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Original Article / Özgün Makale

Long-term results of additional thrombolytic therapy in patients with acute deep vein thrombosis treated with pharmacomechanical thromboaspiration: A comparative study

Farmakomekanik tromboaspirasyon ile tedavi edilen akut derin ven trombozlu hastalarda trombolitik tedavi ilavesinin uzun dönem sonuçları: Karşılaştırmalı çalışma

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ABSTRACT

Background: This study aims to evaluate the clinical and ultrasonographic long-term results of additional thrombolytic therapy to pharmacomechanical thromboaspiration in patients with acute and subacute lower extremity deep vein thrombosis.

Methods: Medical data of a total of 68 patients (41 males, 27 females; mean age 38 years; range, 25 to 56 years) who were admitted to our department with the diagnosis of hyperacute or acute deep vein thrombosis between January 2013 and January 2015 were retrospectively analyzed. The patients were divided into two groups: thrombectomy without thrombolytic therapy (Group 1, n=33) and thrombectomy with thrombolytic therapy (Group 2, n=35). All patients were administered Clinical Symptom Scoring and Doppler ultrasonography at one, six, and 12 months.

Results: Clinical symptom scores were higher in Group 1 at one month (p<0.001), while there was no significant difference between the groups at six months (p=0.102). Group 1 had higher scores at 12 months (p=0.043). The complete patency rates for both groups were similar at one month (p=0.181); however, the rates were higher in Group 2 at six and 12 months (p=0.019 and p=0.002, respectively). There was no significant difference in the complete patency rates between the groups at one and six months (p=0.563 and p=0.064, respectively), while these rates were higher in Group 2 at 12 months (p=0.013). In patients with acute deep vein thrombosis, the complete patency rates were found to be higher in all control Doppler ultrasonography examinations.

Conclusion: In the treatment of both hyperacute and acute deep vein thrombosis, the addition of thrombolytic therapy to pharmacomechanical thromboaspiration improves the clinical symptoms and venous patency rates.

Keywords: Aspiration; deep vein thrombus; pharmacomechanical thrombectomy; thrombolytic.

ÖZ

Amaç: Bu çalışmada akut ve subakut alt ekstremite derin ven trombozlu hastalarda trombolitik tedavinin farmakomekanik tromboaspirasyona ilavesinin klinik ve ultrasonografik uzun dönem sonuçları değerlendirildi.

Çalışma planı: Ocak 2013 - Ocak 2015 tarihleri arasında hiperakut veya akut derin ven trombozu tanısı ile kliniğimize başvuran toplam 68 hastanın (41 erkek, 27 kadın; ort. yaş 38 yıl; dağılım 25-56 yıl) tıbbi verileri retrospektif olarak incelendi. Hastalar iki gruba ayrıldı: trombolitik tedavi olmaksızın trombektomi (Grup 1, n=33) ve trombolitik tedavi ile trombektomi (Grup 2, n=35). Hastaların tümüne bir, altı ve 12. ayda Klinik Semptom Skorlaması ve Doppler ultrasonografisi yapıldı.

Bulgular: Grup 1'de birinci ayda klinik semptom skoru daha yüksek iken (p<0.001), altıncı ayda gruplar arasında anlamlı bir fark yoktu (p=0.102) On ikinci ayda ise Grup 1'de skorlar daha yüksek bulundu (p=0.043). Her iki grup için tam açıklık oranları birinci ayda benzerdi (p=0.181); ancak, oranlar altı ve 12. aylarda Grup 2'de daha yüksekti (sırasıyla p=0.019 ve p=0.002). Birinci ve altıncı ayda gruplar arasında tam açıklık oranları açısından anlamlı bir fark yok iken (sırasıyla p=0.563 ve p=0.064), bu oranlar Grup 2'de 12. ayda daha yüksek bulundu (p=0.013). Akut derin ven trombozlu hastalarda, tüm kontrol Doppler ultrasonografi muayenelerinde tam açıklık oranları daha yüksek bulundu.

