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Clinical Study on Risk Factor Prediction of Pulmonary Embolism in Northern Shaanxi

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Abstract: The aim of this study is to analyze the risk factors and clinical characteristics of pulmonary embolism in northern Shaanxi. In this study, 162 patients with venous thrombosis admitted between June 2023 and June 2024 underwent CT pulmonary angiography to investigate the risk factors and clinical characteristics of pulmonary embolism (PE) in northern Shaanxi. The patients were divided into a control group (no PE, n = 98) and a study group (PE, n = 64) based on the presence or absence of PE. Data were collected using a Case Report Form, and statistical analyses were conducted to summarize clinical features and risk factors, followed by three months of targeted therapy. Significant differences were observed between the two groups in clinical manifestations such as pleural pain, dyspnea, and hemoptysis, as well as in past medical histories (including malignant tumor history and right ventricular dysfunction), physical signs like lung rales, and laboratory parameters such as hemoglobin, albumin, white blood cell count, D-dimer, blood oxygen saturation, total cholesterol, triglycerides, and high-density lipoprotein cholesterol (all $P < 0.05$). Multivariate logistic regression analysis identified pleural pain, dyspnea, malignancy, right ventricular dysfunction, lung rales, D-dimer, white blood cell levels, and blood oxygen saturation as risk factors for PE in patients with venous thrombosis. Following targeted therapy, the proportions of patients with pleural pain, dyspnea, and lung rales decreased significantly, with concurrent reductions in right ventricular end-diastolic inner diameter (RVD), D-dimer, and white blood cell levels, and a significant increase in blood oxygen saturation. These findings suggest that early prevention and intervention based on these risk factors can effectively reduce the incidence of PE in northern Shaanxi.

Keywords: Venous thrombosis; Pulmonary embolism; Risk factors; Clinical characteristics; Northern Shaanxi region

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1. Introduction

Pulmonary embolism, a common clinical condition, is a pathophysiological syndrome caused by the obstruction of pulmonary arteries by exogenous or endogenous emboli, leading to pulmonary circulation and right heart dysfunction. If not treated promptly, it may progress to pulmonary infarction, posing a serious threat to the patient's life safety [1]. This disease is highly concealed and has a high fatality rate. It does not present specific clinical manifestations in its early stages and is often confused with diseases such as coronary heart disease and pulmonary

infection in the clinical diagnosis process, leading to missed diagnosis and misdiagnosis [2]. In recent years, with the emergence of new diagnostic techniques and treatments for pulmonary embolism, the mortality rate of patients has decreased. However, long-term anticoagulation therapy is still required after discharge and the prognosis is poor, with up to 50% of patients experiencing adverse clinical events [3]. Northern Shaanxi is the central part of the Loess Plateau in China, with a higher altitude and unique geographical and dietary characteristics of the residents. The incidence of pulmonary embolism is higher than that in plain areas. However, there are currently very few targeted large-sample studies on pulmonary embolism in China. Therefore, this study focuses on patients with venous thrombosis, analyzes the risk factors for pulmonary embolism in northern Shaanxi, and implements targeted treatment for patients, providing theoretical and research basis for the prevention and treatment of pulmonary embolism in northern Shaanxi in the future.

2. Materials and methods

2.1. General information

A total of 162 patients with venous thrombosis admitted to our hospital between June 2023 and June 2024 were enrolled in this study. Following CT pulmonary angiography, patients were divided into a control group (without pulmonary embolism, $n = 98$) and a study group (with pulmonary embolism, $n = 64$). The inclusion criteria were as follows: (1) meeting the standards outlined in the "Guidelines for the Diagnosis, Treatment, and Prevention of Pulmonary Embolism" issued by the Chinese Medical Association Respiratory Disease Branch in 2018, and (2) having normal coagulation function [4]. Patients were excluded if they had incomplete clinical data or if they presented with severe heart, liver, or kidney damage. This study was reviewed and approved by the hospital ethics committee.

2.2. Research methods

Based on the patient's case report form (CRF), the general information of the patients was queried and recorded (see **Table 1** for specific items). The results of patient examinations were statistically analyzed, risk factors and clinical features were summarized, and targeted treatment was implemented for a duration of 3 months.

2.3. Observation indicators

Changes in clinical symptoms, signs, and laboratory indicators of patients with pulmonary embolism before and after treatment were observed to evaluate the treatment effect.

