https://doi.org/10.31925/farmacia.2025.6.13 **ORIGINAL ARTICLE**

EVALUATION OF SERUM INFLAMMATORY MARKER LEVELS, DEGREE OF VASCULAR INJURY AND POST-THROMBOTIC SYNDROME IN TREATING LOWER EXTREMITY DEEP VEIN THROMBOSIS WITH RIVAROXABAN COMBINED WITH XUESHUANTONG INJECTION

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Abstract

Deep vein thrombosis (DVT) is a common complication after hip replacement, impairing limb function and posing systemic risks if untreated. This study evaluated the therapeutic effects of rivaroxaban combined with Xueshuantong Injection on DVT after hip replacement, focusing on vascular injury and post-thrombotic syndrome. A total of 137 patients with postoperative DVT were randomly assigned to rivaroxaban (n = 45), Xueshuantong Injection (n = 45), or combination therapy (n = 47). Outcomes included venous lumen morphology, flow rate, blood rheology, coagulation parameters, inflammatory markers, vascular injury and incidence of post-thrombotic syndrome. Clinical effectiveness rates were 80.0%, 82.2% and 95.7% for the respective groups, with the combination group showing significantly superior improvement ($p < 0.05$). Although Groups 1 and 2 showed modest differences after treatment, combination therapy notably reduced femoral and popliteal vein diameters, increased venous flow and decreased whole blood and plasma viscosity. Coagulation parameters improved, with prolonged APTT, PT and TT, and decreased fibrinogen levels, accompanied by reductions in serum inflammatory markers. Ultrasound-assessed vascular injury scores and Villalta scores were also significantly lower in the combination group. Overall, rivaroxaban plus Xueshuantong Injection enhanced hemorheology and coagulation status, reduced inflammation and vascular injury, and demonstrated clear clinical benefits in managing DVT after hip replacement.

Rezumat

Tromboza venoasă profundă (TVP) reprezintă o complicație frecventă după artroplastia de șold, afectând funcția membrului și putând genera riscuri sistemice dacă nu este tratată. Acest studiu a evaluat efectele terapeutice ale rivaroxabanului în combinație cu injecția Xueshuantong asupra TVP postoperatorii, cu accent pe leziunile vasculare și sindromul posttrombotic. Un total de 137 de pacienți cu TVP după artroplastia de șold au fost repartizați aleatoriu în trei grupuri: rivaroxaban (n = 45), injecție Xueshuantong (n = 45) sau terapia combinată (n = 47). Parametrii evaluați au inclus morfologia lumenului venos, viteza fluxului venos, reologia sângelui, parametrii de coagulare, markerii inflamatori, gradul de lezare vasculară și incidența sindromului posttrombotic. Ratele de eficacitate clinică au fost de 80,0%, 82,2% și 95,7% pentru cele trei grupuri, terapia combinată prezentând îmbunătățiri semnificative ($p < 0.05$). Deși Grupurile 1 și 2 au prezentat diferențe modeste după tratament, terapia combinată a redus în mod semnificativ diametrele venelor femurală și poplitee, a crescut viteza fluxului venos și a scăzut vâscozitatea sângelui integral și a plasmei. Parametrii de coagulare s-au ameliorat, cu prelungirea APTT, PT și TT și reducerea fibrinogenului, concomitent cu scăderea markerilor inflamatori serici. Scorurile ecografice ale leziunilor vasculare și scorurile Villalta au fost, de asemenea, semnificativ mai mici în grupul combinat. *Per* ansamblu, rivaroxabanul asociat cu injecția Xueshuantong a îmbunătățit reologia și statusul coagulării, a redus inflamația și lezarea vasculară și a demonstrat beneficii clinice clare în managementul TVP după artroplastia de șold.

Keywords: total hip arthroplasty, deep vein thrombosis, rivaroxaban, Xueshuantong Injection, vascular injury

Introduction

Following deep vein thrombosis (DVT) of the lower extremities, pulmonary artery occlusion can lead to reduced or obstructed blood flow, resulting in haemodynamic changes and the manifestation of pulmonary hypertension. This can subsequently lead to decreased left heart output, which, in severe cases, may result in patient mortality [1]. Key factors contributing to the development of lower extremity DVT include reduced blood flow velocity, vascular wall injury and a hypercoagulable state [2, 3]. Previous studies reported a high incidence of DVT following hip and knee arthroplasty [4]. Clinically, low-molecular-weight heparin is commonly used for the prevention of lower extremity DVT; however, it carries a risk of bleeding complications following treatment.