Sonuç: Hem hiperakut hem de akut derin ven trombozunun tedavisinde trombolitik tedavinin farmakomekanik tromboaspirasyona ilavesi klinik semptomları ve venöz açıklık oranlarını artırır.

Anahtar sözcükler: Aspirasyon; derin ven trombozu; farmakomekanik trombektomi; trombolitik.

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Deep vein thrombosis (DVT) is a critical disease which mostly affects the lower extremity veins due to inherited or acquired risk factors. Annual incidence of DVT is 5 to 20/100,000 individuals and is expected to increase due to the increasing life span and increased exposure to risk factors, such as obesity, long distance travel, and long hospital stays.[1] Deep vein thrombosis may lead to the development of fatal pulmonary embolism, or to the development of post-thrombotic syndrome (PTS) as an acute and late complication.[2,3]

Standard treatment of DVT mainly includes systemic anticoagulation. The mechanism of systemic anticoagulation is to limit the progression of the thrombus and to prevent the development of pulmonary embolism. However, with anticoagulation, the complete resolution of the thrombus cannot be achieved and, in the long-term, this may result in the development of PTS.

Aggressive removal of the thrombus reduces the risk and severity of PTS. To achieve a higher venous patency, systemic thrombolysis and catheter-directed thrombolysis (CDT) have been proposed as a treatment option. In the Cochrane review, PTS was shown to be significantly lower with fibrinolysis, and it further decreased with CDT, compared to systemic thrombolysis.[4,5] However, thrombolysis is associated with a high bleeding risk.[5] To minimize the risk of bleeding complications, different mechanical thrombectomy techniques, such as pharmacomechanical thrombectomy or percutaneous aspiration thrombectomy, have been proposed as alternatives or adjunct therapies to pharmacological thrombolysis. Early thrombus removal techniques are also strongly recommended in patients with limb-threatening venous ischemia due to iliofemoral DVT; however, the recommendation for the remaining patients is weak.[6] As all of the developed techniques have their own advantages and disadvantages, complications and success rates, there is no consensus on the treatment protocol for DVT.

In this study, we aimed to evaluate the clinical and ultrasonographic long-term results of additional thrombolytic therapy to pharmacomechanical thromboaspiration in acute DVT patients.

PATIENTS AND METHODS

Medical data of a total of 68 patients (41 males, 27 females; mean age 38 years; range, 25 to 56 years) who were admitted to our department with the diagnosis of hyperacute or acute DVT and treated either with pharmacomechanical thrombectomy using aspiration or direct thrombolysis between January 2013 and January 2015 were retrospectively analyzed. Between January 2013 and January 2014, according to our department protocol, we performed thrombectomy without thrombolytic therapy. After January 2014, our treatment protocol was amended and we added thrombolytic therapy to thrombectomy. Our study group was divided into two groups: thrombectomy without thrombolytic therapy (Group 1, n=33) and thrombectomy with thrombolytic therapy (Group 2, n=35), according to the amended protocol. Data including demographic and clinical characteristics of the patients and risk factors for the DVT were recorded. Patients between the ages of 18 to 60 with presentation of hyperacute (diagnosed within two days) or acute (diagnosed between 2 and 14 days) iliofemoral or femoropopliteal DVT were included in the study. Patients who had DVT lasting longer than two weeks, who had a contraindication to the use of anticoagulation or thrombolytic therapy, who had prior major surgery within the last six weeks, who were pregnant or in lactation period, or who had malignancy were excluded from the study. All patients were informed about the procedure and thrombolytic therapy and a written informed consent was obtained. The study protocol was approved by the Bakırkoy Dr. Sadi Konuk Training and Research Hospital Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Group 1 received pharmacomechanical thrombectomy alone using aspiration, while Group 2 received pharmacomechanical thrombectomy using aspiration + thrombolytic therapy by introducing the catheter into the iliofemoral vein at the region of thrombectomy. For pharmacomechanical thrombectomy, the Cleaner™ (Argon Medical, Dallas, USA) device was used in all patients.

