mean \pm SD)

Group	<i>n</i>	Atropine dosage (mL)	Cholinesterase normalization time (days)	Time to regain consciousness (days)	Hospitalization duration (days)
Observation group	30	201.65 \pm 19.75	5.41 \pm 0.97	5.20 \pm 0.76	10.75 \pm 1.36
Reference group	30	315.29 \pm 23.44	8.04 \pm 1.53	7.83 \pm 1.48	15.29 \pm 2.24
<i>t</i>		20.307	7.952	8.658	9.489
<i>P</i>		< 0.001	< 0.001	< 0.001	< 0.001

3.3. Comparison of complication rates

Table 3 shows that the complication rate in the observation group was significantly lower than that in the reference group ($P < 0.05$).

Table 3. Comparison of complication rates [*n* (%)]

Group	<i>n</i>	Intermediate syndrome	Pulmonary edema	Respiratory failure	Cerebral edema	Gastrointestinal bleeding	Incidence (%)
Observation group	30	0	1	1	0	1	3 (10.00%)
Reference group	30	1	3	3	1	2	10 (33.33%)
χ^2							4.812
<i>P</i>							0.028

3.4. Comparison of serological indicators

Before emergency treatment, there was no significant difference in serological indicators between the two groups ($P > 0.05$). After 24 hours of emergency treatment, the observation group had significantly lower levels of ALT, AMS, and cTnI than the reference group ($P < 0.05$), as shown in **Table 4**.

Table 4. Comparison of serological indicators (mean \pm SD)

Group	<i>n</i>	ALT (IU/L)		AMS (U/L)		cTnI (ng/mL)	
		Before emergency treatment	24 hours after emergency treatment	Before emergency treatment	24 hours after emergency treatment	Before emergency treatment	24 hours after emergency treatment
Observation group	30	65.75 \pm 6.84	31.55 \pm 4.02	188.65 \pm 17.92	132.06 \pm 14.51	17.92 \pm 2.35	4.69 \pm 0.51
Reference group	30	65.19 \pm 6.91	39.42 \pm 4.87	187.53 \pm 19.02	150.63 \pm 16.77	17.88 \pm 2.43	6.70 \pm 0.76
<i>t</i>		0.315	6.826	0.235	4.587	0.065	12.029
<i>P</i>		0.754	< 0.001	0.815	< 0.001	0.949	< 0.001

3.5. Comparison of inflammatory factors

Before emergency treatment, there was no significant difference in inflammatory factors between the two groups ($P > 0.05$). After 24 hours of emergency treatment, the levels of IL-6, CRP, and TGF- β 1 in the observation group were significantly lower than those in the reference group ($P < 0.05$), as shown in **Table 5**.

Table 5. Comparison of inflammatory factors (mean \pm SD)

Group	<i>n</i>	IL-6 (pg/mL)		CRP (mg/L)		TGF- β 1 (ng/L)	
		Before emergency treatment	24 hours after emergency treatment	Before emergency treatment	24 hours after emergency treatment	Before emergency treatment	24 hours after emergency treatment
Observation group	30	151.65 \pm 19.77	75.45 \pm 6.92	81.55 \pm 9.12	45.09 \pm 4.67	3,315.62 \pm 186.41	762.56 \pm 37.84
Reference group	30	150.86 \pm 20.34	85.11 \pm 7.16	81.49 \pm 9.05	50.49 \pm 5.13	3,314.95 \pm 189.60	855.42 \pm 40.74
<i>t</i>		0.153	5.314	0.026	4.263	0.014	9.147
<i>P</i>		0.879	< 0.001	0.980	< 0.001	0.989	< 0.001

4. Discussion

SOPP is one of the critical conditions encountered in emergency departments, characterized by symptoms such as dyspnea, abnormal blood pressure, and tachycardia, often accompanied by arrhythmias and multiple organ damage^[2]. The primary routes of poisoning include inhalation, skin contact, and ingestion. Inhalation poisoning typically manifests as eye redness and breathing difficulties; skin contact poisoning as erythema, blisters, and a burning sensation; and ingestion poisoning as nausea and vomiting. This condition progresses rapidly, affecting multiple systems in a short time and increasing the risk of mortality.

Emergency treatments, including gastric lavage, catharsis, and detoxification, are the main approaches for SOPP patients. These methods remove acetylcholine from the body and alleviate poisoning symptoms but cannot eliminate organophosphorus compounds and toxins, leading to frequent complications. HP is an effective therapy for SOPP, leveraging the strong adsorptive properties of activated charcoal to remove organophosphorus compounds and efficiently clear blood toxins via systemic circulation, thus purifying the blood^[3]. Ultra-early HP can shorten the onset time of emergency treatment, prevent further absorption of organophosphorus pesticide components by organs, and reduce the risks associated with SOPP.

This study shows that the overall emergency treatment efficacy in the observation group was higher than in the reference group. The observation group also required less atropine, and had shorter cholinesterase normalization time, consciousness recovery time, and hospitalization duration than the reference group ($P < 0.05$). The primary reason for this is that ultra-early HP treatment effectively removes toxic substances. The adsorbents used in HP, including resin materials and activated charcoal, have strong adsorption and lipophilic properties, allowing them to bind with large proteins, adsorb cytokines, inflammatory factors, and immune complexes, thereby protecting tissues and organs and improving emergency treatment efficacy^[4]. Following ultra-early HP treatment, the poisoning symptoms in patients were significantly alleviated, cholinesterase levels and consciousness states recovered promptly, and treatment cycles were shortened.

The complication rate in the observation group was lower than in the reference group ($P < 0.05$). The primary

reason is that ultra-early HP treatment is highly proactive. It can be performed simultaneously with emergency treatments like gastric lavage or detoxification, preventing organophosphorus compounds from entering multiple organ tissues through the bloodstream. This inhibits the binding of organophosphorus to cholinesterase, reducing phosphorylated cholinesterase levels in the body, lowering acetylcholine content, and thereby preventing complications.

ALT is a sensitive indicator for evaluating liver function and predicting the extent of liver damage caused by organophosphorus pesticides. AMS is secreted by the salivary and pancreatic glands, and in cases of poisoning, significant spasms in intestinal smooth muscles can lead to pancreatic duct obstruction, thereby increasing AMS levels^[5]. cTnI is a common marker of myocardial injury, used to assess the extent of myocardial tissue damage caused by organophosphorus pesticides. After ultra-early HP treatment, the serological indicators (ALT, AMS, and cTnI) in the observation group were significantly lower than those in the reference group ($P < 0.05$). The main reason is that HP can adsorb both free and lipid- or protein-bound organophosphorus compounds, reducing pesticide-related damage to the central nervous system, alleviating respiratory muscle paralysis, and mitigating damage to cardiac and hepatic tissues. This also prevents pancreatic duct obstruction and lowers serological indicator levels^[6].

SOPP activates the monocyte-lymphocyte system, increasing the release of inflammatory factors and inducing systemic inflammatory response syndrome. The results show that after ultra-early HP treatment, the inflammatory factors in the observation group were significantly lower than those in the reference group ($P < 0.05$). The primary reason is that this treatment uses extracorporeal circulation to promptly remove exogenous toxins and efficiently adsorb inflammatory factors, preventing the systemic spread of inflammatory mediators through the blood system and effectively mitigating the inflammatory response.

5. Conclusion

In conclusion, ultra-early HP treatment is highly effective for SOPP. It enhances emergency treatment efficiency, improves patients' physiological functions, and leads to better prognoses.

Disclosure statement

The author declares no conflict of interest.

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Clinical Analysis of Combining Probiotics with High-Dose Dual Therapy for *Helicobacter pylori* Eradication

Mengnan Chen, Huaili Xu, Juanli Zhang, Tao Li, Erwei Wang*

Department of Gastroenterology, Genertec Universal Medical XD Group Hospital, Xi'an 710000, Shaanxi Province, China

*Corresponding author: Erwei Wang, 526583798@qq.com

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Abstract: *Objective:* To compare the eradication rates of *Helicobacter pylori* (HP) and the incidence of adverse reactions among three treatment methods. *Methods:* A total of 139 patients with *Helicobacter pylori* infection diagnosed at the outpatient clinic or during hospitalization in the Department of Gastroenterology of West Electric Group Hospital from January 2022 to April 2023 were enrolled. Patients were divided into three groups: dual therapy group (46 cases), triple therapy group (62 cases), and quadruple therapy group (31 cases). The dual therapy group received omeprazole and amoxicillin; the triple therapy group received omeprazole, amoxicillin, and probiotics; the quadruple therapy group received omeprazole, colloidal bismuth pectin capsules, amoxicillin, and furazolidone. All treatments lasted for two weeks. The eradication rates and incidence of adverse reactions were compared among the three groups. *Results:* The eradication rates for the dual, triple, and quadruple therapy groups were 84.8%, 85.5%, and 85%, respectively ($P > 0.05$). The primary adverse reactions included gastrointestinal symptoms such as bloating, abdominal pain, loss of appetite, and abdominal discomfort, with incidence rates of 1, 2, and 6 cases in the dual, triple, and quadruple therapy groups, respectively ($P = 0.574$). However, a significant difference was found between the dual and quadruple therapy groups ($P = 0.03$) and between the triple and quadruple therapy groups ($P = 0.026$). Neurological side effects, such as dizziness and headache, were rare, with incidences of 0, 1, and 1 cases in the dual, triple, and quadruple therapy groups, respectively ($P = 0.611$). *Conclusion:* The efficacy of dual, triple, and quadruple therapy for eradicating *Helicobacter pylori* showed no significant difference. However, the dual and triple therapy groups had lower adverse reaction rates, making them suitable alternatives to traditional quadruple therapy for reducing patient discomfort. The probiotic group also contributed to the restoration of normal gastrointestinal microbiota.

Keywords: *Helicobacter pylori*; Eradication rate; Adverse reactions

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1. Introduction

Helicobacter pylori (*H. pylori*, HP) has been identified as a causative agent for chronic gastritis, digestive system

ulcers, and gastric cancer. Recently, the 15th edition of carcinogens published by the U.S. Public Health Service confirmed HP as a carcinogen, with global natural bacterial infections exceeding 50% ^[1]. The sixth national consensus on the management of HP infection (non-eradication treatment) emphasized that all confirmed HP infections, regardless of symptoms or complications, should receive eradication therapy in the absence of contraindications ^[1,2].

Currently, the most common methods for eradicating HP include bismuth-based quadruple therapy and triple therapy. In recent years, high-dose amoxicillin combined with proton pump inhibitors has emerged as a new option for HP eradication, endorsed by the Toronto Consensus and the American Gastroenterological Association guidelines as a recommended regimen. Studies have demonstrated that high-dose dual therapy achieves eradication rates comparable to traditional bismuth-based quadruple and triple therapies ^[3].

However, the increasing resistance to HP and the prominent side effects of medications pose challenges. Probiotics, which are active microorganisms capable of colonizing the gastrointestinal and reproductive systems, play a crucial role in maintaining microbiota balance. They have been incorporated into HP eradication treatments, with multiple studies showing that probiotics can enhance eradication rates and mitigate adverse reactions ^[4].

Currently, there are no reports on combining probiotics with high-dose dual therapy for HP eradication. This study aims to evaluate the clinical effects of adding probiotics to high-dose dual therapy for HP eradication.

2. Materials and methods

2.1. Patient selection

A total of 139 *Helicobacter pylori* (HP)-positive patients who attended the Department of Gastroenterology outpatient clinic or were hospitalized at West Electric Group Hospital from January 2022 to April 2023 were enrolled in the study. Patients were randomly divided into three groups: dual therapy group (46 cases), triple therapy group (62 cases), and quadruple therapy group (31 cases).

(1) Dual therapy group: 46 cases, 18 males, 28 females, average age (46.61 ± 9.50) years.

(2) Triple therapy group: 62 cases, 34 males, 28 females, average age (47.63 ± 9.55) years.

(3) Quadruple therapy group: 31 cases, 21 males, 19 females, average age (51.58 ± 9.24) years.

There were no significant differences in general characteristics, including sex, age, family history of gastric cancer, or alcohol consumption, among the three groups.

Inclusion criteria: (1) Age 18–70 years, no sex restrictions; (2) HP-positive patients diagnosed by ¹³C-urea breath test with $\text{DOB} \geq 6$ or ¹⁴C-urea breath test with $\text{DPM} \geq 150$; (3) First-time eradication treatment; (4) No use of antibiotics, Jin Hua Weikang, Pudi Lan, Moluo Dan, berberine, Scutellaria-containing herbal medicines, or similar agents within four weeks before treatment; (5) No use of PPIs, H₂ receptor antagonists, aluminum magnesium carbonate, bismuth agents, sucralfate, or misoprostol within two weeks before treatment; (6) Patients provided informed consent to participate in the study.

Exclusion criteria: (1) Severe dysfunction of the heart, lungs, liver, kidneys, malignant tumors, or other conditions that could affect study evaluation; (2) Pregnant or breastfeeding women; (3) Complications such as pyloric obstruction, perforation, or upper gastrointestinal bleeding; (4) Allergic history to the study drugs; (5) History of esophageal, gastric, or duodenal surgery; (6) Poor compliance.

Termination criteria: (1) Intolerable adverse reactions during treatment, as determined by the investigator; (2) Disease progression or deterioration, rendering the study protocol unsuitable for continuation.

2.2. Methods

2.2.1. Dual therapy group

Omeprazole enteric-coated tablets (manufacturer: AstraZeneca; approval number: H201811233; specification: 20 mg) 40 mg/dose, BID (30 minutes before breakfast and dinner); amoxicillin capsules (manufacturer: CSPC Zhongnuo Pharmaceutical Co., Ltd.; approval number: H13021770; specification: 0.5 g) 1.0 g/dose, TID (30 minutes after breakfast, lunch, and dinner). Treatment duration: 14 days.

2.2.2. Triple therapy group

Same as the dual therapy group, with the addition of *Clostridium butyricum* (manufacturer: Northeast Pharmaceutical Group Co., Ltd.; approval number: S10950019; specification: 0.25 g) 0.5 g/dose, TID (2 hours after breakfast, lunch, and dinner). Treatment duration: 14 days.

2.2.3. Quadruple therapy group

Furazolidone (manufacturer: Tianjin Lisheng Pharmaceutical Co., Ltd.; approval number: H12020160; specification: 0.1 g) 0.1 g/dose, BID (30 minutes after breakfast and dinner); colloidal bismuth tartrate capsules (manufacturer: Shanxi Xinbaoyuan Pharmaceutical Co., Ltd.; approval number: H20059772; specification: 55 mg) 220 mg/dose, BID (30 minutes before breakfast and dinner); amoxicillin capsules (same as above) 1.0 g/dose, BID (30 minutes after breakfast and dinner); omeprazole enteric-coated capsules (manufacturer: Shandong Luoxin Pharmaceutical Co., Ltd.; approval number: H20033444; specification: 20 mg) 40 mg/dose, BID (30 minutes before breakfast and dinner). Treatment duration: 14 days.

2.3. Observation indicators

- (1) HP eradication rate: After discontinuing the medication for at least one month, ¹³C-urea or ¹⁴C-urea breath tests were performed. Negative results indicated successful eradication; positive results indicated eradication failure.
- (2) Adverse reaction rate: The incidence of adverse reactions was recorded.

2.4. Statistical analysis

Statistical analysis was conducted using SPSS 26.0 software. Count data were expressed as [*n* (%)], and differences between groups were compared using the χ^2 test or Fisher's exact test. Normally distributed measurement data were expressed as mean \pm standard deviation (SD), and differences between groups were compared using the *t*-test. A *P* value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of general information

The age of enrolled patients ranged from 21 to 68 years, with an average age of 48.17 ± 9.59 years. There were 68 male and 71 female patients. No statistically significant differences were observed among the groups in terms of age, sex, family history of gastric cancer, or history of alcohol consumption (*P* > 0.05). See **Table 1**.

Table 1. Comparison of general information among groups

Group	Age (years)	Gender (male) [n (%)]	Family history of gastric cancer [n (%)]	History of alcohol consumption [n (%)]
Total	48.17 ± 9.59	68 (48.9)	3 (2.1)	26 (18.7)
Dual therapy	46.61 ± 9.50	18 (26.5)	0 (0.0)	7 (26.9)
Triple therapy	47.63 ± 9.55	34 (50)	1 (33.3)	11 (42.3)
Quadruple therapy	51.58 ± 9.24	16 (23.5)	2 (66.7)	8 (30.8)
Statistical value	$F = 2.74$	$\chi^2 = 2.72$	$\chi^2 = 3.03$	$\chi^2 = 1.43$
<i>P</i> value	0.068	0.26	0.16	0.50

3.2. Comparison of HP eradication rates among groups

The eradication rates of HP were 84.8% (39/46) in the dual therapy group, 85.5% (53/62) in the triple therapy group, and 83.9% (23/31) in the quadruple therapy group. There were no statistically significant differences among the three groups ($P > 0.05$). Pairwise comparisons between groups also showed no significant differences ($P > 0.05$). See **Table 2**.

Table 2. Comparison of HP eradication rates among groups

Group	Total cases (n)	Effective cases (n)	Ineffective cases (n)	χ^2 value	<i>P</i> value
Dual therapy	46	39	7	0.138	> 0.05
Triple therapy	62	53	9		
Quadruple therapy	40	34	6		

3.3. Comparison of adverse reactions after HP eradication therapy among groups

The main adverse reactions in the three groups were gastrointestinal symptoms (e.g., abdominal pain, bloating, and abdominal discomfort) and neurological symptoms.

- (1) Gastrointestinal symptoms: The incidence was 1 case in the dual therapy group, 2 cases in the triple therapy group, and 6 cases in the quadruple therapy group. Although there was no overall significant difference among the three groups ($P > 0.05$), pairwise comparisons revealed significant differences between the dual and quadruple therapy groups ($P = 0.03$) and the triple and quadruple therapy groups ($P = 0.026$). No significant difference was found between the dual and triple therapy groups ($P > 0.05$).
- (2) Neurological symptoms: The incidence of neurological side effects (e.g., dizziness, headache) was low, with 0 cases in the dual therapy group, 1 case in the triple therapy group, and 1 case in the quadruple therapy group ($P = 0.611$).

Table 3. Comparison of adverse reactions among groups

Adverse reaction	Dual therapy (n)	Triple therapy (n)	Quadruple therapy (n)	<i>P</i> value
Gastrointestinal symptoms	1*	2 [#]	6	0.574
Cardiovascular symptoms	0	0	0	0.611
Neurological symptoms	0	1	1	
Allergy reactions	0	0	0	
Other adverse effects	0	0	0	

Note: * indicates a significant difference between the dual and quadruple therapy groups ($P < 0.05$); [#] indicates a significant difference between the triple and quadruple therapy groups ($P < 0.05$).

4. Discussion

Probiotics are a class of active microorganisms beneficial to human health when ingested. They colonize specific parts of the body, altering the microbial community to benefit the host. Common probiotics include yeast, *Bacillus licheniformis*, *Clostridium butyricum*, and *Lactobacillus* species. In this study, the probiotic used was *Bacillus licheniformis* (sold as “Intestin-bac”). This Gram-positive, non-pathogenic, spore-forming organism antagonizes pathogenic bacteria like *Staphylococcus* and yeast-like fungi while promoting the growth of beneficial bacteria such as *Bifidobacterium* and *Lactobacillus*. *Bacillus licheniformis* has demonstrated the ability to inhibit *H. pylori*, and its secretion of antibiotics has been known for at least 40 years. These antibiotics, which include peptides, lipopeptides, and aminoglycosides, sometimes have unique primitive chemical structures. *Bacillus licheniformis* secretes an antimicrobial substance with properties similar to isocoumarin antibiotics, which exhibit anti-inflammatory effects and anti-stress ulcer properties ^[5].

Recent research highlights the critical role of probiotics in eradicating *H. pylori* while reducing drug-related side effects. Zhang ^[6] demonstrated that combining *Bifidobacterium* triple viable capsules with traditional quadruple therapy significantly improved *H. pylori* eradication rates and reduced adverse reactions. Similarly, Feng *et al.* ^[7] found that adding probiotics to conventional quadruple therapy for *H. pylori*-associated gastritis reduced inflammation and improved eradication rates.

There are several advantages of high-dose dual therapy:

- (1) Enhanced acid suppression to improve efficacy: Amoxicillin’s antibacterial activity against *H. pylori* is pH-dependent. When gastric acid is adequately suppressed, maintaining a gastric pH level of 6 or above for most of the day, amoxicillin achieves optimal antibacterial effects. Increased dosage and frequency of acid suppressants enhance their effectiveness, thereby improving amoxicillin’s efficacy. Since the effectiveness of proton pump inhibitors (PPIs) is influenced by genetic variations in drug metabolism, increasing the dosage and frequency minimizes these genetic effects and ensures sufficient acid suppression.
- (2) Increased amoxicillin dosage and frequency to enhance efficacy: Amoxicillin’s antibacterial effect against *H. pylori* is time-dependent, meaning its effectiveness improves with prolonged exposure to bacteria. Increasing the dosage frequency prolongs contact time with the gastric mucosa and maintains effective drug concentrations in the bloodstream, thereby enhancing its bactericidal effect and improving treatment success rates.

However, conventional quadruple therapy involving furazolidone is associated with serious side effects, such as irreversible neuritis and severe skin reactions. Furthermore, due to factors like patient compliance, antibiotic resistance, and drug side effects, eradication rates have declined from the original 80–95% to the current 60–85%. Therefore, finding new treatment strategies has become an urgent need.

5. Conclusion

In conclusion, the results of this study indicate that the *H. pylori* eradication rates were similar across all three groups. Thus, the authors suggest that the probiotic regimen could serve as a viable alternative to traditional quadruple therapy. The relationship between *H. pylori* infection, its eradication, and the disruption and restoration of intestinal microbiota balance is critical. Adding probiotics during *H. pylori* eradication therapy helps restore

normal gastrointestinal microbiota and reduces gastrointestinal side effects. However, the sample size in this study was relatively small. Further research with larger sample sizes is needed to confirm these findings.

Disclosure statement

The authors declare no conflict of interest.

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Clinical Observation on the Management of Gestational Heart Failure and Delivery Outcomes

Hongjie Li[†], Chenxi Li[†], Peng Sun*, Yuxiang Zhai*, Li Wang, Jie Cui, Yanli Mu, Jiebing Han, Wei Yuan, Xinmei Hu, Dapan Liang

Affiliated Hospital of Hebei University, Baoding 07100, Hebei Province, China

[†]These authors contributed equally to this work and shared first authorship.

*Corresponding authors: Peng Sun, sunpeng5696@outlook.com; Yuxiang Zhai, 31351521lhj@sina.com

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Abstract: *Objective:* This study focuses on the clinical observation of the impact of different treatment methods for gestational heart failure on delivery outcomes. *Method:* A total of 160 pregnant women with heart failure admitted to our hospital between October 2020 and October 2021 were selected as the study subjects. They were categorized based on delivery mode, delivery timing, heart failure control time, and cardiac function status. The delivery outcomes of the different groups were then compared. *Result:* In terms of delivery methods, the rate of neonatal asphyxia was higher following vaginal delivery than cesarean section. Regarding delivery timing, the neonatal mortality rate was lower for cesarean sections performed at 32–36 + 6 weeks compared to those conducted at 37–39 + 6 weeks. With respect to heart failure control time, the rates of neonatal asphyxia and pulmonary hyaline membrane disease were lower in the ≤ 48-hour group than in the > 48-hour group. From the perspective of cardiac function status, patients with cardiac function I–II exhibited relatively lower rates of neonatal asphyxia and perinatal mortality compared to those with cardiac function III–IV. The observed differences were statistically significant ($P < 0.05$). *Conclusion:* For patients with gestational heart failure, cesarean section is the recommended mode of delivery, with the optimal timing being between 32 and 36+6 weeks of pregnancy. During cesarean section, the timing of delivery should be carefully selected based on the mother's cardiac function status.