Rivaroxaban belongs to the class of anticoagulant medications. It offers advantages such as target specificity, good stability and high bioavailability [5]. The formation

of DVT is primarily attributed to factors such as slow blood flow within the veins, a hypercoagulable state and vascular wall injury. Rivaroxaban exerts its effects by directly and effectively inhibiting the activity of factor Xa, thereby preventing the conversion of fibrinogen to fibrin and aiding in the mitigation of DVT formation [6, 7]. However, anticoagulant therapy alone can only prevent further extension of the thrombus and does not fully dissolve the existing thrombus, leading to long-term vascular obstruction, which may increase the risk of post-thrombotic syndrome. Xueshuantong therapy, as an effective means to promote thrombus dissolution, can partially restore vascular patency, improve haemodynamic and reduce thrombus-related complications. The Xueshuantong Injection used, composed of total saponins from *Panax notoginseng*, is known for its efficacy in promoting blood circulation and alleviating vascular blockage [8]. Additionally, the total saponin components of *Panax notoginseng* can inhibit platelet activation factor-induced platelet aggregation. This contributes to the resolution of congestion and ecchymosis [9]. Ingredients such as *Astragalus* and *Salvia miltiorrhiza* act directly on vascular smooth muscle, promoting vasodilation, which increases vascular diameter and capacity while reducing vascular resistance. This improvement in the blood circulation enhances tissue blood and oxygen supply [10, 11]. Therefore, Xueshuantong Injection demonstrates effects such as vasodilation, microcirculation improvement, anticoagulation and vascular endothelial protection. Furthermore, it can inhibit platelet adhesion and aggregation on damaged vascular walls and enhance the generation and activity of plasmin, thereby suppressing thrombus formation and reducing the risk of thrombus-related complications [12].

Currently, research on the effects of the combination of rivaroxaban and Xueshuantong Injections on serum inflammatory markers, incidence of post-thrombotic syndrome and other aspects in patients with lower limb DVT following hip replacement surgery is insufficient. This study aimed to explore the therapeutic efficacy of rivaroxaban combined with Xueshuantong Injections in the treatment of lower limb DVT after hip replacement surgery. The research not only focused on traditional coagulation function and vascular ultrasound indicators, but also comprehensively evaluated serum inflammatory marker levels, extent of vascular injury and the incidence of post-thrombotic syndrome, providing effective treatment strategies to reduce the risk of DVT formation following hip replacement surgery.

Materials and Methods

Research objects

This study included 137 patients who developed DVT of the lower extremities following unilateral hip arthroplasty between June 2021 and June 2024. The 75 males and 62 females were 58 ~ 75 years old (mean = 65.1 ± 3.8). Regarding principles outlined in the Declaration of Helsinki, all participants provided informed consent, and the Changde First People's Hospital ethics committee approved this work.

Inclusion criteria: (i) all patients were definitively diagnosed with lower extremity DVT based on the standards of the Vascular Surgery of the Chinese Medical Association [13]; (ii) before hip arthroplasty, colour Doppler ultrasound examinations confirmed the absence of DVT in both lower extremities; iii) no contraindications existed for the medications used in this study.

Exclusion criteria: (i) presence of malignant tumours; (ii) receipt of anticoagulant or antiplatelet therapy within the past two weeks; (iii) significant dysfunction of vital organs such as the heart, liver, or kidneys; (iv) presence of endocrine disorders; (v) cognitive impairment or other psychiatric conditions; (vi) women who were pregnant or breastfeeding.

Treatment measures

A total of 137 patients who developed DVT following unilateral hip replacement surgery and met the inclusion criteria were assigned numbers. Random numbers were generated using a random number table, and patients were sequentially allocated to three groups based on the order of the random numbers: Group 1, Group 2 and Group 3, comprising 45, 45 and 47 patients, respectively. All patients received anti-infective therapy upon admission and underwent hip arthroplasty *via* a lateral approach under general anaesthesia performed by the same surgical team.

In Group 1, 10 mg of rivaroxaban was administered orally once daily, starting 6 hours postoperatively (Bayer Healthcare, China).

