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The association between deep vein thrombosis at admission and the time from injury to admission in hip fractures

Jian Liu[1], Miao He[1], Ruoyu Song[1] and Jie Li[1*]

Abstract

Objective This study aims to explore the association between deep vein thrombosis (DVT) of the lower limbs at admission and the time from injury to admission (TFITA), providing clinical references for the prevention of DVT at admission.

Patients and methods Data was collected from patients who were admitted to our hospital for hip fractures between January 2017 and December 2023. Univariable and multivariable logistic regression analyses were conducted to examine the relationship between TFITA and DVT at admission, using both continuous and categorized variables based on thresholds for TFITA. Propensity score matching (PSM) and subanalyses stratified by TFITA and characteristics of DVT at admission were further employed to investigate the relationship. Additionally, restricted cubic splines (RCS) analysis was performed to determine whether a non-linear association exists between TFITA and DVT at admission.

Results A total of 1230 patients were included in the statistical analysis, comprising 116 patients with DVT at admission and 1114 without. Both Univariable and multivariable logistic regression analyses indicated a positive association between TFITA and DVT at admission before and after matching. Subanalyses revealed significant associations for older age, low-energy injuries, high D-dimer levels, and low platelet counts subgroup with TFITA and DVT at admission. RCS analysis indicated no non-linear relationship between TFITA and DVT at admission.

Conclusion For patients with hip fractures, longer TFITA is positively correlated with the incidence of DVT at admission. These findings support the potential of TFITA as an intervention strategy for managing DVT at admission.

Keywords Deep vein thrombosis, Time from injury to admission, Fracture, Risk factor

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Background

Hip fractures are a unique pathological phenomenon that increase in incidence with age [1], primarily as intracapsular (femoral neck) and extracapsular (intertrochanteric) fractures [2]. Their high prevalence makes them a major public health issue, posing significant economic and social burdens [3–4]. Deep vein thrombosis (DVT) is a common complication in hip fracture patients. The development of DVT involves an interplay of factors. Hypercoagulability - induced micro - thrombi slow blood flow, and this sluggish blood flow damages the vascular endothelium, forming a cycle. Inflammatory cytokines also promote thrombosis by activating coagulation and affecting endothelial cells [5]. Hip fracture patients are more prone to DVT mainly because long - term bed rest severely impairs lower limb muscle - pump function, causing extreme blood - flow sluggishness [6]. Also, hip fractures damage rich local blood vessels, releasing much tissue factor and intensifying coagulation [6]. If not promptly prevented or treated, DVT can lead to chronic pain, varicose veins, ulcers, or pulmonary embolism (PE). The long-term consequences of DVT can result in significant disabilities, including post-thrombotic syndrome and chronic thromboembolic pulmonary hypertension. PE is the third leading cause of death within 24 h of trauma, with DVT being its primary source [7]. Thus, timely prevention and treatment of DVT are crucial for reducing mortality and improving quality of life.

Research has shown a positive association between delayed admission and DVT, indicating that each additional day of delay increases the risk of DVT by 37% [8]. The mechanisms involve a peak in the hypercoagulable state and post-traumatic stress within 1 to 4 days following injury [9]. An extension of 2 days in the time from injury to admission can lead to a preoperative DVT incidence as high as 54% [10]. Furthermore, prolonged admission times remain a risk factor for preoperative DVT, even in patients receiving thromboprophylaxis [11, 12]. Despite these findings, studies on the time from injury to admission (TFITA) and its association with DVT at admission are limited, with most focusing on preoperative DVT [13–15].

This study aims to conduct a retrospective analysis of hip fracture patients to evaluate the incidence of DVT at admission across different TFITA groups. Specifically, TFITA refers to the time period, measured in hours, from the exact moment when a patient suffers a hip fracture to the time when they are officially admitted to our hospital. We hope to identify the association between increasing TFITA and DVT occurrence at admission, providing insights for clinical practices in preventing preoperative DVT.