Keywords: Pregnancy; Heart failure management; Delivery method; Clinical observation

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1. Introduction

Heart failure during pregnancy is a severe complication with potentially life-threatening consequences for both the mother and the infant. Although its incidence is relatively low, the condition poses significant risks. Gestational heart failure can result from various underlying factors, including gestational hypertension, congenital heart

disease, and valvular heart disease. As pregnancy progresses, the cardiovascular burden on the maternal heart increases substantially, particularly during the later stages, where additional blood volume and pressure may exacerbate pre-existing heart conditions or precipitate heart failure.

Effectively managing gestational heart failure requires selecting appropriate delivery methods and timing to ensure the safety of both mother and infant. In recent years, advancements in medical technology and an enhanced understanding of gestational heart failure have led to updated clinical research and improved treatment strategies. These developments aim to provide more scientifically grounded and effective diagnostic and therapeutic approaches for patients with gestational heart failure.

This study examines 160 patients with gestational heart failure admitted to our hospital, focusing on the impact of delivery methods, timing, and heart failure management on maternal and neonatal outcomes.

2. Materials and methods

2.1. General information

This study included 160 pregnant women with heart failure admitted to the hospital between October 2020 and October 2021. The patients were aged between 22 and 38 years, with a mean age of 27.3 ± 2.5 years. Among them, 120 patients underwent cesarean section delivery, while 40 opted for vaginal delivery. All patients had singleton pregnancies. Of the 120 cesarean deliveries, 98 were performed at gestational weeks 32–36 + 6, and 22 at gestational weeks 37–39 + 6. Regarding heart failure control time, 110 patients achieved control within ≤ 48 hours, while 50 patients required > 48 hours. Based on cardiac function classification, 108 patients were categorized as grades I–II, and 52 as grades III–IV ^[1].

Inclusion criteria: Patients were included if they met the diagnostic criteria for gestational heart disease and heart failure, had no prior history of kidney, heart, liver, or hypertensive disease, and provided informed consent along with their families.

Exclusion criteria: Patients with other diseases or comorbidities, or those unable to cooperate fully with the study, were excluded.

2.2. Research methods

Upon diagnosis of gestational heart failure, a comprehensive treatment plan was implemented. While medication was administered to control heart failure symptoms, particular attention was paid to protecting pulmonary function. Dexamethasone was frequently used, as it promotes fetal lung maturation and mitigates potential pulmonary edema, ensuring adequate preparation for subsequent cesarean section surgery.

Based on individual patient conditions, a cesarean section was scheduled within 24 to 48 hours. During this period, medical staff closely monitored heart failure control. If a patient's condition was stable, gestational age relatively early, and heart failure symptoms well-managed, gestational age was extended to allow further fetal development. Conversely, if fetal health was poor, regardless of maternal heart failure control, cesarean section was performed within 24 hours to prioritize maternal and neonatal safety ^[2]. Employing a comprehensive treatment strategy ensured maternal safety while optimizing fetal health outcomes.

2.3. Evaluation indicators

(1) Assessment of asphyxia: Neonatal Apgar scores were utilized as a benchmark for evaluation. Newborns

scoring 4–7 within 1 minute of birth were classified as experiencing neonatal asphyxia.

- (2) Low birth weight determination: Newborns with a birth weight of less than 2,500 grams were categorized as low birth weight infants. These infants face heightened health risks, including developmental delays and weakened immunity.
- (3) Adverse prognosis: This included outcomes such as neonatal pulmonary hyaline membrane disease and mortality. Pulmonary hyaline membrane disease, often resulting from immature lung development or injury, poses a significant risk to neonatal life and health ^[3].

2.4. Statistical methods

Statistical analyses were conducted using SPSS 13.0 software. Data were entered into the system, and t-tests were employed to determine whether differences between groups were statistically significant. For categorical data, the chi-square test was applied to assess the correlation between variables. This test evaluates whether differences between observed and expected values are due to random error or indicative of an actual correlation or difference. A result was considered statistically significant if $P < 0.05$.

3. Result

3.1. Pregnancy outcomes under different delivery methods

A comparison of pregnancy outcomes between delivery methods revealed that the neonatal asphyxia rate was significantly higher in the vaginal delivery group than in the cesarean section group, and this difference was statistically significant ($P < 0.05$). These findings suggest that, when other factors are controlled, cesarean section reduces the risk of neonatal asphyxia to a certain extent. However, regarding the rates of low birth weight, pulmonary hyaline membrane disease, and perinatal mortality, no statistically significant differences were observed ($P > 0.05$) between the two groups. This indicates that the delivery method alone may not be a decisive factor in these outcomes, or its effects may be influenced by other significant factors. Detailed data are presented in **Table 1**.

Table 1. Pregnancy outcomes of different delivery methods [n (%)]

Group	Neonatal asphyxia	Low-birth-weight infants	Pulmonary hyaline membrane disease	Perinatal death
Cesarean section ($n = 120$)	14 (11.7)	57 (47.5)	8 (6.7)	3 (2.5)
Vaginal delivery ($n = 40$)	12 (30.0)	23 (57.5)	7 (17.5)	2 (5.0)

3.2. Surgical timing

The timing of cesarean section surgery significantly affects neonatal health. Specifically, cesarean sections performed at 32–36 + 6 weeks of gestation were associated with a significantly higher incidence of low-birth-weight infants compared to surgeries performed at 37–39 + 6 weeks, and this difference was statistically significant ($P < 0.05$). This indicates that earlier cesarean sections increase the risk of low-birth-weight infants. However, no statistically significant differences ($P > 0.05$) were observed in the rates of neonatal asphyxia, pulmonary hyaline membrane disease, or perinatal mortality between the two timing groups. Detailed data are presented in **Table 2**.

Table 2. Pregnancy outcomes at different cesarean section timings [*n* (%)]

Timing	Neonatal asphyxia	Low-birth-weight infants	Pulmonary hyaline membrane disease	Perinatal death
32–36 + 67 weeks (<i>n</i> = 98)	9 (9.2)	52 (53.1)	7 (7.1)	2 (2.0)
37–39 + 6 weeks (<i>n</i> = 40)	3 (7.5)	4 (10.0)	1 (2.5)	0 (0.0)

3.3. Heart failure control time

The duration of heart failure control significantly impacts neonatal outcomes. Patients whose heart failure was controlled within 48 hours had a significantly lower incidence of neonatal asphyxia and pulmonary hyaline membrane disease compared to those with control times exceeding 48 hours, and these differences were statistically significant ($P < 0.05$). However, no significant differences ($P > 0.05$) were observed in the rates of low birth weight or perinatal mortality between the two groups. Detailed data are presented in **Table 3**.

Table 3. Pregnancy outcomes at different heart failure control times [*n* (%)]

Timing	Neonatal asphyxia	Low-birth-weight infants	Pulmonary hyaline membrane disease	Perinatal death
≤ 48 hours (<i>n</i> = 110)	4 (3.6)	38 (34.5)	3 (2.7)	2 (1.8)
> 48 hours (<i>n</i> = 50)	13 (26.0)	20 (40.0)	7 (14.0)	1 (2.0)

3.4. Classification of cardiac function

Cardiac function classification significantly affects neonatal asphyxia and perinatal mortality rates. Neonatal asphyxia and mortality rates were significantly lower among patients with cardiac function grades I–II compared to those with grades III–IV ($P < 0.05$). However, no statistically significant differences ($P > 0.05$) were observed in the rates of pulmonary hyaline membrane disease or low-birth-weight infants between the two groups. Detailed data are presented in **Table 4**.

Table 4. Pregnancy outcomes based on cardiac function classification [*n* (%)]

Classification	Neonatal asphyxia	Low-birth-weight infants	Pulmonary hyaline membrane disease	Perinatal death
I–II (<i>n</i> = 108)	0 (0.0)	49 (45.4)	7 (6.5)	1 (0.9)
III–IV (<i>n</i> = 52)	13 (25.0)	11 (21.2)	1 (1.9)	2 (3.8)

4. Discussion

Pregnancy-induced heart failure represents a severe complication in obstetrics, posing significant threats to the lives of pregnant women and profoundly influencing neonatal prognosis. This study investigates the relationships between termination methods, surgical timing, heart failure control duration, cardiac function status, and neonatal outcomes in patients with gestational heart failure, with the aim of providing a foundation for informed clinical decision-making.

Regarding the choice of pregnancy termination methods, the findings of this study indicate that cesarean section has significant advantages over vaginal delivery in reducing the incidence of neonatal asphyxia. This can be attributed to the shorter duration of the delivery process during cesarean section, which alleviates the cardiac

burden on the mother and promptly alleviates intrauterine hypoxia in the fetus. Consequently, cesarean section is a safer and more effective option for patients with gestational heart failure ^[4].

In terms of surgical timing, this study demonstrates that cesarean sections performed within 32–36+6 weeks of gestation are associated with a lower incidence of low-birth-weight infants compared to other gestational periods, contributing to improved neonatal prognosis. Therefore, while actively managing heart failure symptoms, it is essential for medical personnel to plan surgical timing carefully to ensure the safety of both mother and child.

The duration of heart failure control also significantly influences neonatal outcomes. The results show that prolonged heart failure control time increases the risk of neonatal asphyxia and pulmonary hyaline membrane disease. This underscores the necessity of initiating effective treatment promptly to control heart failure symptoms in the shortest time possible, thereby creating optimal conditions for subsequent cesarean delivery.

Additionally, the study highlights the importance of maternal cardiac function status, showing that pregnant women with better cardiac function experience a lower incidence of neonatal asphyxia. This finding emphasizes the critical role of a comprehensive preoperative cardiac function assessment and the development of individualized treatment plans based on the patient's cardiac status.

5. Conclusion

In conclusion, the clinical management of pregnant patients with heart failure is a complex and meticulous process requiring the careful consideration of multiple factors. Selecting an appropriate termination method, optimizing surgical timing, effectively controlling heart failure symptoms, and thoroughly evaluating cardiac function status are essential steps to ensure maternal and neonatal safety, reduce the risk of neonatal complications, and enhance overall treatment outcomes. In future clinical practice, medical personnel should continue to advance research on gestational heart failure, refine treatment protocols, and contribute to improving maternal and child health outcomes.

Disclosure statement

The authors declare no conflict of interest.

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Impact of Preoperative Psychological Interventions on Patients Undergoing Elective Surgery

Jianqiang Yang*

Lanzhou Modern Vocational College, Lanzhou 730300, Gansu Province, China

*Corresponding author: Jianqiang Yang, ysyl8907545567@163.com

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Abstract: *Objective:* To assess the impact of preoperative psychological interventions on the care of patients undergoing elective surgery. *Methods:* Ninety-two patients scheduled for elective surgery in the surgical department between August 2021 and August 2023 were selected and divided into groups using a random number table. The observation group received preoperative psychological interventions, while the reference group received standard preoperative care. Anxiety and depression scores, fear grading, vital signs, and self-efficacy levels were compared. *Results:* After the intervention, the anxiety and depression scores in the observation group were lower than those in the reference group, and the proportion of fear graded as Level I was higher. During the waiting period and 15 minutes before entering the operating room, vital sign levels in the observation group were lower than those in the reference group. Additionally, the self-efficacy scores of the observation group were significantly higher than those of the reference group ($P < 0.05$). *Conclusion:* Preoperative psychological interventions can alleviate negative emotions, stabilize preoperative vital signs, and significantly improve self-efficacy in patients undergoing elective surgery, demonstrating high feasibility for implementation.

Keywords: Preoperative psychological intervention; Elective surgery; Negative emotions; Vital signs; Self-efficacy

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1. Introduction

Elective surgery is a commonly employed treatment method in clinical surgery, characterized by a broad range of applications and high curative potential. However, as a significant stressor, surgery often induces anxiety and fear in patients^[1]. Moreover, the limited understanding of surgical procedures among patients can lead to pronounced psychological stress reactions before surgery, potentially affecting surgical outcomes. Elective surgery requires patients to wait for an appropriate surgical timing, exacerbating their psychological burden and resulting in abnormal vital signs, such as increased heart rate or elevated blood pressure before entering the operating room. These factors reduce the patient's surgical tolerance^[2].

Consequently, clinical surgical departments place great emphasis on preoperative psychological interventions

for elective surgery patients. Systematic and targeted interventions aim to regulate negative emotions, help patients approach surgery with a positive mindset, and actively cooperate during the procedure. Against this background, this study evaluated the effects of preoperative psychological interventions by selecting 92 patients undergoing elective surgery.

2. Materials and methods

2.1. General information

A total of 92 patients undergoing elective surgery in the surgical department between August 2021 and August 2023 were selected. Patients were randomly divided into two groups using a random number table. The observation group included 46 patients (25 males and 21 females) aged 19–71 years, with a mean age of 45.92 ± 5.17 years. The reference group also consisted of 46 patients (27 males and 19 females) aged 20–73 years, with a mean age of 46.13 ± 5.23 years. There were no statistically significant differences in baseline characteristics between the two groups ($P > 0.05$).

Inclusion criteria: Patients with an education level above junior high school; first-time surgery; meeting the indications for elective surgery; normal cognitive abilities; and informed consent to participate in the study.

Exclusion criteria: Missing clinical data; presence of psychiatric disorders; malignant tumors; inability to tolerate surgery; or voluntary withdrawal during the study.

2.2. Methods

2.2.1. Reference group

Patients received standard preoperative care. This included regular monitoring and recording of vital signs, detailed explanations about the purpose, procedure, and outcomes of elective surgery, assessing the patient's knowledge of surgery, targeted education, assisting with preoperative examinations, and preoperative preparations, and providing dietary and exercise guidance.

2.2.2. Observation group

Patients received preoperative psychological interventions, including:

(1) Formation of a responsible team

- (a) Team composition: The team consisted of a senior nurse (team leader), an operating room nurse, and a responsible nurse.
- (b) Responsibilities of the team leader: Analyze causes of preoperative psychological stress, and key points of psychological intervention for elective surgery, and formulate intervention plans based on the department's conditions. The leader also organized discussion meetings used brainstorming to improve measures, regularly evaluated intervention effects, and implemented continuous improvements.
- (c) Responsibilities of team members: The operating room nurse conducted visits one day before surgery and immediately before entering the operating room. The responsible nurse accompanied patients throughout, assessing their psychological states and providing timely, individualized guidance.

(2) Intervention methods

- (a) Day of admission: The responsible nurse communicated with the patient to understand their cognitive

level, disease condition, psychological traits, and medical history. A smile service approach with patience, sincerity, and friendliness was used to welcome patients, familiarize them with the environment, and explain hospital regulations. The nurse evaluated the patient's mindset, encouraged them to express concerns about surgery, and provided physical gestures like nodding and back-patting to build trust.

- (b) Waiting period for surgery: Once the surgery date was determined, patients were given educational materials and information about the safety and efficacy of the surgery. Videos and PowerPoint presentations were used to help patients understand surgical procedures comprehensively. Psychological state evaluations were conducted:
 - (i) For anxiety: Patients were encouraged to perform deep breathing exercises (2–3 times daily, 20 minutes each session) and engage in reading or drawing.
 - (ii) For depression: Patients were encouraged to keep a journal and participate in peer support groups to share experiences.
 - (iii) For fear: Operating room nurses provided one-on-one education on topics such as incision size, surgical duration, and recovery timelines. Three days before surgery, nurses demonstrated postoperative positioning and breathing exercises, prepared patients for surgery, and addressed potential psychological issues with interventions like meditation training.
- (c) Day of surgery: Operating room nurses welcomed patients, and responsible nurses accompanied them throughout. Operating room nurses informed patients about the qualifications of the surgeon and anesthesiologist, shared success stories, and emphasized perioperative self-management techniques to help patients relax.

2.3. Observation indicators

- (1) Anxiety and depression scores: Anxiety was assessed using the Self-Rating Anxiety Scale (20 items; standard score of 50), and depression was assessed using the Self-Rating Depression Scale (20 items; standard score of 53). Higher scores indicated more severe negative emotions.
- (2) Fear grading: Fear was evaluated using a three-grade scale:
 - (a) Grade I: No or mild fear, no avoidance of surgery.
 - (b) Grade II: Moderate fear, with attempts to avoid surgery.
 - (c) Grade III: Severe fear, with clear avoidance of surgery.
- (3) Vital signs: Pulse, systolic blood pressure, and diastolic blood pressure were measured during the waiting period and 15 minutes before entering the operating room.
- (4) Self-efficacy: Measured using the Self-Efficacy Scale for Perceived Personal Health (SUPPH), which includes 10 items on stress relief, 3 on self-decision-making, and 15 on positive attitudes. Each item is rated on a 1–5 scale, with total scores ranging from 28 to 140. Higher scores indicate better self-efficacy.

2.4. Statistical analysis

Data were analyzed using SPSS 28.0. Measurement data were expressed as mean \pm standard deviation (SD), and *t*-tests were used for comparisons. Count data were expressed as [*n* (%)], and χ^2 tests were used for comparisons. A *P*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of anxiety and depression scores

Before the intervention, there were no significant differences in anxiety and depression scores between the two groups ($P > 0.05$). After the intervention, the observation group showed significantly lower anxiety and depression scores compared to the reference group ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of anxiety and depression scores between the two groups before and after the intervention (mean \pm SD, points)

Group	<i>n</i>	Anxiety		Depression	
		Before	After	Before	After
Observation group	46	54.29 \pm 4.71	29.62 \pm 2.84	52.16 \pm 4.77	26.32 \pm 2.40
Reference group	46	54.22 \pm 4.62	35.14 \pm 2.93	52.13 \pm 4.79	30.19 \pm 2.48
<i>t</i>		0.072	9.175	0.030	7.605
<i>P</i>		0.943	0.000	0.976	0.000

3.2. Comparison of fear grading

Before the intervention, no significant differences were observed in fear grading between the two groups ($P > 0.05$). After the intervention, the proportion of Grade I fear (no or mild fear) in the observation group was significantly higher than that in the reference group ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of fear grading between the two groups before and after the intervention [*n* (%)]

Group	<i>n</i>	Grade I fear		Grade II fear		Grade III fear	
		Before	After	Before	After	Before	After
Observation group	46	19 (41.30)	29 (63.04)	21 (45.65)	13 (28.26)	6 (13.04)	4 (8.70)
Reference group	46	18 (39.13)	19 (41.30)	20 (43.48)	19 (41.30)	8 (17.39)	8 (17.39)
χ^2		0.045	4.356	0.044	1.725	0.337	1.533
<i>P</i>		0.832	0.037	0.834	0.189	0.562	0.216

3.3. Comparison of vital signs

During the waiting period for surgery and 15 minutes before entering the operating room, the observation group had significantly lower levels of all vital signs (pulse, systolic blood pressure, and diastolic blood pressure) compared to the reference group ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of vital signs between the two groups (mean \pm SD)

Group	<i>n</i>	Pulse (bpm)		Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)	
		During waiting	15 min before	During waiting	15 min before	During waiting	15 min before
Observation group	46	67.21 \pm 4.15	69.44 \pm 4.62	118.53 \pm 9.67	125.37 \pm 8.74	72.53 \pm 5.95	75.15 \pm 6.31
Reference group	46	75.16 \pm 4.20	79.61 \pm 4.81	126.17 \pm 9.70	131.32 \pm 8.83	77.51 \pm 5.79	82.46 \pm 6.42
<i>t</i>		9.132	10.342	3.783	3.248	4.068	5.508
<i>P</i>		0.000	0.000	0.000	0.002	0.000	0.000

3.4. Comparison of self-efficacy

Before the intervention, there was no significant difference in self-efficacy scores between the two groups ($P > 0.05$). After the intervention, the observation group had significantly higher self-efficacy scores than the reference group ($P < 0.05$), as shown in **Table 4**.

Table 4. Comparison of self-efficacy between the two groups before and after the intervention (mean \pm SD, points)

Group	<i>n</i>	Stress relief		Self-decision making		Positive attitude	
		Before	After	Before	After	Before	After
Observation group	46	20.36 \pm 4.12	30.18 \pm 4.51	8.56 \pm 1.43	12.24 \pm 1.82	40.36 \pm 4.97	51.23 \pm 5.38
Reference group	46	20.42 \pm 4.18	25.98 \pm 4.43	8.58 \pm 1.48	11.17 \pm 1.63	40.31 \pm 4.82	47.13 \pm 5.32
<i>t</i>		0.069	4.506	0.066	2.970	0.049	3.675
<i>P</i>		0.945	0.000	0.948	0.004	0.961	0.000

4. Discussion

Patients undergoing elective surgery often experience preoperative negative emotions, which can be attributed to several factors:

- (1) Patients may doubt the professional competence of their attending physician and fear unexpected complications during surgery, including damage to other organs.
- (2) Concerns about significant pain from the procedure and its potential impact on postoperative physiological function are common ^[3].
- (3) The high cost of surgery can increase the financial burden on patients.
- (4) Limited knowledge about surgical procedures and expected outcomes often leads to excessive anxiety or fear.

Given these psychological characteristics, it is essential to provide psychological interventions for patients undergoing elective surgery. Professional, continuous, and individualized measures can alleviate their negative emotions and ensure better surgical outcomes ^[4,5].

Preoperative psychological intervention employs a bidirectional communication mechanism to increase interaction between healthcare providers and patients. By addressing patients' psychological states, surgical schedules, and medical conditions, this approach reduces preoperative psychological stress. It helps patients recognize their emotional challenges and learn to regulate them, enabling more effective collaboration with medical staff ^[6,7]. This intervention addresses patients' knowledge gaps through brief educational sessions and psychological counseling, fulfilling their informational needs about the surgery, enhancing trust, and embodying a humanistic approach to care ^[8].

The results indicate that after the intervention, the anxiety and depression scores of the observation group were significantly lower than those of the reference group ($P < 0.05$), consistent with the findings of Shen ^[9]. Additionally, the proportion of Grade I fear in the observation group was higher than that in the reference group after the intervention. During the waiting period for surgery and 15 minutes before entering the operating room, vital signs were lower in the observation group than in the reference group. Moreover, self-efficacy scores in the observation group were higher than those in the reference group after the intervention ($P < 0.05$).

The reasons for these results can be analyzed as follows: Preoperative psychological intervention uses

psychological theories to analyze the common psychological characteristics of patients undergoing elective surgery. By implementing a time-sequential intervention, patients' psychological states can be continuously assessed and addressed in a timely manner. Respecting individual differences, the intervention considers the underlying causes of negative emotions and stimulates patients' active participation, enabling them to self-regulate their emotions and maintain stable vital signs^[10,11]. This intervention gradually cultivates patients' self-management abilities, equipping them with the skills needed for preoperative preparation, thereby enhancing their self-efficacy.

5. Conclusion

In conclusion, preoperative psychological intervention can improve the negative emotions of patients undergoing elective surgery, reduce physiological stress before surgery, and enhance self-efficacy, facilitating the smooth progression of elective procedures.

Disclosure statement

The authors declare no conflict of interest.

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Plasma Combined with Drugs: Synergistic Mechanisms for Eliminating Cancer Cells

Jie Bai*

Peptide Holdings (Hainan) Group Co., Ltd., Haikou 571000, Hainan Province, China

*Corresponding author: Jie Bai, 13366667724@qq.com

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Abstract: With the continuous advancement of cancer treatment methods, plasma combined with drug therapy has garnered widespread attention as an emerging therapeutic strategy. This paper elaborates on the generation and characteristics of plasma, as well as its mechanisms of action on cancer cells when used alone, including the production of reactive oxygen and nitrogen species, and damage to cancer cell membranes, and organelles. It emphasizes the synergistic mechanisms observed when plasma is combined with various anticancer drugs (e.g., chemotherapeutic agents, targeted drugs, and immunotherapies). The analysis focuses on enhancing drug uptake, promoting the activation of drug action targets, and improving the tumor microenvironment. These insights provide a theoretical basis for optimizing plasma-drug combination therapy for cancer.