In Group 2, 175 mg of the Xueshuantong Injection was infused intravenously once daily, starting 6 hours postoperatively (Harbin Shengtai Biological Pharmaceutical Co., China) (5 mL of Xueshuantong Injection was dissolved in 250 mL of 0.9% sodium chloride injection and administered once daily).

In Group 3, patients received both oral rivaroxaban and intravenous Xueshuantong Injection treatment starting 6 hours postoperatively, following the same administration protocols as in Groups 1 and 2. All three groups underwent continuous treatment for 14 days.

Criteria for efficacy evaluation

The assessment of treatment efficacy was conducted based on the evaluation criteria established in the principles and practice of surgery [14]: (i) *Marked improvement*: great reduction in the limb swelling, substantial alleviation of pain and colour Doppler ultrasound indicating partial recanalization of obstructed vessels; (ii) *Effective*: some improvement in limb swelling and pain, with colour Doppler ultrasound indicating minor recanalization of obstructed vessels; (iii) *Ineffective*: no significant change in limb swelling or pain, with colour Doppler ultrasound showing no blood flow signals in the obstructed vessels. The overall

clinical effective rate = (marked improvement number + effective case number)/total patient number.

Evaluation indicators

Measurement of venous diameter and flow rate was performed. The total femoral vein, deep femoral vein, superficial femoral vein and popliteal vein of the affected limb were scanned using the LOGIQ E9 XDclear 2.0 colour Doppler ultrasound (GE, USA) to determine the diameters and flow rates of the femoral and popliteal veins.

Haematological rheology assessment was conducted. Venous blood was collected both preoperatively and three days postoperatively. Whole blood high-shear viscosity (WBHSV), WB middle-shear viscosity (WBMSV), WB low-shear viscosity (WBLSV) and plasma viscosity (PV) were analysed using the HT-100G fully automated blood rheology analyser (Zibo Hengtuo Analytical Instrument Co., China).

Coagulation function assessment was performed. Venous blood was collected both preoperatively and three days postoperatively. Activated partial thromboplastin time (APTT), prothrombin time (PT), thrombin time (TT) and fibrinogen (FIB) were measured using the AU680 fully automated biochemical analyser (Beckman Coulter, USA).

Serum inflammatory marker assessment was implemented. Fasting venous blood was collected at baseline (0 d), 1 d, 3 d, 7 d and 14 d postoperatively. After centrifugation, serum was separated, and high-sensitivity C-reactive protein (hs-CRP), interleukin (IL)-1β, IL-8 and tumour necrosis factor (TNF)-α were measured employing ELISA according to manufacturer instructions. All kits were purchased from Shanghai Boke Biotechnology Co., China.

The evaluation of vascular injury was conducted using vascular ultrasound examinations of the affected limb, performed with the LOGIQ E9 XDclear 2.0 colour Doppler ultrasound (GE, USA). The assessment of embolised vessels was based on the scoring criteria for the iliac-femoral vein [15].

The incidence of post-thrombotic syndrome was assessed utilising the Villalta score [16], which includes changes in symptoms and signs. The total score is 42, with higher scores implying a more pronounced occurrence of post-thrombotic syndrome.

Various adverse reactions during the treatment period were documented.

Statistical processing

Data analysis in this study was performed using SPSS 23.0 (IMB, USA). Categorical data were presented as frequency and percentage (n (%)), with inter-group differences analysed using the Chi-square (χ^2) test. For continuous data, the Shapiro-Wilk test was first used to assess normality, and the Levene's test was employed to evaluate the homogeneity of variance. Data that met the assumptions of normality and homogeneity of variance are presented as mean ± standard deviation ($\bar{x} \pm s$). One-way analysis of variance (One-Way ANOVA) was used for overall comparisons between the three groups. If significant differences were found, pairwise comparisons were conducted using the Least-Significant Difference (LSD) method when variances were homogeneous, and the Tamhane's T2 method was used when variances were heterogeneous. A p value of < 0.05 was considered statistically significant.

Results and Discussion

Baseline data and pre-treatment indicators

In Table I, negligible differences existed in age, gender, comorbidities and other baseline data between Group 1, Group 2 and Group 3 ($p > 0.05$). Furthermore, there were also no noticeable differences in venous diameters and flow rates, haematological rheology parameters, coagulation function indicators, serum inflammatory markers, vascular ultrasound scores and Villalta scores among the three groups prior to treatment ($p > 0.05$).

