International Surgery Journal
Philip VK et al. Int Surg J. 2022 Sep;9(9):1540-1547
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20222076

Original Research Article

Thrombectomy in deep vein thrombosis: a definitive treatment

Vinoth Kumar Philip*, Mohamed Yasir

Department of Plastic and Microvascular Surgery, VJ Hospital, Tamil Nadu, India

Received: 16 July 2022
Revised: 30 July 2022
Accepted: 01 August 2022

***Correspondence:**
Dr. Vinoth Kumar Philip,
E-mail: philipvinoth@hotmail.com

ABSTRACT

Background: The development of blood clots (thrombi) in the deep veins is known as deep vein thrombosis (DVT). It frequently affects the deep pelvic veins or the deep leg veins (such as the calf veins, femoral vein, or popliteal vein). It is a potentially fatal condition that may result in morbidity and mortality that can be prevented. Aim was to assess the effectiveness of thrombectomy in treating patients with DVT.
Methods: The 196 patients with DVT reporting to VKP's VJ hospital, Tirunelveli, Tamil Nadu, were selected for this retrospective study. Thrombectomy was chosen as the treatment modality in this study.
Results: Most patients were in the age group between 41 to 60 years (59.5%), with male predominance noted (77.4%). Pain and swelling are the most typical clinical features, 64.6% of patients presented with this sign. In patients with chronic and sub-acute DVT, 25% and 10.2% had residual thrombus visualized in doppler. Late complication, varicose veins were seen higher in patients with common iliac vein thrombosis (2/3) 66.7%, 52.6% (10/19) in external iliac vein thrombosis and 34.8% (8/23) in popliteal vein thrombosis. Late complication recurrence was seen higher in patients with partial occlusion (5/14) 35.7%, 21.4% (3/14) had varicose veins.
Conclusions: The best course of treatment for DVT patients is thrombectomy, which can restore venous patency, stop DVT from returning, alleviate PTS, and prevent pulmonary embolism.

Keywords: DVT, Pulmonary embolism, Venous thromboembolism, Thrombectomy

INTRODUCTION

Deep vein thrombosis (DVT) occurs when blood clots form in the veins of patients being treated for cancer, infectious diseases, or following major surgery. Only in the United States each year, 20 million cases of DVT occur in the lower extremities.[1] There are high chances that patients undergoing orthopaedic surgery are 60% more likely to have postsurgical venography than those who don't.[2] Recent studies have refuted the widely held belief that the prevalence of VTE is lower in Asians than in Westerners.[3] Postoperative DVT is as common in Indian patients undergoing major lower limb surgery as in the West (43.2% and 607u6y-% in the prophylaxis groups, respectively).[4] In India, the prevalence of DVT is under-recognized, and a literature review reveals only a few studies in this area. Although the incidence rate of DVT in the general population in India is unknown, most of the available literature comes from orthopaedic departments.[5] DVT can lead to fatal pulmonary embolism (PE) or post-thrombotic syndrome's acute and long-term complications (PTS).[6] Systemic anticoagulation is the primary treatment for DVT. The systemic anticoagulation action mechanism inhibits thrombus growth and decreases the risk of pulmonary embolism. However, complete thrombus resolution is impossible with anticoagulation; this could lead to the development of PTS in the future. Furthermore, patients undergoing aggressive thrombus removal are less likely to develop PTS.[7] Systemic thrombolysis, and catheter-directed thrombolysis (CDT) have been suggested as treatment options to improve venous patency.[8] However, CDT has some evident drawbacks like high bleeding from prolonged exposure to thrombolytic agents.[9] As a result

of these shortcomings, various thrombectomy devices have been developed and innovated, such as percutaneous aspiration thrombectomy and pharmaco-mechanical thrombectomy. In the study the effectiveness of thrombectomy in treating patients with DVT analysed.

METHODS

This retrospective observational study was conducted in the department of plastic surgery at Dr VKP's VJ hospital, Tirunelveli, Tamil Nadu from January 2017-April 2022, in patients with venous doppler proven DVT showing occlusive thrombus. Patients were recruited in consecutive sampling method.