Keywords: Plasma; Anticancer drugs; Synergy; Enhancement mechanisms

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1. Introduction

Cancer is one of the major diseases posing a severe threat to human health worldwide. While traditional cancer treatments, such as surgery, radiotherapy, and chemotherapy, have achieved notable success to some extent, they still face significant limitations, including toxicity to normal tissues, tumor recurrence, and metastasis. In recent years, plasma technology has brought new hope for cancer treatment due to its unique physical and chemical properties, which enable the generation of diverse reactive species that directly destroy cancer cells. Furthermore, plasma combined with drugs demonstrates synergistic potential, offering the possibility of improving therapeutic outcomes and reducing drug-related toxicity. Therefore, studying the mechanisms by which plasma and drugs synergistically eliminate cancer cells holds significant theoretical and clinical importance.

2. Generation and characteristics of plasma

Before delving into the synergistic mechanisms of plasma combined with drugs for eliminating cancer cells, it

is essential to first understand the basics of plasma itself. This section focuses on two key aspects: how plasma is generated and its unique physical and chemical characteristics. These insights not only provide a foundation for understanding the independent effects of plasma on cancer cells but also lay the groundwork for further exploration of its combined mechanisms with drugs.

2.1. Methods of plasma generation

Plasma is an ionized gas composed of charged particles (positive ions, negative ions, and electrons), photons, and neutral particles (atoms, molecules, free radicals, and active groups), and it is macroscopically electrically neutral. Compared with the usual three states of matter (solid, liquid, and gas), plasma differs fundamentally in both composition and properties, earning it the designation as the “fourth state of matter.” Plasma contains a variety of active particles, such as high-energy electrons, ions, free radicals, excited gas atoms and molecules, and photons ^[1].

In practical applications, whether in laboratory research or clinical disease treatment, there are multiple methods for generating plasma. Among these, gas discharge methods are the most common, including dielectric barrier discharge, radiofrequency discharge, and microwave discharge. Other methods include laser-induced and plasma jet techniques. The core principle of these methods involves applying energy to specific gases, causing ionization of gas atoms or molecules, and transforming them into a plasma state, thereby creating the foundation for various applications.

2.2. Physical and chemical characteristics of plasma

Plasma exhibits significant characteristics such as high temperature, high energy, and high reactivity. Among its many properties, the generation of reactive oxygen species (e.g., hydroxyl radicals, superoxide anions) and reactive nitrogen species (e.g., nitric oxide, nitrogen dioxide) is a key factor in inducing biological effects. These reactive species, due to their strong oxidative properties, can chemically react with various biomolecules in cancer cells, such as lipids in cell membranes, intracellular proteins, and nucleic acids, leading to structural and functional damage, ultimately causing cell injury or death.

Additionally, physical factors generated by plasma, such as electric fields, magnetic fields, and ultraviolet radiation, can also affect cancer cells. These factors may alter membrane potential or impact internal metabolic processes, thereby exerting various effects on cancer cells.

3. Mechanisms of plasma acting alone on cancer cells

After understanding the generation and characteristics of plasma, it becomes crucial to investigate its mechanisms of action when used independently against cancer cells. This section discusses two primary aspects:

- (1) How reactive oxygen and nitrogen species generated by plasma mediate damage to cancer cells.
- (2) The direct effects of physical factors in plasma on cancer cell membranes and organelles.

Clarifying these mechanisms provides a deeper understanding of the intrinsic principles of plasma’s anticancer properties, offering critical theoretical support for subsequent studies on its combination with drugs.

3.1. Cell damage mediated by reactive oxygen and nitrogen species

Reactive oxygen and nitrogen species produced by plasma are highly aggressive and can directly target critical organelles in cancer cells, including cell membranes, mitochondria, and nuclei. This triggers a series of severe

damage responses, such as lipid peroxidation, protein oxidation, and DNA damage.

Specifically, hydroxyl radicals can chemically react with unsaturated fatty acids in the cell membrane, compromising membrane integrity and causing leakage of intracellular substances. Superoxide anions can penetrate the cell and induce oxidative stress reactions in mitochondria, disrupting normal energy metabolism. Reactive nitrogen species interact with DNA bases, forming DNA adducts, ultimately leading to genetic mutations and pushing cancer cells toward apoptosis.

3.2. Direct effects on cancer cell membranes and organelles

In addition to the effects of reactive species, physical factors such as electric fields and ion flows in plasma can also directly influence cancer cell membranes. Plasma treatment can increase membrane permeability, leading to an imbalance in ion exchange inside and outside the cell, disrupting the intracellular ionic equilibrium and impairing normal physiological functions.

Furthermore, plasma impacts intracellular organelles such as mitochondria and the endoplasmic reticulum, altering their structures and causing functional impairments. This hinders processes such as energy supply, material synthesis, and transport, collectively driving cancer cells toward death from multiple angles.

4. Synergistic mechanisms of plasma combined with chemotherapeutic drugs

In cancer treatment, identifying more effective strategies is crucial. While the independent mechanisms of plasma acting on cancer cells have been clarified, the synergistic mechanisms when combined with chemotherapeutic drugs have become a new focus of research. This chapter analyzes these synergistic principles in depth, addressing three critical aspects: enhancing drug uptake, activating drug targets, and synergistically inducing apoptosis. The aim is to reveal how this combination therapy overcomes the limitations of traditional chemotherapy and paves new pathways for improving cancer treatment efficacy.

4.1. Enhancing drug uptake

The efficacy of chemotherapeutic drugs depends on their ability to enter cancer cells. However, cancer cells often develop resistance mechanisms that significantly hinder drug uptake, adversely affecting chemotherapy outcomes. Plasma treatment offers a novel solution to this problem by disrupting the integrity of the cancer cell membrane and increasing its permeability. This creates more efficient pathways for chemotherapeutic drugs to enter cancer cells ^[2]. For example, studies have shown that in the combined treatment of lung cancer cells with plasma and cisplatin, the uptake of cisplatin by cancer cells was significantly increased, thereby enhancing its cytotoxic effect and improving overall anticancer efficacy.

4.2. Activating drug targets

Some chemotherapeutic drugs exert their anticancer effects by acting on specific cellular targets, such as DNA repair proteins or tubulin. The reactive species generated by plasma can uniquely modify or activate these targets, enhancing the efficacy of drug-target interactions. For instance, plasma treatment can oxidize DNA repair proteins in cancer cells, inhibiting their repair functions ^[3]. Consequently, the cancer cell's ability to repair DNA damage is reduced, amplifying the DNA-damaging effects of chemotherapeutic drugs and ultimately enhancing their anticancer effectiveness.

4.3. Synergistically inducing apoptosis

Both plasma and chemotherapeutic drugs have unique pathways for inducing apoptosis in cancer cells. When used in combination, they produce significant synergistic effects, greatly increasing the extent of apoptosis. Specifically, plasma can activate apoptotic signaling pathways within cancer cells, such as mitochondrial and death receptor pathways, prompting the self-destruction of cancer cells. Meanwhile, chemotherapeutic drugs inhibit the expression of anti-apoptotic proteins, reducing the cell's ability to resist apoptosis^[4]. Together, these mechanisms complement each other, making cancer cells more susceptible to apoptosis and improving the overall therapeutic effect, thereby offering greater survival prospects for patients.

5. Synergistic mechanisms of plasma combined with targeted drugs

The combination of plasma and targeted drugs has shown tremendous potential in the evolving field of cancer treatment. This chapter explores the synergistic mechanisms of this combination, focusing on three dimensions: improving the tumor microenvironment, enhancing the specificity of targeted drug binding, and overcoming resistance to targeted drugs. These insights provide a solid theoretical basis for clinical applications and advance cancer treatment toward greater precision and efficacy.

5.1. Improving the tumor microenvironment

The efficacy of targeted drugs is largely influenced by the tumor microenvironment. Common conditions such as hypoxia and increased interstitial pressure in tumor tissues often weaken the action of targeted drugs. Plasma offers a potential solution to these challenges by modulating cytokines and angiogenic factors within the tumor microenvironment^[5]. For instance, plasma treatment can reduce the expression of vascular endothelial growth factor (VEGF) in tumor tissues, inhibiting angiogenesis. This not only decreases the nutrient supply to tumor cells but also optimizes blood flow and oxygenation within the tumor, enabling targeted drugs to more effectively kill cancer cells and improve overall treatment outcomes.

5.2. Enhancing the specificity of targeted drug binding

Targeted drugs often work by binding to specific receptors or markers on the surface of cancer cells to exert their anticancer effects. Plasma treatment can play a unique role in this process by altering the molecular conformation on the surface of cancer cells or changing the expression levels of relevant molecules, ultimately making targeted drug binding more effective. For example, in the treatment of EGFR-positive cancer cells with plasma combined with epidermal growth factor receptor (EGFR) targeted drugs, plasma can increase the expression of EGFR on the cancer cell surface. This significantly enhances the binding affinity between the targeted drug and the cancer cells, improving the cytotoxic effects and opening new avenues for cancer therapy^[6].

5.3. Overcoming resistance to targeted drugs

While targeted drugs are widely used in cancer treatment, resistance developed by cancer cells poses a major challenge. Plasma combined with targeted drugs offers a promising solution to this issue through multiple pathways. On one hand, plasma can suppress the expression and activity of resistance-related proteins within cancer cells, restoring their sensitivity to targeted drugs. On the other hand, reactive species generated by plasma can directly act on drug-resistant cancer cells, bypassing their resistance mechanisms and enhancing the

cytotoxicity of targeted drugs. This dual approach provides new strategies and directions for improving cancer treatment outcomes ^[7].

6. Synergistic mechanisms of plasma combined with immunotherapeutic drugs

With continuous innovations in cancer treatment, the combination of plasma and immunotherapeutic drugs has emerged as a promising direction. This chapter focuses on the synergistic mechanisms underlying this combination, analyzing its principles in depth. By activating the immune system to overcome tumor immune evasion, increasing tumor antigen exposure to enhance immune cell recognition and synergistically boosting immune cell cytotoxicity, these mechanisms provide essential theoretical support and practical guidance for optimizing cancer immunotherapy strategies and improving treatment outcomes.

6.1. Activating the immune system

Immunotherapeutic drugs work by activating the immune system to identify and eliminate cancer cells. However, tumor cells often develop immune evasion mechanisms, limiting the efficacy of these drugs. Plasma can serve as an immunological adjuvant by activating immune cells (e.g., dendritic cells and T lymphocytes) and modulating the secretion of cytokines (e.g., interleukins and interferons), thereby enhancing the body's antitumor immune response ^[8]. For example, plasma treatment can promote the maturation of dendritic cells and their antigen-presenting capabilities, effectively activating T lymphocytes and enhancing the efficacy of immunotherapeutic drugs.

6.2. Increasing tumor antigen exposure

Tumor antigens on the surface of cancer cells are key targets for recognition and attack by the immune system. However, tumors often deploy complex mechanisms to conceal or downregulate these antigens, evading immune surveillance and attack. Plasma treatment offers an effective solution to this issue ^[9]. It can disrupt the structural integrity of the tumor cell membrane, exposing previously hidden intracellular antigens and improving immune cells' efficiency in recognizing and killing tumor cells. Furthermore, reactive species generated by plasma can chemically modify tumor antigens, enhancing their immunogenicity and further optimizing the effects of immunotherapy, opening new directions for cancer immunotherapy.

6.3. Synergistically enhancing immune cell cytotoxicity

In cancer treatment, the combined application of plasma and immunotherapeutic drugs exhibits unique advantages. Their synergistic effects significantly enhance immune cells' cytotoxic activity against cancer cells. Specifically, plasma can upregulate the expression of activating receptors on immune cell surfaces, strengthening their cytotoxic functions and enabling more effective attacks on cancer cells ^[10]. Simultaneously, immunotherapeutic drugs can inhibit immune checkpoints, relieving the suppression of immune cells and fully unleashing their activity. When used together, these mechanisms drastically enhance immune cells' ability to destroy cancer cells, offering better treatment outcomes and recovery prospects for patients while advancing the development of cancer therapies.

7. Conclusion

In summary, plasma combined with drug therapies demonstrates significant synergistic mechanisms in cancer

treatment. By enhancing drug uptake, activating drug targets, improving the tumor microenvironment, overcoming drug resistance, and activating the immune system, the combination of plasma with chemotherapeutic, targeted, and immunotherapeutic drugs holds promise for improving treatment efficacy and providing new hope for cancer patients.

However, plasma-assisted drug therapies are still in the research phase, with many issues yet to be resolved, such as the optimal treatment parameters for plasma, the safety of combination therapies, and their long-term efficacy. Future efforts should focus on conducting further fundamental research and clinical trials to optimize plasma-based combination therapy protocols. This will advance the application and development of this emerging therapeutic strategy in clinical cancer treatment, providing more effective tools for precision oncology.

Disclosure statement

The author declares no conflict of interest.

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Applying Snyder's Hope Theory to Enhance Self-Management in Diabetic Patients

Rui Gao¹, Cuiyu Han², Yanhong Cheng², Li Jiang³, Zhixin Zhang⁴, Yujie Gu^{5*}

¹Blood Collection Center, Affiliated Hospital of Hebei University, Baoding 071000, Hebei Province, China

²Outpatient Department, Affiliated Hospital of Hebei University, Baoding 071000, Hebei Province, China

³Department of Tuberculosis, Affiliated Hospital of Hebei University, Baoding 071000, Hebei Province, China

⁴Department of Head and Neck Surgery, Affiliated Hospital of Hebei University, Baoding 071000, Hebei Province, China

⁵Department of Endocrinology, Affiliated Hospital of Hebei University, Baoding 071000, Hebei Province, China

*Corresponding author: Yujie Gu, 15176391853@163.com

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Abstract: *Objective:* To explore the application effect of self-management based on Snyder's hope theory in diabetic patients. *Methods:* A total of 260 patients with diabetes from a community were selected through convenient sampling and randomly divided into an experimental group and a control group using the random number table method, with 130 cases in each group. Five cases were lost in the experimental group, resulting in 125 effective cases, while all 130 cases in the control group were effective. The control group received standard lectures on diabetes self-management behavior and traditional approaches, such as the distribution of educational manuals. The experimental group underwent a self-management behavior intervention program for diabetic patients based on Snyder's hope theory model, encompassing three components: goals, pathways, and motivational thinking. The levels of hope and self-management behavior were compared between the two groups. *Results:* After the intervention, the scores for hope levels and self-management behaviors in both groups were significantly higher than those recorded before the intervention ($P < 0.05$). Furthermore, the hope level and self-management behavior scores of the experimental group were significantly higher than those of the control group ($P < 0.05$). *Conclusion:* The application of Snyder's hope theory model in diabetic patients demonstrates significant benefits, improving patients' hope levels and, consequently, enhancing their self-management behaviors.

Keywords: Diabetes; Snyder's hope theory; Self-management; Treatment compliance

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1. Introduction

The 10th edition of the International Diabetes Federation (IDF) report states that in 2021, 537 million adults aged 20–79 years worldwide were living with diabetes ^[1]. In China, the prevalence of diabetes among adults increased

from 8.8% in 2011 to 10.8% in 2021, with 140.9 million individuals aged 20–79 years diagnosed with diabetes, placing China first globally. Additionally, the IDF estimated that global health expenditure on diabetes in 2021 was \$966 billion, with China contributing approximately \$165.3 billion. Diabetes and its complications impose a substantial economic burden on patients, families, and society ^[1].

Diabetes management requires continuous adjustment based on the progression of the disease, with self-management serving as the foundation. Effective self-management is crucial for glycemic control and the prevention of complications. However, both domestic and international studies have revealed that the self-management behaviors of diabetic patients remain suboptimal. Poor self-management often results in blood glucose fluctuations and a series of complications. Self-management has been found to correlate with the development of various diabetes-related complications. Laxy *et al.* ^[2] and Kent *et al.* ^[3] reported a negative correlation between self-management and the risk of diabetic neuropathy. Chen *et al.* ^[4] found that regular physical exercise and good dietary control significantly reduced the incidence of retinopathy. Mehravar *et al.* ^[5] emphasized that self-management plays a pivotal role in reducing the incidence of nephropathy and neuropathy in patients with type 2 diabetes mellitus. Similarly, Khanna *et al.* ^[6] and Lin *et al.* ^[7] suggested that active participation in self-management not only improves clinical outcomes, such as glycated hemoglobin levels and the occurrence of complications but also enhances patients' quality of life. Consequently, improving self-management behaviors in diabetic patients remains an urgent concern.

Perceptions and beliefs regarding the disease are critical factors influencing self-management behaviors in diabetic patients ^[8]. Hope, a positive psychological factor, significantly impacts patients' quality of life and disease prognosis. Snyder's hope theory ^[9] is based on three components: goals, pathway thinking, and motivational thinking. Goals represent the central element of the theory. Once a goal is established, pathways are designed to achieve the goal, forming pathway thinking. Motivational thinking refers to the motivational system required to attain the goal and constitutes the motivational component of hope. These three elements are independently unified and interact dynamically.

This study develops a self-management intervention program for diabetic patients based on Snyder's hope theory and evaluates its preliminary application to assess the intervention's effectiveness. The findings aim to provide a basis for behavioral interventions targeting self-management in diabetic patients, offering guidance to enhance self-management levels, reduce the incidence of complications, and improve patients' quality of life.

2. Materials and methods

2.1. General information

Diabetic patients in a tertiary hospital were selected from July 2022 to September 2023. The sample size was calculated using the formula $n_1 = n_2 = 2\{[(Z_{\alpha/2} + Z_{\beta})\sigma]/\delta\}^2$, with parameters derived from references. The calculated sample size was $n_1 = n_2 = 120$ cases, and an additional 10% was included to account for invalid cases, resulting in 132 cases to be collected. Ultimately, the experimental and control groups included 65 cases each.

Patients were required to meet the 1999 World Health Organization (WHO) diagnostic criteria for diabetes mellitus.

Inclusion criteria: (1) Age ≥ 18 years; (2) Diagnosis duration ≥ 1 month; (3) Full cognitive and behavioral abilities; (4) Informed consent provided.

Exclusion criteria: (1) Presence of malignant tumors; (2) Gestational diabetes mellitus; (3) Physical activity limitations due to complications or comorbidities; (4) Acute complications; (5) Medical personnel or individuals

engaged in healthcare work.

This study was approved by the Ethics Committee of the Affiliated Hospital of Hebei University (Approval No. HDFY-LL-2022-035).

2.2. Research methodology

2.2.1. Intervention design

The selected diabetic patients were randomly assigned to the experimental and control groups using the random number table method. The control group received traditional education methods, including regular lectures on diabetes self-management and the distribution of educational brochures. The experimental group underwent a self-management behavioral intervention program based on Snyder's hope theory, focusing on goals, pathways, and motivational thinking. The intervention lasted six months, with follow-ups conducted at one, three, and six months. The effects of the intervention were assessed by observing self-management behaviors, hope levels, self-efficacy, and glycated hemoglobin improvements. Details of the intervention program are outlined in **Table 1**.

Table 1. Self-management behavioral intervention program based on Snyder's hope theory

Phase	Theme	Content	Form and place	Duration
First week	Build trust	(1) Conduct face-to-face conversations with patients to explain the study's purpose and content. (2) Establish WeChat groups.	Individual interventions, hospital wards	15–30 minutes
	Baseline survey	Administer a questionnaire to assess self-management skills, hope levels, and self-efficacy.		
	Encourage openness	Guide patients to discuss their disease course, significant past events, and personal achievements.	Individual interventions	15–30 minutes
	Instill hope	(1) Inspire patients with positive visions for their future, tailored to age, gender, and interests. (2) Collaborate with patients to create lists of future goals, fostering optimism.		
Second week	Establish goals	(1) Develop individualized self-management goals for cognitive, affective, and motor skill domains based on Bloom's taxonomy. (2) Organize goals to provide patients with a sense of accomplishment, enhancing their confidence.	Individual interventions, online platforms	15–30 minutes
Third week	Pathway thinking	(1) Diabetes education, including topics on diet, exercise, blood glucose monitoring, and medication. (2) Customized intervention methods tailored to the characteristics of the participants, teaching objectives, and content: (a) Cognitive domain: Lectures, case studies, and discussions. (b) Emotional domain: Experience sharing and presentations. (c) Motor skills domain: Demonstrations and hands-on practice. (3) Utilization of mind maps, short videos, educational cards, and health education manuals for better comprehension and engagement.	Individual interventions were conducted via microblogging platforms, group interventions were facilitated through the Tencent Conference.	15–30 minutes per session, conducted three times in total (once for each domain: cognitive, emotional, and motor skills).
Fourth week	Motivational thinking	(1) Commitment strategy: Patients receive rewards upon reaching specific milestones, with progressive upgrades to increase motivation and engagement. (2) Happy factor method: Guidance is provided to help patients maintain a positive outlook, adjust their mindset, and reintegrate into society. Individual questions are addressed one-on-one. (3) Positive reinforcement: Targeted encouragement and rewards are offered to patients with low hope levels, poor self-management skills, or limited adherence, aiming to enhance their self-efficacy and hope. (4) Role model guidance: Sharing of successful cases by patients with good glycemic control, along with presentations of their strategies and insights, to inspire others. (5) Self-motivation: Patients are encouraged to boost their confidence through affirmations such as "I can do it" and "I will not back down."	Individual interventions were conducted via microblogging platforms, group interventions were facilitated through the Tencent Conference.	15–30 minutes per session, conducted twice in total.

2.3. Observational indicators and research tools

The following indicators and tools were used to observe and assess the intervention outcomes:

- (1) General information: General demographic and socioeconomic information was collected, including age, gender, marital status, education level, ethnicity, occupation, religious beliefs, monthly family income, medical expense coverage, and type of diabetes.
- (2) Self-management behavioral scale for diabetic patients: The Diabetes Self-Management Questionnaire (DSMQ), developed by the Diabetes Society of Bad Mergentheim, Germany, was utilized ^[10]. The questionnaire comprises 16 items across six dimensions: medication compliance (2 items), glucose monitoring (3 items), dietary control (4 items), physical activity (3 items), follow-up (3 items), and overall evaluation (1 item). Responses were scored on a 4-point Likert scale (0 = not applicable, 1 = somewhat applicable, 2 = moderately applicable, 3 = highly applicable). Positive scores were assigned to items 1, 2, 3, 4, 6, 8, and 9, while others were reverse scored. The total score ranged from 0 to 48, with higher scores indicating better self-management behavior. The scale demonstrated good reliability (Cronbach's $\alpha = 0.764$) and validity, with exploratory factor analysis yielding a cumulative variance contribution rate of 67.572%, and factor loadings above 0.40.
- (3) Hope scale: Herth's Hope Scale, translated and introduced by Zhao ^[11], was employed to evaluate patients' hope levels. The scale consists of 12 items distributed across three dimensions: positive attitudes toward reality and the future (items 1, 2, 6, and 11), taking positive actions (items 4, 7, 10, and 12), and maintaining close relationships (items 3, 5, 8, and 9). Responses were scored on a 4-point Likert scale, with reverse scoring for items 3 and 6. Total scores ranged from 12 to 48, categorized as low hope (12–23), moderate hope (24–35), and high hope (36–48). The scale exhibited strong reliability (Cronbach's $\alpha = 0.87$).
- (4) Self-efficacy scale: The General Self-Efficacy Scale (GSES), developed by Schwarzer and translated into Chinese by Zhang and Schwarzer ^[12], was utilized to assess self-efficacy. The scale includes 10 items scored on a 4-point Likert scale. Higher total scores indicate stronger self-efficacy. Based on the score index (score index = actual score/highest possible score \times 100%), self-efficacy levels were categorized as high ($\geq 80\%$), medium (60–80%), and low ($\leq 60\%$). The scale demonstrated reliability, with Cronbach's α ranging from 0.75 to 0.94 across studies, and retest reliability ranging from 0.55 to 0.75.
- (5) Glycated hemoglobin (HbA1c): The American BIO-RAD VARIANT II hemoglobin testing system was employed to measure HbA1c, reflecting blood glucose levels over the preceding 2–3 months. Measurements were taken at baseline (hospital admission) and three and six months post-intervention.