The procedure was performed in the angiography laboratory in all patients. Local anesthesia was given in the region of the femoral vein located contralaterally to thrombosis. An opaque material was inserted to visualize the patency of the vena cava inferior. A vena cava filter was placed under the renal vein (Figure 1). Diluted heparin (5,000 U) was given from the catheter intravenously. The patients were instructed to lay down in a prone position. The popliteal vein was punctured with a Seldinger needle (Newtech Medical Devices New Delhi, Delhi India) under the guidance of ultrasonography. A 7F sheath was introduced and venography was, then, done by inserting the opaque material to visualize the side of the thrombus. The mechanical thrombectomy device was pushed forward from the 7F catheter and started up (Figures 2, 3). Meanwhile, a 1/10 diluted

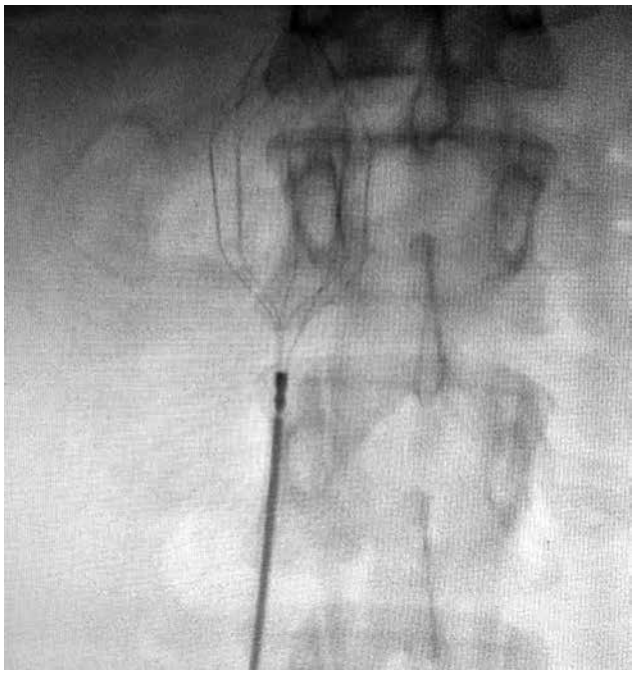

Figure 1. Introduction of vena cava filter.

20 mg alteplase (Actilyse, Boehringer Ingelheim Pharma GmbH & Co. KG. Biberach/Riss. Germany), as a thrombolytic agent, was given from the device port during the mechanical thrombectomy. Then,

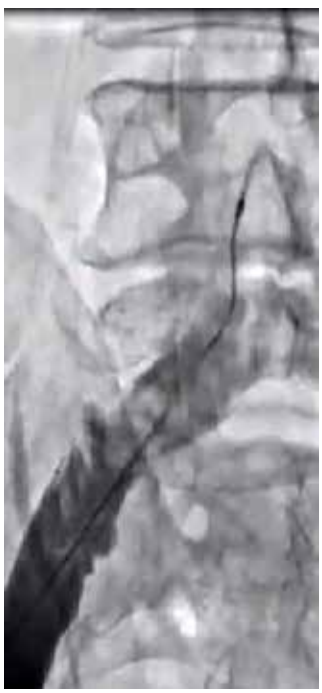

Figure 3. Cleaner™ machine for the removal of the thrombus.

