

Research Article

Risk Factors of Venous Thromboembolism After Radical Hysterectomy in Patients With Cervical Cancer

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This retrospective study aimed to determine the risk factors for venous thromboembolism (VTE) in patients undergoing radical hysterectomy for cervical cancer. Data from 366 patients who underwent radical surgery between June 2020 and December 2021 were collected from medical records. The patients were divided into a thrombosis group and a nonthrombotic group based on the presence or absence of VTE. Multivariate analyses revealed that age greater than 45 years, open radical hysterectomy surgery, an operation time exceeding 4 hours, intraoperative blood transfusion, and postoperative plasma D-dimer levels greater than 2.0 mg/L were significant independent risk factors for postoperative VTE, which could be used to help identify patients at an increased risk of VTE.

Keywords: cervical cancer; risk factors; venous thromboembolism

1. Introduction

Venous thromboembolism (VTE) comprising deep vein thrombosis (DVT) and pulmonary embolism (PE) is a well-recognized and severe disease associated with gynecological cancers that often occur after surgical procedures [1, 2]. As a potentially fatal perioperative complication, VTE has attracted more and more attention of our gynecological surgeons. In general, the incidence rate of VTE in patients with various types of malignancies is associated with increased morbidity, mortality, and medical cost burdens [3]. The incidence rate of VTE among hospitalized cancer patients in the United States has increased in recent years from 3.5% in 1995 to 6.5% in 2012, and in-hospital mortality was observed in 15.0% of patients with VTE including 19.4% with a PE [4]. However, the incidence rate of VTE in patients with gynecological cancer ranges from 3% to 25% over their lifetime [5]. A population-based study in Taiwan reported that the 5-year cumulative risk of VTE among all cervical cancer patients was 3.3%, and cervical cancer patients

without VTE had markedly higher survival (75.3% vs. 30.3%) [6]. In the absence of prophylaxis, the DVT prevalence in hospitalized patients undergoing major gynecological surgery is approximately 15% to 40% [7]. In patients with malignant tumors, the incidence of VTE varies significantly and may be closely related to factors such as performance status, history of venous diseases, cancer site, stage, grade, and treatment modalities including surgery and chemotherapy [3].

Cervical cancer, one of the most common gynecological malignancies, was diagnosed in approximately 600,000 patients and resulted in 342,000 deaths worldwide in 2020 [8]. The mainstays of cervical cancer treatment are surgery and radiotherapy, supplemented by chemotherapy [9]. Surgery is the standard treatment for early-stage cervical cancer (Federation International of Gynecology and Obstetrics (FIGO) 2018 stages IA-IB2 and IIA1), with a 5-year survival rate exceeding 90% [10]. However, as the discourse surrounding surgical procedure for early-stage cervical cancer has evolved, postoperative complications have

increasingly come under scrutiny [11]. Common short-term postoperative complications include urinary tract infections, lymphatic cysts, edema in the lower limbs and perineum, surgical wound infections, and, less frequently, intestinal blockage, incontinence, lymphatic leakage, DVT, ureteral fistula, and dehiscence of vaginal were observed in 31.45% (700/2226) of cases [12]. A randomized controlled study involving 636 patients reported only one case (0.157%) of DVT following radical hysterectomy for cervical cancer [11]. Additionally, the incidence of postoperative DVT among 2226 patients collected by Ganzhou Cancer Hospital over a decade was only 16 cases (0.718%) [12]. Although the literature indicates a low rate of VTE following cervical cancer surgery, VTE is recognized as a common cause of mortality in cancer patients [13] and has also been shown to negatively impact survival outcomes in endometrial cancer [14]. It is crucial to remain vigilant regarding VTE in cancer patients, as it is a rare yet life-threatening complication that poses significant risks to patient safety.