2.4. Data collection

An intervention team was formed to implement the study. The primary investigator contacted the hospital to explain the study's purpose and significance, securing institutional support. Eligible diabetic patients were enrolled after meeting the inclusion criteria and providing informed consent. The intervention program was administered to the experimental group, while the control group received standard education. Patients' self-management abilities, hope levels, and self-efficacy were assessed before the intervention and at one, three, and six months afterward. HbA1c levels were evaluated at three and six months post-intervention to assess glycemic control.

2.5. Statistical analysis

Statistical analyses were conducted using SPSS 25.0. Descriptive statistics, including mean, standard deviation,

frequency, and percentage, were used to summarize demographic and baseline characteristics. Repeated-measures analysis of variance (ANOVA) was applied to compare diabetes self-management behaviors, hope levels, self-efficacy, and HbA1c levels between the experimental and control groups at one, three, and six months post-intervention. Statistical significance was determined using a two-sided test with a significance level of $P < 0.05$.

3. Results

3.1. General information

The comparison of general information between the two groups of patients did not yield statistically significant differences ($P > 0.05$), indicating comparability. See **Table 2** for details.

Table 2. General information

Variant		Experimental group ($n = 65$)	Control group ($n = 65$)	t/χ^2	P
Age (mean \pm SD)		54.55 \pm 20.18	54.17 \pm 15.89	0.121	0.904
Gender [n (%)]	Male	33 (50.8%)	31 (47.7%)	0.123	0.726
	Female	32 (49.2%)	34 (52.3%)		
Ethnic group [n (%)]	Han	64 (98.5%)	1 (1.5%)	0.000	1.000
	Others	1 (1.5%)	1 (1.5 %)		
Religious belief [n (%)]	Yes	6 (9.2%)	4 (6.0%)	0.433	0.510
	No	59 (90.8%)	61 (93.8%)		
Educational attainment [n (%)]	Primary and below	8 (12.3%)	3 (4.5%)	7.205	0.125
	Junior high school	19 (29.2%)	30 (46.2%)		
	Secondary/High school	17 (26.2%)	19 (29.2%)		
	Three-year college	12 (18.5%)	9 (13.8%)		
	Undergraduate and above	9 (13.8%)	4 (4.5%)		
Marital status [n (%)]	Single	8 (12.3%)	6 (9.2%)	6.507	0.320
	Married	54 (83.1%)	59 (90.8%)		
	Divorced	1 (1.5%)	0 (0%)		
	Widowed	2 (3.0%)	0 (0%)		
Residential area [n (%)]	Rural	34 (52.3%)	31 (47.7%)	0.277	0.599
	Urban	31 (47.7%)	34 (52.3%)		
Monthly per capita household income [n (%)]	< 2,000	23 (35.5%)	16 (24.6%)	11.046	0.011
	2,000–3,999	17 (26.1%)	35 (53.8%)		
	4,000–5,999	17 (26.1%)	11 (16.9%)		
	≥ 6000	8 (12.3%)	3 (4.5%)		
Medical expense payment method [n (%)]	Medical insurance	34 (52.3%)	47 (72.3%)	6.661	0.036
	Self expenses	29 (44.6%)	18 (27.7%)		
	Commercial insurance	2 (3.0%)	0 (0%)		
Type of diabetes [n (%)]	Type 1	9 (13.8%)	7 (10.8%)	0.285	0.593
	Type 2	56 (26.1%)	58 (89.2%)		

3.2. Comparison of self-management behaviors, hope levels, and self-efficacy between the two groups before and after the intervention

Repeated measures ANOVA was conducted to compare self-management behaviors, hope levels, and self-efficacy scores between the two groups. The time factor in this study comprised four levels: baseline (pre-intervention), 1-month post-intervention, 3-month post-intervention, and 6-month post-intervention. The intervention factor was present at two levels in both the control and intervention groups.

Mauchly's sphericity test was applied to the scores for each outcome, with Mauchly's W values of 0.517, 0.339, and 0.301 for self-management behaviors, hope levels, and self-efficacy, respectively. As $P < 0.05$ for all tests, the assumption of sphericity was violated. Consequently, the Greenhouse-Geisser correction was applied.

3.2.1. Comparison of self-management behaviors before and after intervention

Table 3 presents a detailed comparison of self-management behavior scores at different time points in both groups.

Table 3. Comparison of self-management behaviors before and after intervention (score, mean \pm SD)

	Pre-intervention	Post-intervention			Repeated measures ANOVA	
		1 month	3 months	6 months	F	P
Control group	38.02 \pm 8.12	35.00 \pm 7.70	31.88 \pm 6.93	31.88 \pm 8.93		
Experimental group	39.77 \pm 9.24	39.15 \pm 7.12	37.40 \pm 7.60	36.43 \pm 8.09		
Intervention main effect					45.634	0.000
Time main effect					10.631	0.01
Intervention \times Time					7.915	0.000

3.2.2. Comparison of hope levels before and after intervention

Table 4 presents a detailed comparison of hope levels at different time points in both groups.

Table 4. Comparison of hope levels before and after intervention (score, mean \pm SD)

	Pre-intervention	Post-intervention			Repeated measures ANOVA	
		1 month	3 months	6 months	F	P
Control group	32.99 \pm 5.30	36.83 \pm 6.16	38.38 \pm 4.36	39.03 \pm 3.95		
Experimental group	34.60 \pm 6.12	37.45 \pm 5.09	37.20 \pm 5.00	37.12 \pm 4.97		
Intervention main effect					0.06	0.907
Time main effect					86.041	0.000
Intervention \times Time					14.495	0.000

3.2.3. Comparison of self-efficacy before and after intervention

Table 5 presents a detailed comparison of self-efficacy at different time points in both groups.

Table 5. Comparison of self-efficacy before and after intervention (score, mean \pm SD)

	Pre-intervention	Post-intervention			Repeated measures ANOVA	
		1 month	3 months	6 months	F	P
Control group	22.70 \pm 7.29	27.72 \pm 7.38	30.25 \pm 4.70	31.10 \pm 3.93		
Experimental group	25.57 \pm 9.07	28.78 \pm 8.25	28.30 \pm 8.22	28.10 \pm 8.19		
Intervention main effect					0.000	0.997
Time main effect					46.713	0.000
Intervention \times Time					30.952	0.000

3.3. Comparison of dynamic changes in glyated hemoglobin levels before and after intervention in the two groups of patients

Mauchly's sphericity test was performed on the glyated hemoglobin scores of the intervention and control groups at each time point (**Table 6**). The Mauchly's W value was 0.320, with a *P*-value < 0.05 , indicating that the sphericity assumption was not met. Therefore, Greenhouse-Geisser correction was applied in this analysis.

Table 6. Comparison of glyated hemoglobin levels before and after the intervention in the two groups (mean \pm SD)

	Pre-intervention	Post-intervention		Repeated measures ANOVA	
		3 months	6 months	F	P
Control group	8.78 \pm 2.57	6.82 \pm 1.61	6.81 \pm 1.93		
Experimental group	8.47 \pm 2.71	7.53 \pm 2.09	7.62 \pm 2.39		
Intervention main effect				35.833	0.662
Time main effect				260.770	0.000
Intervention \times Time				34.044	0.000

4. Discussion

Diabetes mellitus is a common chronic lifelong disease, and patient self-management is crucial for glycemic control and the prevention of complications^[13]. Hope plays an important role in disease progression and serves as a positive factor influencing both the quality of life and the prognosis of diabetic patients. Snyder's theory of hope posits that hope is a theoretical framework based on an intrinsic sense of success and positive motivational states, centered on goals and structured through the interaction of motivational and pathways thinking^[14,15].

4.1. Nursing interventions based on Snyder's theory of hope increase the level of hope in diabetic patients

The results of this study revealed that the level of hope in both the experimental and control groups increased after the intervention, which is consistent with the findings of Wei^[16]. Analysis of the underlying reasons includes the following points:

- (1) Clear goals were set: Individualized self-management behavioral education goals for diabetic patients were discussed and formulated with patients and their families. These goals were adjusted as needed based on the changes in the patient's conditions, ensuring that they met the evolving needs of the patients

while also tailoring interventions to their specific circumstances. Compared with conventional nursing models, the involvement of patients in goal development improved their self-management abilities, enhanced communication with nurses, and reinforced the perception that the hospital was oriented toward meeting patients' needs. The hospital's primary focus on disease prevention and health maintenance further contributed to the patients' engagement.

- (2) Application of "path thinking": Different intervention methods were adopted based on the characteristics of the teaching material, objectives, and content. For example, cognitive interventions included lectures and case studies, emotional interventions involved personal experiences and shared stories, while motor skill training utilized demonstrations, mind maps, and short videos. This multifaceted approach aimed to improve adherence to treatment and enhance the self-management outcomes for diabetic patients.
- (3) Hope intervention through "motivational thinking": Motivational thinking was integrated throughout the self-management process, encouraging active participation from both patients and their families. Timely motivational interventions helped patients adjust their mindset, integrate into society, and bolster their confidence and motivation to achieve their goals. In conclusion, interventions based on Snyder's hope theory effectively enhanced the level of hope in diabetic patients.

4.2. Nursing interventions based on Snyder's theory of hope improve self-efficacy in diabetic patients

Self-efficacy is a key determinant of self-management behavior in diabetic patients^[17]. This study demonstrated that, prior to the intervention, the self-efficacy of patients in both groups was low. However, after the systematic intervention, the self-efficacy scores of patients in both the control and experimental groups increased, with a significantly greater improvement in the experimental group ($P < 0.05$). The difference in self-efficacy between the experimental and control groups after the intervention was statistically significant ($P < 0.05$), aligning with findings from related studies^[18,19]. The underlying causes of these improvements can be attributed to the following factors:

- (1) Humanistic and personalized care: The nursing interventions, based on Snyder's hope theory, emphasized humanistic care and provided individualized support, which helped patients navigate frustration and enhance their confidence in overcoming the disease. This increased both their hope levels and self-efficacy.
- (2) Empowering patients: Patients with higher self-efficacy are better able to perceive their disease management systems, face challenges with a positive mindset, and adopt behaviors conducive to health. As a result, they are more likely to engage in self-management practices^[11]. By improving self-efficacy, patients were better equipped to cope with challenges in disease management, leading to better blood glucose control.

4.3. Nursing interventions based on Snyder's theory of hope improve self-management of diabetic patients

Self-management is a critical factor in the prognosis of diabetic patients^[17]. The results of this study showed that self-management behavior was initially low in both groups, but after the intervention, self-management behavior improved in both the control and experimental groups. The experimental group demonstrated significantly greater improvement ($P < 0.05$), with a statistically significant difference between the experimental and control groups after the intervention ($P < 0.05$), consistent with findings from similar studies^[18,19]. The causes for these

improvements include:

- (1) Cognitive bias correction: Nursing interventions based on Snyder's theory of hope helped correct patients' cognitive biases, enabling them to master self-management techniques and reduce the negative impact of the disease on their hope levels. Patients with negative emotions, such as tension, anxiety, and pessimism, often experience increased blood glucose levels, complications, and higher medical costs^[20,21]. Hope interventions, such as sharing successful cases of glycemic control and inviting patients with good glycemic control to share their experiences, helped reinforce patients' belief in their ability to achieve their goals.
- (2) Encouragement and motivation: Peer support and positive feedback for physical activity improved both physical function and emotional well-being, fostering positive expectations for the future. This, in turn, stimulated intrinsic motivation for self-management, enhancing patients' ability to engage in self-care behaviors.
- (3) Timely adjustments: After implementing hope interventions, timely adjustments were made based on changes in the patient's condition. These adjustments not only helped control blood glucose levels and delay complications but also encouraged patients to actively seek out self-management methods. The provision of personalized, safe, reasonable, and effective long-term guidance made patients feel that the hospital was genuinely focused on their needs, aiming to prevent disease, maintain health, and improve quality of life.

5. Conclusion

In summary, applying Snyder's hope theory to the self-management of diabetic patients facilitates improvements in their hope levels, self-efficacy, and self-management behaviors, ultimately helping to maintain blood glucose levels within the normal range. The findings from this study have a positive impact on the prevention of complications in diabetic patients and provide valuable evidence for clinical practice.

Disclosure statement

The authors declare no conflict of interest.

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The Gut Microbiota in Hepatic Encephalopathy: From Recognition to Treatment

Chenghe Ding*

NHC Key Laboratory of Nuclear Technology Medical Transformation, Mianyang Central Hospital, School of Medicine, University of Electronic Science and Technology of China, Mianyang 621000, China

*Corresponding author: Chenghe Ding, dch6701@sc-mch.cn

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Abstract: The role of the gut microbiota in the pathogenesis and treatment of hepatic encephalopathy (HE) has garnered increasing attention due to significant advancements in understanding the gut microbiota over recent years. A growing body of evidence from laboratory and clinical studies highlights a substantial relationship between gut microbiota and HE. Identifying the role of gut microbiota in maintaining normal cognitive function, including its influence on the gut barrier and immune cells, is essential to elucidate the mechanisms underlying the development of HE. This understanding offers novel perspectives for its prevention and treatment. This paper provides a comprehensive review of the research progress concerning the gut microbiota, HE, and their interrelationship, along with current treatment methods for HE. Furthermore, it outlines the limitations and challenges associated with microbiota-based therapeutic research.

Keywords: Gut microbiota; Hepatic encephalopathy; Gut barrier; Treatment

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1. Gut microbiota

1.1. Awareness of gut microbes

The human gut hosts thousands of microorganisms distributed across various anatomical sites, maintaining a stable, symbiotic, and mutually beneficial relationship with their hosts. Macrogenomic studies of the gut microbiota in healthy individuals have revealed considerable differences in its composition across individuals^[1-3]. Each person possesses a unique gut microbiota shaped by their genetic background, physiological status, microbial interactions, environmental factors, and diet^[4-6].

The relationship between the microbiome and its influences is intricate and bidirectional. External factors induce compositional changes that stabilize into an adapted microbiome state, while the microbiome also provides feedback to the host through mechanisms such as the production of specific metabolites. Over 500 microbial species inhabit the human gut, with microbial diversity typically increasing from infancy to around three years of age, at which point it reaches levels comparable to those of adults^[7].

Advances in science and technology have significantly enhanced the understanding of the types of microbes present in the gut, their functions, and their roles in human health and disease. The gut microbiota is now recognized as an anaerobic bioreactor capable of synthesizing molecules that directly influence the mammalian immune system, modify the human epigenome, and regulate host metabolism^[8-10].

1.2. Stages of research on the gut microbiota

In recent years, extensive research has been conducted to evaluate the correlation between gut microbiota, disease, and external environmental factors. As the depth and scope of studies continue to expand, metagenome-wide association studies (MWAS) have emerged as a focus for scientists^[11]. The relationship between gut microbiota and disease remains complex. For example, in some patients with colorectal cancer^[12] or arthritis^[13], specific marker taxa are associated with the disease but exert a minimal effect on the overall microbial composition, such as the reduced abundance of particular bacterial species. Conversely, certain disease states are significantly linked to broader compositional changes in the microbiota. For instance, reduced species diversity or richness has been observed in patients with obesity^[14] or inflammatory bowel disease^[15].

It remains unclear in most cases whether microbiota dysbiosis triggers the onset of the disease or whether the disease itself induces changes in the microbiota. Furthermore, recent studies have demonstrated limited ability to explain microbial variations^[16], potentially due to the low accuracy of current taxonomic classification systems^[17].

1.3. Methods for studying the gut microbiota

The development of new experimental techniques and methods is crucial for advancing the study of gut microbiota. However, these methods face inherent limitations, such as amplification bias^[18], primer bias^[19], and restricted functional insights^[20]. Whole-genome analysis offers advantages, including the ability to provide information on the relative abundance of functional genes, high-resolution identification, and population-averaged genomes through gene assembly^[21,22]. However, it also presents challenges, such as bias introduced by host DNA or organelle contamination, library construction, and the assembly and annotation of reference databases. Additionally, this method struggles to distinguish between samples.

While transcriptome sequencing analysis captures intra-individual microbial dynamics^[23] and directly assesses microbial activity (e.g., interference or exposure)^[24], it is one of the most expensive, labor-intensive, and complex techniques^[25]. It also requires the exclusion of host mRNA and is prone to contamination by rRNA^[26].

To address these challenges, multi-omics analysis, absolute quantitative microbial analysis (QMP), and other methods have been developed. Multi-omics approaches complement macro-genomic studies by integrating macro-transcriptomic, macro-proteomic, and macro-metabolomic analyses^[27,28]. In recent years, metabolomic studies have been employed to assess associations between gut flora, metabolites, and diseases, such as the relationships between serum metabolites and type II diabetes^[29]. Additionally, macro-transcriptomic studies can directly reveal microbial gene expression and provide insights into potential microbial functions^[30,31]. In contrast, macro-proteomic analyses remain limited, with only a few pilot-scale studies conducted to date^[32,33]. The characteristics, advantages, and limitations of these various methods are summarized in **Table 1**.

Despite their potential, multi-omics studies face several challenges. The integration of heterogeneous data types and compositions creates a complex chain of evidence that must be analyzed holistically^[27,33]. This complexity also affects the understanding of key microbiome concepts, such as the significance of functional plasticity^[34]. Absolute quantitative microbiological analyses offer improvements in sensitivity and accuracy for microbiome association studies. These advances are primarily achieved through the use of internal markers^[35], the

introduction of exogenous bacteria to quantify absolute bacterial abundance^[36], and flow cytometry^[37].

2. The gut microbiota and hepatic encephalopathy

2.1. Hepatic encephalopathy

Hepatic encephalopathy (HE) refers to brain dysfunction caused by hepatic insufficiency and/or portal system shunting. It encompasses a continuum of symptoms ranging from cognitive impairment to coma, with key clinical manifestations including altered consciousness, behavioral disturbances, and coma^[38]. The association between liver disease, particularly jaundice, and emotional or behavioral disturbances dates back to Hippocrates, the father of Western medicine (460–371 B.C.)^[39]. However, experimental studies in the late 19th and 20th centuries began elucidating the pathophysiological mechanisms underlying this relationship, identifying behavioral changes as consequences of chronic liver insufficiency and liver disease.

HE is classified into covert hepatic encephalopathy (CHE) and overt hepatic encephalopathy (OHE) based on the severity of its clinical manifestations^[40]. It is well-documented that HE is a primary cause of hospitalization in patients with cirrhosis. Evidence suggests that OHE occurs in 30–40% of patients with cirrhosis during their clinical course^[41].

2.2. Occurrence and progression

HE represents a typical model of gut-liver-brain axis disease, although its pathogenesis remains unclear. There is growing consensus that alterations in gut microbial composition and its metabolic by-products, local and systemic inflammation, and a compromised intestinal barrier (leaky gut) collectively contribute to the development of HE^[42]. Among the microbial by-products, indole and ammonia are particularly neurotoxic. Indole interacts with voltage-gated sodium channels in the brain, acting as a sedative that induces coma in both human and animal models^[43,44]. Ammonia disrupts pH levels, membrane potential, cellular metabolism, and neurotransmission, leading to astrocyte swelling and brain edema^[45].

The composition of the sigmoid colon microbiota in patients with HE differs significantly from that of healthy individuals^[46]. In HE patients, the abundance of *Roseburia* is reduced, while *Enterococcus*, *Veillonella*, *Megasphaera*, and *Burkholderia* are elevated. Cognitive performance and lower inflammation markers have been associated with *Blautia*, *Faecalibacterium*, *Roseburia*, and *Dorea*, whereas cognitive deficits correlate with *Enterococcus*, *Streptococcus*, *Burkholderiaceae*, *Veillonellaceae*, *Megasphaera*, *Rikenellaceae*, *Alistipes*, *Streptococcaceae*, *Alcaligenaceae*, *Sutterella*, *Porphyromonadaceae*, and *Parabacteroides*. Notably, *Alcaligenaceae* produce ammonia via urea degradation, potentially linking them to cognitive impairments. Bajaj *et al.* also reported that *Enterobacteriaceae*, *Fusobacteriaceae*, and *Veillonellaceae* are positively correlated with inflammation, while *Ruminococcaceae* are negatively correlated^[47].

The association between altered gut microbiota and neurological deficits in patients with cirrhosis (with or without HE) has been further clarified through nuclear magnetic resonance spectroscopy and magnetic resonance diffusion tensor imaging. Patients with HE exhibit an increased abundance of *Staphylococcaceae*, *Enterococcaceae*, and *Porphyromonadaceae* compared to those without HE^[48]. Animal studies have shown that *Porphyromonadaceae* is linked to cognitive dysfunction and the development of fatty liver disease^[46,49,50]. Brain MRI spectra have revealed positive correlations with *Streptococcaceae*, *Enterobacteriaceae*, and *Lactobacillus*, as well as negative correlations with *Spirulinaceae*, *Ruminococcaceae*, and *Clostridium perfringens*. It has been established that *Spirulinaceae*, *Clostridium tumefaciens*, and *Clostridium tetradecium* dominate healthy gut

microbiota, contributing to short-chain fatty acid (SCFA) production and bile acid 7-alpha dehydroxylation ^[51,52]. As cirrhosis progresses, the abundance of *Lactobacillaceae* and *Streptococcaceae* decreases, while potentially harmful bacteria, such as *Streptococcaceae* and *Enterobacteriaceae*, increase ^[53]. Interestingly, Ahluwalia *et al.* reported an increase in *Lactobacillaceae* in the fecal samples of HE patients and cirrhosis mouse models ^[48,54].

Patients with cirrhosis are particularly susceptible to dysbiosis due to the diverse pathological interactions between the liver and gastrointestinal tract, which have significant clinical implications. Altered intestinal dynamics, elevated gastric pH, and reduced colonic bile acid concentrations in cirrhotic patients can lead to uncontrolled bacterial overgrowth. Furthermore, cirrhosis impairs the liver's ability to regulate systemic immune responses. Compared to controls, cirrhotic patients exhibit increased monocyte proliferation and chemotaxis but significantly reduced neutrophil activity ^[55]. This disruption compromises the intestinal barrier, promotes bacterial translocation, and heightens the risk of intestinal bacterial infections and liver failure ^[56,57].

3. Treatment of hepatic encephalopathy

Current clinical treatments for HE primarily focus on regulating gut microbiota to reduce pathogenic bacteria, bacterial urease activity, and intestinal pH. This, in turn, decreases ammonia production and absorption ^[51,52,58]. Common treatment methods include dietary interventions, lactulose, the antibiotic rifaximin, probiotics, and fecal microbiota transplantation (**Figure 1**). Although these approaches have demonstrated therapeutic efficacy, concerns persist among some experts regarding their long-term effectiveness and potential side effects in clinical practice. This underscores the need to develop novel treatment strategies informed by a comprehensive understanding of the underlying mechanisms of gut microbiota.

3.1. Dietary interventions

As gut microbiota are closely linked to dietary habits and play a pivotal role in HE pathogenesis, dietary interventions have been proposed as a potential treatment for alleviating HE symptoms ^[59]. Traditionally, it was believed that protein catabolism increased ammonia levels, leading to recommendations for protein restriction in patients with HE. However, recent studies have shown that normal protein intake is both well-tolerated and beneficial in HE, ensuring sufficient substrates for energy synthesis and liver function ^[60,61]. Consequently, experts now strongly recommend avoiding protein restriction in patients with HE.

3.2. Lactulose

Lactulose, a synthetic disaccharide composed of lactose and galactose, is classified as a prebiotic. A distinctive feature of prebiotics is their resistance to absorption in the gastrointestinal tract. Lactulose, along with other non-absorbable disaccharides such as inulin, fructooligosaccharides (FOS), and galactooligosaccharides (GOS), stimulates the growth and activity of beneficial gut bacteria, such as bifidobacteria ^[62].

Lactulose reduces ammonia production and absorption through several mechanisms:

- (1) Osmotic effect: It increases osmotic pressure and lowers pH in the intestinal lumen ^[63].
- (2) Ammonia utilization: It promotes bacterial uptake of ammonia for protein synthesis ^[64].
- (3) Inhibition of glutaminase activity: It reduces intestinal glutamine absorption and its subsequent conversion to ammonia ^[65].

