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Original Article

Percutaneous mechanical thrombectomy combined with catheter-directed thrombolysis improves clinical outcomes in subacute lower extremity deep vein thrombosis

Junqiang Xue[1*], Ping Yin[2*], Jianping He[1], Hui Wei[3], Cuijie Geng[1], Yuxian Luo[1]

[1]Department of Vascular Surgery, Shijiazhuang People's Hospital, Shijiazhuang 050011, Hebei, China; [2]Department of Laboratory Medicine, Shijiazhuang Hospital of Traditional Chinese Medicine, Shijiazhuang 050011, Hebei, China; [3]Department of Catheter Room, Shijiazhuang People's Hospital, Shijiazhuang 050011, Hebei, China. [*]Equal contributors.

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Abstract: Objective: To explore the clinical efficacy of percutaneous mechanical thrombectomy (PMT) combined with catheter-directed thrombolysis (CDT) for subacute lower extremity deep vein thrombosis (DVT). Methods: A retrospective analysis was conducted on 93 patients with subacute lower extremity DVT, divided into the CDT group (n=45) and combined group (PMT + CDT, n=48) by treatment regimen. Clinical efficacy, thrombus clearance, related indicators and safety were compared between the two groups. Results: The total effective rate of the combined group (97.92%) was significantly higher than that of the CDT group (82.22%) ($P<0.05$), with superior thrombus removal grade, significantly shorter thrombolysis duration, lower drug dosage and shorter hospital stay (all $P<0.05$). After treatment, the combined group showed more significant improvements in coagulation, inflammation, limb circumference difference and hemorheology indexes, with a lower recurrence rate (4.17% vs 17.78%, $P<0.05$). There was no significant difference in complication rate between the two groups ($P>0.05$). Conclusion: PMT combined with CDT exerts significant efficacy and favorable safety in treating subacute lower extremity DVT, and can reduce recurrence risk.

Keywords: Lower extremity deep vein thrombosis, subacute, percutaneous mechanical thrombectomy, catheter-directed thrombolysis

Introduction

Deep vein thrombosis (DVT) of the lower extremities is a common and potentially life-threatening emergency in vascular surgery. Clinically, it is characterized by sudden swelling, pain, and superficial venous dilatation of the affected limb. Besides causing limb dysfunction, dislodged thrombi can lead to fatal pulmonary embolism; moreover, inadequate or delayed intervention may progress to post-thrombotic syndrome, resulting in a persistent decline in patients' quality of life [1]. The pathological progression of DVT is closely associated with the duration of thrombus formation, and it is clinically classified into acute, subacute, and chronic phases. Anticoagulation therapy serves as the cornerstone of DVT management, which can effectively inhibit thrombus propagation and recurrence. However, this modality has limited efficacy in lysing established large-scale thrombi, leaving substantial room for improvement in overall therapeutic outcomes [2]. Therefore, exploring efficient and safe therapeutic strategies for DVT has become a priority in current clinical research.

Catheter-directed thrombolysis (CDT) is a targeted revascularization technique. By inserting a thrombolytic catheter directly into the thrombus for local drug infusion, CDT can significantly increase the concentration of thrombolytic agents at the target site, thereby enhancing thrombolysis efficiency while minimizing the

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risk of systemic bleeding [3]. However, in subacute DVT, partial fibrosis of the thrombus often necessitates increased drug dosage or prolonged treatment duration to achieve satisfactory outcomes with CDT alone, which in turn increases the potential risk of bleeding [4]. Percutaneous mechanical thrombectomy (PMT) is a physical thrombectomy approach that utilizes specialized devices to rapidly fragment or aspirate thrombi. It can quickly reduce thrombus burden and restore venous blood flow, making it more suitable for the treatment of organized subacute thrombi [5]. However, monotherapy with PMT may result in incomplete thrombus removal, and residual microthrombi, which has a certain impact on long-term patency, thus increasing the risk of disease recurrence.

A key pathological feature of subacute lower extremity DVT is partial thrombus organization and dense structure. In this context, the penetration of thrombolytic drugs via CDT monotherapy is often insufficient, with a low thrombolysis efficacy. Thus, increased drug dosage or extended treatment courses are required, which substantially raise the risk of complications. Besides, although PMT monotherapy can rapidly clear most thrombi, residual microthrombi remain a threat to long-term vascular patency. Based on the respective advantages and limitations of these two modalities, the combined therapy of PMT and CDT theoretically enables synergistic effects through the complementarity of physical thrombectomy and pharmacologic thrombolysis. This combination is expected to enhance thrombus removal efficiency, reduce the dosage of thrombolytic agents, and lower the incidence of complications.