Clinical efficacy

The overall clinical effectiveness rate differed slightly between Group 1 and Group 2 after treatment ($p > 0.05$). Nevertheless, the overall clinical effectiveness rate in Group 3 was markedly superior to that in both Group 1 and Group 2 ($p < 0.05$) (Table II).

Table I

Baseline data and pre-treatment indicators among three groups of patients

Data	Group 1 (n = 45)	Group 2 (n = 45)	Group 3 (n = 47)	*P*
Age (years old)	65.51 ± 5.63	64.93 ± 4.15	66.08 ± 3.29	0.565
Sex [*n* (%)]				0.196
Male	23 (51.1)	24 (53.3)	28 (59.6)	
Female	22 (48.9)	21 (46.7)	19 (40.4)	
Basic disease [*n* (%)]				0.433
Hypertension	16 (35.6)	16 (35.6)	18 (38.3)	
Diabetes	6 (13.3)	5 (11.1)	7 (14.9)	
Surgical duration (min)	120.50 ± 25.63	118.93 ± 22.15	122.08 ± 20.29	0.853
Intraoperative blood loss (mL)	200.23 ± 50.43	198.20 ± 48.21	201.17 ± 49.30	0.920
Postoperative hospital stays (days)	7.56 ± 1.48	7.71 ± 1.53	7.60 ± 1.49	0.784
Venous diameter (cm)				
Femoral vein	7.82 ± 1.06	7.70 ± 1.12	7.76 ± 1.18	0.341
Popliteal vein	6.56 ± 0.71	6.63 ± 0.74	6.59 ± 0.82	0.540

Data	Group 1 (n = 45)	Group 2 (n = 45)	Group 3 (n = 47)	*P*
Venous flow velocity (cm/s)				
Femoral vein	12.50 ± 2.67	12.48 ± 2.51	12.53 ± 2.53	0.518
Popliteal vein	7.68 ± 1.12	7.73 ± 1.20	7.75 ± 1.08	0.421
Hemorheology (mPa·s)				
WBHSV	19.23 ± 4.43	19.20 ± 4.21	19.17 ± 4.30	0.473
WBMSV	6.06 ± 1.55	6.11 ± 1.42	6.03 ± 1.41	0.416
WBLSV	4.28 ± 0.81	4.21 ± 0.97	4.25 ± 0.88	0.332
PV	1.55 ± 0.17	1.54 ± 0.15	1.55 ± 0.19	0.420
Coagulation function				
APTT (s)	25.02 ± 3.54	25.10 ± 3.61	24.97 ± 3.19	0.574
PT (s)	10.81 ± 2.12	10.79 ± 2.35	10.80 ± 2.24	0.422
TT (s)	10.79 ± 1.87	10.77 ± 2.16	10.84 ± 1.98	0.368
FIB (g/L)	4.73 ± 1.03	4.69 ± 1.09	4.71 ± 1.05	0.527
Serum inflammatory factors				
hs-CRP (mg/L)	8.11 ± 1.07	8.15 ± 1.09	8.20 ± 1.14	0.539
IL-1β (mg/L)	4.24 ± 0.50	4.19 ± 0.44	4.17 ± 0.52	0.481
IL-8 (ng/L)	0.39 ± 0.11	0.42 ± 0.10	0.40 ± 0.09	0.395
TNF-α (ng/L)	18.12 ± 2.44	18.35 ± 2.59	18.38 ± 2.38	0.334
Vascular ultrasound scoring	7.56 ± 0.48	7.71 ± 0.53	7.60 ± 0.49	0.502
Villata score	10.39 ± 1.52	10.68 ± 1.19	10.27 ± 0.87	0.476

Table II

Clinical efficacy among three groups of patients [*n* (%)]

Group	Marked effective	Effective	Ineffective	Overall effective
Group 1 (n = 45)	23 (51.1)	13 (28.9)	9 (20.0)	36 (80.0)
Group 2 (n = 45)	22 (48.9)	15 (33.3)	8 (17.8)	37 (82.2)
Group 3 (n = 47)	27 (57.4)	18 (38.3)	2 (4.3)	45 (95.7)