Numerous studies have focused on the role of lactulose in improving quality of life and cognitive function

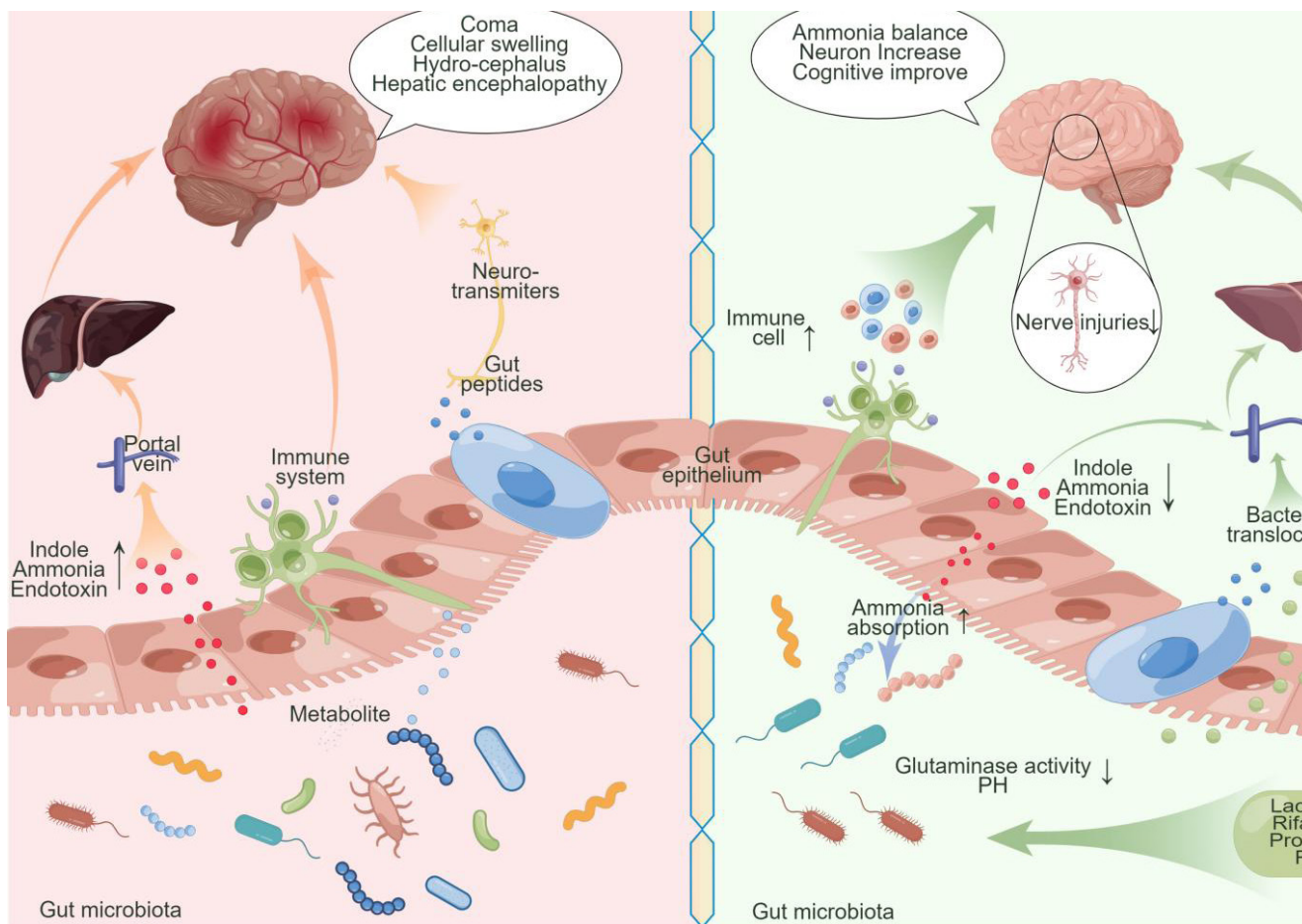


Figure 1. Schematic representation of microbiota in the progression of hepatic encephalopathy. In HE, gut dysbiosis increases metabolites like indole, ammonia, and endotoxins, which affect the brain via the portal venous, immune, and nervous systems, leading to coma, cell swelling, hydrocephalus, and HE. Treatments such as lactulose, rifaximin, antibiotics, and FMT reduce pathogenic bacteria, bacterial urease activity, glutaminase activity, and pH, while decreasing bacterial translocation. These interventions lower the production or absorption of ammonia, indole, and endotoxins, enhance immune function, reduce brain damage, restore ammonia balance, increase neurons, and improve cognition.

in HE patients. In 2014, the American Association for the Study of Liver Diseases (AASLD) and the European Association for the Study of the Liver (EASL) jointly recommended lactulose as a treatment for overt HE ^[38]. Compared to placebo or no intervention, lactulose significantly reduces the risk of overt HE, lowers blood ammonia levels, and enhances health-related quality of life ^[66].

In patients with mild HE, lactulose decreases arterial ammonia levels, inflammatory markers (e.g., TNF- α , IL-6, IL-18), and serum endotoxins ^[67]. Animal studies have demonstrated that lactulose increases neuroplasticity by promoting neurite growth and enhancing the formation of new neurons in the hippocampus. Lactulose also exerts neuroprotective effects by increasing glial fibrillary acidic protein (GFAP)-immunoreactive cells ^[68].

Furthermore, lactulose has been shown to reduce bacterial DNA translocation in mild HE patients, resulting in lower serum ammonia levels and improved neurocognitive performance ^[69]. Approximately one-third of mild HE patients experience inflammatory bacterial antigen translocation, which lactulose reduces to 16%. This effect has also been observed in a rat model of acute liver failure, suggesting that lactulose inhibits bacterial translocation

and alleviates HE symptoms by improving intestinal permeability, accelerating intestinal transit, and reducing small intestinal bacterial overgrowth^[69,70].

3.3. Rifaximin

Rifaximin, a derivative of rifamycin, inhibits bacterial RNA and protein synthesis by irreversibly binding to the β -subunit of bacterial DNA-dependent RNA polymerase^[71]. It targets a broad spectrum of intestinal aerobic and anaerobic bacteria^[72]. In cirrhotic patients with HE-related symptoms, rifaximin has been shown to lower serum ammonia levels, significantly improve neurological signs and symptoms of overt HE, prevent HE episodes, and reduce hospitalization rates^[73,74].

Rifaximin has also demonstrated efficacy in treating acute HE^[75]. In two long-term randomized, non-blinded studies, rifaximin improved neurological and neuromotor abnormalities associated with cirrhosis and reduced the recurrence of HE episodes^[76,77]. Bajaj *et al.* further highlighted rifaximin's effectiveness in preventing HE relapse^[78].

Short-term rifaximin administration reduces blood ammonia levels, improves psychometric test scores, and decreases small intestinal bacterial overgrowth^[79]. Moreover, rifaximin has a direct impact on intestinal barrier function and the metabolome^[80,81]. A study investigating metabolic and microbial changes following rifaximin treatment found increased levels of eubacteria and beneficial bacterial species, reduced oxidative stress, and decreased production of aromatic amino acids and nitrogen. A reduction in *Verrucomicrobiaceae* levels was also observed in fecal samples. The development of HE, particularly mild HE, has been linked to increased *Eubacterium vulgare* in the feces and colonic mucosa of cirrhotic patients^[82].

Overall, research indicates that rifaximin improves HE by modulating bacterial metabolic function rather than altering overall bacterial abundance.

3.4. Combined treatment

Sharma *et al.* conducted a prospective randomized study involving 120 patients with cirrhosis to evaluate the synergistic effects of rifaximin and lactulose in the treatment of overt hepatic encephalopathy (OHE). The combination therapy of rifaximin and lactulose was found to be significantly more effective in achieving complete regression of HE compared to lactulose alone (76% vs. 44%, respectively)^[83]. Additionally, the combined treatment reduced mortality rates in OHE patients relative to lactulose monotherapy.

The impact of combined rifaximin and lactulose therapy on the composition of mucosal flora was also investigated. This combination significantly reduced the abundance of *Rothschildia spp.*, *Lauterichia spp.*, and *Veronococcaceae*, while increasing the abundance of *Propionibacterium spp.* compared to lactulose alone^[47]. Another study demonstrated that combined treatment with lactulose and rifaximin was more effective than monotherapy in improving cognitive function and reducing ammonia levels. Collectively, these findings suggest that combination therapies can enhance treatment efficacy by targeting multiple physiological levels^[84].

3.5. Probiotics

In addition to sugars and antibiotics, probiotics play a crucial role in the treatment of HE. Probiotics have been shown to be effective in managing irritable bowel syndrome^[85], ulcerative colitis^[86], and non-alcoholic fatty liver disease^[87], with an even more pronounced impact on HE. Studies indicate that probiotics increase the abundance of beneficial flora, reduce pathogenic bacteria, lower physical and psychosocial disease impact scores, and significantly reverse minimal hepatic encephalopathy (MHE), thereby reducing the occurrence of OHE^[88,89].

The therapeutic rationale for probiotics is based on the hypothesis that the pathogenesis of HE is linked to harmful microbial by-products, such as ammonia and indoles. The increased concentration of these toxic metabolites, combined with the impaired clearance function of the diseased liver, results in significant pathophysiological effects. Probiotic supplementation helps reduce ammonia levels by promoting the growth of beneficial bacteria, such as *Bifidobacteria* and *Lactobacilli*, thereby restoring balance to the intestinal microbiota ^[90].

A recent study further revealed that probiotics significantly reduced levels of C-reactive protein, tumor necrosis factor (TNF), FABP-6, and claudin-3, while markedly increasing neutrophil oxidation in HE patients receiving probiotic intervention ^[91]. These effects contributed to maintaining intestinal flora homeostasis by enhancing immune adaptability.

3.6. Fecal microbiota transplantation

Although lactulose and rifaximin are standard treatments for HE, recurrent HE is associated with high rates of disability and mortality. Additionally, both treatments are associated with issues such as microbial resistance and adverse side effects. Probiotics, while beneficial, have not been shown to be superior to lactulose or antibiotics in achieving remission in HE patients ^[92], highlighting the need for novel therapeutic approaches.

Growing research into advanced liver cirrhosis and HE has recognized the potential of fecal microbiota transplantation (FMT) as a treatment for recurrent HE. In one case study, a male patient with HE (MELD score 10) received FMT over five consecutive weeks. Improvements in concentration, serum ammonia levels, and quality of life were observed during the study period, with no hospitalizations reported. However, the beneficial effects of FMT did not persist after discontinuation, suggesting that heterologous microbiota did not colonize the new host, and repeated treatments may be necessary to maintain the therapeutic effect ^[93].

Larger sample sizes are needed to support and validate these findings. A recent non-blinded randomized controlled trial (RCT) evaluating the safety of FMT for recurrent HE reported a reduced incidence of serious adverse events in the FMT group (20%) compared to the control group (80%). FMT also increased the relative abundance of commensal bacterial groups, such as *Lactobacillaceae*, *Bifidobacteriaceae*, and *Ruminococcaceae* ^[94].

Furthermore, antibiotic pretreatment combined with FMT has been shown to improve intestinal dysbiosis and reduce hospitalizations. Bajaj et al. demonstrated that FMT restores the diversity of intestinal microbiota diminished by antibiotic use, while also addressing changes in short-chain fatty acids and bile acids ^[95]. Over longer periods, patients with HE who received antibiotic pretreatment combined with FMT exhibited improvements in clinical symptoms and cognitive function ^[96].

These findings confirm the significant therapeutic potential of FMT in treating HE. However, current studies primarily focus on the structural and functional changes in intestinal microorganisms and the safety of FMT ^[97]. Further research is required to identify the specific effective flora and metabolites, as well as the precise pathways and mechanisms underlying FMT's therapeutic effects.

4. Conclusion and perspective

The gut microbiota plays a pivotal role in human health and disease. Correcting microbiota dysbiosis and restoring normal gut microbiota has been reported to alleviate disease symptoms and complications, including advanced severe liver diseases such as cirrhosis and hepatic encephalopathy (HE). However, current clinical research on HE primarily focuses on cognition, metabolites, the inflammatory environment, and the composition and function of

intestinal microbiota, with several limitations.

Most studies investigating the treatment of diseases through the improvement of intestinal flora are restricted to animal models or isolated cases. While these studies have yielded promising results, differences in systems and physiology between humans and animals pose significant challenges in generalizing these findings to humans. Furthermore, in animal studies involving mice, factors such as fecal feeding behavior and cage effects can contribute to inaccuracies^[98].

It is important to note that the efficacy of intestinal microbiota-based treatments depends on factors such as the donor, the composition of the microbiota, the route of transplantation, and other variables. Additionally, the lack of long-term follow-up studies and appropriate controls hinders the assessment of potential adverse reactions, thereby affecting the broader application and promotion of these treatments.

Moreover, research on the role of gut microbiota in the early development of the nervous system is limited, and it remains unclear whether gut microbiota influences the occurrence and progression of related diseases in adulthood. To confirm that adjustments to intestinal flora can improve patient symptoms and prevent the progression of HE, more randomized controlled trials are required. Such studies should focus on changes in the composition of intestinal flora, the features of its metabolic products, their impact on the host, and the specific mechanisms involved.

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Effect of Nursing Interventions Based on APACHE II Scores on Gastrointestinal Function Recovery Time in Patients with Severe Pancreatitis

Yinfeng Wu*

Taizhou People's Hospital, Taizhou 225300, Jiangsu Province, China

*Corresponding author: Yinfeng Wu, wyf15996018931@126.com

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Abstract: *Objective:* To explore the application effect of nursing interventions based on APACHE II scores in patients with severe pancreatitis and its impact on the recovery time of the gastrointestinal function. *Methods:* A total of 86 patients with severe pancreatitis treated in our hospital from March 2023 to March 2024 were selected. Using a random number table method, the patients were divided into a control group receiving conventional nursing care and a study group receiving nursing interventions based on APACHE II scores, with 43 patients in each group. The intervention effects of the two groups were compared. *Results:* The recovery time of gastrointestinal function in the study group was significantly shorter than that in the control group ($P < 0.05$). After the intervention, the quality of life scores in the study group was significantly higher than those in the control group ($P < 0.05$). The incidence of complications in the study group was significantly lower than in the control group ($P < 0.05$). *Conclusion:* Nursing interventions based on APACHE II scores can shorten gastrointestinal recovery time and reduce complications in patients with severe pancreatitis, contributing to improved quality of life.

Keywords: Severe pancreatitis; APACHE II score; Nursing; Gastrointestinal function

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1. Introduction

As a common condition in intensive care units, severe pancreatitis poses critical risks to patients due to its rapid progression and changes. The clinical mortality rate of the disease ranges from 36% to 50%^[1]. Severe pancreatitis damages multiple organs in the body and can lead to complications such as multiple organ dysfunction syndrome, systemic inflammatory response syndrome, and pancreatic tissue infection, significantly increasing the risk of mortality^[2]. Studies have shown that effective treatment and intervention for severe pancreatitis can reduce the risk of complications and mortality^[3]. Based on this, a comparative study was conducted on 86 patients with severe pancreatitis treated at our hospital from March 2023 to March 2024 to investigate the effects of nursing

interventions based on APACHE II scores on the recovery time of the gastrointestinal function.

2. Materials and methods

2.1. General information

A total of 86 patients with severe pancreatitis admitted to our hospital from March 2023 to March 2024 were selected. Using a random number table method, the patients were divided into a control group (receiving conventional nursing care) and a study group (receiving nursing interventions based on APACHE II scores), with 43 patients in each group. The general information of the two groups was comparable ($P > 0.05$), as shown in **Table 1**. All patients and their families were informed about the purpose and methods of the study and signed informed consent forms. The study was conducted with the approval of the hospital's ethics committee.

Table 1. Comparison of general information between the two groups

Group	<i>n</i>	Gender		Age (years)	Disease duration (h)	BMI (kg/m ²)
		Male (%)	Female (%)			
Control	43	24 (79.07)	19 (44.19)	57.34 ± 8.32	2.25 ± 0.23	23.66 ± 3.51
Study	43	23 (53.48)	20 (46.51)	57.12 ± 8.61	2.23 ± 0.14	23.75 ± 3.62
χ^2 / t		0.047		0.120	0.487	0.117
<i>P</i>		0.829		0.904	0.626	0.907

2.2. Inclusion and exclusion criteria

Inclusion criteria:

- (1) Patients with typical clinical symptoms meet the diagnostic criteria ^[4] and are confirmed by diagnostic tests.
- (2) Patients capable of cooperating with nursing care independently or with the assistance of family members.
- (3) Patients with an Acute Physiology and Chronic Health Evaluation II (APACHE II) score of no less than 8.

Exclusion criteria:

- (1) Patients with cognitive or consciousness disorders, severe organ dysfunction, or malignant tumors.
- (2) Patients with pancreatic hemorrhage or necrosis.
- (3) Patients with bradycardia or hemodynamic instability.
- (4) Patients with incomplete clinical data.

2.3. Methods

2.3.1. Control group

Patients received conventional nursing care, including gastrointestinal decompression, medication guidance, monitoring vital signs, and observing disease progression.

2.3.2. Study group

On the basis of conventional care, patients received nursing interventions tailored to APACHE II scores:

- (1) APACHE II score evaluation: Specialized physicians with intensive care qualifications conducted APACHE II scoring upon admission. Higher scores were assigned to higher-level nurses, with

scoring repeated every 12 hours to adjust nursing methods. Senior nurses with provincial critical care qualifications acted as team leaders to collect score data, supervise implementation, and ensure adherence to nursing measures.

(2) Interventions based on APACHE II scores:

(a) Scores below 16:

- (i) 1:1 nurse-patient ratio. Nurses used communication techniques to address patient and family concerns, explain the disease and treatments, and alleviate anxiety.
- (ii) Vital signs (e.g., temperature, respiration) were recorded, along with cough frequency and sputum volume. Skin integrity was monitored.
- (iii) Abdominal massage and acupressure (e.g., Hegu and Zusanli points) were performed to promote bowel movements.
- (iv) Patients were guided to move their limbs to prevent deep vein thrombosis (DVT).

(b) Scores 16–25:

- (i) 1:1.5 nurse-patient ratio. Individualized nursing plans were developed.
- (ii) Vital signs were recorded every 2 hours. Abdominal massage, acupressure, regular turning, and limb massage were performed.
- (iii) Preventive measures against DVT and pressure ulcers were implemented.

(c) Scores above 25:

- (i) 1.5:2 nurse-patient ratio. Vital signs were monitored hourly, and cough and sputum volume were recorded.
- (ii) Airway management and turning were performed every 0.5 hours.
- (iii) Abdominal massage, acupressure, and limb activity guidance were strengthened.
- (iv) Patients were encouraged to lift their hips 80 times daily, soak their feet twice daily, and use intermittent gradient pressure devices to prevent DVT in comatose patients.

2.4. Observation indicators

- (1) Gastrointestinal function recovery time: Recovery metrics included time to first flatulence, bowel movement, relief from abdominal distension and pain, and restoration of bowel sounds.
- (2) Quality of life scores: Quality of life was assessed using the SF-36 Health Survey^[5], covering dimensions such as bodily pain, physical function, role-physical, general health, vitality, social function, emotional role, and mental health. Each dimension had a maximum score of 100, with higher scores indicating a better quality of life.
- (3) Incidence of complications: Complications assessed included pancreatic infection, pneumonia, and respiratory failure.

2.5. Statistical methods

Data were analyzed using SPSS 22.0 software. Normally distributed measurement data were expressed as mean \pm standard deviation (SD) and tested with *t*-tests, while count data were expressed as frequency [*n* (%)] and tested with χ^2 tests. A *P*-value of < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of gastrointestinal function recovery time between the two groups

The gastrointestinal function recovery time in the study group was significantly shorter than in the control group ($P < 0.05$). See **Table 2**.

Table 3. Comparison of gastrointestinal function recovery time between the two groups (mean \pm SD)

Group	<i>n</i>	First flatulence time (h)	First bowel movement time (h)	Abdominal pain relief time (d)	Abdominal distension relief time (d)	Bowel sound recovery time (d)
Control	43	22.32 \pm 5.32	51.33 \pm 12.32	5.13 \pm 1.32	6.54 \pm 1.32	5.98 \pm 1.63
Study	43	18.56 \pm 4.43	31.42 \pm 6.34	3.43 \pm 0.53	3.65 \pm 0.85	4.15 \pm 1.03
<i>t</i>		3.561	9.423	7.837	12.071	6.224
<i>P</i>		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

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

The quality of life scores in the study group after the intervention were significantly higher than those in the control group ($P < 0.05$). See **Table 3**.

Table 3. Comparison of quality of life scores before and after intervention (mean \pm SD, points)

		Control group (<i>n</i> = 43)	Study group (<i>n</i> = 43)	<i>t</i>	<i>P</i>
Bodily pain	Before	45.63 \pm 6.53	45.62 \pm 6.34	0.007	0.994
	After	81.02 \pm 8.32*	91.45 \pm 7.35*	6.161	< 0.001
Physiological function	Before	47.35 \pm 5.63	47.53 \pm 5.45	0.151	0.881
	After	81.03 \pm 6.35*	89.23 \pm 7.33*	5.545	< 0.001
Physical function	Before	43.32 \pm 9.32	43.63 \pm 9.42	0.153	0.878
	After	82.42 \pm 6.42*	91.06 \pm 5.52*	6.692	< 0.001
General health	Before	45.13 \pm 6.23	45.24 \pm 6.35	0.081	0.936
	After	82.78 \pm 6.35*	90.11 \pm 8.36*	4.579	< 0.001
Vitality	Before	47.14 \pm 6.62	47.46 \pm 6.21	0.231	0.818
	After	83.25 \pm 7.35*	92.02 \pm 8.52*	5.111	< 0.001
Social function	Before	44.24 \pm 6.73	44.32 \pm 6.35	0.057	0.955
	After	85.01 \pm 8.35*	93.52 \pm 9.42*	4.433	< 0.001
Emotional function	Before	46.24 \pm 8.35	46.44 \pm 8.31	0.111	0.912
	After	85.62 \pm 6.35*	93.22 \pm 8.25*	4.787	< 0.001
Mental health	Before	43.53 \pm 9.42	43.63 \pm 9.22	0.050	0.960
	After	84.98 \pm 6.33*	92.89 \pm 3.35*	7.242	< 0.001

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

3.3. Comparison of complication rates between the two groups

The complication rate in the study group was significantly lower than in the control group ($P < 0.05$). See **Table 4**.

Table 4. Comparison of complication rates between the two groups [n (%)]

Group	n	Pancreatic infection	Pneumonia	Respiratory failure	Total incidence
Control	43	3 (6.98)	2 (4.65)	1 (2.33)	6 (13.95)
Study	43	1 (2.33)	0 (0.00)	0 (0.00)	1 (2.33)
χ^2					3.888
P					0.049

4. Discussion

The onset of severe acute pancreatitis (SAP) is associated with various factors, including excessive alcohol consumption, overeating, and history of gallbladder disease, with middle-aged and elderly individuals being at higher risk ^[6]. SAP has an acute onset and severe progression, with a high mortality rate that significantly impacts patients' prognosis and quality of life. In addition to implementing scientific and standardized treatment measures, effective nursing interventions are crucial for the treatment and prognosis of SAP patients ^[7].

The Acute Physiology and Chronic Health Evaluation II (APACHE II) scoring system is primarily used to assess the condition and prognosis of critically ill patients. Research by Bi *et al.* ^[8] has shown that the APACHE II score is positively correlated with pancreatic infection in SAP patients. This correlation provides guidance for clinical interventions and has a positive effect on improving patient outcomes. Interventions guided by APACHE II scores can enhance the specificity and effectiveness of nursing care, thereby improving clinical outcomes ^[9].

In SAP patients, inflammatory mediators released due to various injuries and ischemia-reperfusion impair the intestinal mucosal barrier function, leading to an imbalance and translocation of intestinal toxins and metabolites. This can result in gut-derived bacteria and endotoxemia, making the restoration of gastrointestinal function critically important ^[10]. Tan *et al.* ^[11] noted that scientific nursing interventions in SAP patients can promote gastrointestinal recovery.