Based on the above background, the present study retrospectively analyzed the clinical data of patients with subacute lower extremity DVT, systematically comparing the differences in clinical efficacy, safety, thrombus removal degree, and long-term recurrence rate between the combined PMT-CDT therapy and CDT monotherapy. Through comprehensive evaluation of multi-dimensional indicators, this study aims to clarify the clinical application value of the combined therapy regimen in subacute DVT, and provide evidence-based medical support for formulating more rational and individualized therapeutic strategies in clinical practice.

Materials and methods

General information

This was a single-center retrospective clinical study. A total of 93 patients with subacute lower extremity DVT admitted to Shijiazhuang People's Hospital from March 2023 to December 2024 were enrolled as research subjects. According to the different treatment regimens, the patients were divided into a CDT group (PMT + CDT, n=45) and a combined group (n=48). The study protocol was approved by the Medical Ethics Committee of Shijiazhuang People's Hospital, and the entire research process strictly complied with the relevant ethical principles of the Declaration of Helsinki. Given that this was a retrospective study involving only the collection and analysis of existing clinical data, with no disclosure of patient privacy or additional clinical interventions, the Institutional Review Board waived the requirement for informed consent from patients.

Inclusion criteria: (1) Conformed to the diagnostic criteria for lower extremity DVT [6]; (2) Confirmed by color Doppler ultrasound and/or lower extremity deep vein angiography, and diagnosed with a first occurrence of acute symptomatic lower extremity DVT; (3) Clinically staged as subacute phase, with the interval from disease onset to admission for interventional treatment ranging from 14 to 30 days. (4) Complete clinical data.

Exclusion criteria: (1) Absolute contraindications to anticoagulation or thrombolysis; (2) Heparin-induced thrombocytopenia; (3) Severe allergy to contrast agents or thrombolytic drugs (such as urokinase); (4) Severe heart, liver, or kidney dysfunction; (5) Advanced malignant tumors or other diseases with an expected survival of less than 1 year; (6) Contraindications to inferior vena cava filter placement or the presence of non-retrievable/permanent filters.

Methods

The CDT group: All patients received routine anticoagulation combined with CDT. A thrombolytic catheter was inserted through the popliteal vein or posterior tibial vein of the affected limb, ensuring that the side-hole segment of the catheter was completely embedded within the thrombus. Urokinase (Nanjing Nanda Pharmaceutical Co., Ltd.) was continuously administered via the thrombolytic catheter in a pulsed mode at a dosage of 400,000 U per day. For anticoagulation, a mixture of 50 mL normal saline and 100 mg (125,000 U) unfractionated heparin was continuously infused through the sheath at a rate of 5 mL per hour. The position of the thrombolytic catheter was adjusted according to the results of daily follow-up angiography until thrombus resolution with restored venous blood flow was achieved, or the maximum thrombolysis duration of 7 days was reached. After the termination of thrombolysis, oral rivaroxaban (Bayer Healthcare Co., Ltd.) was prescribed at a dose of 20 mg once daily for a 3-month anticoagulation course.

Combined treatment group: On the basis of the CDT regimen, patients were additionally treated with percutaneous mechanical thrombectomy using the AngioJet™ Thrombectomy System (Boston Scientific Corporation). Under the guidance of digital subtraction angiography (DSA), the AngioJet device was advanced to the proximal end of the thrombus. The thrombectomy mode was activated, and the device was gently maneuvered through the thrombosed segment in a "forward-retraction" fashion to fragment and aspirate the thrombus. For vascular segments with high thrombus burden, the procedure was repeated 2-3 times until DSA confirmed the restoration of blood flow in the main venous trunk. Subsequent thrombolysis and anticoagulation protocols were consistent with those of the CDT group.

Observation indicators

The primary outcome measures of this study included: (1) overall clinical response rate; (2) thrombus removal grade and thrombus clearance rate; (3) disease recurrence rate.

The secondary outcome measures included: duration of thrombolysis, total dosage of thrombolytic agents, length of hospital stay, coagulation function parameters [fibrinogen (FIB), D-dimer (D-D), platelet count (PLT)], inflammatory parameters [vascular cell adhesion molecule-1 (VCAM-1), platelet endothelial cell adhesion molecule-1 (PECAM-1)], lower extremity circumference difference, hemorheological parameters, and incidence of perioperative complications.

(1) Short-term efficacy parameters: The circumference difference at 10 cm above the patella of the affected limb and the Venous Clinical Severity Score (VCSS) were recorded and compared between the two groups.

(2) Thrombus clearance rate was assessed by lower extremity deep vein angiography after treatment. The degree of vascular occlusion caused by thrombus was scored based on intraoperative angiographic findings: >95% occlusion = 3 points; 50-95% occlusion = 2 points; <50% occlusion = 1 point; no occlusion = 0 points. Thrombus clearance rate (%) = (Pre-thrombolysis score - Post-thrombolysis score)/Pre-thrombolysis score × 100%. Thrombus removal grade was classified according to the clearance rate: Grade III (>95%), Grade II (50-95%), and Grade I (<50%). Overall clinical response rate = (Number of Grade III cases + Number of Grade II cases)/Total number of cases × 100%.

