

Analysis of the occurrence and influencing factors of deep vein thrombosis in the lower extremities after radical resection of Cervical Cancer

Zhang Ling¹, Ma Suhui¹, Wang Xiaoqian¹, Yan Tao^{2*}

Xingtai Central Hospital, Gynecology, Xingtai, Hebei, China 054000

Xingtai Medical College, Xingtai, Hebei, China 054000

*3824271611@qq.com

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Abstract: Objective To explore the occurrence and influencing factors of lower extremity deep vein thrombosis (LEDVT) after radical resection of cervical cancer in patients. Methods: A retrospective collection was made of 162 patients with cervical cancer in our hospital from January 2021 to April 2025. All of them underwent radical resection. The incidence of LEDVT within 15 days after the operation was statistically analyzed. The patients were grouped according to the presence or absence of LEDVT. The clinical data of the two groups were compared, and the influencing factors of LEDVT occurrence were analyzed. Based on the influencing factors, a Logistic prediction model for LEDVT was constructed, and the value of this model in predicting LEDVT was evaluated through the receiver operating characteristic (ROC) curve. Results: Among 162 patients with cervical cancer, 34 patients developed LEDVT within 15 days after the operation, with an incidence rate of 20.99% (34/162). The postoperative bed rest time in the LEDVT group was longer than that in the non-LEDVT group, the proportions of FIB and receiving air pressure wave therapy were higher in the LEDVT group, and the INR and RHDS scores were lower in the LEDVT group than in the non-LEDVT group ($P < 0.05$). Postoperative bed rest time, FIB, INR, RHDS score, and receiving an air pressure wave therapy device are independent risk factors for LEDVT in patients with cervical cancer after surgery ($P < 0.05$). A risk prediction model was constructed based on the five high-risk factors shown by Logistic. $\text{Logit}(P) = 11.873 + \text{postoperative bed rest time} \times 0.202 + \text{FIB} \times 0.260 + \text{INR} \times (-0.355) + \text{RHDS score} \times (-0.351) + \text{receiving an air pressure wave therapy device} \times (-0.319)$. The ROC curve was plotted. The results showed that the AUC of this risk prediction model was 0.923 (95%CI: 0.881-0.964), and the sensitivity and specificity were 80.00% and 87.69%, respectively. Conclusion: The incidence of LEDVT after cervical cancer surgery is relatively high, which is closely related to postoperative bed rest time, FIB, INR, RHDS score, and the use of air pressure wave therapy equipment. Based on this, the Logistic model constructed has a high predictive efficiency in predicting the risk of LEDVT after surgery.

KeyWords: Cervical cancer ;radical resection;Deep vein thrombosis of the lower extremities;Influencing factors

Statistics show that there are approximately 135,000 to 150,000 new cases

of cervical cancer in China each year, accounting for 23% to 30% of the global total cases, ranking first in the world . It is also the second most common cancer among women aged 15 to 44 ^[1]. Radical surgery can effectively remove the primary lesion and potential metastatic lymph nodes, and is the core approach for the cure of early-stage cervical cancer. However, the surgery can damage the vascular endothelium. Coupled with the tumor-related hypercoagulable state and the blood flow stasis caused by postoperative immobile, the risk of deep vein thrombosis (LEDVT) in the lower extremities of patients after surgery is significantly increased ^[2-3]. Postoperative LEDVT not only can cause acute pulmonary embolism, but also can lead to ischemic necrosis of the affected limb, delay subsequent treatment, accelerate tumor progression, and increase the risk of death. Identifying the risk factors of postoperative LEDVT in patients with cervical cancer is conducive to the formulation of treatment plans and prognosis improvement ^[4]. At present, the specific causes of LEDVT after cervical cancer surgery are not yet clear. In recent years, many clinical studies have been carried out ^[5-6], but the conclusions vary and there is a lack of reliable predictive models, which makes the progress of prevention and treatment work difficult. In view of this background, this study selected 162 cervical cancer patients in our hospital as the research subjects. While investigating the current situation of postoperative LEDVT, it further screened and identified its influencing factors and constructed a risk prediction model, with the aim of providing a scientific basis for improving and optimizing the prevention plan in clinical practice. The report is as follows.