In this study, the gastrointestinal recovery time in the study group was significantly shorter than that in the control group. The nursing interventions, designed based on patients' APACHE II scores, enabled targeted and individualized care, enhancing the effectiveness of the interventions. Abdominal and acupoint massages promoted gastrointestinal recovery. Furthermore, the quality of life scores in the study group after the intervention were significantly higher than those in the control group. Effective nursing interventions improved disease control, alleviated symptoms, reduced psychological burdens, and enhanced physical and mental comfort, contributing to patient recovery and improved quality of life.

The results also demonstrated that the incidence of complications in the study group was significantly lower than in the control group. Nursing interventions based on APACHE II scores facilitated gastrointestinal recovery and improved patient monitoring, enabling timely detection of disease changes. Preventive measures were taken against potential complications, effectively reducing their incidence.

5. Conclusion

In conclusion, nursing interventions guided by APACHE II scores in SAP patients can promote gastrointestinal recovery, reduce complications, and improve quality of life, demonstrating clinical value.

Disclosure statement

The author declares no conflict of interest.

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Investigating the Current State of Caring Behavior Among Nursing Students

Cancan Cui^{1*}, Wenwen Guo¹, Yongxia Wei², Limin Cao³, Huan Li¹

¹Sias University, Zhengzhou 451100, Henan Province, China

²Seventh People's Hospital of Zhengzhou City, Zhengzhou 450000, Henan Province, China

³The First Affiliated Hospital of Zhengzhou University, Zhengzhou 450000, Henan Province, China

*Corresponding author: Cancan Cui, cui_cancan@hotmail.com

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Abstract: *Objective:* To investigate the current state of caring behavior among nursing students in a 3A hospital and analyze its influencing factors. *Methods:* A convenient sampling method was employed to survey 157 nursing students in a 3A hospital from October 2023 to March 2024, using a self-designed general data questionnaire and the Chinese version of the Caring Behavior Scale. *Results:* The caring behavior score of the nursing students was 102.39 ± 14.42 . Among the three dimensions, the highest score was observed in “respect and connection” (40.29 ± 6.65), while the lowest score was in “knowledge and skill” (22.25 ± 3.53). Statistically significant differences in caring behavior scores were found in relation to education level, relationship with parents (general), and unwillingness to engage in nursing work after graduation ($P < 0.05$). *Conclusion:* The caring behavior scores of the nursing students in this study were at a moderate level. Education level, the quality of the relationship with parents (general), and an unwillingness to pursue nursing as a career after graduation were identified as the primary influencing factors.

Keywords: Nursing students; Caring behavior; Status survey

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1. Introduction

Caring is a unique human “emotional” mode that provides comfort to patients ^[1]. Nurses’ caring behavior represents the essence and core of nursing practice ^[2]. As early as 1979, Watson *et al.* ^[3] examined nursing care behavior from philosophical and ethical perspectives. In China, research on caring behavior began relatively late, with most studies focusing on the impact of objective factors on caring behavior ^[4,5].

As the future workforce of the nursing industry, the caring behavior of nursing students directly influences patients’ medical experiences and levels of satisfaction ^[6]. Thus, the caring behavior of nursing students holds significant importance.

2. Materials and methods

2.1. General information

This survey adopted a convenience sampling method and selected 157 nursing students meeting the inclusion and exclusion criteria at a 3A hospital from October 2023 to March 2024.

Inclusion criteria: (1) Internship duration of ≥ 3 months; (2) Enrollment in a full-time nursing program; (3) Voluntary participation.

Exclusion criteria: (1) Absence from work during the investigation period.

2.2. Research tools

The questionnaire comprised two sections: a self-developed general data sheet and the Chinese version of the Nurse Caring Behavior Scale (CBI).

2.2.1. General data

The general data sheet was developed based on the objectives of the survey and included variables such as gender, age, and reasons for selecting nursing as a college major.

2.2.2. The Chinese version of the Nurse Caring Behavior Scale (Caring Behaviors Inventory, CBI)

The Caring Behaviors Inventory (CBI) was originally developed by Wolf in 1994^[7] and later translated into Chinese by Da in 2016^[8]. It is designed to measure the level of care demonstrated by student nurses toward patients. The inventory consists of 24 items distributed across three dimensions: respect and connection (items 1, 2, 3, 4, 5, 6, 7, 8, 13, 14), knowledge and skills (items 9, 10, 11, 12, 23), and support and assurance (items 15, 16, 17, 18, 19, 20, 21, 22, 24).

A six-point Likert scale was employed, where responses ranged from “never” (1 point) to “always” (6 points). The total score ranged from 24 to 144 points. The Cronbach’s α coefficient for the inventory was 0.959, indicating high reliability.

2.3. Statistical analysis

Statistical analysis was performed using SPSS 24.0. Quantitative data were described using the mean \pm standard deviation (SD), while qualitative data were expressed as frequency and relative frequency. Influencing factors of caring behavior were analyzed using the *t*-test, *F*-test, and multiple linear regression analysis. A *P*-value of < 0.05 was considered statistically significant.

2.4. Ethical considerations

All participants in this survey provided informed consent on a voluntary basis, with anonymity ensured throughout the process. All materials collected during the survey were used exclusively for scientific research purposes.

3. Results

A total of 180 questionnaires were distributed during the survey, with 157 completed and deemed valid, resulting in an effective recovery rate of 87.20%.

3.1. General information

The survey included 157 nursing students, of whom 142 (90.40%) were female, and 150 (95.50%) were undergraduate students. Detailed demographic and general information are presented in **Table 1**.

Table 1. General information of nursing students ($n = 157$)

Categories	Sub-categories	Number of cases	Composition ratio (%)
Gender	Male	15	9.55
	Female	142	90.45
Age (years)	≤ 22	69	43.95
	≥ 23	88	56.05
Level of education	Undergraduate	150	95.50
	Graduate and above	7	4.50
Only child status	Yes	38	24.20
	No	119	75.80
Relationship with parents	Good support	116	73.89
	Average	39	24.84
	Disharmony	2	1.27
Reason for selecting nursing as a major	Voluntary choice	49	31.21
	Family's wishes & peer influence	68	43.31
	Adjust	40	25.48
Care behavior education by hospital teachers	A lot of	26	16.56
	More	74	47.13
	Average	47	29.94
	Less	8	5.10
	Rarely	2	1.27
Willingness to work in nursing after graduation	Very willing	13	8.28
	General willing	98	62.42
	Willing	20	12.74
	Unwilling	26	16.56

3.2. Scores of nursing students across dimensions of caring behavior

The total score for caring behavior was 102.39 ± 14.42 , with the highest-scoring dimension being “respect and connection” (40.29 ± 6.65), and the lowest-scoring dimension being “knowledge and skills” (22.25 ± 3.53). Detailed scores across all dimensions are provided in **Table 2**.

Table 2. Scores of nursing students across dimensions of caring behavior ($n = 157$, mean \pm SD)

Dimension	Number of items	Score (mean \pm SD)	Rank
Respect and connection	10	40.29 \pm 6.65	1
Support and reassurance	9	39.85 \pm 6.06	2
Knowledge and skills	5	22.25 \pm 3.53	3
Total	24	102.39 \pm 14.42	-

3.3. Single-factor analysis of nursing students' caring behavior

Independent sample t -tests and analysis of variance revealed significant differences in nursing students' caring behavior scores based on education level, relationship with parents, reasons for selecting nursing as a major, care behavior education by hospital teachers, and willingness to work in nursing after graduation ($P < 0.05$). Detailed results are presented in **Table 3**.

Table 3. Univariate analysis of factors affecting the caring behavior of nursing students ($n = 157$, mean \pm SD)

Category	Sub-category	Number of cases	Score	F/t	P
Gender	Male	15	99.20 \pm 13.12	-0.902	0.369
	Female	142	102.73 \pm 14.55		
Age (years)	≤ 22	69	100.56 \pm 14.71	-1.412	0.160
	≥ 23	88	103.83 \pm 14.11		
Level of education	Undergraduate	150	101.55 \pm 13.74	-3.505	0.001
	Graduate and above	7	120.43 \pm 17.99		
Only child status	Yes	38	101.66 \pm 14.37	-0.361	0.719
	No	119	102.63 \pm 14.49		
Relationship with parents	Good support	116	104.22 \pm 14.46	4.422	0.014
	Average	39	97.85 \pm 13.22		
	Disharmony	2	85.50 \pm 2.12		
Reason for selecting nursing as a major	Voluntary choice	49	106.27 \pm 15.60	3.229	0.042
	Family's wishes & peer influence	68	101.78 \pm 13.41		
	Adjust	40	98.70 \pm 13.80		
Care behavior education by hospital teachers	A lot of	26	107.81 \pm 15.85	3.090	0.018
	More	74	103.51 \pm 15.53		
	Average	47	99.98 \pm 11.03		
	Less	8	93.00 \pm 7.71		
	Rarely	2	85.00 \pm 9.90		
Willingness to work in nursing after graduation	Very willing	13	110.00 \pm 12.36	5.626	0.001
	General willing	98	104.22 \pm 14.73		
	Willing	20	100.45 \pm 11.37		
	Unwilling	26	93.63 \pm 12.58		

3.4. Multiple linear regression analysis of nursing students' caring behavior

To further explore predictors of nursing students' caring behavior, variables showing significant differences in the univariate analysis (education level, relationship with parents, reason for selecting nursing, care behavior education by hospital teachers, and willingness to work in nursing after graduation) were included as independent variables. Dummy variables were assigned, and multiple linear regression analysis was conducted. The results indicated that education level, relationship with parents (general), and unwillingness to work in nursing after graduation entered the regression equation ($R^2 = 0.165$, adjusted $R^2 = 0.149$). Details are provided in **Table 4**.

Table 4. Multiple linear regression analysis of factors influencing nursing students' caring behavior ($n = 157$)

Entry	<i>B</i>	<i>SE</i>	<i>B'</i>	<i>t</i>	<i>P</i>
(Constant)	104.51	1.32		79.197	< 0.001
Education level	18.879	5.15	0.271	3.668	< 0.001
Relationship with parents (general)	-5.735	2.46	-0.172	-2.329	0.021
Willingness to work in nursing after graduation (unwilling)	-9.238	2.86	-0.239	-3.228	0.002

4. Discussion

4.1. Current situation of nursing students' caring behavior

In this survey, the total score for the caring behavior of nursing students during their practical training was 102.39 ± 14.42 , which corresponds to a medium level. This score is lower than that reported in Zhou's survey of 260 clinical nurses, indicating that the caring behavior of nursing students in China requires improvement^[9]. Among the three dimensions, "respect and connection" received the highest score (40.29 ± 6.65), while "knowledge and skills" received the lowest (22.25 ± 3.53), consistent with the findings of Chi's study^[10]. This outcome may be attributed to the heightened sensitivity of nurse interns to ethical considerations when first entering clinical practice, as well as their increased availability to communicate with patients^[4,11]. However, the knowledge and clinical skills acquired during training may not yet be adequately applied to real-world clinical settings.

4.2. Factors influencing nursing students' caring behavior

4.2.1. Education level

As indicated in **Table 4**, the education level of nursing students demonstrates a significant effect on their total caring behavior scores ($P < 0.001$). This aligns with Xu's conclusion that humanistic care training serves as a key factor influencing the caring behavior of clinical nurses^[12]. The findings suggest that higher levels of education provide more comprehensive and detailed training in caring behavior, thereby enhancing its development among nursing students.

4.2.2. Relationship with parents (general)

Table 4 also shows that a "general" relationship with parents significantly impacts the total caring behavior scores of nursing students ($P = 0.021$). This outcome may stem from the positive influence of parental care, which often serves as a model, encouraging nursing students to adopt a caring approach in practice^[13]. Such guidance may foster a stronger sense of empathy and attentiveness toward patients, thereby improving patients' overall medical experiences and compliance^[14].

4.2.3. Willingness to work in nursing after graduation (unwilling)

The willingness to pursue a nursing career after graduation (specifically, those categorized as “unwilling”) is another factor that significantly affects the total caring behavior scores of nursing students ($P = 0.002$), as indicated in **Table 4**. This finding may be attributed to the observation that nursing students who possess a strong interest in the nursing profession are more likely to channel their energy and enthusiasm into the field^[10,15].

5. Conclusion

The caring behavior of nursing students is at a medium level. Education level, the quality of the relationship with parents (general), and willingness to work in nursing after graduation (unwilling) have been identified as the primary factors influencing the caring behavior of nursing students.

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Meta-analysis of Influencing Factors of Psychological Distress in Patients with Enterostomy

Jingjing Wang, Long Zhang*

School of Nursing, Yanbian University, Yanji 133000, Jilin Province, China

*Corresponding author: Long Zhang, zhanglong@ybu.edu.cn

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Abstract: *Objective:* To explore the factors affecting the psychological pain of patients with enterostomy through meta-analysis, with the aim of reducing psychological pain and improving patients' quality of life. *Methods:* Published literature on psychological pain in enterostomy patients was retrieved from Chinese and English databases, including CNKI, Wanfang, VIP, China Biomedical Network, PubMed, Embase, Ovid, and Web of Science. The search period covered the establishment of the databases until October 2024. Literature was screened based on inclusion and exclusion criteria, and its quality was evaluated. Data analysis was performed using R Studio software. *Results:* A total of 2,237 articles involving 1,221 patients with enterostomy and 11 influencing factors were identified. The results of the meta-analysis indicated that age, marital status, ostomy complications, self-care ability, pain severity, and sleep quality were the primary contributors to psychological distress. *Conclusion:* Multiple factors influence psychological pain in enterostomy patients. Medical staff should prioritize addressing these factors to alleviate psychological pain and enhance patients' quality of life.

Keywords: Enterostomy; Psychological pain; Influencing factors; Meta-analysis

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1. Introduction

Enterostomy, also referred to as an artificial anus, is a commonly employed procedure in the treatment of Crohn's disease, ulcerative colitis, colorectal cancer, and other conditions ^[1]. Globally, the number of patients requiring enterostomy is substantial. In China alone, the number of patients with enterostomies has exceeded one million and continues to grow ^[2,3]. Following enterostomy, patients often face issues such as changes in body image, odor, and postoperative complications, which contribute to feelings of stigma and varying levels of psychological pain ^[4,5].

Psychological pain represents a significant challenge for patients with enterostomy. It is characterized as an unpleasant emotional experience triggered by various factors and is recognized by the NCCN as the "sixth vital sign," following pain ^[6]. The WCET International Ostomy Guide highlights that psychological pain negatively impacts patients' quality of life, with heightened negative emotions exacerbating psychological pain and further impairing quality of life ^[7].

Healthcare professionals must focus on the factors contributing to psychological pain in enterostomy patients. While existing research has examined these influencing factors, discrepancies among findings persist. Additionally, no meta-analyses have been conducted to comprehensively investigate the factors influencing psychological pain in this patient population.

Therefore, this study employs meta-analysis to identify and evaluate the influencing factors of psychological pain in patients with enterostomy. The findings aim to guide clinical practices in addressing psychological pain and implementing effective interventions to improve patient's quality of life.

2. Materials and methods

2.1. Sources of data

Chinese and English databases, including CNKI, Wanfang, VIP, China Biomedical Network, PubMed, Embase, Ovid, and Web of Science, were searched. The search period spanned from the establishment of the databases to October 2024. The search strategy combined subject terms and free terms. The Chinese search terms included “enterostomy, enterostomy,”; “psychological pain, psychological distress, emotional distress,”; and “influencing factors, correlating factors, risk factors, correlations, etc.” The English search terms included “colostomy, stoma”; “psychological distress, distress syndrome, emotional distress, related factors, and cross-sectional study.”

2.2. Literature inclusion and exclusion criteria

Inclusion criteria:

- (1) Study subjects: patients over 18 years old with enterostomy;
- (2) Type of study: cross-sectional study;
- (3) Research tool: psychological pain thermometer;
- (4) Outcome index: influencing factors of psychological pain.

Exclusion criteria:

- (1) Non-Chinese and non-English literature;
- (2) Conference papers, dissertations, reviews, etc.;
- (3) Studies where the full text was unavailable;
- (4) Studies that did not report the influencing factors of patients' psychological distress.

2.3. Literature screening, quality evaluation, and data extraction

The literature was imported into EndNote X20 software, and duplicate entries were removed. Titles and abstracts were then reviewed, followed by a detailed selection of studies meeting the inclusion criteria. This study adopted the cross-sectional research criteria of the JBI Evidence-Based Health Care Center^[8]. Quality evaluation was conducted using four dimensions: “yes,” “no,” “unclear,” and “not applicable.” The extracted data included the first author, year of publication, region, type of study, assessment tool, average age, sample size, influencing factors, OR value/B value, and 95% CI.

2.4. Statistical processing

Meta-analysis was performed using R Studio software. The I^2 value was used to assess the heterogeneity of the included studies. If $P > 0.1$ and $I^2 \leq 50\%$, the studies were considered to have good homogeneity and a fixed-effect model was applied to integrate the influencing factors. For studies with heterogeneity, a random-effect model was

used. In cases of heterogeneity, sensitivity analysis was conducted to identify its root cause.

3. Results

3.1. Literature search results

The database search yielded a total of 2237 articles, including 40 from CNKI, 1846 from Wanfang, 13 from VIP, 37 from the China Biomedical Network, 19 from PubMed, 81 from Web of Science, 212 from Embase, and 68 from Ovid. After stepwise screening, six papers ^[9-14] were ultimately included. The process of literature screening is illustrated in **Figure 1**.

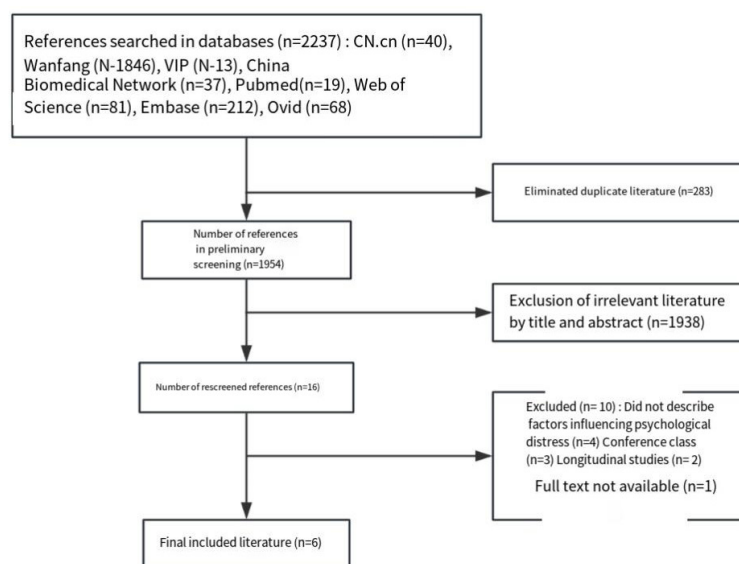


Figure 1. Literature screening flow chart

3.2. Basic characteristics of included literature

Six cross-sectional studies were included in this meta-analysis, involving a total of 1221 patients with enterostomy. The basic characteristics of the included literature are detailed in **Table 1**.

Table 1. Basic characteristics of the included literature

Included studies	Years	Survey area	Assessment tools	Average age (years)	Sample size	Influencing factors
Mou Qianqian ^[9]	2018	Sichuan	Psychological pain thermometer	53.30 ± 11.60	137	②⑦
Liu Xin ^[10]	2019	Guangxi	Psychological pain thermometer	52.80 ± 10.09	180	③⑤⑥⑧
Shi Yanping ^[11]	2019	Henan	Psychological pain thermometer	61.00 ± 9.00	112	①③④⑤⑩
Jing Min ^[12]	2020	Hebei	Psychological pain thermometer	63.96 ± 11.08	86	①②⑥⑦
Wang Airu ^[13]	2020	Sichuan	Psychological pain thermometer	-----	146	②⑥⑦
Wu Wei ^[14]	2020	Harbin	Psychological pain thermometer	56.23 ± 8.35	560	①④⑤⑦⑨⑩

Note: ① Age; ② Marital status; ③ Education; ④ Family income; ⑤ Ostomy complications; ⑥ Ostomy self-care ability; ⑦ Pain level; ⑧ Carer; ⑨ Psychological status; ⑩ Sleep status; ⑪ Personality.

3.3. Quality evaluation

The selected studies were determined to be of high quality. The quality evaluation results are presented in **Table 2**.

Table 2. Quality evaluation of included studies

Included studies	①	②	③	④	⑤	⑥	⑦	⑧
Mou Qianqian ^[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Liu Xin ^[10]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shi Yanping ^[11]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jing Min ^[12]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wang Airu ^[13]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wu Wei ^[14]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: ① Are the inclusion criteria of the subjects clearly defined? ② Are the research objects and research sites described in detail? ③ Were exposure factors measured using valid and reliable methods? ④ Are objective and standardized methods used to measure health problems? ⑤ Are confounding factors identified? ⑥ Are measures taken to control confounding factors? ⑦ Are effective and credible methods used to measure outcome indicators? ⑧ Is the data analysis method appropriate?

A meta-analysis was conducted on the influencing factors identified in the included studies. Eight influencing factors with effect sizes that could be synthesized were extracted. The results revealed good homogeneity for marital status and sleep status ($I^2 < 50\%$). For these factors, the fixed-effect model was employed, and significant differences were observed ($P < 0.05$). In contrast, high heterogeneity ($I^2 > 50\%$) was identified for age, education level, family income, ostomy complications, ostomy self-care ability, and pain level. For these factors, the random-effects model was applied. Significant differences were found for age, ostomy complications, ostomy self-care ability, and pain level ($P < 0.05$), while education level and family income did not show significant differences ($P > 0.05$). Sensitivity analysis indicated stable results for all influencing factors.

Table 3. Meta-analysis results of influencing factors of psychological distress in enterostomy patients

Influencing factors	Number of articles	Heterogeneity test		Effect model	Meta-analysis		Sensitivity analysis
		I^2 (%)	P value		OR (95% CI)	P value	OR (95% CI)
Age	3 ^[11,12,14]	76.1	0.015	Random	0.05 (0.01; 0.17)	0.001	0.03 (0.02; 0.04)
Marital status	3 ^[9,12,13]	0.0	0.969	Fixed	0.23 (0.13; 0.41)	0.001	0.23 (0.13; 0.41)
Literacy	2 ^[10,11]	86.6	0.006	Random	0.84 (0.44; 1.57)	0.575	0.96 (0.79; 1.17)
Household income	2 ^[11,14]	91.7	0.001	Random	0.65 (0.03; 15.77)	0.354	0.65 (0.26; 1.62)
Ostomy complications	3 ^[10,11,14]	70.5	0.034	Random	6.40 (1.92; 21.38)	0.003	4.94 (2.84; 8.59)
Ostomy self-care ability	3 ^[10,12,13]	82.4	0.003	Random	3.77 (1.74; 8.18)	0.001	5.48 (4.15; 7.23)
Pain level	4 ^[9,12-14]	91.3	0.001	Random	5.70 (2.11; 15.42)	0.001	5.52 (4.32; 7.06)
Sleep status	2 ^[11,14]	0.0	0.846	Fixed	3.58 (1.69; 7.57)	0.001	3.58 (1.69; 7.57)

4. Discussion

4.1. General factors

This study found that the age of patients with enterostomy was associated with psychological distress. Specifically, as age increases, the degree of psychological distress tends to decrease. This finding is consistent with the results reported by Wu *et al.* ^[14], which may be attributed to the stronger psychological endurance of older individuals ^[12]. The influence of marital status on psychological distress was statistically significant. Multiple studies have indicated that the higher incidence of psychological distress among unmarried patients, compared to married patients, may be related to their experience of significant illness events at an early stage in life, changes in body image, excessive concern about how others perceive them, and a lack of emotional support ^[9,12,13]. The meta-analysis conducted in this study showed that the combined results for education level and total household income were not statistically significant.