(3) Long-term efficacy parameters: All patients were followed up after discharge. The incidence of post-thrombotic syndrome (PTS) was evaluated using the Villalta scoring system [7]: 5-9 points indicated mild PTS, 10-14 points indicated moderate PTS, and ≥15 points indicated severe PTS. Deep venous patency was assessed using color Doppler ultrasound.

(4) Surgery and hospitalization-related parameters: The duration of thrombolysis (time from treatment initiation to DSA-confirmed patency of the main venous trunk), total dosage of urokinase, and total length of hospital stay were recorded in detail for both groups.

(5) Coagulation and inflammatory parameters: Fasting venous blood samples were collected from all patients before treatment and on the first morning after treatment completion. FIB, D-D, and PLT levels were measured using an automatic coagulation analyzer. Serum VCAM-1 and PECAM-1 levels were determined using enzyme-linked immunosorbent assay (ELISA).

(6) Lower extremity circumference difference: The circumference of the thickest part of the calf was measured bilaterally, and the difference between the affected and unaffected limbs was calculated.

(7) Hemorheological parameters: Plasma viscosity, hematocrit, platelet adhesion rate, and

Table 1. Comparison of baseline data

Variables	Combined Group (n=48)	Catheter-directed Thrombolysis Group (n=45)	t/χ^2	P
Age (years, $\bar{x}$ ± sd)	55.83±9.14	56.42±8.67	0.319	0.751
Gender (Male/Female, n)	27/21	25/20	0.005	0.947
Thrombus Location (n)			0.004	0.998
Left Lower Extremity	31	29		
Right Lower Extremity	15	14		
Bilateral Lower Extremities	2	2		
Thrombus Type (n)			0.123	0.726
Central Type	22	19		
Mixed Type	26	26		
Time from Onset to Admission (days, $\bar{x}$ ± sd)	19.25±3.74	18.93±3.41	0.426	0.671

Table 2. Comparison of venous clinical severity scores in terms of short-term efficacy ($\bar{x}$ ± sd, points)

Groups	Before Treatment	After Treatment	t	P
Combined Group (n=48)	8.65±1.82	3.12±1.05	18.234	<0.001
Catheter-directed Thrombolysis Group (n=45)	8.72±1.76	4.88±1.34	11.645	<0.001
t	0.188	7.074		
P	0.851	<0.001		

whole blood high-shear viscosity were measured using an automatic hemorheology analyzer before and after treatment.

(8) Safety and recurrence: Perioperative complications were recorded, including the incidence of bleeding events and symptomatic pulmonary embolism. Bleeding events were categorized as minor bleeding (e.g., local puncture site oozing, subcutaneous ecchymosis, hematoma) and major bleeding (bleeding requiring surgical intervention or blood transfusion). Post-discharge follow-up was performed, and disease recurrence was confirmed via color Doppler ultrasound.

Statistical analysis

All statistical analyses were performed using SPSS 27.0 software. Measurement data were presented as mean ± standard deviation ($\bar{x}$ ± sd), and count data were expressed as case number (percentage). Paired t-test was used for intragroup comparisons of indicators before and after treatment, while independent samples t-test was used for intergroup comparisons. The chi-square (χ^2) test was applied for the comparison of count data. For data with non-normal distribution, the corresponding nonparametric test was used. A value of $P<0.05$ was considered statistically significant.

Results

Comparison of baseline data

No statistically significant differences were observed in the baseline data, including age, gender, thrombus location, thrombus type, and interval from disease onset to hospital admission, between the two groups (all $P>0.05$). These findings indicated that the baseline characteristics of the two groups were well-balanced and comparable. See **Table 1**.

Comparison of clinical efficacy

For short-term efficacy, the overall clinical response rate of the combined group was 97.92% (47/48), which was significantly higher than that of the CDT group [82.22% (37/45), χ^2=4.873, P=0.027]. Simultaneously, the combined group exhibited a superior effect in reducing the VCSS compared with the CDT group ($P<0.05$). See **Table 2**.

For long-term efficacy, a 6-month follow-up revealed that the combined treatment group had a lower incidence of PTS and a higher rate

Table 3. Comparison of long-term efficacy [n (%)]

Groups	Incidence of post-thrombotic syndrome (Villalta Score ≥5 Points)	Deep Venous Patency Rate
Combined Group (n=48)	5 (10.42)	43 (89.58)
Catheter-directed Thrombolysis Group (n=45)	12 (26.67)	33 (73.33)
X^2	4.106	4.106
P	0.043	0.043

Table 4. Comparison of thrombus removal grade [n (%)]

Groups	III	II	I	0
Combined Group (n=48)	40 (83.33)	7 (14.58)	1 (2.08)	0 (0.00)
Catheter-directed Thrombolysis Group (n=45)	25 (55.56)	12 (26.67)	6 (13.33)	2 (4.44)
Z				3.081
P				0.002

of deep venous patency than the CDT group. See **Table 3**.