1. Objects and Methods

1.1 Objects

A retrospective collection was made of 162 patients with cervical cancer in our hospital from January 2021 to April 2025. Their ages ranged from 20 to 65 years old, with an average of (44.46 ± 7.92) years old. There were 35 cases in stage I, 56 cases in stage IIA and 71 cases in stage IIB according to the International Federation of Obstetrics and Gynecology (FIGO) staging. There were 105 cases of squamous cell carcinoma, 42 cases of adenocarcinoma, and 15 cases of squamous adenocarcinoma. Inclusion: Confirmed cervical cancer by pathological diagnosis, with FIGO stage I to IIB; Received radical cervical cancer treatment for the first time; LEDVT is diagnosed with reference to the “Guidelines for the Diagnosis and Treatment of Deep Vein Thrombosis (Third Edition)” ^[7]. The clinical data and postoperative follow-up data are complete and can meet the requirements of this study. Exclusion: Preoperative presence of thromboembolic diseases such as LEDVT; Currently taking anticoagulant and antiplatelet drugs; Suffering from other cancers; There are diseases that affect the venous return of the lower extremities. Severe hematological diseases; Serious complications occurred after the operation due to non-thrombotic factors. This research has been reviewed and approved by the Ethics Committee of our hospital.

1.2 Methods

1.2.1 General Information

Age, body mass index (BMI), histological classification, FIGO stage, operation time, intraoperative blood loss, postoperative bed rest time, past medical history (diabetes, hypertension, smoking, drinking), and coagulation function were extracted from the patient's medical record system. Prothrombin time (PT), thrombin time (TT), and activated partial thromboplastin time (A) were detected using a blood coagulator PTT, fibrinogen (FIB), International normalized ratio of prothrombin time (INR) during the perioperative period, and the Chinese version of the Readiness for Discharge Scale (RHDS). RHDS consists of 3 dimensions and 12 items, with a total score of 120 points. The overall Cronbach coefficient of the scale is 0.890, and the score is positively correlated with the readiness for discharge.

1.2.2 Quality Control

Assign each research subject a specific serial number, which can be named according to personal preference, but it should be simple and named in English or numbers. Initially organize the exported data into a format recognizable by SPSS, and use a third party to review the data to ensure its authenticity and accuracy. Data export and organization are all handled by dedicated personnel who have received training and assessment.

1.3 Observation Indicators

(1) Calculate the incidence of LEDVT in patients with cervical cancer within 15 days after surgery; (2) Those with LEDVT were included in the LEDVT group, while those without were included in the non-LEDVT group. The clinical data of the two groups were compared. (3) Construct a prediction model for LEDVT based on influencing factors.

1.4 Statistical Methods

SPSS27.0 software was adopted. Counting data were described by the number of cases and the χ^2 test was used. Measurement data were described as mean $\pm$ standard deviation and t-test was used. Conduct a multivariate regression analysis. The influencing factors of LEDVT were analyzed through Logistic. The value of the Logistic prediction model in predicting LEDVT was evaluated through the receiver operating characteristic (ROC) curve. A P value < 0.05 was considered statistically significant.

2 Results

2.1 Postoperative LEDVT occurrence

A total of 162 patients with cervical cancer who underwent radical resection were included in this study. Among them, 34 patients developed LEDVT within

15 days after the operation (LEDVT group), with an incidence rate of 20.99% (34/162), and 128 patients did not develop LEDVT (non-LEDVT group).

2.2 Two sets of general information

The postoperative bed rest time in the LEDVT group was longer than that in the non-LEDVT group, the proportion of FIB and receiving air pressure wave therapy was higher than that in the non-LEDVT group, and the INR and RHDS scores were lower than those in the non-LEDVT group ($P < 0.05$), as shown in **Table 1**.

Table 1. compares general information of two groups($\bar{x} \pm s$)/n(%)

index	LEDVT group (n=34 cases)	Non LEDVT group (n=128 cases)	χ^2/t	P
Age (years)	44.72±6.34	43.54±6.19	0.983	0.327
BMI(kg/m ²)	21.46±1.27	21.29±1.23	0.712	0.478
histological classification			0.677	0.411
Squamous cell carcinoma	20(58.82)	85(66.40)		
adenocarcinoma	11(32.46)	31(24.22)		
Squamous adenocarcinoma	3(8.82)	12(9.38)		
FIGO Installment			0.831	0.362
phase I	10(29.41)	25(19.53)		
phase IIA	14(41.18)	42(32.81)		
phase IIB	10(29.41)	61(47.66)		
Surgical duration (min)	273.91±46.21	268.74±43.59	0.607	0.545
Intraoperative bleeding volume (ml)	132.73±11.44	129.86±10.97	1.344	0.181
Postoperative bed rest time (d)	5.18±1.28	3.75±0.73	8.497	< 0.001
past history				
diabetes	7(20.59)	14(10.94)	2.218	0.136
hypertension	5(14.71)	9(7.03)	2.004	0.157
smoke	8(23.53)	15(11.72)	3.076	0.079
drink alcohol	11(32.25)	24(18.75)	2.935	0.087
PT(s)	13.72±1.45	13.56±1.41	0.585	0.560
TT(s)	14.28±1.16	14.46±1.19	0.788	0.432
APTT(s)	36.59±3.47	35.94±3.24	1.024	0.307
FIB(g/L)	4.12±0.55	3.41±0.49	7.317	< 0.001
INR	1.37±0.34	1.67±0.41	3.921	< 0.001
RHDS score (points)	76.71±4.82	87.96±5.12	11.525	< 0.001
Accept air pressure wave therapy device			4.487	0.034
correct	13(38.24)	75(58.59)		
deny	21(61.76)	53(41.41)		