Inclusion criteria

Patients with age 10-90 years, DVT up to the level of hepatic veins, blue leg syndrome, DVT of the popliteal, femoral, common femoral, external iliac, common iliac veins and inferior vena cava included in study.

Exclusion criteria

Patients with proximal DVT extending up to right atrium, proximal DVT above the level of the hepatic vein, infra-popliteal DVT, active pulmonary embolism, ASA class IV or above, venous doppler ultrasound inconclusive of DVT were excluded from the study.

Informed written consent was obtained before the procedure. Under strict aseptic precautions, spinal anaesthesia was administered. The patient was placed supine, and parts were painted and draped. Incision over the groin is made longitudinally. A great saphenous vein was identified and was traced to the common femoral vein. Intermediary branches were clipped. Then the thrombosed common femoral vein was explored, and control was taken proximally and distally. Venotomy was performed, and the thrombus was removed. Then, a suction catheter was used to remove the clots proximally. With proximal control in place, irrigation was done distally to bring all the thrombus out of the superficial femoral vein. Then the return blood flow was assessed. The venotomy closed with a 5'0 prolene suture. Wound closure was done in layers. A compression bandage was applied. Newer oral anticoagulants (NOACs) were recommended for at least six months after thrombectomy.

Data were presented as frequency and percentage. Categorical variables were compared using the Pearson chi-square test. Significance was defined by p values less than 0.05 using a two-tailed test. Data analysis was performed using IBM-SPSS version 21.0 (IBM-SPSS Science Inc., Chicago, IL).

RESULTS

In this study, 195 patients with DVT were included. Most patients were in the age group between 41 to 60 years (59.5%), with male predominance noted (77.4%). Pain and swelling are the commonest clinical features, 64.6% of patients presented with this sign. In addition, 61% of patients presented with signs and symptoms of less than 5 days (61%) and 7.2% presented after 11 days. In this study, 19.5% of patients had CAD, 8.2% were infected with covid 19 and 6.7% had a history of CVA (Table 1).

Table 1: Distribution of demographic and clinical presentation.

Patients' characteristics		N	Percent (%)
Age group (years)	<30	11	5.6
	31-40	22	11.3
	41-50	48	24.6
	51-60	68	34.9
	61-70	32	16.4
	>71	14	7.2
Gender	Female	44	22.6
	Male	151	77.4
Clinical presentation	Pain	33	16.9
	Swelling	29	14.9
	Pain and swelling	126	64.6
	Discomfort	6	3.1
	Asymptomatic	1	0.5
Duration of symptoms (days)	<5	119	61
	6-10	62	31.8
	>11	14	7.2
Comorbidities related to DVT	Autoimmune disorders	2	1
	Chronic liver disease	1	0.5
	Coronary artery disease	38	19.5
	Hematopoietic disorders	1	0.5
	History of SARS CoV2 infection	16	8.2
	Inherited thrombophilia	6	3.1
	Post-surgery immobilization > 3 days	3	1.5
	Pregnancy	1	0.5
	Prior DVT/ PE	3	1.5
	Prior stroke/ TIA	13	6.7
	Nil	111	56.9

The 38.5% of patients had elevated D-dimmer levels. Most cases had acute DVT (70.8%), 4.1% had chronic, while 25.1% reported sub-acute DVT. Proximal DVT was reported as the commonest thrombus location in the present study (37.4%), followed by the femoral vein (30.8%), while 11.8% had it in the popliteal vein. The appearance of thrombus was mainly hypoechoic in the

majority of the patients (76.4%) and anechoic in 13.8% of patients. 92.8% of patients had complete occlusion (Table 2).

Table 2: Distribution of patient's diagnostics findings.