Comparison of thrombus removal grade

The thrombus removal grade of the combined group was significantly higher than that of the CDT group ($P<0.05$). See **Table 4** and **Figure 1**.

Comparison of thrombolysis duration, thrombolytic dosage and hospital stay

The combined group had significantly shorter thrombolysis duration and hospital stay, as well as a significantly lower total dosage of thrombolytic agents, compared with the CDT group (all $P<0.05$). See **Figure 2**.

Comparison of coagulation indicators

After treatment, the levels of FIB and D-D were decreased in both groups, and the reduction amplitudes in the combined group were significantly greater than those in the CDT group ($P<0.05$). No statistically significant difference was found in the PLT level between the two groups ($P>0.05$). See **Figure 3**.

Comparison of inflammatory markers

After treatment, the serum levels of VCAM-1 and PECAM-1 were reduced in both groups, and the combined group achieved a more significant reduction than the CDT group (both $P<0.05$). See **Table 5**.

Comparison of lower extremity circumference difference

After treatment, the lower extremity circumference difference was reduced in both groups, and the reduction in the combined group was significantly greater than that in the CDT group ($P<0.05$). See **Table 6**.

Comparison of hemorheological parameters

After treatment, the plasma viscosity, hematocrit, platelet adhesion rate, and whole blood high-shear viscosity were decreased in both groups, and the combined treatment group showed a more pronounced reduction in all the above indicators compared with the CDT group (all $P<0.05$). See **Table 7**.

Comparison of complications and recurrence

The recurrence rate of the combined group was 4.17%, which was significantly lower than 17.78% of the CDT group ($P<0.05$). No statistically significant difference was observed in the total incidence of complications between the two groups ($P>0.05$). See **Table 8**.

Discussion

DVT of the lower extremities is a common acute and critical condition in vascular surgery, primarily caused by vascular endothelial injury, venous blood stasis, and hypercoagulable state [8]. Subacute DVT is at a critical transitional stage from acute thrombus organization to chronic fibrosis; the thrombus is not yet fully