2.4. Statistical analysis

SPSS 21.0 software was used for statistical analysis and a *P*-value less than 0.05 was considered statistically significant.

3. Results

3.1. Univariate analysis of pulmonary embolism in venous thrombosis patients

As shown in **Table 1**, there were significant differences between the two groups in clinical manifestations such as pleural pain, dyspnea, and hemoptysis ($P < 0.05$). Significant differences were also observed in medical histories, such as a history of malignant tumors and right ventricular dysfunction ($P < 0.05$). Additionally, there were notable differences in physical signs like lung rales ($P < 0.05$), as well as laboratory indicators including hemoglobin,

albumin, white blood cell count, D-dimer, blood oxygen saturation, total cholesterol, triglycerides, and high-density lipoprotein cholesterol ($P < 0.05$).

Table 1. Univariate analysis of factors associated with pulmonary embolism in venous thrombosis patients (*n*,%)

Factors	Category	Control group (*n* = 98)	Research group (*n* = 64)	X^2	*P*
Age (years)	>65	63	40	0.053	0.817
	≤65	35	24		
Gender (cases)	Male	67	45	0.069	0.793
	Female	31	19		
BIM	>24	37	30	1.328	0.249
	≤24	61	34		
Altitude of residence	>1000 meters	42	31	0.487	0.485
	≤1000 meters	56	33		
Clinical manifestations (cases)	Pleuritic chest pain	14	31	22.509	< 0.001
	Chest tightness	34	36	1.837	0.175
	Palpitations	41	36	1.653	0.199
	Dyspnea	24	37	18.313	< 0.001
	Cough	66	47	0.068	0.409
	Hemoptysis	6	27	31.054	< 0.001
Past medical history (cases)	Hypertension	42	31	0.487	0.485
	Diabetes	26	14	0.451	0.502
	Malignant tumor	11	26	18.990	< 0.001
	Right ventricular insufficiency	16	31	19.384	< 0.001
Physical signs (cases)	Shortness of breath	49	36	0.606	0.436
	Fever	51	37	0.520	0.471
	Tachycardia	34	29	0.680	0.409
	Lung rales	15	45	67.436	< 0.001
	Edema of lower extremities	46	32	0.145	0.703
Laboratory indicators	Hemoglobin > 140g/L	9	21	14.326	< 0.001
	D-dimer (mg/L) > 0.5mg/L	12	46	59.895	< 0.001
	Albumin < 35g/L	14	26	14.455	< 0.001
	White blood cell count > 10×10^9/L	18	27	10.950	< 0.001
	Blood oxygen saturation (<90%)	16	38	32.268	< 0.001
	Serum sodium (abnormal)	40	27	0.030	0.862
	Total cholesterol (abnormal)	16	39	34.360	< 0.001
	Triglycerides (abnormal)	24	31	9.902	0.002
	Low-density lipoprotein cholesterol (abnormal)	15	17	3.095	0.079
	High-density lipoprotein cholesterol (abnormal)	28	41	19.945	< 0.001

Note: Reference range for serum sodium: 135–145 mmol/L; Reference range for total cholesterol: 2.9–5.18 mmol/L; Reference range for triglycerides: 0.4–1.7 mmol/L; Reference range for low-density lipoprotein cholesterol: 1–3.37 mmol/L; Reference range for high-density lipoprotein cholesterol: 1.04–2.08 mmol/L.

3.2. Multivariate logistic regression analysis of pulmonary embolism in patients with venous thrombosis

Using the occurrence of pulmonary embolism in venous thrombosis patients as the dependent variable, and pleuritic pain, dyspnea, hemoptysis, malignant tumor, right ventricular insufficiency, lung rales, hemoglobin, D-dimer, albumin level, white blood cell count, blood oxygen saturation, total cholesterol, triglycerides, and high-density lipoprotein cholesterol as independent variables, we assigned values to these variables (see **Table 2**).