Low-molecular-weight heparin is explicitly recommended by the European Society for Medical Oncology (ESMO) guidelines for both short-term and long-term management of VTE [15]. However, postoperative anticoagulation therapy may lead to major bleeding; therefore, it is essential to focus on preventing postoperative VTE while balancing the risks of bleeding and VTE. Consequently, identifying risk factors for postoperative VTE in patients with cervical cancer is crucial. The risk factors for VTE in cancer patients include age [16], comorbidities [17], a history of venous diseases [18], surgery [2], active cancer [19], chemotherapy [20], and radiotherapy [21]. To reduce postoperative complications, our objective is to identify the high-risk factors associated with VTE in patients with cervical cancer following surgery.

In this study, we aimed to identify the risk factors for postoperative VTE by retrospectively analyzing the clinicopathological data of 366 patients with cervical cancer who underwent radical hysterectomy at our hospital between June 2020 and December 2021.

2. Methods

2.1. Study Population. The medical records of patients diagnosed with cervical cancer who underwent radical hysterectomy between June 2020 and December 2021 were reviewed retrospectively. All patients with pathologically confirmed cervical cancer who underwent either laparoscopic or open radical hysterectomy, along with systemic pelvic lymphadenectomy at our hospital, were included in the study. Patients with preoperative VTE, incomplete perioperative clinical data, or other malignancies in addition to cervical cancer were excluded from the analysis.

2.2. Study Design and Data Collection. In this case-control study, patients were categorized into a thrombosis group ($n = 33$) and a nonthrombotic group ($n = 333$) based on the presence or absence of VTE following radical hysterectomy

for cervical cancer. Clinical data for both groups were retrospectively collected, including age, body mass index (BMI), and comorbidities such as hypertension and diabetes. Additionally, perioperative data were gathered, encompassing tumor stage, pathological type, administration of neoadjuvant chemotherapy, surgical procedure, operation time, intraoperative blood loss volume, intraoperative blood transfusion, and postoperative plasma D-dimer levels. Cervical tumors were classified according to the 2018 FIGO staging criteria.

Intraoperative blood loss was calculated as the total of the intraoperative suction volume and the blood volume absorbed by gauze (with each gauze estimated to contain 30 mL of blood) minus the volume of the surgical rinse medium.

2.3. Diagnosis, Prophylaxis, and Treatment of VTE. The diagnosis of VTE was symptom-oriented. The patients with swollen and painful legs underwent compression ultrasonography to either rule out or confirm the presence of DVT. In cases where there was clinical suspicion of PE, indicated by symptoms such as unexplained shortness of breath, tachycardia, chest pain, or oxygen saturation levels of 93% or lower at rest, computed tomographic pulmonary angiography was conducted. Mechanical thromboprophylaxis, which included the use of elastic stockings and intermittent pneumatic compression, was routinely implemented in the postoperative setting.

The patients with postoperative DVT were treated with anticoagulation therapy and immobilization of the affected lower extremity. Plasma D-dimer levels were monitored regularly. PE was managed through systemic anticoagulation and the placement of an inferior vena cava filter, based on risk stratification. The patients' hemodynamic stability was closely monitored. Those with postoperative VTE were prescribed oral anticoagulants for at least 3 months following hospital discharge.

2.4. Statistical Analysis. An analysis of all the data was performed using SPSS software (version 25.0; IBM Corp., Armonk, NY, USA). Means and standard deviations are used to describe continuous variables, while frequencies and percentages are used to represent categorical variables. Differences between the thrombosis and nonthrombotic groups were analyzed using independent sample *t*-tests and chi-square tests, as appropriate. Continuous variables, including age, operation time, intraoperative blood loss volume, and postoperative plasma D-dimer levels were divided into two groups according to different cutoff values. The association between variables and the occurrence of VTE was initially assessed using univariate logistic regression. Variables with a *p* value < 0.1 from the univariate analysis were included in the conditional multivariate logistic regression model using stepwise forward and backward selection. Risks were quantified using odds ratios (ORs) and 95% confidence intervals (CIs). Statistical significance was set at $p < 0.05$.