Materials and methods

Study design and patients

From January 2017 to December 2023, all patients, regardless of age, with hip fractures determined by X-rays or CT scans and who were admitted to the orthopedic department of Chongqing Emergency Medical Center (Chongqing University Central Hospital) for the first time were potentially included in the study, based on defined inclusion and exclusion criteria (see Fig. 1). The inclusion criteria were intertrochanteric fracture (AO 31A1-3) and femoral neck fracture (AO 31B1-3) as they are the commonest types for focused research, closed fracture to avoid infection-related and thrombosis-interfering factors from open fractures, and admission within 14 days post-injury considering the stability of patient's condition and thrombosis-risk stage. The exclusion criteria included multiple fractures due to complex trauma-induced systemic changes affecting thrombosis mechanism analysis; history of thromboembolic events, including all types of deep vein thrombosis (proximal, distal, and mixed), pulmonary embolism, and arterial thromboembolism as their abnormal coagulation system could distort results; old fractures (admission > 14 days post-injury) because of altered fracture-healing and body-repair processes; previous hip surgeries for anatomical and hemodynamic changes; antithrombotict therapy(e.g., aspirin, heparin, low molecular weight heparin, warfarin, rivaroxaban, apixaban, dabigatran) as drugs mask fracture-and time-related thrombosis effects; and patients with missing lab results, imaging, or medication/comorbidity information since it's crucial for accurate risk assessment and reliable study results.

Definition of TFITA

TFITA was measured as the time, in hours, between the hip fracture occurrence (confirmed by patient reports, witnesses or EMS records) and hospital admission registration. It holds significance because a longer TFITA can lead to more immobility, causing sluggish lower - limb blood flow, a key factor promoting DVT. Moreover, the body's inflammatory response may increase over time, heightening blood hypercoagulability. Understanding this relationship helps clinicians identify high - risk patients early for better prevention and treatment.

DVT diagnostic criteria

DVT diagnosis was based on the Robinov group's criteria [16], with color Doppler ultrasound of the entire lower extremities performed within 24 h of admission by an experienced radiologist. All ultrasound results were reviewed by a senior radiologist, and any discrepancies were re-evaluated by another senior radiologist. DVT was categorized into three types: proximal DVT, distal DVT, and mixed DVT. Proximal DVT includes