Table 2. Independent variable assignment table

Independent Variables	Assignment
Pleuritic Pain	Yes = 1, No = 0
Dyspnea	Yes = 1, No = 0
Hemoptysis	Yes = 1, No = 0
Malignant Tumor	Yes = 1, No = 0
Right Ventricular Dysfunction	Yes = 1, No = 0
Lung Rales	Yes = 1, No = 0
Hemoglobin	> 140g/L=1，≤ 140g/L=0
D-dimer	> 0.5mg/L=1，≤ 0.5mg/L=0
Albumin	< 35mg/L=1，≥ 35mg/L=0
White Blood Cell Count	$> 10 \times 10^9$mg/L=1，$\leq 10 \times 10^9$mg/L=0
Blood Oxygen Saturation	< 90%=1，≥ 90%=0
Total Cholesterol	Abnormal = 1, Normal = 0
Triglycerides	Abnormal = 1, Normal = 0
High-Density Lipoprotein Cholesterol	Abnormal = 1, Normal = 0

The results of multivariate logistic regression analysis showed that pleuritic pain, dyspnea, malignant tumors, right ventricular insufficiency, lung rales, D-dimer, white blood cell levels, and blood oxygen saturation are all risk factors for pulmonary embolism in patients with venous thrombosis ($P < 0.05$), as shown in **Table 3**.

Table 3. Multivariate logistic regression analysis of pulmonary embolism in patients with venous thrombosis

Influencing Factors	β value	SE	*Wald* X^2 value	*P* value	*OR* value	95%*CI*
Pleuritic pain	0.804	0.561	4.912	0.019	9.063	(1.435，16.229)
Dyspnea	0.973	0.460	4.331	0.071	4.082	(1.411，12.882)
Hemoptysis	1.208	0.631	3.502	0.064	0.324	(0.080，1.076)
Malignant tumor	0.356	0.127	8.604	0.004	1.469	(1.126，13.844)
Right ventricular dysfunction	0.614	0.217	8.022	0.003	1.875	(1.216，21.864)
Lung rales	0.701	0.206	8.133	0.004	1.589	(1.125，2.186)
Hemoglobin	2.240	0.982	5.437	0.118	0.059	(1.431，17.623)
D-dimer	0.498	0.250	12.479	< 0.001	1.693	(1.219，32.241)
Albumin	-0.138	0.549	0.073	0.764	0.847	(0.321，2.376)

Table 3 (Continued)

Influencing Factors	β value	SE	*Wald* X^2 value	*P* value	*OR* value	95%*CI*
White blood cell count	1.437	0.681	4.516	0.004	4.321	(1.118，16.013)
Blood oxygen saturation	-4.430	0.208	4.326	0.042	4.162	(1.246，5.729)
Total cholesterol	1.294	0.082	0.131	0.724	1.154	(0.579，2.259)
Triglycerides	0.025	0.483	0.081	0.776	1.025	(0.869，1.206)
High-density lipoprotein cholesterol	-0.483	0.462	1.148	0.304	0.678	(0.246，1.557)

3.3. Evaluation of treatment effects for patients with pulmonary embolism

Both groups underwent nursing intervention for rehabilitation therapy and were given urokinase thrombolysis. Additionally, the study group received targeted interventions based on the risk factors identified in 2.2:

(1) For those with pleuritic pain, dyspnea, and blood oxygen saturation below 90%: non-steroidal anti-inflammatory drugs were used for pain relief, and high-concentration oxygen was administered through a nasal cannula or mask

(2) For those with malignant tumors: treatment was provided based on the tumor type and stage, while low molecular weight heparin was administered to prevent thrombus progression. Regular monitoring of coagulation function and tumor-related indicators was conducted to adjust the treatment plan

(3) For those with right ventricular dysfunction: furosemide was used to reduce cardiac load. For patients with underlying diseases such as chronic obstructive pulmonary disease, bronchodilators were administered to improve ventilation and oxygenation, relieving right ventricular pressure

(4) For those with lung rales: in cases caused by lung infection, antibiotics were used for anti-infective treatment based on the pathogen. For lung rales caused by left heart failure, diuretic and cardiotonic treatments were employed to improve cardiopulmonary function and correct hypoxic conditions;

(5) For those with elevated D-dimer levels: low molecular weight heparin was chosen for initial anticoagulation therapy, followed by a transition to oral warfarin, with monitoring of coagulation indicators

(6) For those with elevated white blood cell counts: indicating the presence of infection, anti-infective treatment was provided

Compared to before treatment, the proportion of patients with pleuritic pain, dyspnea, and lung rales significantly decreased after treatment ($P < 0.05$). The right ventricular end-diastolic inner diameter (RVD) of the patients decreased, while D-dimer and white blood cell levels significantly reduced, and blood oxygen saturation was significantly higher ($P < 0.05$), as shown in **Table 4** and **Table 5** below. Among the 26 patients with pulmonary embolism complicated by malignant tumors, 2 died during treatment, and 24 survived, with a mortality rate of 7.69%, which is relatively low.