3. Results

3.1. Postoperative VTE in Patients With Cervical Cancer. A total of 366 patients diagnosed with histologically confirmed cervical cancer undergoing radical surgery were included in the study. The average age of the participants was 50.4 years (range: 26–75 years), and the average BMI was 23.02 kg/m². The clinical characteristics of the patients with and without VTE are given in Table 1. Among the 366 patients, the average operation time was 4 h, ranging from 1 to 7 h. Intraoperative blood loss varied from 50 to 1200 mL, with an average of 230 mL. Postoperative plasma D-dimer levels ranged from 0.2 to 16 mg/L, with an average of 2.0 mg/L. Thirty-three patients (9%) developed VTE after radical hysterectomy for cervical cancer, including 19 with DVT of the lower extremities, four with PE, and 10 with both DVT and PE. There were no VTE-associated deaths in this cohort.

3.2. Comparison of Clinicopathological Traits Between Thrombotic and Nonthrombotic Patient Groups. Older age ($p = 0.028$), prolonged operation time ($p = 0.002$), increased intraoperative blood loss ($p = 0.001$), a high intraoperative blood transfusion rate ($p = 0.009$), and elevated plasma D-dimer levels ($p < 0.001$) were all significantly related to the incidence of postoperative VTE (see Table 2). There were no significant differences in BMI, comorbidities, FIGO stage, neoadjuvant chemotherapy, pathological type, or surgical approach between the groups.

3.3. Risk Factors for Postoperative VTE in Patients With Cervical Cancer After Radical Hysterectomy. Continuous variables were categorized using age cutoff values of 45 and 50 years, surgical time cutoff values of 4 and 5 h, intraoperative blood loss cutoff values of 400 mL and 500 mL, and postoperative plasma D-dimer cutoff values of 1.5, 2.0, and 2.5 mg/L for univariate analysis. In the univariate analysis, old age, open radical hysterectomy surgery, prolonged operation time, increased intraoperative blood loss volume, intraoperative blood transfusion, and elevated postoperative plasma D-dimer were significantly associated with VTE with p value < 0.1 (see Table 3). However, in the conditional multivariate regression model, age ≥ 45 years (OR: 5.255, 95% CI: 1.185–23.302, $p = 0.029$), open radical hysterectomy surgery (OR: 3.406, 95% CI: 1.119–10.37, $p = 0.031$), operation time ≥ 4 h (OR: 4.435, 95% CI: 1.429–13.765, $p = 0.01$), intraoperative blood transfusion (OR: 2.778, 95% CI: 1.060–7.280, $p = 0.038$), and postoperative plasma D-dimer level ≥ 2.0 mg/L (OR: 2.547, 95% CI: 1.162–5.583, $p = 0.02$) were identified as independent risk factors of VTE in patients with cervical cancer (see Table 4).

4. Discussion

The incidence of VTE was higher in patients with cancer compared to those without [22]. The occurrence of cancer-associated VTE varied based on tumor characteristics [20, 23], patient demographics [17, 24, 25], and treatment-

TABLE 1: Patient characteristics ($N = 366$).

Parameter	Number of patients, n (%)
Age, years	
26–40	61 (16.7)
41–50	104 (28.4)
51–60	156 (42.6)
61–75	45 (12.3)
Comorbidities	
Hypertension and diabetes	8 (2.2)
Hypertension	50 (13.7)
Diabetes	10 (2.7)
No concomitant diseases	298 (81.4)
FIGO stage	
IA	25 (6.8)
IB1–IB2	158 (43.2)
IB3	22 (6.0)
IIA1	53 (14.5)
IIA2	17 (4.6)
IIB	12 (3.3)
IIIC	79 (21.6)
Operation time (h)	
1–3	75 (20.5)
3.5–4	139 (40.0)
4.5–5	92 (25.1)
5.5–7	60 (16.4)
Intraoperative blood loss (mL)	
50–250	251 (68.6)
300–450	83 (22.7)
500–1200	32 (8.7)
Postoperative plasma D-dimer (mg/L)	
< 0.5	10 (2.7)
0.50–1.50	137 (37.4)
1.51–2.50	132 (36.1)
2.51–16.00	87 (23.8)