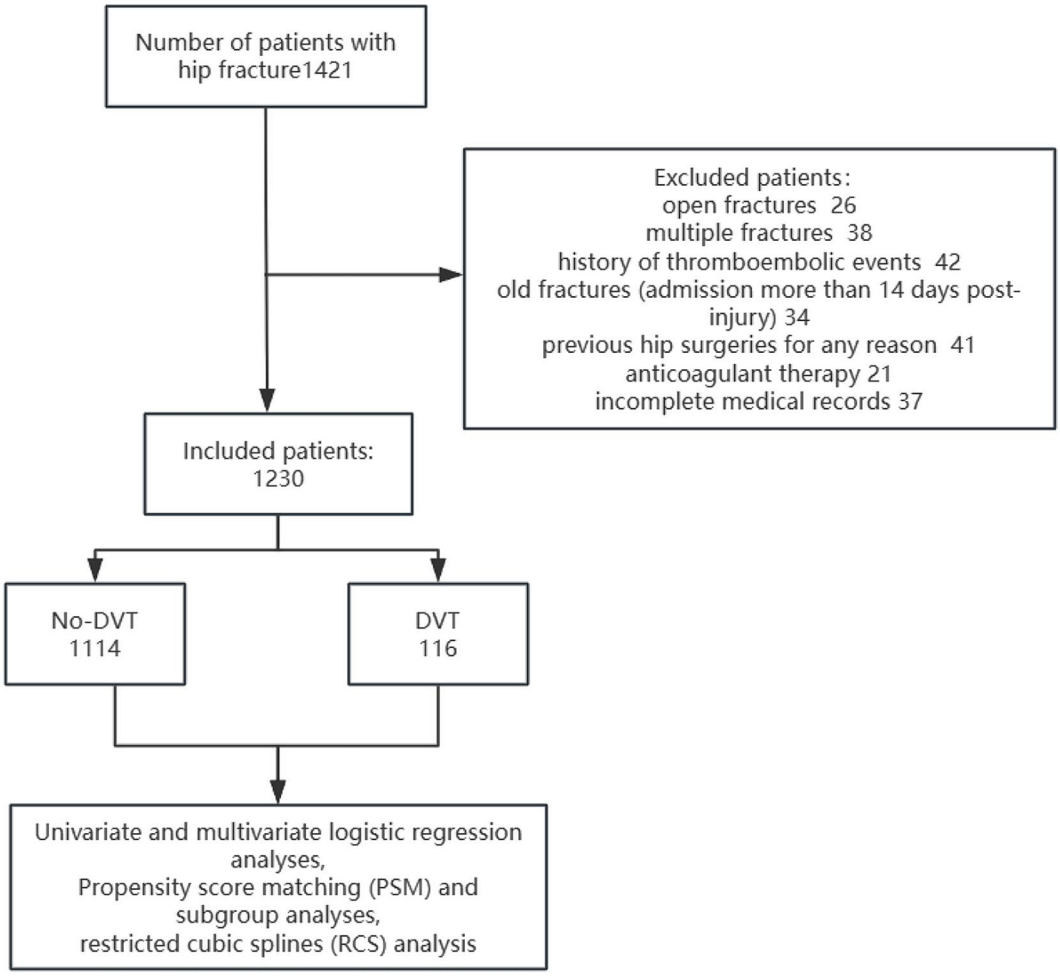

Fig. 1 Flowchart and eligibility

thrombosis in the popliteal vein or proximal sites such as the iliac vein, femoral vein, or popliteal vein. Distal DVT refers to thrombosis in the tibial or fibular veins, which may also involve associated muscle vein thromboses in the vicinity. Mixed DVT encompasses both types.

Data collection

This study reviewed patients' demographic characteristics, fracture details, and laboratory indicators. Demographic and fracture characteristics included age, sex, diagnosis (hip fractures were classified into intertrochanteric hip fractures, which occur between the greater and lesser trochanters of the femur and are categorized as 31A1–3 according to the AO classification, and femoral neck hip fractures, which are located at the narrow part of the femur just below the femoral head and fall into the 31B1–3 category in the AO classification system), comorbidities, mechanism of injury, and time from injury to admission. Laboratory values at admission included D-dimer levels (Latex-enhanced immunoturbidimetry), total albumin (ALB), hemoglobin (HGB), and platelet (PLT) counts.

Statistical analysis

Statistical analyses were performed using R software version 4.2.2 to analyze the data of this study. Descriptive analysis was conducted for each participant's characteristics. Continuous variables are expressed as mean ± standard deviation (SD). QQ plot was used to assess normality. The Mann-Whitney U test was applied to compare two groups of non-normally distributed data, and the Welch Two-Sample t-test was used to compare two groups of normally distributed data. Categorical variables are expressed as frequencies (percentages) and compared via the χ^2 test. In this study, propensity score matching (PSM) was used at a 1:2 ratio to balance cases and controls, with a caliper value set at 0.1. This ratio is commonly used in PSM to enhance statistical power and minimize potential biases in observational studies [17]. The variables used for matching included gender, age, diagnosis, high energy injury, D-dimer, ALB, HGB, PLT,

and comorbidities. Univariable and multivariable (Enter approach) logistic regression analyses were utilized to determine whether TFITA was associated with DVT at admission. In the model, TFITA was treated as both a continuous variable and categorized into binary variables based on thresholds **determined by the Youden method.** Additionally, subanalyses were conducted based on sex, age, diagnosis, energy of injury, D-dimer, ALB, HGB, PLT, and comorbidities before and after PSM. Restricted cubic spline (RCS) analysis based on multivariable logistic regression in model 2 was used to assess the nonlinear relationship between TFITA and DVT at admission, with a knot value set at 3. A p-value of < 0.05 was considered statistically significant.

Ethics approval

This retrospective study involving human participants was conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Ethics Committee of the Central Hospital affiliated with Chongqing University. Informed con sent was obtained from all participants.

Results

Patient demographics and clinical characteristics

Between January 1, 2017, and December 1, 2023, statistical analysis was performed on 1230 participants. The study included 116 patients with deep vein thrombosis (DVT) at admission and 1114 patients without DVT at admission. Table 1 presents the general characteristics of the study population based on DVT status at admission. The findings indicated that patients with DVT at admission were more likely to be older, have longer TFITA, experience intertrochanteric fractures, and present with lower levels of ALB and HGB compared to those without DVT. The mean ± standard deviation for the TFITA in the two groups was 20 ± 50 h for patients without DVT and 40 ± 76 h for those with DVT. To further validate the relationship between TFITA and preoperative thrombotic risk, a nearest-neighbor propensity score matching (PSM) method (1:2) was employed to establish a comparative control group. After matching, 223 patients without DVT at admission were paired with 115 patients with

Table 1 Characteristics of the study population before matching and after matching