4.2. Ostomy complications

The incidence of enterostomy complications in China is reported to be as high as 53.8% ^[15]. This study demonstrated that ostomy complications significantly impact the psychological distress of patients, indicating that complications increase the risk of psychological distress. In other words, patients with ostomy complications tend to experience a higher level of psychological distress. This may be attributed to the fact that the occurrence of complications further increases the economic burden on patients, a finding that aligns with the results of Shi *et al.* ^[11]. Therefore, healthcare professionals should prioritize the prevention and management of postoperative complications to alleviate psychological distress among patients.

4.3. Self-care ability of ostomy

The effect of ostomy self-care ability on psychological distress was found to be statistically significant in this study. Patients with higher self-care abilities exhibited a lower incidence of psychological distress and an improved quality of life ^[13,14]. This indicates that self-care ability plays a crucial role in reducing psychological distress among patients with enterostomy.

4.4. Pain level

The findings of this study suggest that pain is closely associated with the occurrence of psychological distress. The risk of psychological distress increases with the severity of pain. Persistent pain can exacerbate psychological distress, thereby negatively affecting the quality of life ^[14]. Healthcare professionals should strengthen the assessment of patients' pain levels and implement effective interventions promptly to alleviate pain, reduce psychological distress, and enhance the overall quality of life.

4.5. Sleep status

The results of this study indicate that sleep status is significantly related to psychological distress, with patients experiencing sleep disorders having a higher incidence of psychological distress. Sleep disorders can lead to anxiety, depression, and other adverse emotions, which, in turn, exacerbate psychological distress, weaken immune function, and accelerate disease progression ^[16]. The research by Cui *et al.* ^[17] similarly highlights that excessive psychological stress can cause insomnia, leading to anxiety and depression, and subsequently intensifying psychological distress. Therefore, healthcare professionals should address sleep-related issues among patients

with enterostomy. Effective interventions should be implemented for patients with sleep disorders to alleviate psychological distress.

Psychological distress is a common condition among patients with enterostomy^[18]. The study by Chen *et al.*^[19] reported that the overall detection rate of psychological distress in such patients was as high as 56.8%. In the current study, a meta-analysis was conducted, revealing that the degree of psychological distress is influenced by factors such as age, marital status, complications, self-care ability, pain severity, and sleep status.

4.6. Limitations

While previous studies have systematically evaluated psychological distress in patients with enterostomy, these studies primarily focused on detection rates and did not thoroughly assess the influencing factors. Consequently, this study has some limitations. First, the included studies are generally of high quality but are all cross-sectional, which may affect the reliability of the results. Second, there is a limited number of original studies on factors influencing psychological distress in enterostomy patients, potentially affecting the accuracy of the findings. Lastly, only studies that provided odds ratios (ORs) and 95% confidence intervals were included, and the limited number of studies prevented subgroup analyses and publication bias detection.

5. Summary

This study identified age, marital status, ostomy complications, ostomy self-care ability, pain severity, and sleep status as the primary factors contributing to psychological distress among patients with enterostomy. Currently, the prevalence of psychological distress in patients with enterostomy remains high but has not received sufficient attention. It is essential for healthcare professionals to recognize these contributing factors and implement measures to reduce the incidence of psychological distress among patients.

Disclosure statement

The authors declare no conflict of interest.

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The Application of Infusion Project Team in the Safety Risk Management of Indwelling Needle Use

Liumei Wei, Wenjing Li*, Huiyu Zhou, Siyi Xian, Xuemei Xi

Maternal and Child Health Care Hospital of Guangxi Zhuang Autonomous Region, Nanning 530000, Guangxi Zhuang Autonomous Region, China

*Corresponding author: Wenjing Li, wcw13471180158@163.com

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Abstract: *Objective:* To explore the effectiveness of applying an infusion project team in the safety risk management of indwelling needle use. *Methods:* A total of 200 patients who used intravenous indwelling needles during hospital treatment from July to October 2022 were selected and randomly divided into an observation group and a control group, with 100 patients in each group. Patients in the control group received routine nursing methods, while those in the observation group were managed using the safety risk management method of the infusion project team. The tube blocking rate and tube removal rate were compared between the two groups. *Results:* The one-time puncture success rate and the standard implementation rate of intravenous indwelling needle use in the observation group were significantly higher than those in the control group. The total incidence of complications in the observation group was significantly lower than that in the control group, and patient satisfaction in the observation group was notably higher, with statistically significant differences ($P < 0.05$). *Conclusion:* The application of an infusion project team in the safety risk management of indwelling needle use is effective and has positive impacts on improving the one-time puncture success rate, the standard implementation rate of intravenous indwelling needle use, and patient satisfaction. It is a practice worth promoting in clinical settings.

Keywords: Infusion project team; Indwelling needle use; Safety risk management; Application

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1. Introduction

Intravenous indwelling needles are essential tools in clinical infusion therapy, with their safety directly influencing therapeutic outcomes and patient comfort^[1]. However, the use of intravenous indwelling needles is associated with safety risks, such as infection, thrombosis, vascular injury, and other complications^[2]. These risks not only increase patient discomfort but also negatively impact therapeutic effectiveness. Consequently, managing the safety risks associated with indwelling needle use and minimizing complications has become a critical focus in clinical nursing practice.

This study aims to investigate the application and effectiveness of infusion project teams in the safety risk management of indwelling needle use. The goal is to provide scientific and standardized guidance for the clinical use of indwelling needles, thereby enhancing safety and treatment outcomes.

2. Materials and methods

2.1. General information

A total of 200 patients who underwent intravenous indwelling needle treatment during hospitalization from July to October 2022 were selected. The patients were randomly divided into an observation group and a control group, with 100 patients in each group. In the observation group, there were 60 male and 40 female patients, ranging in age from 1 to 6 years, with a mean age of (5.34 ± 0.78) years. The control group comprised 59 male and 41 female patients, aged 1 to 6 years, with a mean age of (5.51 ± 0.66) years.

Inclusion criteria: (1) Met the clinical use criteria for intravenous indwelling needles; (2) Underwent continuous intravenous infusion therapy for more than 72 hours; (3) The patient's guardian voluntarily signed an informed consent form after being fully briefed on the purpose, potential risks, and precautions associated with the intravenous indwelling needle.

Exclusion criteria: (1) Extensive or severe skin damage, inflammation, or infection affecting venipuncture success rates and safety; (2) Allergies to the components of the clear dressing used for securing the indwelling needle; (3) Use of hypertonic solutions or highly chemically irritating medications in treatment protocols.

2.2. Methods

2.2.1. Control group

Patients in the control group received standard nursing care for indwelling needles, which included the following steps:

- (1) Patient education: The procedure and purpose of using intravenous indwelling needles were explained to the patients and their parents, along with precautions during the indwelling period. This ensured that patients and their guardians were adequately informed ^[3].
- (2) Puncture procedure: Based on each patient's condition, appropriate blood vessels and puncture sites were selected. Sterile procedures were strictly followed during the insertion of the indwelling needle. Post-procedure, patients and their parents were reminded of safety and comfort-related precautions ^[4].
- (3) Health education: A 30-minute health education session was conducted for patients and their parents. The session covered the use, maintenance, possible complications, and troubleshooting of the indwelling needle to enhance awareness and self-care capabilities ^[5].
- (4) Routine monitoring: Regular inspections were conducted to monitor the indwelling needle, puncture site, and the patient's overall condition for one week ^[6].

2.2.2. Observation group

In addition to standard nursing care, the observation group adopted a safety risk management approach led by the infusion project team, which entailed the following:

- (1) Establishment of an infusion management project team: A specialized project team comprising experienced nurses was established to develop rules, regulations, operating procedures, and emergency protocols for

indwelling needle use. The team regularly supervised and evaluated implementation to ensure adherence to established measures ^[7].

- (2) Nurse training: Systematic training was provided to nurses, focusing on the “Industry Standard for Intravenous Therapy Nursing.” Training included theoretical sessions, practical exercises, and case analyses to enhance technical skills and awareness of safety risks ^[8].
- (3) Key aspects of detailed nursing: The project team compiled a list of key nursing practices for indwelling needle operation and maintenance. This included selecting and disinfecting puncture sites, securing and protecting the needle, managing extension tubes and joints, and replacing and monitoring dressings. Nurses were trained to focus on these details to minimize errors ^[9].
- (4) Operation video and teaching programs: A detailed video demonstrating the correct procedures for using indwelling needles was produced. The video covered the entire process, from preparation to post-puncture care. Nurses were required to watch the video to refine their skills. Additionally, experienced nurses mentored less experienced staff, sharing effective techniques for puncture and maintenance. Weekly competitions emphasizing “steady, accurate, and fast” puncture techniques were held to improve performance ^[10].
- (5) Systematic nursing interventions: A series of interventions were implemented, including (a) Educating patients and guardians to improve understanding and cooperation; (b) Establishing a registration and tracking system for indwelling needle use to ensure accurate monitoring; (c) Conducting regular safety risk assessments to identify and address potential hazards; (d) Monitoring patients’ skin conditions and using improved dressing materials ^[11].

2.3. Observation indicators

- (1) The one-time puncture success rate and the standard implementation rate of intravenous indwelling needle use were compared between the two groups.
- (2) Complications, such as phlebitis, drug extravasation, and accidental extubation, were recorded for both groups.
- (3) A self-developed nursing satisfaction questionnaire was used to evaluate the satisfaction of patients’ parents. The questionnaire assessed three dimensions—nursing procedures, service attitude, and timeliness—using a score range of 0 to 100, with higher scores indicating greater satisfaction.

2.4. Statistical methods

Data were analyzed using SPSS 20.0 statistical software. Categorical data were expressed as percentages, while continuous data were presented as mean \pm standard deviation (SD). The χ^2 tests and *t*-tests were used for analysis, with statistical significance set at $P < 0.05$.

3. Results

3.1. One-time puncture success rate and standard implementation rate of intravenous indwelling needle

The success rate of one-time puncture and the standard implementation rate of intravenous indwelling needle use was significantly higher in the observation group compared to the control group, with statistical significance ($P <$

0.05). Detailed data are presented in **Table 1**.

Table 1. One-time puncture success rate and standard implementation rate of intravenous indwelling needle in the two groups during the nursing period

Group (<i>n</i> = 100)	One-time puncture success rate (%)	The standard implementation rate of intravenous indwelling needle (%)
Observation group	95.00	94.00
Control group	72.00	73.00

3.2. Occurrence of complications in the two groups

The total incidence of complications in the observation group was significantly lower than that in the control group, with statistical significance ($P < 0.05$). Detailed data are shown in **Table 2**.

Table 2. Incidence of complications in the two groups

Group (<i>n</i> = 100)	Catheter blockage	Phlebitis	Skin reactions	Drug exosmosis	Total
Observation group	1	1	1	1	2
Control group	5	4	6	2	17

3.3. Satisfaction of parents in both groups

Parental satisfaction in the observation group was significantly higher than in the control group, with statistical significance ($P < 0.05$). The comparison of satisfaction scores between the two groups is detailed in **Table 3**.

Table 3. Satisfaction of parents of patients in the two groups (score, mean \pm SD)

Group (<i>n</i> = 100)	Nursing operations	Service attitude	Timeliness of care
Observation group	95.45 \pm 3.55	97.25 \pm 4.25	96.77 \pm 4.23
Control group	70.56 \pm 4.53	74.33 \pm 4.22	75.45 \pm 4.11

4. Discussion

4.1. Influencing factors for the safety risk management of indwelling needle use

Indwelling needles are an essential component of modern medical treatment, and ensuring their safe use is critical. However, their safety is influenced by various factors, such as the duration of indwelling. Prolonged indwelling time increases the risks of infection and thrombosis ^[12]. Nursing staff must carefully manage the duration of indwelling and perform timely replacements based on the patient's specific conditions and clinical requirements. To mitigate risks associated with long-term use, continuous observation, and enhanced nursing care are essential to identify and address potential complications promptly ^[13].

For instance, the success rate of a puncture is a significant factor. Puncture failure not only causes pain to patients but may also result in vascular damage, bleeding, and an increased risk of infection. Therefore, nursing staff should prioritize training to enhance their puncture skills and adopt correct techniques to ensure a high success rate. Similarly, issues such as blood accumulation or return in the extension tube or joint can impede the patency of the indwelling needle and create an environment conducive to bacterial growth, thus increasing

infection risks. To address this, nurses must strictly adhere to aseptic principles, regularly inspect and clean the extension tube and joint, and ensure internal cleanliness to prevent contamination.

4.2. Application of the infusion project team in safety risk management of indwelling needle use

This study analyzed data obtained from selected patients and highlighted the impact of the infusion project team on the safety risk management of indwelling needle use.

Firstly, the observation group demonstrated a significantly higher one-time puncture success rate and standard implementation rate of intravenous indwelling needle use compared to the control group. This finding underscores the positive role of the infusion project team. Through professional training, guidance, and the establishment of detailed operating procedures and regulations, nursing staff improved their puncture skills substantially. This ensured the standardization and safety of indwelling needle use, reduced puncture failures, and alleviated patient discomfort. By adhering strictly to established guidelines during clinical practice, nurses effectively minimize risks associated with improper procedures.

Secondly, the observation group exhibited a markedly lower total incidence of complications compared to the control group, further confirming the effectiveness of the infusion project team. Enhanced risk monitoring and preventive measures enabled nursing staff to promptly identify and address potential safety hazards, thereby reducing the occurrence of complications ^[14].

Finally, parental satisfaction in the observation group was significantly higher than that in the control group, highlighting the role of the infusion project team in enhancing service quality. By optimizing service workflows and strengthening communication, nursing staff were better equipped to meet the needs of patients and their families, thereby improving the overall medical experience ^[15].

5. Conclusion

In conclusion, the application of the infusion project team in the safety risk management of indwelling needle use has yielded remarkable results. The findings indicate that the infusion project team significantly enhances the professional skills and adherence to operating standards among nursing staff, effectively reduces the incidence of complications, and improves patient and parental satisfaction.

Thus, the infusion project team's approach to managing the safety risks associated with indwelling needle use is both effective and deserving of broader adoption in clinical practice. Moving forward, nursing staff should continue to refine and expand this management model, exploring innovative methods to enhance safety risk management in the use of indwelling needles. This will contribute to delivering safer, more efficient, and higher-quality medical services to patients.

Disclosure statement

The authors declare no conflict of interest.

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C-reactive Protein (CRP) and Procalcitonin (PCT) Combined Testing in the Diagnosis of Elderly Patients with Bacterial Pneumonia

Bingzhi Li*

Daqing Third Hospital, Daqing 163712, Heilongjiang Province, China

*Corresponding author: Bingzhi Li, libing_zhi2024@163.com

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Abstract: *Objective:* To analyze the diagnostic value of combined testing of C-reactive protein (CRP) and procalcitonin (PCT) in elderly patients with bacterial pneumonia. *Methods:* This study included 50 elderly patients with bacterial pneumonia as the observation group and 50 patients with non-bacterial pneumonia as the control group, recruited from May 2022 to October 2023. Fasting venous blood samples were collected in the morning from all 100 participants. CRP levels were measured using a fully automated biochemical analyzer, while PCT levels were detected using the immunoturbidimetric luminescence method. *Results:* CRP and PCT levels were significantly higher in bacterial pneumonia patients [(98.25 ± 11.59) mg/L and (3.57 ± 1.35) µg/L, respectively] compared to the control group [(5.55 ± 2.78) mg/L and (0.25 ± 0.12) µg/L, respectively], with significant intergroup differences ($P < 0.05$). Patients with severe bacterial pneumonia exhibited higher serum CRP and PCT levels compared to those with moderate or mild disease ($P < 0.05$). The combined testing of CRP and PCT showed higher sensitivity and specificity than individual tests. In the observation group, CRP and PCT levels significantly decreased after treatment compared to pre-treatment levels. *Conclusion:* The combination of CRP and PCT testing provides high diagnostic accuracy for bacterial pneumonia in elderly patients. It effectively differentiates bacterial from non-bacterial infections, offering valuable data to guide clinical treatment.

Keywords: C-reactive protein (CRP); Procalcitonin (PCT); Combined testing; Elderly bacterial pneumonia

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1. Introduction

Elderly individuals are among the high-risk populations for bacterial pneumonia, where diagnosis and treatment often present significant challenges. Due to age-related immune decline and coexisting chronic conditions, the clinical manifestations of bacterial pneumonia in elderly patients are often atypical and easily confused with other respiratory diseases, leading to unclear diagnostic results and worse patient outcomes^[1]. Timely diagnosis and effective treatment are therefore critical for reducing mortality and complications associated with bacterial

pneumonia in elderly patients.

C-reactive protein (CRP) and procalcitonin (PCT) are commonly used inflammatory biomarkers widely applied in diagnosing and assessing infectious diseases. Advances in medical technology and an increasing understanding of elderly bacterial pneumonia have demonstrated that the combined testing of CRP and PCT improves diagnostic accuracy for bacterial pneumonia in elderly patients ^[2].

Based on this, the present study aims to comprehensively analyze the value of CRP and PCT combined testing in the diagnosis of elderly bacterial pneumonia, providing a new diagnostic approach for clinical practice. This study involved 50 cases of bacterial pneumonia and 50 cases of non-bacterial pneumonia recruited from May 2022 to October 2023.

2. Materials and methods

2.1. Clinical data

The study was conducted from May 2022 to October 2023 and included 50 elderly patients with bacterial pneumonia as the observation group and 50 patients with non-bacterial pneumonia as the control group.

Inclusion criteria: (1) Age ≥ 60 years; (2) Agreed to participate in the study and signed an informed consent form.

Exclusion criteria: (1) Patients with mental disorders who could not communicate autonomously or had poor compliance; (2) Patients with coagulation disorders; (3) Patients with malignant tumors.

The clinical data of the two groups, including gender and age, showed no statistically significant differences. Detailed information is displayed in **Table 1**.

Table 1. Clinical data of patients

Group	<i>n</i>	Age	Average age (years)	Gender		Body mass index (kg/m ²)
				Male	Female	
Observation group	50	61–92	78.21 \pm 5.33	26	24	20.16 \pm 1.77
Control group	50	60–93	78.37 \pm 5.65	28	22	20.24 \pm 1.52
<i>t</i> / χ^2			0.067		0.043	0.039
<i>P</i>			> 0.05		> 0.05	> 0.05

2.2. Methods

Fasting venous blood samples were collected in the morning from the elbow of all 100 participants. CRP levels were measured using a fully automated biochemical analyzer, and PCT levels were detected using the immunoturbidimetric luminescence method.

2.3. Observation indicators

- (1) Compare CRP and PCT data between the two groups;
- (2) Analyze CRP and PCT levels in patients with different severities of bacterial pneumonia in the observation group. According to the CPIS score, the 50 patients were classified into a severe group (> 6 points) and a mild/moderate group (≤ 6 points);
- (3) Assess the diagnostic efficacy of single testing and combined testing for bacterial pneumonia;
- (4) Observe the data before and after two weeks of treatment in the observation group.

2.4. Statistical methods

Statistical analyses were performed using SPSS 23.0. Differences in indicators between the observation and control groups were analyzed using *t*-tests and χ^2 -tests. A significance level of $P < 0.05$ was considered statistically significant.

3. Results

3.1. Serum CRP and PCT levels in both groups

Analysis of CRP and PCT levels in the 100 patients revealed significantly higher values in patients with bacterial pneumonia compared to the control group ($P < 0.05$). See **Table 2**.

Table 2. Serum CRP and PCT levels (mean \pm SD)

Group	<i>n</i>	CRP (mg/L)	PCT (μ g/L)
Observation group	50	98.25 \pm 11.59	3.57 \pm 1.35
Control group	50	5.55 \pm 2.78	0.25 \pm 0.12
<i>t</i>		37.652	9.939
<i>P</i>		< 0.05	< 0.05

3.2. Indicators for patients with different severity levels in the observation group

Combined testing of serum CRP and PCT levels revealed that patients with more severe conditions had significantly higher levels compared to those with mild or moderate conditions ($P < 0.05$). See **Table 3**.

Table 3. Indicators by severity in the observation group (mean \pm SD)

Group	<i>n</i>	CRP (mg/L)	PCT (μ g/L)
Severe group	27	104.37 \pm 12.01	3.92 \pm 1.89
Moderate and mild group	23	90.77 \pm 10.49	2.69 \pm 1.05
<i>t</i>		6.506	10.290
<i>P</i>		< 0.05	< 0.05

3.3. Diagnostic efficiency of CRP, PCT, and combined testing

Comparison of CRP, PCT, and combined testing results showed that combined testing achieved higher sensitivity, specificity, and accuracy. See **Tables 4 and 5**.

Table 4. Diagnostic accuracy of single and combined testing

Pathological results	CRP (mg/L)		PCT (μ g/L)		Combined testing	
	Positive	Negative	Positive	Negative	Positive	Negative
Positive (50)	41	9	47	3	50	0
Negative (50)	5	45	2	48	0	50
Total	46	54	49	51	50	50

Table 5. Diagnostic efficiency of single and combined testing

Testing methods	<i>n</i>	Sensitivity	Specificity	Accuracy	Positive predictive value	Negative predictive value
CRP (mg/L)	100	82.00%	90.00%	86.00%	89.00%	83.00%
PCT (µg/L)	100	93.18%	96.00%	94.68%	95.35%	94.12%
Combined testing	100	100.00%	100.00%	100.00%	100.00%	100.00%

3.4. Changes in indicators in the observation group before and after treatment

Analysis of the 50 patients in the observation group before and after treatment showed a significant reduction in CRP and PCT levels following treatment ($P < 0.05$). See **Table 6**.

Table 6. Changes in indicators in the observation group before and after treatment (mean \pm SD)

Time	<i>n</i>	CRP (mg/L)	PCT (µg/L)
Before treatment	50	98.25 \pm 11.59	3.57 \pm 1.35
After treatment	50	15.53 \pm 4.71	1.17 \pm 0.66
<i>t</i>		46.754	11.293
<i>P</i>		< 0.05	< 0.05

4. Discussion

Bacterial pneumonia is a lung infection caused by bacterial pathogens, often introduced through inhalation. The most common causative agents include *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Streptococcus* species [3]. Its clinical manifestations range from mild to severe, including symptoms such as cough, fever, dyspnea, and chest pain [4]. For elderly populations, diagnosing and treating bacterial pneumonia is more complex due to weakened immune function, multiple comorbidities, and physiological decline. Symptoms in older adults often present non-specifically, such as generalized weakness, reduced appetite, or cognitive decline, which can lead to misdiagnosis [4]. Historically, diagnosis relied on clinical symptoms and imaging studies (e.g., X-rays or CT scans). However, because many respiratory diseases share similar symptoms and imaging features, additional methods are needed to determine whether the infection is bacterial [5].

CRP is an acute-phase protein produced by the liver in response to infection, inflammation, or tissue injury. Under normal conditions, CRP levels in the blood are low, but they rise significantly during inflammation or infection, serving as a nonspecific immune response marker. The level of CRP reflects the severity of inflammation and disease activity. Clinical studies have shown that CRP levels peak 6–8 hours after bacterial infection onset [6]. Once the bacterial infection is controlled, CRP levels decrease markedly. However, CRP is not activated in viral infections. Despite its utility, CRP levels can also be influenced by factors like trauma, surgery, or malignancy, resulting in potential misdiagnoses or missed diagnoses if CRP is used as the sole marker [7].

PCT is the precursor form of calcitonin, synthesized by thyroid C cells, and its plasma concentration is typically very low in non-infectious conditions [8]. During infection or severe inflammation, particularly bacterial infections, PCT levels rise significantly. Its production is regulated by bacterial endotoxins and inflammatory mediators such as interleukin-1 and interleukin-6 [9]. Compared to CRP, elevated PCT levels are more specific to bacterial infections, making it a critical biomarker for diagnosing infectious diseases, assessing disease severity,

and guiding antibiotic therapy. Researchers have noted that while PCT does not initiate a sepsis response, it can exacerbate the pathological and physiological processes of sepsis. Thus, elevated PCT levels can differentiate bacterial infections from others, particularly severe bacterial infections, as PCT levels correlate positively with disease severity^[10,11].