Patient characteristics		N	Percent (%)
D-dimer elevation> 500 ng/ml	No	120	61.5
	Yes	75	38.5
Venous Doppler-thrombus timeline	Acute	138	70.8
	Chronic	8	4.1
	Sub-acute	49	25.1
Venous Doppler-thrombus location	Common iliac vein	3	1.5
	Extending across multiple veins	13	6.7
	External iliac vein	19	9.7
	Femoral vein	60	30.8
	Inferior vena cava	3	1.5
	Popliteal vein	23	11.8
	Proximal common femoral vein	73	37.4
	Others	1	0.5
Venous Doppler-thrombus echogenicity	Anechoic	27	13.8
	Hyperechoic	19	9.7
	Hypoechoic	149	76.4
Venous Doppler-occlusion/ recanalization	Complete occlusion	181	92.8
	Partial occlusion	14	7.2

During the procedure, 2 patients (1%) had major bleeding, and 1 (0.5%) had a pulmonary embolism. Late complications related to varicose veins were reported in 21% of patients, recurrence in 7.2% of patients, and deep venous reflux in 4.6% of patients. Residual thrombus was visualized in 6.2% of patients post-surgery. Complete recanalization was seen in 76.4% of patients, 13.8% had partial recanalization, and 9.7% had fibrotic strands. The duration of hospital stay was 3.57±1.09 days (Table 3).

There is no statistically significant association of duration of symptoms with peri-operative outcome p=0.905. Late complication, varicose veins were seen higher in patients presented after 11 days of symptoms (4/14) at 28.6%, but there was no statistically significant association in late complication p=0.769. There was no statistically significant association of duration of symptoms with residual thrombus visualization in Doppler (p=0.103). There was no statistically significant association of duration of symptoms with occlusion/recanalization in doppler p=0.448 (Table 4).

No statistically significant association of type of thrombus with peri-operative outcome p=0.868 was reported. Late complication such as varicose veins was higher in patients with chronic DVT (4/8) at 50% and 32.7% (16/49) in sub-acute DVT. There was no statistically significant association between late complications p=0.064. In patients with Chronic and sub-acute DVT, 25% and 10.2% had residual thrombus visualized in doppler. There was a statistically significant association between type of thrombus and residual thrombus visualization in doppler p=0.020. In addition, 37.5% (3/8) patients with chronic DVT had fibrotic strands, 14.3% of patients in sub-acute DVT had partial recanalization, and 13.8% in acute DVT had partial recanalization. There was a statistically significant association of type of thrombus with occlusion/recanalization in doppler p=0.009 (Table 5).

Table 3: Distribution of outcome of the study

Patients' characteristics		N	Percent (%)
Intra op finding	Thrombosed vein	195	100
Peri-operative outcome	Major bleeding	2	1
	Pulmonary embolism	1	0.5
	Successful thrombectomy	192	98.5
Late complications	Deep venous reflux	9	4.6
	Lymphorrhea	7	3.6
	Post-thrombotic syndrome	4	2.1
	Recurrent symptomatic DVT/PE	14	7.2
	Varicose veins	41	21
	Nil	120	61.5
Venous Doppler-Thrombus timeline (Post surgery)	Residual thrombus not visualized	183	93.8
	Residual thrombus visualized	12	6.2
Venous Doppler-occlusion/ recanalization (Post surgery)	Complete recanalization	149	76.4
	Fibrotic strand	19	9.7
	Partial recanalization	27	13.8%
Duration of stay (days) (mean/SD)		3.57±1.09	

There was no statistically significant association of thrombus location with the peri-operative outcome (p=0.234). Late complication, varicose veins were seen higher in patients with common Iliac vein thrombosis (2/3) 66.7%, 52.6% (10/19) in external Iliac vein thrombosis and 34.8% (8/23) in popliteal vein thrombosis. A statistically significant association of thrombus location with late complication (p=0.001) was observed. In patients with inferior vena cava thrombosis, 66.7% (2/3) had residual thrombus visualized on the doppler. A statistically significant association between

thrombus location and residual thrombus visualization was seen in doppler p=0.001. There was no statistically significant association of thrombus location with occlusion/recanalization in doppler p=0.721 (Table 6).

Table 4: Cross-tabulation of outcome and duration of symptoms.