Abbreviation: FIGO, Federation International of Gynecology and Obstetrics.

related factors [20, 23, 25]. In this study, the incidence of venous thrombosis was found to be 9.01% among hospitalized patients following radical hysterectomy for cervical cancer, which contrasts with findings from previous studies [1]. A study conducted at the University Hospital in Kuala Lumpur, Singapore, indicated that 11 out of 397 patients (2.7%) who underwent abdominal radical hysterectomy during a 14-year period developed VTE postoperatively without routine prophylactic anticoagulation [26]. Our hospital's data revealed a comparatively high incidence of VTE following radical surgery, which may be attributed to the characteristics of the patient cohort we studied. In the previous study, where thrombosis prevention was not implemented and the VTE incidence rate was 2.7%, the patients were primarily young and in the early stages of the disease; 42% of them were under 40 years old, and 90% were at stage I [26]. In contrast, only 16.7% of our patients were younger than 40 years, and 56% were at stage I. The prevalence of thrombosis increases with age [27]. Patients with advanced cervical cancer have been found to exhibit elevated levels of von Willebrand factor, fibrinopeptide A, and D-dimer, which are markers of coagulation cascade activation

TABLE 2: Clinical characteristics of cervical cancer patients with or without postoperative VTE.

Risk factors	VTE group (N= 33)	Non-VTE group (N= 333)	p value
Age, years, mean $\pm$ SD	53.97 $\pm$ 6.76	50.08 $\pm$ 9.9	0.028^a
Body mass index (BMI, kg/m ²)	23.79 $\pm$ 2.47	22.95 $\pm$ 3.14	0.077 ^a
Comorbidity, n (%)			
Hypertension	8 (24.2%)	50 (15.0%)	0.166 ^b
Diabetes	2 (6.1%)	16 (4.8%)	1.0 ^b
FIGO stage, n (%)			0.98 ^b
Stage I	19 (57.6%)	186 (55.9%)	
Stage II	7 (21.2%)	75 (22.5)	
Stage IIc	7 (21.2%)	72 (21.6%)	
Neoadjuvant chemotherapy, n (%)	4 (12.1%)	51 (15.3%)	0.815 ^b
Pathological type, n (%)			0.822 ^b
Squamous cell	25 (75.8%)	258 (77.5%)	
Adenocarcinoma	8 (24.2%)	75 (22.5%)	
Surgical procedure, n (%)			0.126 ^b
Laparoscopic radical hysterectomy	27 (81.2%)	305 (91.6%)	
Open radical hysterectomy	6 (18.2%)	28 (8.4%)	
Operation time (h)	4.73 $\pm$ 1.02	4.13 $\pm$ 1.05	0.002^a
Intraoperative blood loss (mL)	333.03 $\pm$ 277.97	221.62 $\pm$ 173.80	0.001^a
Intraoperative blood transfusion, n (%)	8 (24.2%)	28 (8.4%)	0.009^b
Postoperative plasma D-dimer (mg/L)	3.159 $\pm$ 2.814	1.934 $\pm$ 1.378	< 0.001^a

Note: Significant p values are shown in bold print. n, number of patients.

Abbreviations: FIGO, Federation International of Gynecology and Obstetrics; SD, standard deviation; VTE, venous thromboembolism.

^aStudent t test.

^bChi-square test.

TABLE 3: Univariate analysis of the risk factors for VTE.