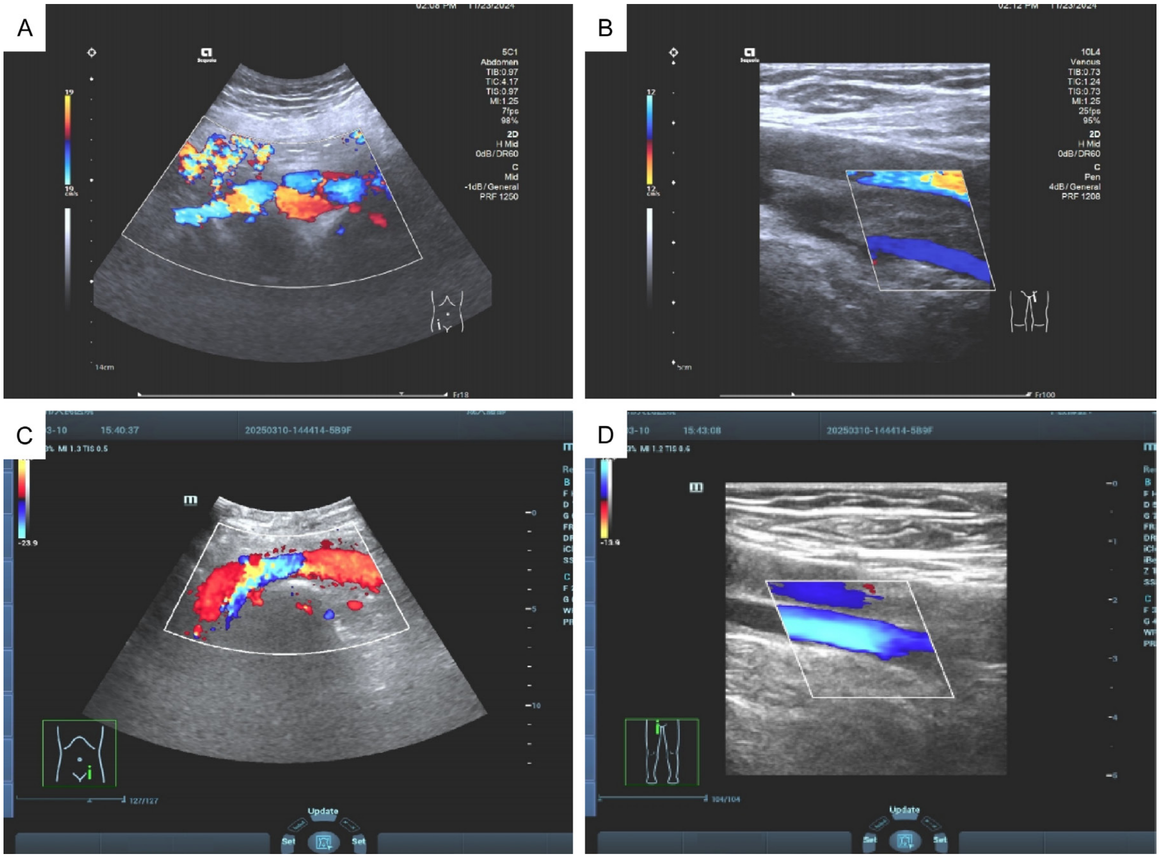

Figure 1. Color Doppler ultrasound changes in patients with subacute lower extremity deep vein thrombosis treated with percutaneous mechanical thrombectomy combined with catheter-directed thrombolysis. A, B: Before treatment, the popliteal vein lumen was filled with heterogeneous, hyperechoic thrombi, and the blood flow signal was significantly reduced or absent, indicating venous occlusion and blood flow obstruction. C, D: After treatment, the thrombus was significantly reduced or disappeared, the lumen was patent, and color Doppler ultrasound showed the restoration of continuous blood flow signal with normal blood flow velocity and direction, indicating good recanalization.

adhered to the vascular wall but has formed a tight connection, with the body initiating inflammatory repair and endogenous fibrinolytic responses [9]. Therefore, subacute DVT exhibits significantly decreased sensitivity to thrombolytic therapy alone, and effective vascular recanalization cannot be achieved by conventional anticoagulation treatment. Improper management may lead to further thrombotic fibrosis and progression to post-thrombotic syndrome, which severely impairs limb function and may even induce fatal pulmonary embolism.

CDT is one of the core interventional modalities for the clinical treatment of lower extremity DVT. By inserting a thrombolytic catheter directly into the thrombus, this technique enables targeted delivery of thrombolytic agents to the lesion site, substantially increasing local drug concentration. Compared with conventional systemic thrombolysis, CDT exerts a more significant thrombolytic effect on established large thrombi with a relatively lower risk of systemic bleeding [10]. However, in subacute DVT, the thrombus has undergone varying degrees of fibrosis, which often limits the thrombolytic efficiency of CDT monotherapy, prolongs the treatment course, and correspondingly increases the risk of bleeding [11]. PMT is a physical thrombectomy technique that can rapidly fragment and aspirate most of the thrombus using specialized devices, quickly restoring venous luminal blood flow and making it more suitable for the treatment of subacute thrombi. However, the application of PMT alone still has the drawback of residual microthrombi [12, 13]. Based on the advantages and disadvantages of these two techniques, the combined therapy of PMT and CDT is expected to

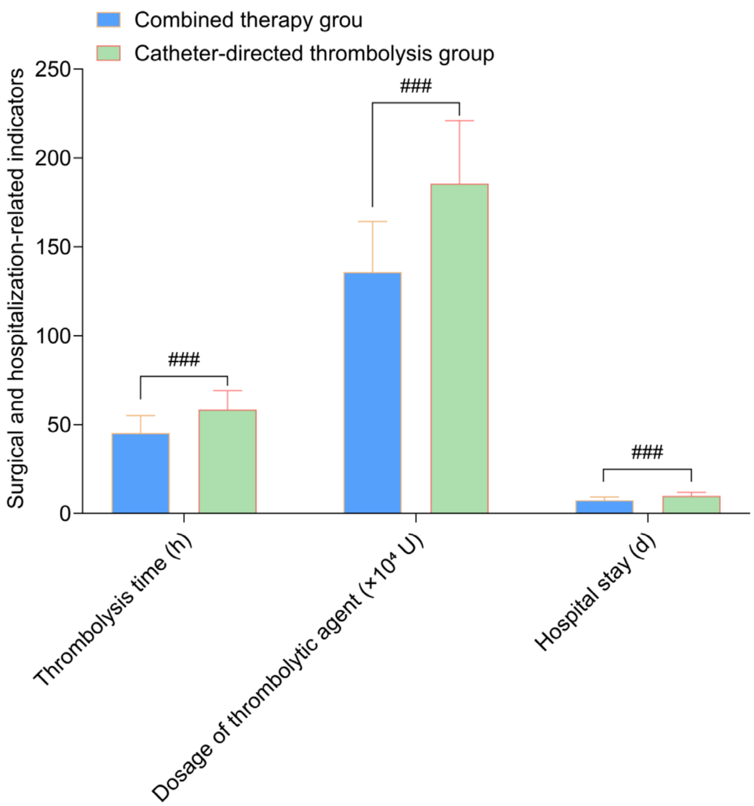

Figure 2. Comparison of surgical and inpatient related indicators between the two groups. Compared with the catheter-directed thrombolysis group, $^{###}$P<0.001.

achieve synergistic effects and further improve the overall therapeutic efficacy.