Variables		Duration of symptoms (days)						P value
		<5		6-10		>11		
		Count	Column, N (%)	Count	Column, N (%)	Count	Column, N (%)	
Peri-operative outcome	Major bleeding	1	0.8	1	1.6	0	0	0.905
	Pulmonary embolism	1	0.8	0	0	0	0	
	Successful thrombectomy	117	98.3	61	98.4	14	100	
Late complications	Deep venous reflux	6	5	3	4.8	0	0	0.769
	Lymphorrhea	3	2.5	4	6.5	0	0	
	Post-thrombotic syndrome	3	2.5	1	1.6	0	0	
	Recurrent symptomatic DVT/ PE	6	5	7	11.3	1	7.1	
	Varicose veins	25	21	12	19.4	4	28.6	
	Nil	76	63.9	35	56.5	9	64.3	
Venous Doppler-thrombus timeline (post surgery)	Residual thrombus not visualized	115	96.6	56	90.3	12	85.7	0.103
	Residual thrombus visualized	4	3.4	6	9.7	2	14.3	
Venous Doppler-occlusion/ recanalization (post surgery)	Complete recanalization	94	79	44	71	11	78.6	0.448
	Fibrotic strand	8	6.7	9	14.5	2	14.3	
	Partial recanalization	17	14.3	9	14.5	1	7.1	

Table 5: Cross-tabulation of outcome and thrombus timeline.

Variables		Venous Doppler-thrombus timeline						P value
		Acute		Chronic		Subacute		
		Count	Column, N (%)	Count	Column, N (%)	Count	Column, N (%)	
Peri-operative outcome	Major bleeding	2	1.4	0	0	0	0	0.868
	Pulmonary embolism	1	0.7	0	0	0	0	
	Successful thrombectomy	135	97.8	8	100	49	100	
Late complications	Deep venous reflux	5	3.6	1	12.5	3	6.1	0.064
	Lymphorrhea	6	4.3	0	0	1	2	
	Post-thrombotic syndrome	2	1.4	0	0	2	4.1	
	Recurrent symptomatic DVT/ PE	9	6.5	1	12.5	4	8.2	
	Varicose veins	21	15.2	4	50	16	32.7	
	Nil	95	68.8	2	25	23	46.9	
Venous Doppler-thrombus timeline (Post surgery)	Residual thrombus not visualized	133	96.4	6	75	44	89.8	0.020
	Residual thrombus visualized	5	3.6	2	25	5	10.2	
Venous Doppler-occlusion/ recanalization (Post surgery)	Complete recanalization	106	76.8	4	50	39	79.6	0.009
	Fibrotic strand	13	9.4	3	37.5	3	6.1	
	Partial recanalization	19	13.8	1	12.5	7	14.3	

Table 6: Cross-tabulation of outcome and thrombus location.

Variables		Venous Doppler-Thrombus location																P value
		Common iliac vein		Extending across multiple veins		External iliac vein		Femoral vein		Inferior vena cava		Popliteal vein		Proximal common femoral vein		Others		
		Ct	Clm, N (%)	Ct	Clm, N (%)	Ct	Clm, N (%)	Ct	Clm, N (%)	Ct	Clm, N (%)	Ct	Clm, N (%)	Ct	Clm, N (%)	Ct	Clm, N (%)	
Peri-op outcome	Major bleeding	0	0	0	0	0	0	0	0	0	0	0	0	2	2.7	0	0	0.234
	Pulmonary embolism	0	0	1	7.7	0	0	0	0	0	0	0	0	0	0	0	0	
	Successful thrombectomy	3	100	12	92.3	19	100	60	100	3	100	23	100	71	97.3	1	100	
Late complications	Deep venous reflux	0	0	0	0	1	5.3	1	1.7	1	33.3	1	4.3	5	6.8	0	0	0.001
	Lymphorrhea	0	0	1	7.7	1	5.3	3	5	0	0	1	4.3	1	1.4	0	0	
	Post-thrombotic syndrome	0	0	0	0	1	5.3	1	1.7	0	0	0	0	2	2.7	0	0	
	Recurrent symptomatic DVT/ PE	0	0	5	38.5	1	5.3	4	6.7	1	33.3	0	0	3	4.1	0	0s	
	Varicose veins	2	66.7	0	0	10	52.6	13	21.7	1	33.3	8	34.8	7	9.6	0	0	
	Nil	1	33.3	7	53.8	5	26.3	38	63.3	0	0	13	56.5	55	75.3	1	100	
Venous Doppler-thrombus timeline (Post surgery)	Residual thrombus not visualized	3	100	11	84.6	18	94.7	59	98.3	1	33.3	21	91.3	69	94.5	1	100	0.001
	Residual thrombus visualized	0	0	2	15.4	1	5.3	1	1.7	2	66.7	2	8.7	4	5.5	0	0	
Venous Doppler-occlusion/ recanalization (Post surgery)	Complete recanalization	3	100	10	76.9	17	89.5	45	75	1	33.3	17	73.9	55	75.3	1	100	0.721
	Fibrotic strand	0	0	2	15.4	0	0	8	13.3	1	33.3	1	4.3	7	9.6	0	0	
	Partial recanalization	0	0	1	7.7	2	10.5	7	11.7	1	33.3	5	21.7	11	15.1	0	0	