2.3 Influencing Factors of postoperative LEDVT

Taking whether LEDVT occurred in patients with cervical cancer as the dependent variable (no =0, yes =1), and the indicators with statistically significant differences in Table 1 as independent variables (postoperative bed rest time, FIB, INR, RHDS score were continuous variables, and the actual values were entered; The air pressure wave therapy device is assigned values of “0, 1”. Logistic regression analysis showed that postoperative bed rest time, FIB, INR, RHDS score, and receiving an air pressure wave therapy device were independent risk factors for LEDVT in patients with cervical cancer after surgery ($P < 0.05$), as shown in **Table 2**. After multicollinearity analysis, the variance inflation factor

(VIF) was less than 10, suggesting that there was no multicollinearity relationship among the variables. Therefore, a Logistic regression equation was established based on the regression coefficient β corresponding to the final variable.

Table 2. Factors affecting postoperative LEDVT

influence factor	β	SE	Wald x2	OR	95%CI	P
Postoperative bed rest time (d)	0.202	0.056	12.966	1.223	1.173 ~ 1.276	< 0.001
FIB	0.260	0.063	16.971	1.296	1.232 ~ 1.364	< 0.001
INR	-0.355	0.071	24.954	0.701	0.673 ~ 0.731	< 0.001
RHDS score	-0.351	0.092	14.545	0.704	0.669 ~ 0.741	< 0.001
Accept air pressure wave therapy device	-0.319	0.097	10.838	0.727	0.692 ~ 0.763	< 0.001
Constant term	11.873					

2.4 Construction and Verification of Risk Prediction Models

A risk prediction model was constructed by referring to the five high-risk factors shown by Logistic. $\text{Logit}(P) = 11.873 + \text{postoperative bed rest time} \times 0.202 + \text{FIB} \times 0.260 + \text{INR} \times (-0.355) + \text{RHDS score} \times (-0.351) + \text{receiving an air pressure wave therapy device} \times (-0.319)$. The predicted probability of the sample was calculated. The predicted probability was used as the test variable, and the LEDVT of patients with cervical cancer after surgery was used as the dependent variable to draw the ROC curve. The results showed that the AUC of this risk prediction model was 0.923 (95%CI: 0.881-0.964), and the sensitivity and specificity were 80.00% and 87.69%, respectively. See **Figure 1**.

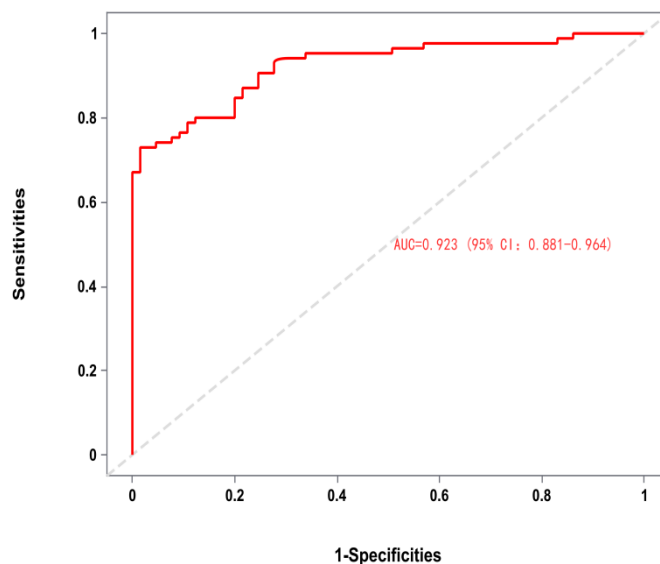


Figure 1. Validation of LEDVT prediction model after cervical cancer surgery

3 Discussion

Postoperative LEDVT can affect the postoperative rehabilitation process of patients with cervical cancer, prolong hospital stays, and increase the risk of

adverse disease outcomes. Identifying its early warning factors and formulating targeted nursing strategies have significant practical significance in reducing the occurrence of LEDVT^[8]. The results of this study show that the incidence of LEDVT after surgery in 162 patients with cervical cancer is 20.99%, which is relatively close to the data reported by Yu Junli et al.^[9], suggesting that the risk of LEDVT occurrence after surgery in patients with cervical cancer is relatively high and requires attention.