The results of this study demonstrated that the combined group achieved significantly higher overall clinical response rate and superior thrombus removal grade compared with the CDT group. The potential mechanism may be as follows: PMT can rapidly eliminate most of the thrombus burden and reconstruct effective venous blood flow channels through mechanical fragmentation and aspiration [14]. On this basis, CDT can more fully contact and penetrate the residual thrombus tissue, further lysing microthrombi and residual thrombi [15]. In addition, mechanical thrombectomy reduces the pressure within the venous system, improves the local microcirculation environment, thereby facilitating the diffusion and action of thrombolytic agents in the thrombus and further enhancing the overall thrombectomy efficiency [16].

In terms of surgery- and hospitalization-related indicators, this study found that the combined group had significantly shorter thrombolysis duration, lower urokinase dosage, and reduced length of hospital stay. This is because PMT can rapidly clear large thrombi in the early stage of treatment, thereby shortening the overall thrombolysis course, reducing the dosage and duration of thrombolytic agent administration, lowering the risk of drug-related adverse reactions, and helping to shorten the hospital stay [17]. These findings highlight the dual advantages of combined therapy in improving treatment efficiency and optimizing medical resource utilization.

Regarding coagulation and inflammatory indicators, the combined treatment group exhibited a more significant reduction in the levels of FIB, D-D, VCAM-1 and PECAM-1 after treatment compared with the CDT group. The underlying reason is that combined therapy can more thoroughly clear the thrombus, reduce the continuous mobilization of coagulation substrates in the body, terminate the fibrinolytic process more quickly, and thus accelerate the decrease in D-D levels [18]. Meanwhile, the rapid relief of thrombus burden can alleviate vascular endothelial injury and local inflammatory responses, thereby downregulating the expression levels of inflammatory adhesion molecules.

In addition, the combined treatment group showed more significant improvements in lower extremity circumference difference and hemorheological parameters, indicating that this regimen can more effectively promote the reflux of interstitial fluid and relieve limb swelling symptoms. Chronic inflammation and tissue hypoxia caused by thrombosis can lead to platelet activation, enhanced erythrocyte aggregation, and increased blood viscosity. Combined therapy improves microcirculation perfusion through efficient thrombectomy, thereby exerting a more positive regulatory effect on hemorheological parameters [19, 20].

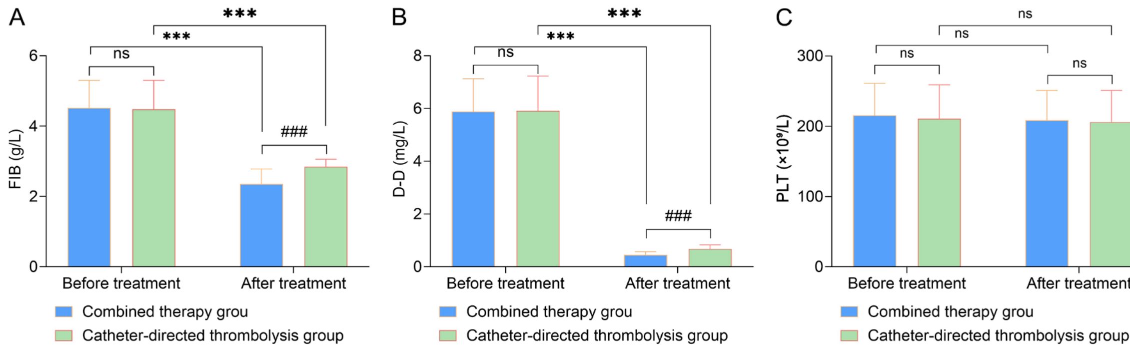

Figure 3. Comparison of coagulation indicators before and after treatment between the two groups ($\overline{X}$ ± sd). A: FIB (g/L); B: D-D (mg/L); C: PLT ($\times 10^9$/L). Compared with before treatment in the same group, ***P<0.001; Compared with the catheter-directed thrombolysis group, ###P<0.001; ns indicates no statistically significant difference. FIB, fibrinogen; D-D, D-dimer; PLT, platelet count.

Table 5. Comparison of inflammatory markers before and after treatment ($\overline{X}$ ± sd)

Groups	VCAM-1 (ng/mL)		PECAM-1 (ng/mL)	
	Before treatment	After treatment	Before treatment	After treatment
Combined Group (n=48)	985.62±145.24	485.63±72.25	65.84±9.42	36.47±5.92
Catheter-directed Thrombolysis Group (n=45)	972.81±138.56	612.52±85.37	64.93±10.13	45.23±6.91
t	0.435	7.754	0.449	6.578
P	0.665	<0.001	0.655	<0.001

Note: VCAM-1, vascular cell adhesion molecule-1; PECAM-1, platelet endothelial cell adhesion molecule-1 PECAM-1.