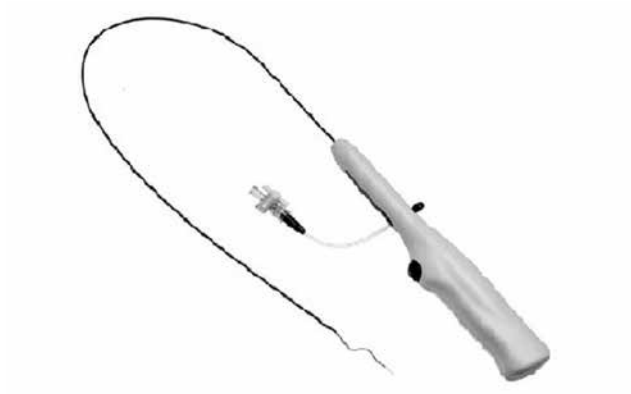

Figure 2. Cleaner™ machine used for thrombectomy.

a mechanical aspiration catheter was placed to the proximal part of the thrombus location and was followed by back and forth aspiration maneuvers. Complete opening was checked with a control venography. Mechanical thrombolysis support was provided with the catheter at the side of thrombus location from the 7F sheath. Later, control venography was performed to ensure complete patency of the vein (Figure 4). The procedure was completed in Group 1. In Group 2, a catheter with holes at the distal 15 cm side was placed in the thrombosis location by the popliteal vein. Alteplase 1 mg/h was given from the catheter for 24 hours. The vena cava filter was removed 24 h after the procedure in all patients.

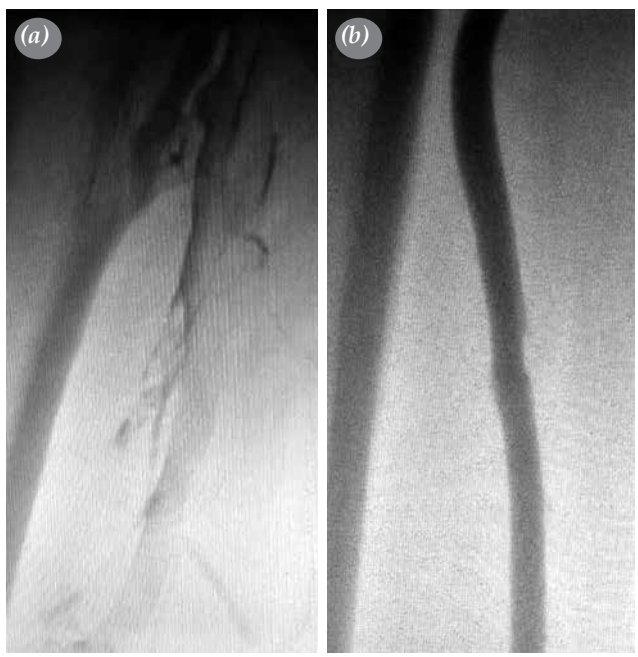

Figure 4. Occlusion of proximal femoral vein **(a)** before the procedure and **(b)** complete patency after the procedure.

Table 1. Demographic and clinical characteristics of patients and risk factors for deep vein thrombosis

	Patients (n=68)				Group 1 (n=33)				Group 2 (n=35)				Group 1-2
	n	%	Mean	Min-Max	n	%	Mean	Min-Max	n	%	Mean	Min-Max	*p*
Age (year)			38	31-42			38	30.5-42			37	31-41	0.446†
Gender													0.656‡
Male	41	60.3			19	57.6			22	62.9			
Female	27	39.7			14	42.4			13	37.1			
Hypertension	8	11.8			4	12.1			4	11.4			1c
Diabetes mellitus	6	8.8			4	12.1			2	5.7			0.421§
Oral contraceptive use	7	10.3			2	6.1			5	14.3			0.429§
Behçet's disease	4	5.9			3	9.1			1	2.9			0.349§
>6 hours travel	18	26.5			9	27.3			9	25.7			0.884‡
Immobilization	6	8.8			4	12.1			2	5.7			0.421§
History of surgery*	6	8.8			4	12.1			2	5.7			0.421§

Min: Minimum; Max: Maximum; * Surgery within 30 days; † Mann-Whitney U test; ‡ Chi-square test; § Fisher's Exact test.

Following the procedures, all patients were put on a low-molecular-weight heparin and warfarin treatment. After the international normalized ratio (INR) levels reached over 2, low-molecular-weight heparin was discontinued and warfarin treatment was continued, until the end of the sixth month.