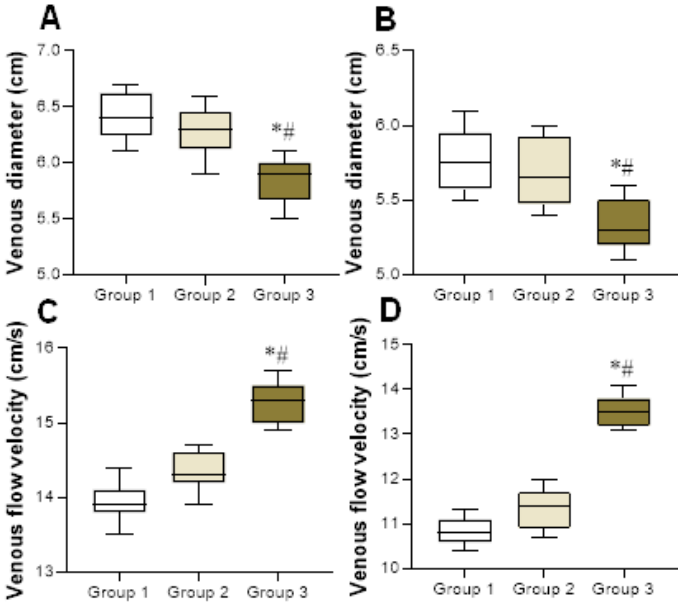

Figure 1.

Contrast of venous diameter and flow velocity among three groups of patients after treatment

A: diameter of femoral vein; B: diameter of popliteal vein; C: velocity of femoral vein; D: velocity of popliteal vein

*p < 0.05 compared to Group 1 and #p < 0.05 compared to Group 2

Comparison of venous diameter and flow velocity after treatment

The femoral vein diameter, femoral vein flow rate, popliteal vein diameter and popliteal vein flow rate differed inconsiderably between Group 1 and Group 2 after treatment (p > 0.05). The femoral vein diameter and popliteal vein diameter in Group 3 were significantly smaller than those in Group 1 and Group 2, while the femoral vein flow rate and popliteal vein flow rate in Group 3 were markedly higher than those in Group 1 and Group 2 (p < 0.05) (Figure 1).

Comparison of post-treatment hemorheology

The haematological rheology parameters, including the WBHSV, WBMSV, WBLSV and PV, differed inconsiderably between Group 1 and Group 2 after treatment ($p > 0.05$). All these parameters in Group 3 were dramatically inferior to those in Group 1 and Group 2 ($p < 0.05$) (Figure 2).

Comparison of coagulation function after treatment

The coagulation function parameters, including APTT, PT, TT and FIB, exhibited negligible differences between Group 1 and Group 2 after treatment ($p > 0.05$). APTT, PT and TT in Group 3 were notably superior to those in Group 1 and Group 2, while FIB was greatly lower in Group 3 *versus* Group 1 and Group 2 ($p < 0.05$) (Figure 3).

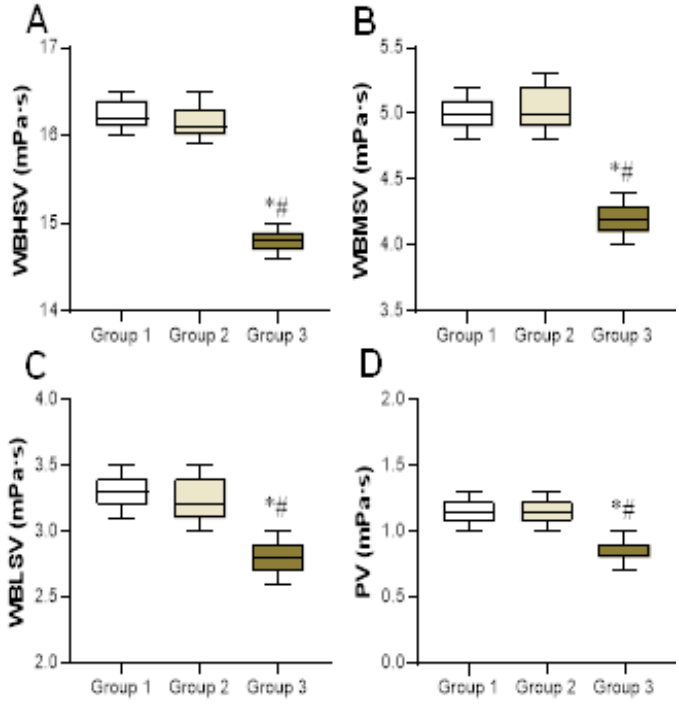

Figure 2.