Table 6. Comparison of lower extremity circumference difference before and after treatment ($\overline{X}$ ± sd)

Groups	Before treatment	After treatment	t	P
Combined Group (n=48)	4.52±1.05	1.52±0.48	18.003	<0.001
Catheter-directed Thrombolysis Group (n=45)	4.48±1.12	2.15±0.63	12.163	<0.001
t	0.178	5.445		
P	0.859	<0.001		

Table 7. Comparison of hemorheological parameters before and after treatment ($\overline{X}$ ± sd)

Groups	Plasma Viscosity (Mpa·S)		Hematocrit (%)		Platelet Adhesion Rate (%)		Whole Blood High-Shear Viscosity (Mpa·S)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Combined Group (n=48)	1.98±0.25	1.52±0.18	45.12±4.56	40.23±3.85	32.45±5.67	25.12±4.23	6.89±0.78	5.12±0.65
Catheter-directed Thrombolysis Group (n=45)	2.01±0.27	1.75±0.22	44.89±4.78	42.85±4.12	33.12±5.89	28.95±4.78	6.92±0.81	5.78±0.72
t	0.556	5.533	0.238	3.170	0.559	4.098	0.182	4.645
P	0.579	<0.001	0.813	0.002	0.578	<0.001	0.856	<0.001

Table 8. Comparison of complications and recurrence rate [n (%)]

Groups	Total incidence of complications	Severe bleeding	Perioperative pulmonary embolism	Recurrence
Combined Group (n=48)	4 (8.33)	1 (2.08)	0 (0.00)	2 (4.17)
Catheter-directed Thrombolysis Group (n=45)	6 (13.33)	2 (4.44)	1 (2.22)	8 (17.78)
X^2	0.196	0.003	0.001	4.873
P	0.658	0.955	0.974	0.027

In terms of safety and long-term prognosis, the results of this study showed no statistically significant difference in the incidence of complications between the two groups, but the disease recurrence rate in the combined treatment group was significantly lower. This suggests that under the premise of standardized operation, PMT combined with CDT does not increase the risk of bleeding or vascular injury, with well-controllable safety, and is conducive to improving the long-term prognosis of patients.

However, this study has certain limitations. First, it is a single-center retrospective study with a limited sample size and potential selection bias. Second, the treatment regimen was non-randomly assigned; although the baseline characteristics of the two groups were balanced and comparable, unmeasured confounding factors may still affect the study results. Third, the 6-month follow-up duration is insufficient for evaluating the long-term incidence of PTS and long-term deep venous patency. Fourth, PMT has high requirements for equipment and operational experience, and the feasibility of popularizing this technique in primary hospitals with limited medical resources needs further verification. Future multicenter, large-sample randomized controlled trials are required to provide higher-level evidence-based medical evidence for the clinical application of this combined treatment regimen.

In conclusion, compared with CDT monotherapy, percutaneous mechanical thrombectomy combined with catheter-directed thrombolysis achieves superior clinical efficacy in the treatment of subacute lower extremity DVT. This combined regimen not only significantly improves thrombus clearance rate, shortens the treatment course, and reduces the dosage of thrombolytic agents but also more effectively ameliorates patients' hemodynamic and inflammatory status. It reduces the risk of disease recurrence while ensuring treatment safety, thus holding significant clinical promotion value.

Disclosure of conflict of interest

None.

Address correspondence to: Yuxian Luo, Department of Vascular Surgery, Shijiazhuang People's Hospital, No. 365, Jianhua South Street, Shijiazhuang 050011, Hebei, China. Tel: +86-17603119866; E-mail: LYXxueguanwaike@163.com

References

[1] Chan SM, Laage Gaupp FM and Mojibian H. ClotTriever system for mechanical thrombectomy of deep vein thrombosis. Future Cardiol 2023; 19: 29-38.

[2] Johnson RR and Faustino EVS. Central venous catheter-associated deep vein thrombosis in critically ill pediatric patients: risk factors, prevention, and treatment. Curr Opin Pediatr 2022; 34: 273-278.

[3] Budak AB, Gunertem OE, Ozisik K and Gunaydin S. Pharmacomechanical catheter-directed thrombolysis for acute iliofemoral deep vein thrombosis in a large study population. J Vasc Surg Venous Lymphat Disord 2022; 10: 818-825.