Ct-Count, Clm-Column.

Table 7: Cross-tabulation of outcome and thrombus echogenicity.

Variables		Venous Doppler-Thrombus echogenicity						P value
		Anechoic		Hyperechoic		Hypoechoic		
		Count	Column, N (%)	Count	Column, N (%)	Count	Column, N (%)	
Peri-operative outcome	Major bleeding	0	0	0	0	2	1.3	0.919
	Pulmonary embolism	0	0	0	0	1	0.7	
	Successful thrombectomy	27	100	19	100	146	98	
Late complications	Deep venous reflux	2	7.4	2	10.5	5	3.4	0.063
	Lymphorrhea	1	3.7	0	0	6	4.0	
	Post-thrombotic syndrome	1	3.7	0	0	3	2	
	Recurrent symptomatic DVT/ PE	4	14.8	2	10.5	8	5.4	
	Varicose veins	9	33.3	7	36.8	25	16.8	
	Nil	10	37	8	42.1	102	68.5	
Venous Doppler-thrombus timeline (Post surgery)	Residual thrombus not visualized	24	88.9	16	84.2	143	96	0.068
	Residual thrombus visualized	3	11.1	3	15.8	6	4	
Venous Doppler-occlusion/ recanalization (Post surgery)	Complete recanalization	18	66.7	13	68.4	118	79.2	0.505
	Fibrotic strand	3	11.1	3	15.8	13	8.7	
	Partial recanalization	6	22.2	3	15.8	18	12.1	

Table 8: Cross-tabulation of outcome and thrombus occlusion.

Variables		Venous Doppler-occlusion/recanalization				P value
		Complete occlusion		Partial occlusion		
		Count	Column, N (%)	Count	Column, N (%)	
Peri-operative outcome	Major bleeding	2	1.1	0	0	0.889
	Pulmonary embolism	1	0.6	0	0	
	Successful thrombectomy	178	98.3	14	100	
Late complications	Deep venous reflux	8	4.4	1	7.1	<0.0001
	Lymphorrhea	7	3.9	0	0	
	Post-thrombotic syndrome	3	1.7	1	7.1	
	Recurrent symptomatic DVT/ PE	9	5	5	35.7	
	Varicose veins	38	21	3	21.4	
	Nil	116	64.1	4	28.6	
Venous Doppler-thrombus timeline (Post surgery)	Residual thrombus not visualized	172	95	11	78.6	0.014
	Residual thrombus visualized	9	5	3	21.4	
Venous Doppler-occlusion/ recanalization (Post surgery)	Complete recanalization	141	77.9	8	57.1	0.181
	Fibrotic strand	17	9.4	2	14.3	
	Partial recanalization	23	12.7	4	28.6	

There was no statistically significant association of thrombus echogenicity with peri-operative outcome p=0.919. There is no statistically significant association between thrombus echogenicity with late complication p=0.063. No statistically significant association of thrombus echogenicity with residual thrombus visualization in doppler (p=0.068) was observed. There was no statistically significant association of thrombus echogenicity with occlusion/recanalization in doppler p=0.505 (Table 7).