Contrast of hemorheological parameters among three groups of patients after treatment

A: WBHSV; B: WBMSV; C: WBLSV; D: PV. *p < 0.05 compared to Group 1 and #p < 0.05 compared to Group 2

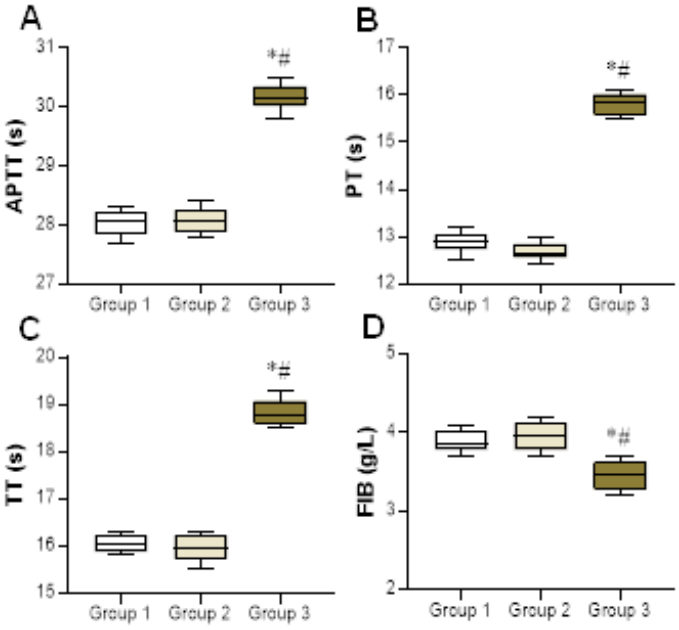

Figure 3.

Contrast of coagulation function parameters among three groups of patients after treatment

A: APTT; B: PT; C: TT; D: FIB. *p < 0.05 compared to Group 1 and #p < 0.05 compared to Group 2

Comparison of serum inflammatory factor levels after treatment

After treatment, levels of peripheral blood inflammatory markers in three groups exhibited a pattern of initial increase followed by a decrease, with all groups reaching peak levels at 1 d post-surgery. These inflammatory markers differed slightly among Group 2 and Group 3 at any time point after treatment ($p > 0.05$). Nevertheless, at 1 d, 3 d, 7 d and 14 d post-treatment, hs-CRP, IL-1β, IL-8 and TNF-α in Group 3 were notably inferior to those in Group 1 and Group 2 ($p < 0.05$) (Figure 4).

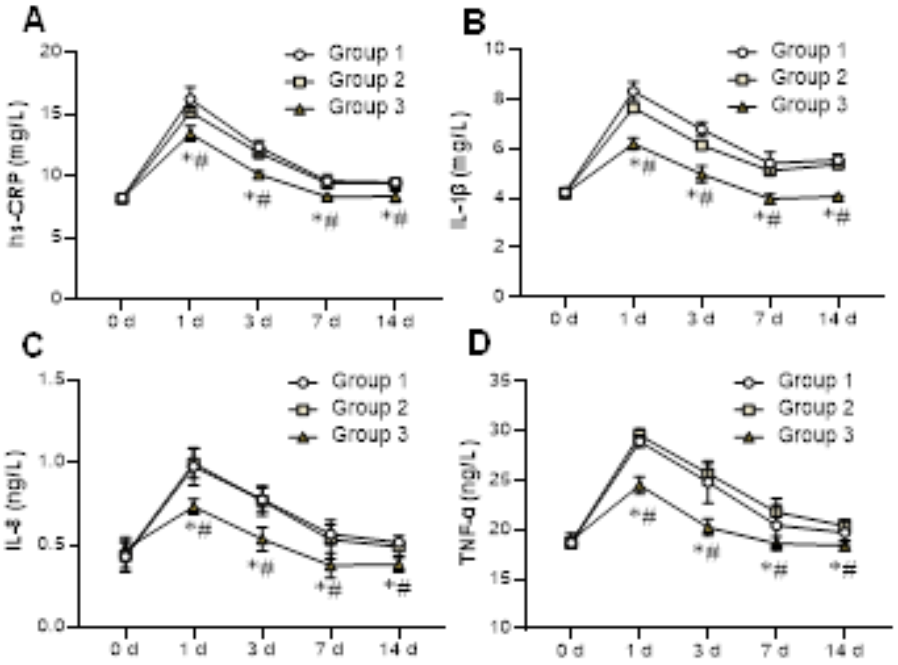

Figure 4.