Statistical analysis

Statistical analysis was performed using the Number Cruncher Statistical System (NCSS) version 2007 software (NCSS LLC., Kaysville, Utah, USA). Descriptive data were expressed in mean ± standard deviation (SD) and number and frequency. Continuous variables, except for age, were presented in median values with the first and third quartile. The Mann-Whitney U test was used to compare the two groups with quantitative data. For the comparison of qualitative data, the Pearson's chi-square test and Fisher's exact test were used. A p value of <0.05 was considered statistically significant.

RESULTS

Demographic and clinical characteristics of the patients and the risk factors for DVT are summarized in Table 1.

All patients (100%) included in the study had leg swelling and pain, and five patients (7.3%) had additionally rash and itching. All patients were under treatment with low-molecular-weight heparin. Deep vein thrombosis was hyperacute in 48 patients (70.5%) and acute in 20 patients (29.5%). Forty-one patients (60.2%) had DVT in the left leg and 20 patients (39.8%) in the right leg. Deep vein

Table 2. Localization of deep vein thrombosis

	Patients (n=68)		Group 1 (n=33)		Group 2 (n=35)		
Variable	n	%	n	%	n	%	*p**
Hyperacute DVT	48	70.6	27	81.18	21	60	0.048
Acute DVT	20	29.4	6	18.2	14	40	0.048
Side							0.959
Left	41	60.3	20	60.6	21	60	
Right	27	39.7	13	39.4	14	40	
Localization							
Femoropopliteal DVT	36	52.9	21	63.6	15	42.9	0.086
Iliofemoral DVT	20	29.4	8	24.2	12	34.3	0.364
Iliofemoral popliteal DVT	12	17.6	4	12.1	8	22.9	0.246

DVT: Deep vein thrombosis; * Chi-square test.

Table 3. Doppler ultrasonography findings and clinical symptoms at one, six, and 12 months

	1st month	6th month	12th month
Group 1			
Total occlusion	0	0	2
Grade 1 patency	3	7	9
Grade 2 patency	4	6	5
Grade 3 patency	26	20	17
Symptom scoring >3	14	7	9
Symptom scoring <3	19	26	24
Group 2			
Total occlusion	0	0	0
Grade 1 patency	1	2	2
Grade 2 patency	2	3	3
Grade 3 patency	32	30	30
Symptom scoring >3	5	1	1
Symptom scoring <3	30	34	34

thrombosis affected the iliofemoral and femoral and popliteal vein in 12 patients (17.6%), the femoral and popliteal vein in 36 patients (52.9%), the iliofemoral vein alone in 20 patients (29.5%). There were no significant differences in the demographic and clinical characteristics, comorbidities and risk factors for DVT between the groups. Demographic and clinical characteristics of the patients and the risk factors for DVT are summarized in Table 1.

Localization of DVT is shown in Table 2. There was no significant difference in the localization of DVT between the groups. However, hyperacute DVT was more common in Group 1, while acute DVT was more common in Group 2 (p=0.048).

No bleeding complications were seen during or after the procedure. Venous patency at one, six, and 12 months using Doppler ultrasonography (DUS) and clinical symptom scores at the predefined time points are shown in Tables 3 and 4. During the follow-up period, two patients developed a complete obstruction and warfarin treatment was re-initiated at one year. While none of the patients in Group 2 had complete obstruction after the procedure, two patients in Group 1 developed DVT in the same leg at a close time of the first year DUS control.

Table 4. Complete patency rates in patients with hyperacute and acute deep vein thrombosis

	Hyperacute DVT (n=48)					Acute DVT (n=20)				
	Group 1 (n=27)		Group 2 (n=21)			Group 1 (n=6)		Group 2 (n=14)		
	n	%	n	%	*p**	n	%	n	%	*p**
1st month										
Stenosis/occlusion	1	3.7	0	0	0.563	6	100	3	21.4	0.002
Complete patency	26	96.3	21	100		0	0	11	78.6	
6th month										
Stenosis/occlusion	7	25.9	1	4.8	0.064	6	100	4	28.6	0.011
Complete patency	20	74.1	20	95.2		0	0	10	71.4	
12th month										
Stenosis/occlusion	10	37	1	4.8	0.013	6	100	4	28.6	0.011
Complete patency	17	63	20	95.2		0	0	10	71.4	

DVT: Deep vein thrombosis; * Fischer's exact test.