Parameters	Univariate analysis		p value
	OR	95% CI	
Age (years)			
≥ 45 vs. < 45	5.829	1.367–24.850	0.017
≥ 50 vs. < 50	2.133	0.962–4.729	0.062
BMI (kg/m ²)			
≥ 25 vs. < 25	1.667	0.787–3.532	0.182
Comorbidity			
Yes vs. no	1.742	0.770–3.939	0.183
FIGO stage			
III vs. I-II	0.976	0.407–2.340	0.957
Neoadjuvant chemotherapy			
Yes vs. no	0.763	0.257–2.262	0.625
Surgical procedure			
Open vs. laparoscopic	2.421	0.922–6.357	0.073
Operation time (h)			
≥ 4 vs. < 4	4.138	1.421–12.051	0.009
≥ 5 vs. < 5	3.252	1.572–6.727	0.001
Intraoperative blood loss volume (mL)			
≥ 400 vs. < 400	2.122	0.932–4.834	0.073
≥ 500 vs. < 500	2.624	0.994–6.928	0.052
Intraoperative blood transfusion			
Yes vs. no	3.486	1.438–8.448	0.006
Postoperative plasma D-dimer (mg/L)			
≥ 1.5 vs. < 1.5	2.212	0.969–5.049	0.059
≥ 2.0 vs. < 2.0	2.836	1.350–5.967	0.006
≥ 2.5 vs. < 2.5	1.932	0.909–4.107	0.087

Note: p values less than 0.1 are shown in bold print.

Abbreviations: BMI, body mass index; CI, confidential interval; FIGO, Federation International of Gynecology and Obstetrics; OR, odds ratio; VTE, venous thromboembolism.

TABLE 4: Multivariate analysis of the risk factors for VTE.

Parameters	Multivariate analysis		
	OR	95% CI	<i>p</i> value
Age, years			
≥ 45 vs. < 45	5.255	1.185–23.302	0.029
Surgical procedure			
Open vs. laparoscopic	3.406	1.119–10.37	0.031
Intraoperative blood transfusion			
Yes vs. no	2.778	1.060–7.280	0.038
Postoperative plasma D-dimer (mg/L)			
≥ 2.0 vs. < 2.0	2.547	1.162–5.583	0.02
Operation time (h)			
≥ 4 vs. < 4	4.435	1.429–13.765	0.01

Note: Significant *p* values are shown in bold print.

Abbreviations: CI, confidential interval; OR, odds ratio; VTE, venous thromboembolism.

[28], potentially contributing to thrombosis. Zhao et al. reported a 5.5% incidence of postoperative VTE in cervical cancer patients at Qianfoshan Hospital, affiliated with Shandong University, from 2014 to 2017 [29]. Their lower incidence rate of VTE compared to ours may be attributed to more effective mechanical thrombosis prevention strategies. In a surgical study involving advanced cervical cancer, 7 out of 42 (17%) patients with stage III cervical cancer who underwent neoadjuvant chemotherapy followed by radical surgery developed VTE [30]. The high incidence of thrombosis in this study was primarily due to the fact that all patients were at stage III and had undergone major surgery, which lasted an average of 6.6 h following neoadjuvant chemotherapy. In contrast, in our study, 55 out of 366 (15.0%) patients underwent neoadjuvant chemotherapy, and 79 out of 366 (21.6%) were diagnosed at FIGO stage IIIC. Published research indicates that chemotherapy increases the risk of VTE in cancer patients [31], and an increased risk of VTE has been directly correlated with longer surgery times [32]. Although the prevalence of VTE varies among the cervical cancer studies mentioned, we believe that the differences can be attributed to factors such as race, comorbidities, surgical teams, tumor treatments, and tumor stages. Therefore, the objective of this study was to investigate the relationship between various risk factors and postoperative VTE in patients with cervical cancer. Several studies have identified age, surgery, chemotherapy, and immobility as risk factors for VTE associated with cervical cancer [24, 33]. In this study, old age, prolonged operation time, intraoperative blood transfusion, high postoperative plasma D-dimer levels, and open radical hysterectomy surgery were identified as independent risk factors for VTE in patients undergoing surgical treatment for cervical cancer.