Contrast of changes in peripheral blood factors among three groups of patients after treatment

A: hs-CRP; B: IL-1β; C: IL-8; D: TNF-α. *p < 0.05 compared to Group 1 and #p < 0.05 compared to Group 2

Comparison of post-treatment vascular injury and post-thrombotic syndrome

The vascular ultrasound scores and Villalta scores showed negligible differences between Group 1 and Group 2 after treatment ($p > 0.05$). Both the vascular ultrasound scores and Villalta scores in Group 3 were markedly inferior to those in Group 1 and Group 2 ($p < 0.05$) (Figure 5).

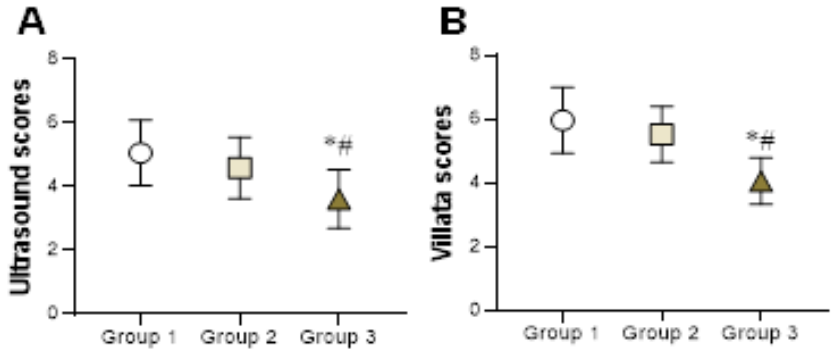

Figure 5.

Contrast of scores among three groups of patients after treatment

A: the vascular ultrasound score; B: Villata score. *p < 0.05 compared to Group 1 and #p < 0.05 compared to Group 2

Comparison of adverse reaction rates

No serious adverse reactions occurred in any of the three groups during the treatment period. In Group 1, there were 2 cases of gingival bleeding, 2 cases of nausea and vomiting and 1 case of skin and mucosal bleeding. In Group 2, there was 1 case of gingival bleeding, 1 case of nausea and vomiting and 1 case of skin itching. In Group 3, there were 3 cases of gingival bleeding, 2 cases of nausea and vomiting and 2 cases of skin itching. The rates of adverse reactions among the three groups showed negligible differences ($p > 0.05$).

Due to prolonged bed rest following fractures, most elderly patients experience a reduction in muscle activity in the affected limb, which adversely affects venous return and subsequently leads to a decrease in blood flow velocity [17]. Furthermore, the elderly fracture population may exhibit varying degrees of endocrine abnormalities and stress responses, leading to changes in blood composition. This can result in increased blood viscosity and elevated levels of activated coagulation factors and thrombin, placing the blood in a hypercoagulable state and making patients highly susceptible to thrombosis [18-20]. DVT of the lower limbs is a serious complication in elderly orthopaedic surgical patients, with venous injury, reduced blood flow velocity and hypercoagulability all contributing to its occurrence [21]. Timely administration of effective anticoagulant medications is a critical strategy for managing lower limb DVT. Rivaroxaban, an Xa factor inhibitor, selectively and competitively inhibits free Xa factor and prothrombin activity, thereby suppressing thrombin generation and ultimately hindering the formation of DVT [22]. Xueshuantong injection is a composite herbal preparation made from traditional Chinese medicinal materials such as *Salvia miltiorrhiza*, *Scutellaria*, *Notoginseng* and *Astragalus*. It possesses properties such as promoting blood circulation, resolving blood stasis, anticoagulation and anti-thrombosis [23]. This study found that the overall effective rates for treating lower limb DVT following hip arthroplasty were 80.0% for rivaroxaban alone, 82.2% for the Xueshuantong injection alone and 95.7% for the combination of rivaroxaban and Xueshuantong injection. Additionally, the combination therapy resulted in a reduction in the diameters of the femoral and popliteal veins and an increase in blood flow velocity. These findings indicate that the combined treatment of the rivaroxaban and Xueshuantong injection yields superior therapeutic effects.