Table 5. Distribution of clinical symptoms and clinical symptom scores in patients with hyperacute and acute deep vein thrombosis

	Hyperacute DVT (n=48)									Acute DVT (n=20)								
	Group 1 (n=27)				Group 2 (n=21)					Group 1 (n=20)				Group 2 (n=20)				
	n	%	Median	Q1-3	n	%	Median	Q1-3	*p*†	n	%	Median	Q1-3	n	%	Median	Q1-3	*p*†
1st month																		
Swelling	11	40.7			0	0			0.001	6	100			4	28.6			0.011
Pain	17	63			5	23.8			0.007*	6	100			4	28.6			0.011
Edema	1	3.7			1	4.8			0.689	6	100			3	21.4			0.002
Rash	4	14.8			3	14.3			0.644	0	0			2	14.3			0.479
Paresthesia	3	11.1			0	0			0.246	0	0			0	0			NC
Restricted motion	7	25.9			0	0			0.014	6	100			4	28.6			0.011
CSS, 1st month			1	1-3			0	0-1	<0.001‡			4	4-4			0	0-4	0.012‡
6th month																		
Swelling	4	14.8			1	4.8			0.369	6	100			4	28.6			0.011
Pain	8	29.6			3	14.3			0.304	6	100			4	28.6			0.011
Edema	0	0			0	0			NC	6	100			2	14.3			0.001
Rash	0	0			1	4.8			0.438	0	0			1	7.1			0.700
Paresthesia	1	3.7			0	0			0.563	1	16.7			1	7.1			0.521
Restricted motion	0	0			2	9.5			0.186	5	83.3			4	28.6			0.05
CSS, 6th month			0	0-1			0	0-0.5	0.450‡			4	4-4			0	0-3.25	0.012‡
12th month																		
Swelling	7	25.9			1	4.8			0.064	6	100			3	21.4			0.002
Pain	7	25.9			3	14.3			0.478	6	100			3	21.4			0.002
Edema	2	7.4			1	4.8			0.595	1	16.7			0	0			0.300
Rash	1	3.7			0	0			0.563	3	50			1	7.1			0.061
Paresthesia	0	0			0	0			NC	2	33.3			1	7.1			0.202
Restricted motion	4	14.8			1	4.8			0.369	5	83.3			2	14.3			0.007
CSS, 12th month			0	0-1			0	0-0	0.184‡			4	3.5-4.25			0	0-1	0.002‡

DVT: Deep vein thrombosis; CSS: Clinical symptom score; NC: Not calculated; * Chi-square test; † Fisher's exact test; ‡ Mann-Whitney U test.

Doppler ultrasonography and clinical symptom distribution at one, six, and 12 months are given in Table 3. At one month, clinical symptom scores were significantly higher in Group 1 ($p<0.001$), and this difference was found to be related to swelling ($p<0.001$), pain ($p<0.001$), and restricted motion ($p=0.008$). At six months, pain was more common in Group 1 ($p=0.045$), but this complaint did not significantly affect the clinical symptom scores ($p=0.102$). At 12 months, the clinical symptom scores were significantly higher in Group 1 ($p=0.028$), and this difference was found to be related to swelling ($p=0.008$), pain ($p=0.041$), and restricted motion ($p=0.043$).