In this study, the incidence of VTE among patients with cervical cancer who underwent radical hysterectomy was found to increase with age. VTE is more likely to occur in patients over 45 years old. The average age of perimenopause in China is 46 years [34]. During the perimenopausal period, physiological changes in hormonal status affect the body's hemostatic mechanisms, leading to an elevated risk of VTE [35]. According to Virchow's triad, age-related vascular dysfunction contributes to the increased likelihood of

developing VTE. One study reported that the incidence of first-time thrombosis in adults aged 45 years or older was 1.92 per 1000 person-years, with VTE rates positively correlated with advancing age, being two-fold higher in patients over 65 years of age [27]. The @RISTOS study identified age over 60 years, advanced cancer, and prolonged surgical duration as significant risk factors for VTE following cancer surgery [36]. Older age is also recognized as a risk factor for VTE in several risk assessment tools [37, 38].

A single-center, prospective, randomized controlled trial indicated that the mean operation times for radical hysterectomy in patients with cervical cancer were 3.37 and 3.6 h in the laparoscopic and laparotomy groups, respectively [39]. The duration of radical surgery for cervical cancer depends on surgical proficiency and surgical volume. In the current study, the mean operation times were 4.73 and 4.13 h in the thrombosis and non-thrombotic groups, respectively, and the risk of postoperative VTE increased when the operation time exceeded 4 h. Immobility resulting from long operation times could lead to blood stasis [32]. Operation times exceeding 3 h in surgically treated patients with cervical cancer were identified as an independent risk factor for postoperative VTE in a previous study [29]. Additionally, a study involving Chinese patients with ovarian cancer found that an operation time greater than 2.5 h was associated with postoperative VTE [40], although the surgical approach was different from cervical cancer surgery. However, another Chinese study reported that the operation time was not associated with the incidence of postoperative VTE in patients with cervical cancer [41].

Our study of patients with cervical cancer after radical hysterectomy found an OR of 2.778 (95% CI: 1.060–7.280) for the risk of VTE in patients receiving red blood cell (RBC) transfusions compared to nontransfused patients. Researchers found that the treatment with packed RBCs had an association with development of postoperative PE [42]. Numerous studies have demonstrated that perioperative blood transfusion is linked to an increased risk of postoperative VTE [43–45]. When patient received blood transfusion, the elevated RBC count contributed to a higher rate of platelet deposition and thrombus formation [46].

However, Aaron et al. found that there was no strong association between RBC transfusion and development of VTE [47].

The D-dimer is the smallest fragment of a specific degradation product of fibrin. Elevated D-dimer levels represent the hypercoagulation stage and fibrinolysis. D-dimer testing and serial sonography are routinely performed in patients exhibiting symptoms of VTE. However, DVT could be asymptomatic; the incidence of VTE may be underestimated. Therefore, developing an effective screening method for VTE after cervical cancer surgery is necessary. At our institution, testing for D-dimer levels has become a common procedure for postoperative patients and a widely accepted approach for diagnosing VTE due to its cost-effectiveness and noninvasiveness. D-dimer levels serve as a reliable negative predictor of VTE, with levels below 0.5 mg/L considered sufficient to exclude the condition [48]. In this study, the mean postoperative plasma D-dimer level in patients with VTE was 3.16 mg/L, significantly higher than that of patients without VTE, who had a mean level of 1.93 mg/L. The *p* values varied under different cutoff values for postoperative plasma D-dimer levels in this study, with the optimal cutoff value determined to be 2.0 mg/L. When the postoperative plasma D-dimer level was more than 2.0 mg/L, the risk of postoperative VTE increased. Previously reported preoperative D-dimer cutoff values for VTE in patients with gynecological cancer included 3.1 mg/L for cervical cancer, 3.2 mg/L for endometrial cancer, and 3.9 mg/L for ovarian cancer [49].

Our study revealed that laparotomy radical hysterectomy is associated with a higher incidence of postoperative VTE compared to the laparoscopic approach (17.64% vs. 8%). Furthermore, the surgical procedure was significantly associated with VTE in a conditional multivariate logistic regression model, which is consistent with previous research. Swift et al. reported that laparotomy is a high-risk factor for postoperative thrombosis in patients with gynecological malignancies [50], while Ashley Graul et al. noted that the minimally invasive surgery group has a lower risk of venous thrombosis in gynecological surgery [51]. Additionally, it has been demonstrated that minimally invasive cancer surgery is associated with a lower risk of venous thromboembolic events [52].