Table 4. Comparison of clinical symptom relief before and after treatment in the study group (n,%)

Time Point	*n*	Pleuritic Pain	Dyspnea	Lung Rales
Before Treatment	64	31 (48.43%)	37 (57.81)	45 (70.31%)
After Treatment	64	8 (12.50%)	7 (10.94%)	10 (15.63%)
x^2	-	19.508	24.112	39.054
P	-	< 0.001	< 0.001	< 0.001

Table 5. Comparison of RVD, D-dimer, white blood cell levels, and blood oxygen saturation before and after treatment in the study group ($\bar{x}\pm s\bar{x}\pm s$)

Time Point	*n*	RVD(mm)	D-dimer(mg/L)	White blood cell count($\times 10^9$mg/L)	Blood oxygen saturation(%)
Before Treatment	64	28.64 ± 1.58	2.68 ± 1.21	18.36 ± 3.41	84.26 ± 3.37
After Treatment	64	20.59 ± 1.79	0.49 ± 0.26	8.77 ± 2.64	95.16 ± 2.90
t	-	26.973	14.156	17.790	19.613
P	-	< 0.001	< 0.001	< 0.001	< 0.001

4.Discussion

Venous thromboembolism includes deep vein thrombosis and pulmonary thromboembolism. Among them, pulmonary embolism is an occult disease with a high mortality rate. However, there are no significant features in the early stages of the disease, making clinical diagnosis difficult, and the rates of missed diagnosis and misdiagnosis are relatively high. Therefore, clarifying the risk factors and clinical characteristics of pulmonary embolism is of great significance for the early diagnosis and treatment of the disease.

The results of this study show that clinical symptoms/signs such as pleural inflammatory pain, dyspnea, and lung rales are risk factors for pulmonary embolism in venous thrombosis patients in northern Shaanxi ($P < 0.05$). Chest pain is a common symptom of pulmonary embolism patients. Generally, when the embolism site is close to the pleura, it can cause pleural inflammation with high cellulose content, leading to pleural inflammatory pain related to respiration. Additionally, according to the pathophysiological mechanism of pulmonary embolism, when human pulmonary arteries are embolized, the lungs' blood vessels are blocked, leading to insufficient blood supply in the lungs' tissues and increased lung exudate, resulting in lung rales [5]. Coupled with various factors such as the body's neurohumoral regulation and underlying diseases, the body also exhibits corresponding clinical symptoms and signs, such as dyspnea. Therefore, venous thrombosis patients presenting with clinical symptoms and signs such as pleural inflammatory pain, dyspnea, and lung rales should be alert to the possibility of pulmonary embolism.

The results of this study also show that malignancies and right ventricular dysfunction are also risk factors for pulmonary embolism ($P < 0.05$). The reason is that malignant tumor cells can express and release coagulation-promoting substances such as tumor procoagulant factors and amino acid protease factors, and tumor cells can activate and aggregate platelets to form blood clots. Therefore, the blood of patients with malignancies is more likely to be in a hypercoagulable state, leading to pulmonary embolism [6]. In addition, changes in cardiopulmonary function in patients with pulmonary embolism depend on the degree of pulmonary artery obstruction and the patient's original lung function status. When patients have right ventricular dysfunction, it suggests that the pulmonary embolism is more severe. The mechanism may be that pulmonary embolism causes ischemia in the embolized lung segment, leading to increased pulmonary artery pressure and right ventricular dilation [7].