APTT reflects the activity of the intrinsic coagulation system, PT is utilised to assess extrinsic coagulation factors, and TT serves as a sensitive indicator for evaluating coagulation, anticoagulation and fibrin activity [24, 25]. This study found that relative to treatment with rivaroxaban or Xueshuantong injection alone, the combination of rivaroxaban and Xueshuantong injection significantly prolonged APTT, PT and TT, while reducing FIB concentrations. Additionally, the study revealed that the combination therapy resulted in greatly lower whole blood viscosity and plasma viscosity versus either rivaroxaban or Xueshuantong injection alone. It was reported that extracts from *Notoginseng* can reduce platelet aggregation and improve vascular circulation and permeability through mechanisms such as dissolving internal blood stasis [26]. The combination of rivaroxaban and Xueshuantong injection effectively improved coagulation function in patients with lower limb DVT following hip arthroplasty, alleviating the hypercoagulable state through the synergistic effects of the medications. This helps prevent the formation of lower limb DVT. This effect may be attributed to rivaroxaban's ability to effectively block the thrombin amplification cascade and inhibit thrombin release, thereby exerting a favourable anticoagulant effect [27]. Additionally, Xueshuantong injection has properties that promote blood circulation and resolve blood stasis, further enhancing the post-operative circulatory status of patients [28].

The inflammatory state is closely related to the severity of DVT [29]. TNF-α serves as an initiator of inflammation, and elevated levels of TNF-α can trigger the activation of pro-inflammatory cytokines, exacerbating endothelial damage and promoting the formation of DVT [30, 31]. This study found that after treatment, hs-CRP, IL-1β, IL-8 and TNF-α initially increased and then decreased. Notably, patients receiving the combination of rivaroxaban and Xueshuantong injection had markedly lower levels of these inflammatory cytokines *versus* those treated with either agent alone. A state of microinflammation can lead to changes in blood rheology, causing blood flow disturbances that ultimately result in larger thrombus formation [32]. Rivaroxaban specifically inhibits the activity of coagulation factor Xa, which not only plays a role in the coagulation process but also has an important function in inflammatory signalling pathways. Studies showed that activated factor Xa can activate intra-cellular signalling cascades *via* protease-activated receptors, leading to the release of inflammatory mediators such as TNF-α and IL-6 [33]. By inhibiting the activity of factor Xa, rivaroxaban blocks this inflammatory signalling pathway, thereby reducing the production of inflammatory factors. At the cellular level, rivaroxaban can inhibit endothelial cell activation and reduce the expression of adhesion molecules, which in turn decreases the interaction between leukocytes and endothelial cells, mitigating the inflammatory response [34]. The Xueshuantong Injections convert plasminogen into plasmin [35], and plasmin not only degrades fibrin but also breaks down some inflammation-related proteins, thereby alleviating the inflammatory response. The combination of rivaroxaban and Xueshuantong injection effectively reduced peripheral blood pro-inflammatory factors in patients with lower limb DVT following hip arthroplasty, thereby improving the microinflammatory state and helping to inhibit thrombus formation and enlargement. Ultrasound scoring and Villata scoring are important clinical indicators commonly used to assess thrombus status and disease severity [36, 37]. This study found that, relative to treatment with rivaroxaban or Xueshuantong injection alone, the combination of rivaroxaban and Xueshuantong injection resulted in markedly lower ultrasound and Villata scores. Furthermore, the rates of adverse reactions differed slightly among the groups. These findings indicate that the combined therapy is more effective in reducing the degree of vascular injury in patients

with lower limb DVT following hip arthroplasty, improving the occurrence of post-thrombotic syndrome, while maintaining a high safety profile.

Conclusions

Relative to treatment with rivaroxaban or Xueshuantong injection alone, the combination therapy showed superior efficacy in managing lower limb DVT. Rivaroxaban and Xueshuantong Injection synergistically modulated the patient's hypercoagulable state and optimised coagulation function, while also reducing the levels of peripheral pro - inflammatory cytokines, thereby alleviating vascular injury and reducing the incidence of post - thrombotic syndrome. Nevertheless, this work shows certain limitations, such as the absence of follow - up data to analyse the recurrence of lower limb DVT. Future research should include more samples to further investigate the long - term efficacy of combination of rivaroxaban and Xueshuantong injection in treating lower limb DVT.

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Conflict of interest

The authors declare no conflict of interest.

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