The associated risk factors for VTE vary depending on the research population. For instance, a study conducted in the United States identified advanced-stage disease, low albumin levels, and chemotherapy treatment as independent risk factors associated with an increased risk of VTE in women with cervical cancer [24]. Conversely, a study conducted in Japan found that age equal to or greater than 60 years and a tumor long diameter equal to or greater than 40 mm are also significant independent risk factors [33]. The incidence of VTE differs among various ethnic groups; African Americans exhibit the highest frequency, while Asians and Pacific Islanders have the lowest incidence [53]. Genetic factors, including gain-of-function mutations (such as prothrombin mutation G20210A and factor V Leiden), predispose individuals to

thrombophilia [54]. Additionally, the primary mechanism of cisplatin-associated thrombosis may be attributed to endovascular toxicity, which increases von Willebrand factor levels and causes endothelial cell damage [55]. The combination of chemotherapy and genetic risk factors has been shown to elevate the incidence of VTE among Americans.

According to the guidelines for the prevention of VTE after major cancer surgery, patients should receive pharmacological thromboprophylaxis postoperatively for 10 days [15]. However, according to the American College of Chest Physicians guidelines, pharmacological thromboprophylaxis can reduce the risk of VTE after abdominal or pelvic surgery but can also increase the incidence of perioperative bleeding [56]. Due to a lack of related clinical trials, the Asian guidelines do not provide recommendations for routine pharmacological thromboprophylaxis in patients undergoing gynecological surgery [57]. At our medical center, a high proportion of patients with cervical cancer receive pharmacological thromboprophylaxis postoperatively, and each patient is equipped with elastic stockings and intermittent pneumatic compression devices.

This study is significant as it investigates the incidence and risk factors for VTE in patients who have undergone radical surgery for cervical cancer. Converting continuous variables such as age, operation time, and postoperative plasma D-dimer levels into categorical variables facilitates guidance for gynecologists in implementing appropriate postoperative thrombus prevention strategies. However, our study has several limitations. Notably, only symptomatic VTE cases were documented, and no systematic screening for postoperative VTE was performed. This may indicate that the true incidence of VTE in patients with cervical cancer following surgery is higher than reported. Additionally, the study did not collect detailed information regarding the type, duration, and administration of thromboprophylaxis. Although guidelines for VTE prevention in patients undergoing surgery for gynecological tumors were established prior to the study period, gynecologists may choose to delay prophylaxis based on the risk of bleeding. Importantly, our small sample size, single-center design, and retrospective analysis may lead to the omission of potential risk factors. Therefore, larger-scale randomized prospective studies are needed in the future to validate these conclusions.

5. Conclusion

In summary, age greater than 45 years, open radical hysterectomy surgery, an operation time exceeding 4 h, intraoperative blood transfusion, and postoperative plasma D-dimer levels greater than 2.0 mg/L are independent risk factors for VTE in patients who undergo radical hysterectomy for cervical cancer. These findings may help identify patients at an increased risk of VTE after radical hysterectomy for cervical cancer, allowing for the implementation of preventive measures, intensive monitoring, and early intervention.

Data Availability Statement

Data and materials are available from the corresponding author upon reasonable request.

Ethics Statement

The study protocol was reviewed and approved by the Medical Ethics Committee of Union Hospital affiliated to Tongji Medical College of Huazhong University of Science and Technology (UHCT230715) on November 6th, 2023. Written informed consent in the study was waived by our Institutional Review Board because of the retrospective nature of our study (see IEC Approval Letter).

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

Bei Feng: conceptualization and writing—original draft preparation. Zehua Wang: project administration, supervision, and resources. Liqiong Cai: data curation, visualization, and formal analysis. Xiaoqi He: methodology and validation. Yuan Zhang: conceptualization, software, and writing—reviewing and editing. Jing Cai: conceptualization, project administration, and writing—reviewing and editing.

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