Characteristics	Unmatching			Matching		
	Non-DVT(*N* = 1114)	DVT(*N* = 116)	*p*-value	Non-DVT(*N* = 223)	DVT(*N* = 115)	*p*-value
Gender			0.537[a]			0.913[a]
Female	717 (64%)	78 (67%)		148 (66%)	77 (67%)	
Male	397 (36%)	38 (33%)		75 (34%)	38 (33%)	
Age(years)			< 0.001[b]			0.580[c]
Mean ± SD	74 ± 15	78 ± 11		78 ± 13	78 ± 11	
Diagnosis			0.009[a]			0.848[a]
AO 31B1-3	506 (45%)	38 (33%)		76 (34%)	38 (33%)	
AO 31A1-3	608 (55%)	78 (67%)		147 (66%)	77 (67%)	
TFITA (hours)			0.033[c]			0.012[b]
Mean ± SD	20 ± 50	40 ± 76		20 ± 42	40 ± 76	
High energy injury			0.269[a]			0.933[a]
No	1,039 (93%)	105 (91%)		203 (91%)	105 (91%)	
Yes	75 (7%)	11 (9%)		20 (9%)	10 (9%)	
D-dimer (FEU)			0.735[c]			0.801[c]
Mean ± SD	11 ± 9	11 ± 9		11 ± 8	11 ± 9	
ALB (g/l)			< 0.001[b]			0.756[b]
Mean ± SD	39.8 ± 4.3	37.9 ± 4.6		38.1 ± 4.1	38.0 ± 4.5	
HGB (g/l)			0.006[b]			0.733[b]
Mean ± SD	118 ± 19	113 ± 20		114 ± 18	113 ± 20	
PLT (10^9/l)			0.944[c]			0.857[b]
Mean ± SD	180 ± 70	180 ± 67		179 ± 79	181 ± 66	
Comorbidities			0.870[a]			0.774[a]
None	378 (34%)	39 (34%)		70 (31%)	38 (33%)	
1–2	524 (47%)	57 (49%)		107 (48%)	57 (50%)	
≥ 3	212 (19%)	20 (17%)		46 (21%)	20 (17%)	

[a] $\chi 2$ test

[b] Welch Two-Sample t test

[c] Mann-Whitney U test

DVT at admission. Most baseline characteristics showed no significant differences between the two groups before and after matching; however, a significant difference in the TFITA remained.

Relationship between TFITA and lower limb DVT at admission

Univariable logistic regression analysis of TFITA and lower limb DVT at admission

As shown in Table 2, univariable logistic analysis examined the relationship between various factors—including gender, age, diagnosis, TFITA, energy of injury, D-dimer, ALB, HGB, PLT, comorbidity group—and the occurrence of DVT at admission among the patients in this observational study. Our analysis revealed a positive association between age and the incidence of DVT at admission, with an odds ratio (OR) of 1.21 (95% CI:1.05–1.40) per 10 years increase in age. Patients with intertrochanteric fractures were more likely to have DVT at admission compared to those with femoral neck fractures [OR: 1.71; 95% CI: (1.15, 2.59)]. Additionally, both ALB and HGB were negatively correlated with the incidence of DVT at admission, with ORs of 0.91 (95% CI: 0.87–0.95) and 0.99 (95% CI: 0.98–1.00), respectively. Furthermore, when considering TFITA as a continuous variable, it was positively associated with the occurrence of DVT at admission [OR:1.05 (95% CI: 1.02–1.07)] per 10 h increase in TFITA ($p < 0.001$). The threshold for TFITA to be treated as a binary variable was set at 36 h, determined by the Youden method. When TFITA was treated as a binary variable, patients with a longer TFITA (≥ 36 h) exhibited a lower incidence of DVT at admission, with an OR of 2.41 (95% CI: 1.51, 3.74) ($p < 0.001$). After matching, when considering TFITA as a continuous variable, it remained positively associated with the incidence of DVT at admission [OR: 1.06 (95% CI: (1.02–1.10)] per 10 h increase in TFITA ($p = 0.005$). When treated as a binary variable, patients with a longer TFITA (≥ 36 h) also had a lower incidence of DVT at admission, with an OR of 1.90 (95% CI: 1.09–3.29) ($p = 0.023$).