This study shows that the occurrence of LEDVT after cervical cancer surgery is positively correlated with the postoperative bed rest time. That is, the longer the bed rest time, the higher the risk of LEDVT. Long-term bed rest leads to a reduction in the contraction of the lower limb muscles, especially the calf muscle groups, which cannot effectively squeeze the veins to promote blood return. The blood flow velocity in the lower limb veins significantly slows down, and the blood accumulates in the deep veins, creating conditions for thrombosis. Therefore, a time accumulation effect is presented^[10]. Studies have confirmed^[11] that patients who were bedridden for ≥ 48 hours had a 60% higher risk of thrombosis than those who were active at an earlier stage. If bedridden for more than 5 days, the risk increases to 3.8 times that of the general population. Support the conclusion of this study. FIB has the highest concentration in the blood. Its core function is to be activated by thrombin in the coagulation cascade reaction, converted into fibrin and form the thrombus skeleton^[12]. Some scholars have found^[13] that the FIB level in the LEDVT group is significantly higher than that in the non-LEDVT group, which is a risk factor for LEDVT after cervical cancer surgery. This study reached a similar conclusion. The mechanism by which elevated FIB promotes LEDVT after cervical cancer surgery is that when the FIB concentration is > 4 g/L, the plasma viscosity increases, resulting in a slower venous blood flow velocity in the lower extremities and promoting local accumulation of platelets and coagulation factors. FIB binds to platelet surface receptors, accelerating platelet cross-linking to form microthrombi; Fibrin transformed by FIB has a fine structure, which hinders plasmin from dissolving thrombi and prolongs the survival time of thrombi [14-15]. INR is a standardized and corrected indicator of PT, used to assess the blood anticoagulation status, especially directly affecting the risk of postoperative LEDVT in perioperative management^[16]. Cao Minhua et al.^[17] reported that the INR of patients with cervical cancer who developed LEDVT before surgery and on the 1st, 2nd, and 3rd days after surgery showed differences between groups/time and between groups $\cdot$ time points, suggesting that INR is related to the occurrence of LEDVT after surgery. The results of this study indicate that a decrease in INR can increase the risk of LEDVT after cervical cancer surgery. On the one hand, a decrease in INR indicates a shortened prothrombin time and a significant increase in the activity of vitamin K-dependent coagulation factors (II, VII, IX, X). These factors accelerate thrombin production, promote fibrin deposition, and directly initiate thrombosis. On the other hand, after a decrease in INR, blood viscosity increases, and platelets

are more likely to aggregate in the venous valve sinuses^[18]. With the promotion and application of the concept of rapid recovery after illness, discharge readiness is increasingly widely used in discharge decision-making. Evidence-based medicine shows that discharge readiness can affect the recurrence rate, complication rate, readmissions rate, etc. of patients^[19]. This study found that the RHDS score is a protective factor related to LEDVT in patients with cervical cancer after surgery, suggesting that the higher the RHDS score, the lower the risk of LEDVT. This may be attributed to the fact that patients with higher discharge readiness have higher enthusiasm for rehabilitation exercises and better compliance. Su Li et al.^[20] included 125 patients with spinal fractures and found that the RHDS score of patients with LEDVT was significantly lower than that of patients without LEDVT, indicating a significant correlation between discharge readiness and postoperative LEDVT. The air pressure wave therapy device is a physical therapy equipment that applies gradient pressure to the limbs through periodic inflation and deflation. It uses multi-chamber airbags to successively inflate and deflate from the distal end (such as the ankle) to the proximal end (thigh), forming a wave-like compression, which can promote venous return, enhance lymphatic circulation, improve microcirculation and anticoagulation. This study found that compared with patients who did not use the air pressure wave therapy device, the incidence of postoperative LEDVT in users was reduced, which can become a safe and efficient solution for the prevention of postoperative LEDVT. However, all the cases selected in this study originated from the same hospital. Whether they are applicable to different patients in other regions remains to be investigated through multi-center research in the future.

In conclusion, the factors influencing LEDVT after cervical cancer surgery include postoperative bed rest time, FIB, INR, RHDS score, and the use of an air pressure wave therapy device. Based on this, constructing a Logit model has reliable predictive value, guiding clinical diagnosis and treatment and reducing the occurrence of LEDVT after surgery.

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