In further subgroup analysis, Group 1 and 2 treatment protocols were compared between the hyperacute and acute DVT patients according to clinical symptoms and symptom scoring at one, six, and 12 months (Table 4). In patients with hyperacute DVT, the first month symptom scoring scores were higher in Group 1 due to swelling ($p=0.001$), pain ($p=0.007$), and restricted motion ($p=0.014$), while there was no difference at six and 12 months. In patients with acute thrombosis, clinical symptom scores were higher in Group 1 with swelling ($p=0.011$), pain ($p=0.011$), edema ($p=0.002$), and restricted motion ($p=0.011$). At six months, these variables were found to be higher in Group 1, while at 12 months, the clinical symptom scores were still higher in Group 1 ($p=0.002$) with swelling ($p=0.002$), pain ($p=0.002$), and restricted motion ($p=0.007$) (Table 4).

None of the patients had a total occlusion at one and six months, although two patients had a total occlusion at 12 months. To increase the statistical significance, the patients were further classified based on the severity of the stenosis or occlusion. The patients who had narrowing less 50% or more than 50% had Grade 1 or 2 occlusion, respectively, and a total occlusion was categorized as Grade 3. The patients with complete patency formed a different group. Accordingly, there was no significant difference in the complete patency rates between the groups ($p=0.181$). In contrast to this finding, venous patency, as measured by DUS, was found to be significantly higher than the controls in Group 2 at six and 12 months ($p=0.019$ and $p=0.002$, respectively) (Figure 2). The complete patency rates using DUS at one, six and 12 months were also compared by further analysis between the patients with hyperacute and acute DVT (Table 5). While there was no significant difference in the complete patency rates between the two groups in patients with acute DVT at one and six months ($p=0.563$ and $p=0.064$, respectively), these rates were higher in Group 2 ($p=0.013$). In the patients with acute DVT, the complete patency rates were found to be higher in all control DUS examinations.

DISCUSSION

The natural course of DVT depends on the localization. About half of DVT in calf veins which develop after surgery resolve within 72 hours, although one-sixth extends to the proximal veins.[6] Proximal extension is seen in patients who have symptomatic DVT.[7,8] Massive thrombosis results in circulatory impairment and venous gangrene. The presence of symptoms and proximal distention increase the risk of pulmonary embolism. Half of the patients with symptomatic proximal DVT have silent pulmonary embolism, and approximately 10% have symptomatic pulmonary embolism.

If left untreated, the clinical status of 25% of patients with DVT may deteriorate, while symptoms resolve in 20%, and stable condition is observed in 55%.[7,8] About half of the patients not receiving appropriate treatment may develop relapsing DVT.[7,8]

Catheter-directed thrombolysis is performed by the infusion of thrombolytic agents through an infusion catheter placed directly into a venous thrombus. Vedantham et al.[9] demonstrated a greater than 50% reduction in thrombus burden in more than 90% of patients. In a recent randomized-controlled trial, CDT was associated with an absolute risk reduction of 14% for PTS at 24 months, compared to anticoagulation alone. Complete lysis of the thrombus may take several days, and patients should be followed in the intensive care unit, which increases the hospital stay and the costs.

Pharmacomechanical thrombolysis uses a mechanical device which delivers the thrombolytic agent and produces thrombus fragmentation and/or thrombus aspiration.[10,11] In previous reports using the mechanical thrombectomy devices, the primary technical success rate ranged from 83 to 100%.[10] However, in about half of the patients, thrombolytic therapy was added due to incomplete results. In our study, we administered thrombolytic therapy to all of our patients and achieved complete patency in all patients at the end of the procedure. The Peripheral Use of AngioJet™ Rheolytic Thrombectomy with a Variety of Catheter Lengths (PEARL) registry was a prospective multi-center study which included 329 patients with lower extremity DVT. One-third of the patients had only pharmacomechanical thrombectomy and had complete thrombus resolution; even in the

patients who needed lytic therapy, the infusion time was significantly shorter in the AngioJet™ group.[11] The patency rate at one year was reported to be 83%. Small series and retrospective studies comparing pharmacomechanical thrombectomy and CDT also showed that similar efficacy could be achieved by pharmacomechanical thrombectomy without the costs of intensive care unit monitoring and shortened hospital stays,[12] and that PTS could be reduced with pharmacomechanical thrombectomy at one year.[13]