Multivariable logistic regression analysis of TFITA and lower limb DVT at admission

As presented in Table 3, two logistic regression models were constructed to analyze the relationship between TFITA and DVT at admission among the studied patients. Model 1 was adjusted for gender and age, while Model 2 was adjusted for gender, age, diagnosis, energy of injury, D-dimer, ALB, HGB, PLA, and comorbidity group. In all models, the OR and CI for TFITA were 1.05 (95% CI: 1.05–1.09) and 1.05 (95% CI: 1.05–1.08) per 10 h increase in TFITA, which indicated a positive association between TFITA and the risk of DVT ($p < 0.05$). When considering TFITA as a binary variable based on a threshold determined by the Youden method, significant differences were observed across all models, with ORs and 95% CIs of 2.26 (1.42–3.53) and 2.31 (1.34–3.93) ($p < 0.05$). Using our findings for comparison, prolonged

Table 2 Univariable analyses results before matching and after matching

Characteristics	Unmatching		Matching	
	OR (95%CI)	*p*-value	OR (95%CI)	*p*-value
Gender				
Female	ref		ref	
Male	0.88 (0.58–1.31)	0.537	0.97 (0.60–1.56)	0.913
Age (per 10 years increase)	1.21 (1.05–1.40)	0.011	1.00 (0.83–1.20)	0.967
Diagnosis				
AO 31B1-3	ref		ref	
AO 31A1-3	1.71 (1.15–2.59)	0.010	1.05 (0.65–1.70)	0.848
TFITA(per 10 h increase)	1.05 (1.02–1.07)	$p < 0.001$	1.06 (1.02–1.10)	0.005
low	ref		ref	
high	2.41 (1.51–3.74)	$p < 0.001$	1.90 (1.09–3.29)	0.023
High energy injury				
No	ref		ref	
Yes	1.45 (0.71–2.71)	0.271	0.97 (0.42–2.10)	0.933
D-dimer(per 1 FEU increase)	1.01 (0.98–1.03)	0.655	1.00 (0.97–1.03)	0.980
ALB (per 1 g/l increase)	0.91 (0.87–0.95)	< 0.001	0.99 (0.94–1.05)	0.747
HGB (per 1 g/l increase)	0.99 (0.98-1.00)	0.005	1.00 (0.99–1.01)	0.727
PLT (per 1 10^9/l increase)	1.00 (1.00–1.00)	0.905	1.00 (1.00–1.00)	0.865
Comorbidities				
None	ref		ref	
1–2	1.05 (0.69–1.63)	0.809	0.98 (0.59–1.64)	0.942
≥ 3	0.91 (0.51–1.59)	0.756	0.80 (0.41–1.53)	0.508

Table 3 Multivariable analyses results before matching and after matching

Model	Characteristics	Unmatching		Matching	
		OR (95%CI)	*p*-value	OR (95%CI)	*p*-value
Model 1	Total (per 10 h increase)	1.05(1.02–1.09)	0.001	1.06(1.02–1.11)	0.004
	low				
	high	2.26(1.42–3.53)	< 0.001	1.95(1.11–3.42)	0.020
Model 2	Total (per 10 h increase)	1.05(1.02–1.08)	0.002	1.08(1.03–1.14)	0.002
	low				
	high	2.31(1.34–3.93)	0.002	2.37(1.21–4.66)	0.012

Model 1: Adjustments made for gender and age. Model 2: Adjustments made for gender, age, diagnosis, energy of injury, D-dimer, ALB, HGB, PLA, and comorbidity group

TFITA may serve as an independent risk factor for DVT at admission. After matching in both models, a significant association between longer TFITA and increased incidence of DVT was still observed.

Subanalyses before and after matching

As shown in Fig. 2, subanalyses were performed to explore the relationship between TFITA and DVT at admission under different patient characteristics. These characteristics included gender, age, diagnosis, injury mechanism, D-dimer, ALB, HGB, PLT, and comorbidity status. By categorizing continuous variables such as age, D-dimer, ALB, HGB, and PLT into binary groups based on the threshold values determined by the Youden method, we could more clearly observe the impact of these factors on the TFITA-DVT relationship. In patients aged ≥ 68 years, with low-energy injuries, D-dimer ≥ 1.75 FEU, and PLT < 184×10^9/L, significant positive associations were found. Before matching, the ORs were 2.39 (95% CI: 1.47, 3.82), 2.49 (95% CI: 1.55, 3.92), 2.93 (95% CI: 1.88, 4.63), and 2.64 (95% CI: 1.37, 4.86) respectively. After matching, they were 1.82 (95% CI: 1.02, 3.22), 1.97 (95% CI: 1.11, 3.47), 2.00 (95% CI: 1.13, 3.55), and 2.17 (95% CI: 1.00, 4.70). Overall, these subanalyses results provide more detailed evidence for the relationship between TFITA and DVT at admission, highlighting the importance of considering different patient characteristics when evaluating the risk of DVT in hip fracture patients.