There was no statistically significant association of complete or partial occlusion with peri-operative outcome p=0.889. Late complication and recurrence were higher in patients with partial occlusion (5/14) at 35.7%, while 21.4% (3/14) had varicose veins. There was a statistically significant association between complete or partial occlusion with late complications p<0.0001. Patients reporting partial occlusion accounting for 21.4% (3/14), had residual thrombus visualized in the doppler. There was a statistically significant association between complete or partial occlusion and residual thrombus visualization in doppler (p=0.014). There was no statistically significant association of complete or partial occlusion with occlusion/recanalization in doppler (p=0.181) (Table 8).

DISCUSSION

DVT can have long-term effects on patients, including unresolved or worsened symptoms, skin ulceration, recurrence of acute thrombosis, and PTS.[10] These symptoms are typically caused by venous hypertension and thrombus-related obstruction of outflow. Comerota et al, Mewissen, Meissner and Bjarnason et al demonstrated the link between the early restoration of patency and improved interim and long-term outcomes. Anticoagulant therapy is an effective treatment for symptomatic DVT.[11-14]

In patients with acute DVT, adequate anticoagulation therapy prevents pulmonary embolism but is insufficient to restore vein valvular function, leading to PTS. Recent advances in thrombectomy have made it possible to treat acute symptoms earlier, preserve the valvular structure, and prevent PTS.[15,16]

Comorbid conditions complicate the care of patients with DVT in the hospital, a serious clinical and public health issue. These comorbidities may alter the efficacy of treatments and the course of the primary disease. Some comorbid conditions (like congestive heart failure, liver disease, lymphoma, metastatic cancer, renal failure and pregnancy) have been linked to increased mortality risk in adult hospitalized populations.[17] DVT patients in our study had similar comorbidities, but no mortality was observed in the present study.

DVTs may benefit from adding catheter-directed thrombolysis (CDT) to medical treatment. As a result of this evidence, CDT appears to be superior to systemic anticoagulation in terms of reducing clot burden and DVT recurrence.[18] Acute iliofemoral pain is routinely treated with pharmaco-mechanical CDT in some hospitals DVT.[19] According to the systematic review of percutaneous mechanical thrombectomy (PMT) in the treatment of DVT, most studies reported no major bleeding complications. We did not observe any post-procedural bleeding in the patients.[20] During a six-month follow-up period, White et al. studied rehospitalization for VTE in nearly 37,000 patients who had been admitted for DVT in California.[19] Young age, malignancy, surgery, trauma, dementia, and a long initial hospital stay were all linked to an increased risk of rehospitalization, the researchers concluded.[21] For 6 to 8 years, Beyth et al tracked the progress of 124 patients who had experienced a first-time or recurrent DVT and also find that patients under the age of 65 were more likely to experience recurrent events.[10] In the current study, we found no such link between a patient's age and the frequency of recurrences. In our study, we observed recurrent symptomatic DVT/ PE in 14 (7.2%) cases. Another complication we have observed is varicose veins in 41 (21.4%). Our finding consistent with previous findings.[8]

Limitations

We evaluated consecutively registered patients, our study design was retrospective and uncontrolled.

CONCLUSION

In terms of restoring venous patency, preventing recurrence of DVT, treating PTS, and preventing pulmonary embolism, thrombectomy is the most effective treatment for DVT patients. The overall success rate of thrombectomy was high, with reduced bleeding complications. However, it would be helpful to conduct randomized studies to compare the efficacy of different thrombectomy devices and to demonstrate the efficacy of thrombectomy with anticoagulation therapy.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Cronan JJ, Dorfman GS, Grusmark J. Lower-extremity deep venous thrombosis: further experience with and refinements of US assessment. Radiology. 1988;168(1):101-7.
2. Stulberg BN, Insall JN, Williams GW, Ghelman B. Deep-vein thrombosis following total knee replacement. An analysis of six hundred and thirty-eight arthroplasties. J Bone Joint Surg Am. 1984;66(2):194-201.
3. Lee LH, Gu KQ, Heng D. Deep vein thrombosis is not rare in Asia-The Singapore General Hospital