The procedural success and patency rates of our study are comparable with previous studies. However, when we compared the patency rates at one year, we found that the addition of thrombolytic therapy improved the long-term patency. We also compared the symptom status of the patients, which was done previously in only few studies. Cakir et al.[14] demonstrated that percutaneous aspiration thrombectomy with stenting when needed improved the clinical symptom status, compared to anticoagulation alone. The PEARL registry also demonstrated significant improvement in the quality of life with pharmacomechanical thrombectomy. The symptom status of our patients in both hyperacute and acute DVT were improved in both groups at the end of one month. Improvement of symptoms was also permanent in acute DVT; however, it was not significant in the hyperacute DVT group. Although complete patency rates were higher in hyperacute DVT patients, combination therapy still improved the quality of life in acute DVT patients.

Furthermore, pharmacomechanical thrombectomy with thrombolysis can be done effectively even in patients with symptoms lasting longer than 14 days with high success, low complication, and good long-term results.[15] In their study, Baran et al.[16] implemented direct thrombolytic infusion to 85 patients diagnosed with iliofemoral acute DVT. The number of patients who achieved complete patency after intervention was 75 (88.2%), whereas in the other 10 patients (11.8%) achieved partial patency. During follow-up, recurrent venous thrombi were observed in nine patients. At 12 months, 68 patients were reached, and the number of patients with complete patency was 42 (61.7%) and the number of partial patency was 26 (38.3%). Comparing these results to our study findings, it is likely to consider that pharmacomechanical thrombectomy practice is superior, when only it is practiced with the aim of catheter-use thrombolysis.[16] In another study, Tayfur et al.[17] included 30 patients with acute iliofemoral DVT, and only pharmacomechanical thrombolysis was implemented. At the end of the first year, the venous patency rate was almost at the same rate with our patient group who underwent additional thrombolytic and pharmacomechanical thrombolysis.

However, the Acute Venous Thrombosis: Thrombus Removal with Adjunctive Catheter-Directed Thrombolysis (ATTRACT) study, which was presented at the 2017 Society of Interventional Radiology meeting, did not support the data previously published. In the aforementioned study, data on the long-term effects of pharmacomechanical CDT showed that 46.7% of the patients who received interventional therapy and 48.2% of the patients who received anticoagulation alone developed PTS (p=0.56). Due to these controversial results, although early interventional therapy seems to have more promising results, we conclude that there is still controversy in the treatment protocol for the patients with DVT.

Our study results demonstrated that the addition of a 24-h fixed-dose thrombolytic therapy to pharmacomechanical thrombectomy using aspiration increased the patency rates and improved the clinical symptoms at 12 months. Although there was no significant difference in clinical symptom status in the hyperacute patient group, we observed a significant improvement in the acute DVT group. According to the patency rates, the patients with hyperacute DVT had higher patency rates (95.2%) than acute DVT patients (71.4%). These results suggest that early and aggressive treatment increase the success of DVT treatment.

Nonetheless, there are some limitations to our study mainly including the retrospective nature of the study and small sample size. In addition, the lack of major bleeding in our study can be attributed to the fact that our study population was relatively young with a small sample size. Therefore, we recommend further large-scale studies to confirm these findings.

In conclusion, there is no consensus in the treatment protocol for patients with deep vein thrombosis. To the best of our knowledge, this is the first study to compare the long-term effects of pharmacomechanical thrombectomy using aspiration and additional fixed dose thrombolytic therapy in the treatment of deep vein thrombosis. In addition, the results of our study demonstrate that, in the treatment of deep vein thrombosis, the addition of low-dose thrombolytic therapy for 24 h to pharmacomechanical thrombectomy using aspiration improves the clinical symptoms and venous patency rates at one year without any increase in bleeding complications.

Declaration of conflicting interests

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