The non-linear relationship between TFITA and the occurrence of DVT at admission

As shown in the Fig. 3, RCS was plotted based on Model 2 to visually describe the relationship between TFITA and the occurrence of DVT at admission before and after matching. The results of the RCS analysis indicated that there is no non-linear relationship between TFITA and the occurrence of DVT at admission (with p-values for non-linearity of 0.4 and 0.6 before and after matching, respectively).

Discussion

This study analyzed data from patients with hip fractures admitted between January 2017 to December 2023, to investigate the relationship between DVT at admission and TFITA. Our findings revealed significant differences in TFITA between patients with and without DVT at admission, indicating a positive association between TFITA and DVT prevalence. Both Univariable and multivariable logistic regression analyses confirmed this association. We used RCS to analyze the relationship between TFITA and admission - time DVT occurrence. The p - values of no non-linear tests before and after matching are 0.4 and 0.6 respectively. This shows that as TFITA lengthens, the DVT risk has a relatively stable linear increasing trend. This RCS - revealed linear relationship offers clinicians a simple and intuitive basis for assessing patients' DVT risk.

Most existing research has focused on preoperative or postoperative DVT, with less emphasis on DVT that may occur at admission. Studies have shown that 4–11% of thrombi can progress to pulmonary embolism [18], underscoring the critical importance of screening for DVT at admission for all patients with hip fractures. Our study documented a DVT incidence of 10.41% at admission, reinforcing the need for timely intervention. The mechanism linking delayed admission to the development of deep vein thrombosis (DVT) in patients with hip fractures can be understood as follows: Following a hip fracture, patients are often required to remain immobilized in bed, and delayed admission extends this period of bed rest, which reduces muscle activity necessary for venous blood flow, resulting in local blood stasis that is not adequately addressed in a timely manner [19, 20]; delayed admission fails to promptly mitigate the systemic inflammation that accompanies hip fractures, which is intricately associated with inflammatory responses and coagulation activation [5, 21, 22]; furthermore, this delay can exacerbate vascular endothelial injury related to the fracture, leading to an accumulation of coagulation factors that remain unaddressed [1, 23–25]. Collectively, these factors contribute to excessive activation of the coagulation system, ultimately triggering the onset of deep vein thrombosis. Zuo et al. found that early admission (within 24 h post-injury) significantly associated with perioperative DVT rates (21.9% vs. 35.7% for delayed admission) [8], and similar findings have been observed for other traumatic fractures [26, 27], attributed to peak hypercoagulability and stress responses occurring within 1–4 days post-injury [9]. Our study identified, by the Youden method, that 36 h is the critical time