experience. Ann Acad Med Singapore. 2002;31:761-4.
4. Agarwala S, Bhagwat AS, Modhe J. Deep vein thrombosis in Indian patients undergoing major lower limb surgery. Indian J Surg. 2003;65:159-62.
5. Agarwala S, Bhagwat AS, Wadhwani R. Pre and post operative DVT in Indian patients-Efficacy of LMWH as a prophylaxis agent. Ind J Orth. 2005;39:55-8.
6. Watz R, Savidge GF. Rapid thrombolysis and preservation of valvular venous function in high deep vein thrombosis: a comparative study between streptokinase and heparin therapy. Acta Medica Scandinavica. 1979;205(1-6):293-8.
7. Watson LI, Armon MP. Thrombolysis for acute deep vein thrombosis. Cochrane Database Syst Rev. 2004;(4):CD002783.
8. Alesh I, Kayali F, Stein PD. Catheter-directed thrombolysis (intrathrombus injection) in treatment of deep venous thrombosis: A systematic review. Catheterization Cardiovasc Interventions. 2007;70(1):145-50.
9. Meissner MH, Gloviczki P, Comerota AJ, Dalsing MC, Eklof BG, Gillespie DL et al. Society for Vascular Surgery; American Venous Forum. Early thrombus removal strategies for acute deep venous thrombosis: clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum. J Vasc Surg. 2012;55(5):1449-62.
10. Beyth RJ, Cohen AM, Landefeld CS. Long-term outcomes of deep-vein thrombosis. Arch Internal Med. 1995;155(10):1031-7.
11. Comerota AJ, Throm RC, Mathias SD, Haughton S, Mewissen M. Catheter-directed thrombolysis for iliofemoral deep venous thrombosis improves health-related quality of life. Journal of vascular surgery. 2000;32(1):130-7.
12. Mewissen MW. Catheter-directed thrombolysis for lower extremity deep vein thrombosis. Techniques Vascu Interventional Radiol. 2001;4(2):111-4.
13. Meissner MH. Thrombolytic therapy for acute deep vein thrombosis and the venous registry. Rev Cardiovasc Med. 2002;3(S2):53-60.
14. Bjarnason H, Kruse JR, Asinger DA, Nazarian GK, Dietz Jr CA, Caldwell MD et al. Iliofemoral deep venous thrombosis: safety and efficacy outcome during 5 years of catheter-directed thrombolytic therapy. J Vascular Interventional Radiol. 1997;8(3):405-18.
15. Huang CY, Hsu HL, Kuo TT, Lee CY, Hsu CP. Percutaneous pharmacomechanical thrombectomy offers lower risk of post-thrombotic syndrome than catheter-directed thrombolysis in patients with acute deep vein thrombosis of the lower limb. Ann Vascular Surg. 2015;29(5):995-1002.
16. Van Walraven C, Austin PC, Jennings A, Quan H, Forster AJ. A modification of the Elixhauser comorbidity measures into a point system for hospital death using administrative data. Med Care. 2009;626-33.
17. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. Med Care. 1998;8-27.
18. Patterson BO, Hinchliffe R, Loftus IM, Thompson MM, Holt PJ. Indications for catheter-directed thrombolysis in the management of acute proximal deep venous thrombosis. Arteriosclerosis Thrombosis Vascular Biol. 2010;30(4):669-74.
19. Popuri RK, Vedantham S. The role of thrombolysis in the clinical management of deep vein thrombosis. Arteriosclerosis, thrombosis, and vascular biology. 2011;31(3):479-84.
20. Karthikesalingam A, Young EL, Hinchliffe RJ, Loftus IM, Thompson MM, Holt PJ. A systematic review of percutaneous mechanical thrombectomy in the treatment of deep venous thrombosis. Euro J Vascular Endovascular Surg. 2011;41(4):554-65.
21. White RH, Zhou H, Romano PS. Length of hospital stay for treatment of deep venous thrombosis and the incidence of recurrent thromboembolism. Arch Internal Med. 1998;158(9):1005-10.

Cite this article as: Philip VK, Yasir M. Thrombectomy in deep vein thrombosis: a definitive treatment. Int Surg J 2022;9:1540-7.