



Original Article

Catheter-directed thrombolysis and pharmacomechanical thrombectomy improve midterm outcome in acute iliofemoral deep vein thrombosis

Tzu-Ting Kuo^{a,b}, Chun-Yang Huang^c, Chiao-Po Hsu^{a,b,d}, Chiu-Yang Lee^{a,b,e,*}

^a Division of Cardiovascular Surgery, Department of Surgery, Taipei Veterans General Hospital, Taipei, Taiwan, ROC

^b School of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC

^c Division of Cardiovascular Surgery, Far East Memorial Hospital, New Taipei City, Taiwan, ROC

^d Institute of Clinical Medicine, School of Medicine, National Yang-Ming University Taipei, Taiwan, ROC

^e National Defense Medical Center, Taipei, Taiwan, ROC

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Abstract

Background: Aggressive and early thrombus removal strategy has been widely used as a treatment for iliofemoral deep vein thrombosis (DVT). We compared the long-term venous outcome, including postthrombotic syndrome (PTS), in patients undergoing catheter-directed thrombolysis (CDT) and pharmacomechanical thrombectomy (PMT).

Methods: From January 2009 to December 2013, 61 patients with acute proximal DVT were enrolled in this prospective study. Thirty-one patients underwent CDT and 30 patients underwent PMT, and each patient was followed for at least 2 years after treatment. Observations included venous outflow resistance, venous insufficiency, thrombus score (TS), severity of PTS, and surgical complications.

Results: Venous outflow obstruction was similar in the CDT and PMT groups (32.3% vs. 30.0%, $p = 0.695$), and venous insufficiency of each group was 38.7% and 30.0% ($p = 0.774$), respectively. The TS at 24 months of each group showed no significant difference (0.90 vs. 0.70, $p = 0.526$). The mean Villalta scale scores of the CDT and PMT groups were 3.13 and 1.87, respectively ($p = 0.042$). Patients without PTS had significantly lower TS since 1 week postoperatively (1.59 vs. 4.60, $p < 0.001$). The severity of PTS was highly correlated with the TS, rate of thrombolysis, and severity of obstruction, and was moderately correlated with the venous registry index and reflux severity.

Conclusion: CDT and PMT have similar venous outcomes in patients with acute iliofemoral DVT, although PTS is less severe following PMT than after CDT. We propose that early and thorough removal of thrombus, using either CDT or PMT, is beneficial to prevent PTS.

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Keywords: catheter-directed thrombolysis; deep vein thrombosis; pharmacomechanical thrombectomy; postthrombotic syndrome

1. Introduction

The importance of deep vein thrombosis (DVT) cannot be overemphasized, not only because DVT can have lethal consequences such as pulmonary embolism, but also because of

the potential for chronic postthrombotic sequelae. The incidence of postthrombotic syndrome (PTS) ranged from 20% to 50%, and is most frequently associated with iliofemoral venous thrombosis.^{1,2} The traditional treatment of anticoagulant alone does not promote thrombus dissolution, preserve valve function, or reduce PTS. There is increasing evidence that early removal of thrombus results in less venous obstruction, less venous insufficiency, and therefore, a lower rate of occurrence of PTS.^{3,4} The Society for Vascular Surgery and the American Venous Forum have suggested a strategy of early removal of thrombus in selected patients meeting the following criteria: (1) first episode of acute iliofemoral deep

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

* Corresponding author. Dr. Chiu-Yang Lee, Division of Cardiovascular Surgery, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, ROC.

E-mail address: tumorlee0701@hotmail.com (C.-Y. Lee).

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venous thrombosis, (2) symptoms <14 days in duration, (3) low risk of bleeding, and (4) ambulatory with good functional capacity and an acceptable life expectancy (Grade 2C).⁵ With emerging surgical techniques, catheter-directed thrombolysis (CDT) and pharmacomechanical thrombectomy (PMT) are becoming the treatments of choice. In this study, we compared the efficacy, long-term outcome, and complications of these two therapies.

2. Methods

2.1. Patients

From January 2009 to December 2013, 61 patients with acute iliofemoral DVT for ≤ 21 days were enrolled in this prospective study. Duplex sonography was used to diagnose DVT and to confirm the extent of the thrombus. Patient characteristics and clinical characteristics are shown in Table 1. Patients in whom anticoagulants are contraindicated, and those with thrombolysis, severe anemia (hemoglobin <8 g/dL), severe renal failure (creatinine clearance rate <30 mL/min), thrombocytopenia (platelet count <150,000/cumm), or bilateral DVT were excluded. After having received a detailed, nondirective explanation of each procedure, as well as the cost of

PMT, 31 patients underwent CDT and 30 patients underwent PMT, pursuant to each patient's decision. Then, each patient was followed up for at least 2 years after the procedure.