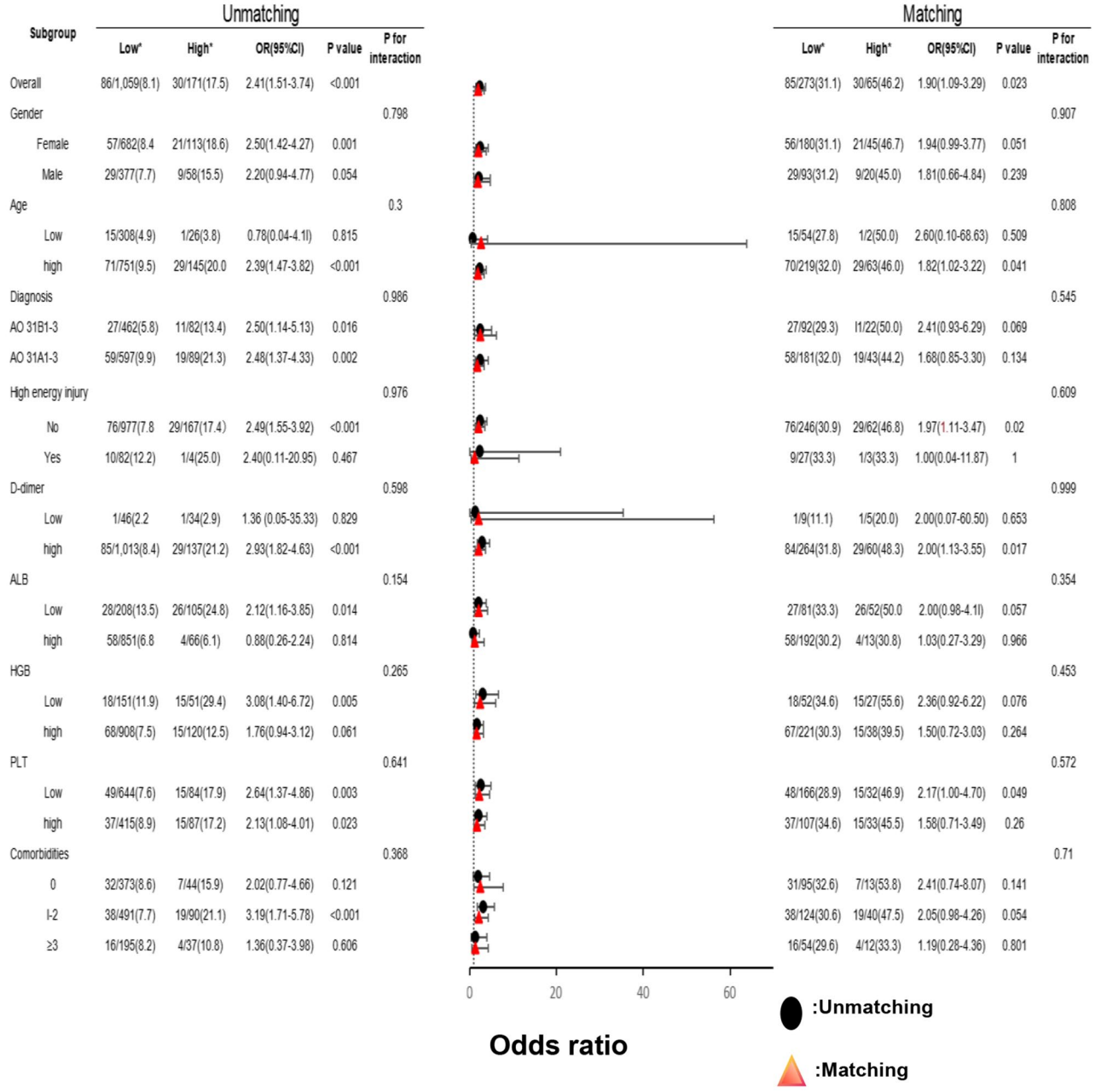

Fig. 2 Subanalyses for the Association between TFITA and DVT: These subanalyses aimed to explore the relationship between TFITA and DVT. Univariable logistic regression was used for these subanalyses

for TFITA. And this finding indicates that delays beyond this threshold significantly increase the risk of DVT. For patients with a long TFITA (≥ 36 h), according to our study, more intensive DVT prevention measures can be implemented. First, tools such as the Wells score can be used for risk stratification [28]. By applying this score to these high-risk patients (long TFITA), we can better identify those with an even higher risk of DVT within this group. Based on the results of the Wells score, specific preventive measures can be taken. This may include earlier initiation of anticoagulant therapy, increased use of mechanical prevention devices such as sequential compression stockings, and more frequent DVT screening using ultrasound. Additionally, the research findings can guide hospitals and healthcare systems in optimizing the admission processes for hip fracture patients. Reducing the time from injury to admission may be a crucial preventive strategy, potentially saving resources associated with DVT treatment and improving the overall prognosis of patients.

Our univariable analysis demonstrated a positive association between age and DVT incidence, consistent with

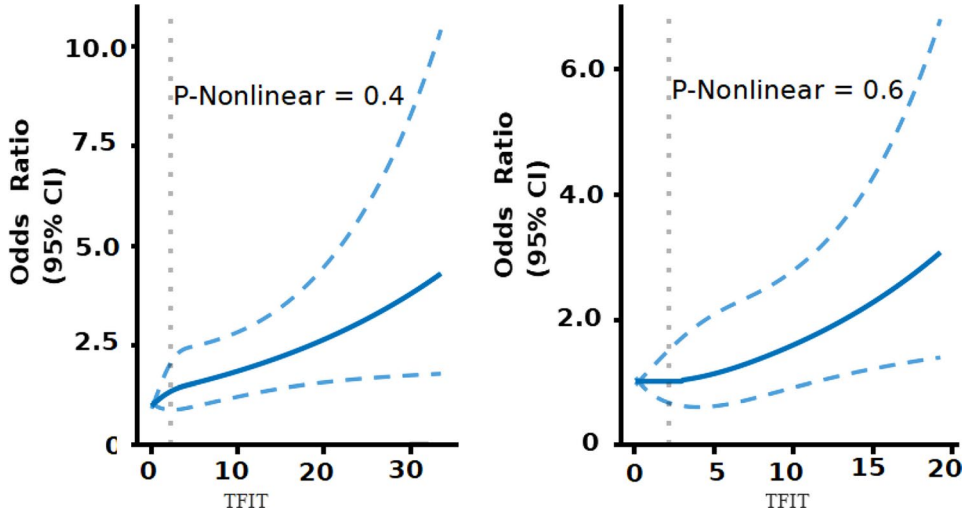

Fig. 3 Nonlinear Associations between TFITA and the risk of DVT legend: RCS before and after matching based on Model 2

previous studies [26, 29, 30]. This association may be attributed to a higher prevalence of conditions such as compromised immune status, venous valve thickening, and increased blood viscosity in elderly patients.