The combined measurement of CRP and PCT improves diagnostic accuracy. By analyzing both markers, clinicians can assess whether patients require antibiotic therapy, minimizing unnecessary antibiotic use and reducing the risk of antibiotic overuse. Additionally, combined testing helps evaluate the severity of bacterial pneumonia and guide treatment planning, ultimately improving patient outcomes^[12].

Ma^[13] investigated the clinical value of combined testing for serum prealbumin (PA), PCT, and CRP in diagnosing bacterial pneumonia in elderly patients. Their study found that serum PCT and CRP levels were higher in the bacterial infection group. Serum PCT testing diagnosed 50 cases, CRP testing diagnosed 43 cases, and combined testing confirmed 59 cases. Sensitivity and negative predictive value were higher with combined testing compared to individual tests. This study concluded that PCT and CRP are sensitive indicators for diagnosing bacterial pneumonia in elderly patients, and combined testing has higher sensitivity. These findings are consistent with this study's results, where CRP and PCT levels were significantly higher in bacterial pneumonia patients than in the control group ($P < 0.05$). Moreover, combined testing demonstrated 100% sensitivity, specificity, accuracy, positive predictive value, and negative predictive value, confirming its high diagnostic value.

5. Conclusion

In summary, bacterial pneumonia is a common and serious infectious disease with high incidence and mortality rates in elderly populations. Early diagnosis and timely treatment are critical for preventing complications. In diagnosing bacterial pneumonia in elderly patients, combined testing of CRP and PCT has high diagnostic accuracy. It effectively distinguishes bacterial from non-bacterial infections, providing robust data to support clinical decision-making.

Disclosure statement

The authors declare no conflict of interest.

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Clinical Significance of Alpha-Fetoprotein Levels in Artificial Liver Therapy for Liver Failure

Xiju Guo¹, Weibo Guo^{2*}, Luyao Wang³, Yongping Wang¹, Mingmei Liao¹, Yingshan Liao¹

¹Department of Gastroenterology, Baoshan People's Hospital of Yunnan Province, Baoshan 678000, Yunnan Province, China

²Department of Gastroenterology, Second Affiliated Hospital of Kunming Medical University, Kunming 650000, Yunnan Province, China

³Kunming City Maternity and Child Health Hospital, Kunming 650118, Yunnan Province, China

*Corresponding author: Weibo Guo, 13987584586@163.com

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Abstract: *Objective:* Through the treatment of liver failure using artificial liver plasma exchange (PE), this study aims to explore the predictive value and clinical significance of alpha-fetoprotein (AFP) levels in the prognosis of liver failure patients. *Methods:* A retrospective analysis was conducted on the clinical data of 96 liver failure patients, all of whom underwent artificial liver plasma exchange therapy in addition to standard medical treatment. Based on AFP test values, patients were divided into three groups: low AFP group (AFP < 100 ng/mL, $n = 32$), medium AFP group ($100 \leq \text{AFP} < 200$ ng/mL, $n = 32$), and high AFP group (AFP ≥ 200 ng/mL, $n = 32$). Serum AFP levels were measured before artificial liver therapy (on the second day of hospitalization), on days 1, 10, and 20 after treatment, and at the final evaluation (before discharge or prior to death) to observe changes. *Results:* Among the 96 patients, 4 (4.2%) had acute liver failure (ALF), 7 (7.3%) had subacute liver failure (SALF), 57 (59.4%) had acute-on-chronic liver failure (ACLF), and 28 (29.2%) had chronic liver failure (CLF), with an overall survival rate of 82.3% (79/96). Patients in the AFP < 100 ng/mL group had a lower survival rate compared to the other two groups, and survival rates increased with higher AFP levels ($P < 0.05$). *Conclusion:* Serum AFP levels are closely related to the efficacy of artificial liver plasma exchange therapy for liver failure, and dynamic monitoring of AFP changes can help assess disease progression.

Keywords: Alpha-fetoprotein; Artificial liver support system; Plasma exchange; Liver failure prognosis; Hepatocyte regeneration

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1. Theoretical basis of this study

Liver failure is a common and severe clinical syndrome characterized by significant impairments or decompensation

of liver functions such as synthesis, detoxification, excretion, and biotransformation. This syndrome often presents with coagulopathy, jaundice, and hepatic encephalopathy as key manifestations ^[1]. According to the “2018 Guidelines for Diagnosis and Treatment of Liver Failure” ^[2], liver failure is classified into four types:

- (1) Acute liver failure (ALF): Acute onset, no history of underlying liver disease, and clinical manifestations characterized by grade II or higher hepatic encephalopathy within two weeks.
- (2) Subacute liver failure (SALF): Rapid onset, no history of underlying liver disease, with clinical manifestations of liver failure occurring within 2–26 weeks.
- (3) Acute-on-chronic liver failure (ACLF): Acute decompensation of liver function and liver failure in a short period on the basis of chronic liver disease.
- (4) Chronic liver failure (CLF): Progressive decline in liver function on the basis of cirrhosis, characterized by repeated ascites or hepatic encephalopathy.

China has a high prevalence of liver diseases, with more than 100 million cases, including approximately 8 million liver failure patients. Liver failure has a complex pathogenesis, and due to severely impaired detoxification functions, a large accumulation of toxic substances occurs in the body, leading to homeostatic imbalance. These toxins further hinder hepatocyte regeneration and functional recovery while damaging vital organs such as the heart, brain, and kidneys. As a result, liver failure progresses rapidly with numerous complications, posing significant treatment challenges and high mortality rates, making it a global therapeutic challenge.

The key to clinical treatment is the prompt and effective removal of toxic substances, disruption of vicious cycles, liver protection, and prevention of multiple organ failure. Treatment methods for liver failure include medical therapy, artificial liver support therapy, and liver transplantation. Medical treatment alone has limited efficacy, with mortality rates ranging from 60–80% ^[3]. Liver transplantation offers effective treatment and improved prognosis, but its application is limited by donor shortages, high technical complexity, high costs, and the need for lifelong immunosuppressive therapy ^[4].

Artificial liver support systems have emerged in recent years as a major breakthrough in extracorporeal liver support technology. These systems have demonstrated effectiveness in reducing mortality rates among liver failure patients, with recognized treatment efficacy and safety. The mechanism is based on the liver’s strong regenerative capacity. By employing mechanical, physicochemical, and biological devices, artificial liver systems help remove harmful substances accumulated due to liver failure, replenish essential substances, and improve the internal environment. This temporary liver function replacement facilitates hepatocyte regeneration and functional recovery or provides time for liver transplantation.

Currently, artificial liver support has become a major treatment modality for liver failure, offering new hope to patients. In cases where liver transplantation is not feasible, artificial liver support systems can temporarily replace liver function. Among these, plasma exchange (PE) is a well-established and widely used artificial liver treatment in China. Plasma exchange operates by using a plasma separator to extract plasma from whole blood, removing large amounts of toxic substances and metabolic byproducts dissolved in the plasma, and replacing them with fresh frozen plasma. This process effectively clears bilirubin, endotoxins, and inflammatory factors while replenishing essential biological substances such as albumin, coagulation factors, immunoglobulins, and complement proteins, maintaining homeostasis ^[6]. Additionally, plasma exchange promotes hepatocyte regeneration and aids in liver function recovery. Enhancing hepatocyte self-repair and regeneration is crucial for patient prognosis.

In recent years, various predictive models for liver failure prognosis have been proposed ^[7-9]. However, most focus on assessing liver functional reserves rather than evaluating hepatocyte regenerative capacity, which is a key

factor influencing prognosis. Alpha-fetoprotein (AFP) is a glycoprotein produced by the yolk sac and liver during fetal development and is known to promote hepatocyte proliferation. After birth, AFP levels rapidly decrease and remain low in healthy adults, with no expression in normal liver tissue. When hepatocytes regenerate or undergo malignant transformation, certain genes are activated to synthesize AFP, leading to elevated AFP levels. Thus, AFP levels can reflect hepatocyte inflammation, necrosis, and regeneration status.

Our preliminary studies have shown that AFP is an effective prognostic marker for liver failure^[10]. This finding suggests that AFP assessment may be a more effective indicator of liver regeneration, potentially guiding artificial liver clinical practice. Therefore, this study aims to explore the predictive value and clinical significance of AFP levels in the prognosis of liver failure patients undergoing artificial liver plasma exchange therapy. This research will help better assess patient prognosis, provide early predictions of disease progression and mortality risk, and assist in selecting appropriate treatment strategies.

2. Research content and protocol

2.1. Selection of study subjects

2.1.1. Inclusion criteria

- (1) All patients' clinical diagnoses meet the diagnostic criteria for liver failure as outlined in the "Guidelines for the Diagnosis and Treatment of Liver Failure" (2018 Edition) formulated by the Infectious Diseases Branch and the Hepatology Branch of the Chinese Medical Association. The criteria include the following classifications:
 - (a) Acute liver failure (ALF): Acute onset, no history of underlying liver disease, and clinical manifestations characterized by hepatic encephalopathy of grade II or above within two weeks.
 - (b) Subacute liver failure (SALF): Relatively acute onset, no history of underlying liver disease, with clinical manifestations of liver failure occurring within 2–26 weeks.
 - (c) Acute-on-chronic liver failure (ACLF): Acute hepatic decompensation and liver failure occurring in a short period based on chronic liver disease, potentially complicated by hepatic encephalopathy, ascites, infections, hepatorenal syndrome, etc.
 - (d) Chronic liver failure (CLF): Progressive decline in liver function based on cirrhosis, mainly characterized by recurrent ascites or hepatic encephalopathy.

The diagnosis and grading of hepatic encephalopathy are based on the "Guidelines for the Diagnosis and Treatment of Hepatic Encephalopathy in Cirrhosis" (2018 Edition)^[2], and the diagnosis of hepatorenal syndrome follows the "Guidelines for the Diagnosis, Evaluation, and Management of Ascites and Hepatorenal Syndrome" issued by the American Association for the Study of Liver Diseases in 2021.

- (2) No gender restrictions, age under 65 years.
- (3) The study was approved by the hospital's ethics committee, and all participants provided informed consent before undergoing any study-related procedures and adhered to the treatment protocol.

2.1.2. Exclusion criteria

- (1) Liver failure patients with AFP ≥ 400 ng/mL who were diagnosed with liver tumors based on imaging examinations.
- (2) Patients with pregnancy, gonadal embryonal tumors, or other malignancies.

- (3) Patients with severe active bleeding or disseminated intravascular coagulation (DIC).
- (4) Patients with severe allergic reactions to blood products or medications used during treatment, such as plasma, heparin, and protamine.
- (5) Patients with circulatory failure or those in an unstable phase of myocardial infarction or stroke.

2.1.3. Screening and evaluation

- (1) Medical history inquiry: Includes history of hepatitis virus infection, prior treatments before screening, comorbid conditions, medication history, alcohol consumption, etc.
- (2) Physical examination.
- (3) Routine blood, urine, and stool tests.
- (4) Blood biochemistry tests: Including liver function, kidney function, blood ammonia, electrolytes, blood glucose, blood lipids, and cardiac enzymes.
- (5) Coagulation function tests.
- (6) Hepatitis virus markers: HBV antigens and HAV, HCV, and HEV antibodies, along with serum HIV antibody testing.
- (7) Serum autoimmune antibody detection.
- (8) Serum tumor markers: AFP, CA50, CA199, etc.
- (9) Liver imaging examinations: Including ultrasounds and CT/MRI.

2.2. Treatment grouping

According to the above criteria, 96 cases of liver failure patients diagnosed from January 2022 to December 2022 at Baoshan People's Hospital and Baoshan Second People's Hospital were selected. Based on the alpha-fetoprotein (AFP) test values, they were divided into a low AFP group ($\text{AFP} < 100 \text{ ng/mL}$) with 32 cases, a medium AFP group ($100 \leq \text{AFP} < 200 \text{ ng/mL}$) with 32 cases, and a high AFP group ($\text{AFP} \geq 200 \text{ ng/mL}$) with 32 cases.

2.2.1. Medical treatment

- (1) Nutritional support and symptomatic treatment: Provide sufficient energy and vitamins, and maintain the patient's water and electrolyte balance.
- (2) Administer albumin infusion daily or every other day to promote hepatocyte regeneration.
- (3) Liver protection and jaundice reduction treatment: Intravenous drip of compound glycyrrhizin, polyene phosphatidylcholine, and adenosylmethionine.
- (4) All hepatitis B patients were treated with Entecavir tablets 0.5 mg/d for antiviral therapy (manufactured by Bristol-Myers Squibb, Shanghai).
- (5) Symptomatic treatment for complications such as hepatorenal syndrome, spontaneous bacterial peritonitis, hepatic encephalopathy, and gastrointestinal bleeding.

2.2.2. Artificial liver treatment

All patients received plasma exchange (PE) treatment with artificial liver on the basis of the above comprehensive medical treatment.

Instruments and materials:

- (1) Machine: X-10 Artificial Liver Treatment Machine (produced by Zhuhai Jianfan Biotechnology Co., Ltd.).

- (2) Consumables: Plasma separator produced by Bellco S.r.l., Italy; disposable blood circuit connection catheter produced by Tianjin Hanaco Medical Materials Co., Ltd.; Abell double-lumen catheter (specification 11.5Fr-16cm) for femoral vein catheterization.

Operation method: Routine venous blood collection before treatment to check AFP, blood routine, liver and kidney function, electrolytes, coagulation function, blood ammonia, etc. In the air-disinfected artificial liver treatment room, routine ECG monitoring, low-flow oxygen inhalation, and femoral vein puncture were performed to insert a single-needle double-lumen catheter to establish an extracorporeal blood circulation pathway. The plasma separator and blood circuit connection catheter were pre-flushed with 500 mL of 4% heparin sodium saline for exhaust, then rinsed with heparin-free saline until the original heparin saline was washed away. Connect the plasma outlet end of the plasma separator and the venous return end to the patient for plasma exchange. Preoperatively, routinely intravenously inject 5 mg of dexamethasone, and intravenously drip 10% calcium gluconate to prevent allergic reactions and other adverse reactions. Adjust the dose of anticoagulant heparin according to the patient's condition and coagulation function. Initially, intravenously inject 20 mg of heparin for systemic heparinization, and adjust the dose during the treatment process based on the patient's body weight, treatment time, transmembrane pressure, plasma separation speed, and prothrombin time (PT). Usually, 4–8 mg/h is pumped in with a micro-pump, blood flow speed is 100–120 mL/min, plasma separation speed is 20–30 mL/min, and plasma exchange volume is 2,000–3,000 mL/time (calculated as body weight (kg) \times 40 mL). The replacement fluid is fresh frozen plasma, and each treatment lasts about 2–3 hours. Stop using heparin 1–1.5 hours before the end of the treatment based on transmembrane pressure. Administer protamine to counteract heparin and amikacin to prevent infection. Determine the frequency and number of artificial liver treatments based on the patient's condition, with treatment intervals of 1–4 days.

2.3. Observation indicators

Venous blood was collected from all patients before artificial liver treatment (on the 2nd day of admission), and on the 1st, 10th, 20th day after treatment, and at the last time (before discharge/before death) to measure serum AFP levels using chemiluminescent immunoassay and observe its changes. The reagent kit was purchased from Shenzhen New Industries Biomedical Engineering Co., Ltd. The normal reference value for serum AFP content is < 7 ng/mL. Detailed case information was recorded. Analyze the relationship between different AFP levels and the prognosis of liver failure patients, compare the differences in survival and mortality rates of liver failure patients with different AFP levels, and evaluate the predictive value and clinical significance of AFP levels in the outcome of liver failure patients.

Adverse reactions: Observe whether patients have allergic reactions, bleeding, hypotension, fever, thrombosis, etc. during artificial liver treatment, and evaluate whether they are related to artificial liver treatment.

2.4. Statistical methods

All data were processed and analyzed using the SPSS 19.0 statistical software package. Measurement data were expressed as mean \pm standard deviation (SD), paired *t*-test was used before and after treatment, independent sample *t*-test was used between groups, and Pearson χ^2 test was used for count data. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Analysis of clinical classification and treatment outcomes of patients

This study included a total of 96 liver failure patients, aged 15 to 65 years, with an average age of (40.6 ± 13.2) years. Among them, 67 were male (69.8%) and 29 were female (30.2%). The clinical types included 4 cases of ALF (4.2%), 7 cases of SALF (7.3%), 57 cases of ACLF (59.4%), and 28 cases of CLF (29.2%). The average hospitalization duration was 23.5 ± 12.1 days. Ultimately, 79 patients survived (82.3%), while 17 patients died (17.7%).

3.2. Analysis of general data of liver failure patients with different AFP levels

There were no statistically significant differences in gender, age, baseline total bilirubin (TBIL), or prothrombin activity (PTA) levels among liver failure patients with different AFP levels ($P > 0.05$, **Table 1**).

Table 1. Analysis of general data of liver failure patients with different AFP levels

Group	Cases	Gender (Male/ Female, <i>n</i>)	Age (years, mean \pm SD)	TBIL ($\mu\text{mol/L}$, mean \pm SD)	PTA (%), mean \pm SD)
AFP < 100 ng/mL group	32	6/2	41.6 ± 11.8	386.9 ± 158.2	32.5 ± 14.2
$100 \leq \text{AFP} < 200$ ng/mL group	32	47/15	40.9 ± 10.9	381.5 ± 157.6	34.8 ± 15.1
AFP ≥ 200 ng/mL group	32	43/12	40.5 ± 10.2	382.7 ± 156.9	35.2 ± 15.9

3.3. Relationship between AFP levels and clinical classification of liver failure

There was no significant difference in the composition ratio of AFP levels among the clinical classifications of liver failure ($P > 0.05$, **Table 2**).

Table 2. Relationship between AFP levels and clinical classification of liver failure [*n* (%)]

Type	Cases	AFP < 100 ng/mL group	$100 \leq \text{AFP} < 200$ ng/mL group	AFP ≥ 200 ng/mL group
ALF	4	0 (0.0)	1 (25.0)	3 (75.0)
SALF	7	1 (14.3)	2 (28.6)	4 (57.1)
ACLF	57	12 (21.1)	36 (63.2)	9 (15.8)
CLF	28	22 (78.6)	5 (17.9)	1 (3.6)

3.4. Comparison of survival rates among liver failure patients with different AFP levels

The survival rate of the AFP < 100 ng/mL group was lower than that of the other two groups, and the survival rate gradually increased with higher AFP levels ($P < 0.05$, **Table 3**).

Table 3. Comparison of survival rates among liver failure patients with different AFP levels

Group	Cases	Survived (<i>n</i>)	Survival rate (%)
AFP < 100 ng/mL group	32	22	68.8
$100 \leq \text{AFP} < 200$ ng/mL group	32	26	81.3
AFP ≥ 200 ng/mL group	32	31	96.9

4. Discussion

Liver failure is characterized by its severe condition, numerous complications, and high mortality rate, making it one of the most challenging health issues worldwide. Currently, there is no specific clinical treatment for liver failure. Artificial liver plasma exchange creates a favorable environment for hepatocyte regeneration and temporarily replaces liver function to achieve therapeutic goals.

The artificial liver support system (ALSS), referred to as the “artificial liver,” began to emerge internationally in the 1950s as a technology providing extracorporeal liver function support for patients with liver failure ^[11]. Its clinical application abroad has opened an important pathway for treating various severe liver diseases, prolonging the lives of patients with advanced liver failure, and providing time for liver transplantation. Since the 1980s, significant progress has been made in China, particularly by the team led by Academician Lanjuan Li of the First Affiliated Hospital of Zhejiang University School of Medicine. After years of development, artificial liver treatment technology has matured, with three main categories emerging.

Non-bioartificial liver (NBAL) refers to devices primarily aimed at toxin removal, with some also capable of supplementing essential substances and regulating the body’s internal environment. NBAL is currently the most developed and widely applied artificial liver technology ^[12]. It has been extensively utilized in clinical settings and has proven effective ^[13-16]. Increasing evidence shows that artificial liver therapy can significantly improve liver function and reduce mortality in patients with liver failure. NBAL modalities include plasma exchange (PE), hemofiltration (HF), hemoperfusion (HP), hemodialysis (HD), plasma exchange and hemofiltration in tandem (PERT), and plasma dialysis filtration (PDF). With advancements in adsorption technology, molecular adsorbent recirculating systems (MARS) and Prometheus systems have been developed. These methods, primarily used in Europe, the U.S., and Russia, have demonstrated certain advantages in treating liver failure and hepatorenal syndrome. However, the average frequency of artificial liver sessions abroad is significantly higher than in China. Currently, over 300 tertiary hospitals in China offer artificial liver treatments, with satisfactory outcomes. The dual plasma molecular adsorption system (DPMAS), a novel artificial liver modality, has shown highly effective results in reducing bilirubin and mitigating septic complications in liver failure. While extensively applied in developed countries like the U.S. and parts of Europe for hyperbilirubinemia, DPMAS is now being implemented in many top-tier hospitals in China, including the First Affiliated Hospital of Zhejiang University, Southwest Hospital of the Third Military Medical University, Xijing Hospital of the Fourth Military Medical University, Beijing Ditan Hospital, and Chengdu Infectious Disease Hospital. It is primarily used for early-stage liver failure, hepatic encephalopathy with jaundice, and systemic inflammatory response syndrome with hyperbilirubinemia. However, as DPMAS does not supplement coagulation factors or fibrinogen, its effect on coagulation improvement is limited. Many researchers advocate combining plasma exchange with DPMAS (PE+DPMAS) for treating liver failure. Studies have shown that this combination enhances efficacy and improves prognosis significantly, although it increases costs and complexity. Therefore, artificial liver treatments should be individualized.

Bioartificial liver (BAL) refers to extracorporeal biological reactors constructed using artificially cultured hepatocytes. These devices not only remove toxins and inflammatory mediators and improve clinical symptoms but also exhibit synthetic and metabolic functions akin to hepatocytes ^[17]. The key challenges in constructing bioartificial livers lie in cell sourcing, cell culture, and bioreactor development. BAL remains in the research stage but holds significant promise for treating liver failure. Recent studies suggest that different types of liver failure induced by various liver diseases may require tailored bioartificial liver treatments for optimal outcomes.

Hybrid artificial liver combines biological and non-biological components to form a comprehensive artificial

liver support system. However, it has not yet been applied in clinical practice.

To evaluate the efficacy of artificial liver plasma exchange and monitor changes in patient's conditions and prognosis, we dynamically observed and compared serum AFP levels to determine the guiding significance of AFP levels in clinical treatment and prognosis assessment. AFP is a globulin synthesized during early fetal development. Elevated AFP levels are commonly seen in primary liver cancer, metastatic liver tumors, or acute and chronic hepatitis with cirrhosis. However, in the pathological changes of hepatocytes in severe hepatitis, continuous necrosis of liver cells stimulates compensatory mechanisms in the body, leading to increased AFP levels, which indicate hepatocyte regeneration. If AFP levels exceed 400 µg/L, an ultrasound examination should be performed to rule out liver cancer.

The results of this study show that the higher the AFP level, the lower the mortality rate of patients. Dynamic changes in AFP levels reflect changes in hepatocyte regeneration capacity. Therefore, clinicians should measure AFP levels early and closely monitor their changes to make real-time and accurate assessments of the severity and prognosis of the condition. This allows for timely adjustments to treatment plans, ultimately improving the survival rate of liver failure patients.

Disclosure statement

The authors declare no conflict of interest.

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Retraction Note: A Case of A Middle-Aged Woman with Cor Triatriatum Dexter and Sick Sinus Syndrome: Comprehensive Cardiovascular Evaluation

Jun Wang, Yongqin Wang, Changqing Zhong*

Department of Hunan Provincial People's Hospital Hunan Normal University First Affiliated Hospital, Changsha 410000, Hunan Province, China

***Corresponding author:** Changqing Zhong, zchqfly@126.com

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The authors wish to retract this article. Concerns have been raised regarding potential conflict of interest and possibility of duplicate publication.

All authors agree with this retraction.

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