Two laboratory indicators, D-dimer and white blood cell levels, were also shown to be independent risk factors for pulmonary embolism in this study. Previous studies have shown that when D-dimer levels increase, the risk of pulmonary embolism increases [8]. Therefore, D-dimer is extremely important in predicting the occurrence of pulmonary embolism. Additionally, research has shown that there is a certain correlation between white blood cell count and the levels of fibrinogen, coagulation factors VII and VIII. Hence, when the white blood cell count is

abnormal, it suggests that the body is in a hypercoagulable state [9]. A retrospective study showed that leukocytosis and systemic inflammatory response syndrome are important factors affecting the prognosis of patients with acute pulmonary embolism, which is consistent with the results of this study [10]. The results of this study also found that blood oxygen saturation below 90% is also an independent risk factor for pulmonary embolism. This is mainly because patients with pulmonary embolism due to blood clot blockage of lung blood vessels can lead to insufficient blood supply to the lungs. This causes blood oxygen saturation to decrease, which in turn affects normal breathing, causing patients to have difficulty breathing.

Based on these independent risk factors, targeted treatment was provided to patients with pulmonary embolism. The results showed that compared to before treatment, after treatment, the proportion of patients with pleural pain, dyspnea, and lung rales significantly decreased ($P < 0.05$). The patients' RVD decreased, D-dimer and white blood cell levels decreased significantly, and blood oxygen saturation was significantly higher ($P < 0.05$). This indicates that identifying the risk factors for pulmonary embolism and making targeted prevention and intervention can improve patients' clinical symptoms and biochemical indicators, ensure patient safety, and reduce mortality.

5. Conclusion

In summary, pleural pain, dyspnea, malignant tumors, right ventricular dysfunction, lung rales, D-dimer, white blood cell levels, and blood oxygen saturation are all risk factors for venous thrombosis patients to develop pulmonary embolism. Early prevention and intervention based on the above risk factors are beneficial to reduce the incidence of pulmonary embolism in northern Shaanxi. However, this study still has some limitations, such as a small sample size and short treatment duration. This study will further improve in the future to provide theoretical support for the prevention and treatment of pulmonary embolism.

Disclosure statement

The author declares no conflict of interest.

References

[1] Chen G, Zhang X, Zhao Z, et al., 2021, Logistic Regression Model Construction And Clinical Predictive Value Of Influencing Factors Of Venous Thromboembolism After Lung Cancer Surgery. Nursing Practice And Research, 18(24): 3635–3639.

[2] Wang H, 2018, Analysis Of Clinical Characteristics And Influencing Factors Of Patients With Pulmonary Thromboembolism Combined With Deep Venous Thrombosis Of Lower Extremities, thesis, North China University of Technology.

[3] Yu G, Wu D, 2023, Influencing Factors Of Poor Prognosis In Patients With Pulmonary Embolism And Construction Of A Risk Prediction Nomogram Model. Journal Of Practical Cardio-Cerebral-Pulmonary Vascular Disease, 31(11): 45–49.

[4] Zhang Y, Zhai Z, 2019, Interpretation And Reflection On The 2018 New Edition Of "Guidelines For The Diagnosis, Treatment, And Prevention Of Pulmonary Thromboembolism" – Guiding Clinical Practice With Evidence-Based Medical Guidelines. Chinese Journal Of New Clinical Medicine, 12(01): 10–12.

[5] Li B, 2024, Clinical Characteristics, Prognostic Evaluation, And Interventional Diagnosis And Treatment Of Acute Pulmonary Thromboembolism, thesis, Jilin University.

[6] Wu J, 2023, Analysis Of Risk Factors Related To Death From Malignant Tumors Combined With Pulmonary Embolism, thesis, Southwest Medical University.

[7] Wen G, Li J, Zhai Z, et al., 2018, Relationship Between Electrocardiographic Changes And Right Ventricular Dysfunction And Prognosis In Patients With Acute Pulmonary Thromboembolism. Chinese Journal Of Practical Internal Medicine, 38(06): 573–577.

[8] Shi C, Zhou H, Tang Y, et al., 2016, Risk Factors For Recurrence Of Venous Thromboembolism In Medical Patients And The Predictive Value Of A Simplified Pulmonary Embolism Severity Index. Chinese Journal Of Hypertension, 24(11): 1100.

[9] Zhang B, Huang Z, 2015, The Role Of White Blood Cell Count In Early Risk Stratification Of Acute Pulmonary Embolism Patients On Admission. Chinese Journal Of Emergency Resuscitation And Disaster Medicine, 10(11): 1069–1071.

[10] Jo J, Lee MY, Lee JW, et al., 2013, Leukocytes And Systemic Inflammatory Response Syndrome As Prognostic Factors In Pulmonary Embolism Patients. BMC Pulm Med, 13: 74.