We categorized hip fractures into intracapsular (femoral neck) and extracapsular (intertrochanteric) types [31]. Our findings indicated that the incidence of DVT was approximately twice as high in patients with extracapsular fractures compared to those with intracapsular fractures (12.83% vs. 7.51%), which aligns with previous research [6]. This discrepancy may be due to the more abundant blood supply outside the acetabular capsule, resulting in greater blood loss and subsequent stasis in extracapsular fractures, thereby exacerbating hypercoagulability following blood loss.

Furthermore, in many studies, low serum albumin has been identified as an independent risk factor for DVT [11, 32], and our study further confirms this. Low serum albumin levels are not likely to have a direct impact on coagulation. Studies show that decreased albumin levels combined with increased CRP levels raise the likelihood of thrombosis, indicating an association among them in thrombus formation [33]. The mechanism may be that albumin serves as a negative acute - phase protein. When albumin levels are low, they increase vascular permeability, weaken antioxidant and anti - inflammatory abilities, triggering inflammation and a rise in CRP. This damages the vascular endothelium, activates the coagulation system, thereby promoting platelet aggregation. Thus, low albumin levels reflect an inflammatory milieu that heightens the DVT risk.

Anemia has also been linked to an increased risk of VTE in patients with hip fractures [34–39]. Our findings support this view and show that admission anemia is an independent DVT risk factor. The mechanisms are multifaceted. Trauma-induced red blood cell damage can cause a hypercoagulable state [40]. Also, anemia may suggest frailty and comorbidities like chronic inflammation or underlying (gastrointestinal) cancers [41, 42]. These comorbidities disrupt the coagulation-anticoagulation balance via inflammatory cytokines, which boost platelet activation and coagulation factor synthesis, increasing DVT risk [43].

Socioeconomic status, healthcare access, and patient factors all impact TFITA. Lower socioeconomic status patients may face admission delays because of financial hardships, like unaffordable transportation or insufficient health insurance. Rural or remote area patients have extended TFITA due to long hospital distances, poor transportation, and scarce emergency resources. Additionally, patients' poor understanding of hip fracture severity, along with family related support and decision - making processes, can cause admission procrastination. These factors interact, collectively influencing TFITA and, in turn, being associated with DVT.

This study has several limitations. Incomplete data might affect result accuracy since not all DVT risk factors were factored into the adjusted model, so future research should use larger samples for validation. Although ultrasound isn't the gold standard for DVT diagnosis and operator skills vary, experienced radiologists minimized such variability in our assessments. Also, some potential DVT risk factors like varicose veins and relevant medical histories were not collected. We excluded anticoagulant - treated patients to reduce confounding factors for exploring the TFITA-DVT relationship, but many elderly patients don't take anticoagulants regularly and still face DVT risks, so clinical DVT risk assessment can't be neglected for those on anticoagulant therapy, and excluding them impacts research generality. Finally, the cross - sectional design restricts dynamic observation of post

- fracture DVT, calling for prospective studies for further investigation.

Conclusion

In summary, we have demonstrated that the formation of DVT at admission in hip fracture patients is related to an increase in the TFITA. We strongly recommend that orthopedic surgeons conduct early DVT screening for patients with delayed admission due to hip fractures to reduce mortality and improve patient quality of life.

Abbreviations

DVT	Deep vein thrombosis
TFITA	Time from injury to admission
HGB	Hemoglobin
ALB	Albumin
PLA	Platelets
CI	Confidence interval
PE	pulmonary embolism

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Not Applicable.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by LJ and HM. The first draft of the manuscript was written by LJ, SRY made meaningful corrections to the structure of the article and guided the statistical methods and data processing, and all authors commented on previous versions of the manuscript. LJ participated in the design of the study and proofread the manuscript as the corresponding author. All authors have read and approved the manuscript.

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Data availability

The datasets generated and/or analysed during the current study are not publicly available as they contain information that could compromise the privacy of research participants but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This retrospective study involving human participants was conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Ethics Committee of the Central Hospital affiliated with Chongqing University. Informed consent was obtained from all participants.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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