[4] Farrokhi M, Khurshid M, Mohammadi S, Yarmohammadi B, Bahramvand Y, Nasrollahi E and Taheri F. Comparison of ultrasound-accelerated versus conventional catheter-directed thrombolysis for deep vein thrombosis: a systematic review and meta-analysis. Vascular 2022; 30: 365-374.

[5] Yuriditsky E, Narula N, Jacobowitz GR, Moreira AL, Maldonado TS, Horowitz JM, Sadek M, Barfield ME, Rockman CB and Garg K. Histologic assessment of lower extremity deep vein thrombus from patients undergoing percutaneous mechanical thrombectomy. J Vasc Surg Venous Lymphat Disord 2022; 10: 18-25.

[6] Min SK, Kim YH, Joh JH, Kang JM, Park UJ, Kim HK, Chang JH, Park SJ, Kim JY, Bae JI, Choi SY, Kim CW, Park SI, Yim NY, Jeon YS, Yoon HK and Park KH. Diagnosis and treatment of lower extremity deep vein thrombosis: Korean practice guidelines. Vasc Specialist Int 2016; 32: 77-104.

[7] Calderon Martinez E and Garza Morales R. Postthrombotic syndrome. 2025 Feb 24. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025.

[8] Nie M, Fu J, Sun J and Wang H. Percutaneous mechanical thrombectomy for acute symptomatic iliofemoral deep venous thrombosis patients with recent aneurysmal subarachnoid hemorrhage. J Endovasc Ther 2023; 30: 250-258.

[9] Li W, Zaid Al-Kaylani A, Zeebregts CJ, El Moumni M, de Vries JPM, van der Doef HPJ and Bokkers RPH. Effectiveness and safety of catheter-directed thrombolysis in conjunction with percutaneous mechanical thrombectomy for acute iliofemoral deep vein thrombosis: a meta-analysis. J Vasc Surg Venous Lymphat Disord 2023; 11: 843-853, e2.

[10] Goldhaber SZ, Magnuson EA, Chinnakondepalli KM, Cohen DJ and Vedantham S. Catheter-directed thrombolysis for deep vein thrombosis: 2021 update. Vasc Med 2021; 26: 662-669.

[11] Wortmann JK, Barco S, Fumagalli RM, Voci D, Hügel U, Cola R, Spirk D, Kucher N and Sebastian T. Coagulation-monitored, dose-adjusted catheter-directed thrombolysis or pharmacomechanical thrombus removal in deep vein thrombosis. Vasa 2023; 52: 416-422.

[12] Lichtenberg MKW, Stahlhoff S, Młyńczak K, Golicki D, Gagne P, Razavi MK, de Graaf R, Kolluri R and Kolasa K. Endovascular mechanical thrombectomy versus thrombolysis in patients with iliofemoral deep vein thrombosis - a systematic review and meta-analysis. Vasa 2021; 50: 59-67.

[13] Pezold M, Jacobowitz GR and Garg K. Percutaneous mechanical thrombectomy of lower extremity deep vein thrombosis in a pediatric patient. J Vasc Surg Cases Innov Tech 2020; 6: 543-546.

[14] Baytaroglu C and Sevgili E. Learning curve for percutaneous thrombectomy in treatment of acute lower extremity deep vein thrombosis. J Vasc Surg Venous Lymphat Disord 2022; 10: 602-606.

[15] Aldağ M and Çiloğlu U. Combined pharmacomechanical thrombectomy with selective catheter-directed thrombolysis in patients with acute proximal deep vein thrombosis. Turk Gogus Kalp Damar Cerrahisi Derg 2022; 30: 176-183.

[16] Zhang H, Li XY, Li JS, Xia SB, Song C, Lu QS, Zhao W and Zhang L. Which one is the best in treating deep venous thrombosis - percutaneous mechanical thrombectomy, catheter-directed thrombolysis or combination of them? J Cardiothorac Surg 2024; 19: 423.

[17] Raskin A, Verma A and Brennan TD. Single-session thrombolysis-free treatment of deep vein thrombosis with a novel mechanical thrombectomy device. JACC Case Rep 2021; 3: 415-420.

[18] Patel MS. Novel percutaneous mechanical thrombectomy device for treating upper extremity deep vein thrombosis in patient with paget-schroetter syndrome. Vasc Endovascular Surg 2024; 58: 235-239.

[19] Mouawad NJ. Chronic venous ulcer resolution and post-thrombotic syndrome improvement after percutaneous mechanical thrombectomy of a 42-year-old deep vein thrombosis. J Vasc Surg Cases Innov Tech 2022; 8: 196-200.

[20] Ju Z, Chen W, Min X, Dai K, Zheng H and Qiu J. Acute right extremity deep vein thrombosis and left-sided inferior vena cava thrombosis treated by percutaneous mechanical thrombectomy (PMT) combined with catheter directed thrombolysis (CDT): a case report. Medicine (Baltimore) 2024; 103: e37849.