This study was approved by the Institutional Review Board at Taipei Veterans General Hospital, and all patients provided their written consent.

2.2. CDT and PMT techniques

Prior to either procedure, each patient routinely received low-molecular-weight heparin (LMWH) daily after admission, but did not receive LMWH on the day of the procedure. At the beginning of the procedure, an intravenous bolus of 3000–5000 U of unfractionated heparin (UFH) was administered to obtain an activated clotting time exceeding 200 seconds. Percutaneous access was either through the lesser saphenous vein or through the popliteal vein under ultrasound guidance. After puncture, a 5F or 6F introducer sheath was inserted via the Seldinger technique. Venography was performed to examine the extent of thrombus.

The CDT protocol of this study was modified from the catheter-directed venous thrombolysis in acute iliofemoral vein thrombosis trial (The CaVenT Study).⁴ The guide wire passed through the thrombosed lesion under the aid of a supporting catheter, followed by a multiple-sidehole infusion catheter. The catheter was placed within the thrombosed vessel and was secured in place. The urokinase solution was infused continuously at a dose of 600–1200 U/kg/h over 48–72 hours. Patient serum fibrinogen, hemoglobin level, and platelet count were checked daily, and the urokinase dose was adjusted accordingly to avoid hemorrhagic complications. During the CDT therapy, UFH was infused simultaneously via the access sheath at the dose of 5–10 U/kg/h to prevent thrombus formation. The activated partial thromboplastin time (aPTT) was maintained between 1.5 and 2.0 times the control level.

In the PMT group, an inferior vena cava (IVC) filter was deployed prior to the procedure. PMT was performed using one of two methods. The first method involved the balloon crush technique, which used a balloon catheter obstructing the proximal end of the thrombosed lesion. Urokinase at a dose of 3000–5000 U/kg was infused from the sheath, and retained for several minutes. The balloon was then withdrawn while aspirating thrombus fragments from the sheath using a large syringe. This sequence was repeated two to three times. Finally, percutaneous angioplasty (PTA) was performed over the thrombosed lesion progressively as the “crush and lyse” technique. The second PMT technique, the AngioJet device (Possis Medical, Inc., Minneapolis, MN, USA), was adapted in our hospital for rheolytic thrombectomy. The angiojet catheter was inserted to the thrombosed lesion, and the operation continued with a solution of urokinase (2000–3000 U/kg per 500 mL saline).

Repeat venography was performed after either procedure, and a multiple-sidehole infusion catheter was left in place for CDT for 1 additional day.

In each procedure, PTA was performed over a site with significant stenosis. Stenting was adapted if there was residual

Table 1
Demographic and clinical characteristics of the study patients.

Characteristic	CDT (n = 31)	PMT (n = 30)	p
Age (y), mean \pm SD	64.48 \pm 15.7	66.97 \pm 18.9	0.354
Female sex, n (%)	14 (45.2)	12 (40)	0.684
BMI, mean \pm SD	26.3 \pm 2.2	26.1 \pm 2.6	0.577
Left side DVT, n (%)	15 (48.4)	17 (56.7)	0.517
Duration of symptoms, n (%)			
≤ 2 wk	27 (87.1)	20 (66.7)	
~ 3 wk	4 (12.9)	10 (33.3)	
Predisposing factors, n (%)			
Malignancy	2 (6.5)	7 (23.3)	0.063
Smoking	9 (29.0)	8 (26.7)	0.837
CVA	3 (9.7)	3 (10)	0.966
Immobilization	3 (9.7)	3 (10)	0.966
Hypertension	2 (6.5)	10 (33.3)	0.008
SLE	2 (6.5)	3 (10)	0.614
CAD	2 (6.5)	4 (13.3)	0.367
Dyslipidemia	1 (3.2)	3 (10)	0.285
Atrial fibrillation	4 (12.9)	2 (6.7)	0.414
Diabetes mellitus	5 (16.1)	1 (3.3)	0.093
Thrombophilia	5 (16.1)	8 (26.7)	0.315
Orthopedics surgery	7 (22.6)	6 (20)	0.757
Recent trauma	5 (16.1)	5 (16.7)	0.955
Oral contraceptive pill	8 (25.8)	6 (20)	0.590

Recent trauma was defined as trauma that occurred 14–30 days prior to the onset of DVT. Previous orthopedic surgery was defined as surgery experienced 30–90 days prior to the onset of DVT.

The scope for a classification of immobilization was 4–30 days prior to the onset of DVT. Thrombophilia was defined as documented biochemical hypercoagulable disorders, such as protein C or S deficiency and Factor V Leiden.

BMI = body mass index; CAD = coronary artery disease; CDT = catheter-directed thrombolysis; CVA = cerebral vascular accident; DVT = deep vein thrombosis; PMT = pharmacomechanical thrombectomy; SD = standard deviation; SLE = systemic lupus erythematosus.

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