Rheolytic Thrombectomy Using AngioJet ZelanteDVT Catheter or Solent Omni Catheter for Treatment of Patients with Proximal Vein Thrombosis

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Research

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Abstract

**Purpose** The present study aimed to investigate the preliminary safety and efficacy of rheolytic thrombectomy (RT) using AngioJet ZelanteDVT catheter or Solent Omni catheter for acute proximal deep vein thrombosis (DVT).

**Material and Methods** We conducted a retrospective review of 40 patients who treated by AngioJet RT divided into ZelanteDVT group (n=17) and Solent group (n=23) from January 2019 to January 2021. Data of demographics, clinical characteristic, technical success, clinical success, complications, and early follow-up were analysed.

**Results** No significant differences regarding demographics were detected (all \( p > .05 \)). The technical success rates were both 100%. ZelanteDVT group had a shorter duration time of RT and a higher primary RT success than those of Solent group (all \( p < .05 \)), and percentage of adjunctive CDT was 29.4% in ZelanteDVT group, significantly lower than that was 79.3% in Solent group \( (p = .010) \). The successful outcome for ZelanteDVT group and Solent group were 100% (17/17) and 95.7% (22/23), both high in the two groups \( (p > .05) \). Except for transient macroscopic hemoglobinuria occurred in all patients at the first 24 hours post-RT, none suffered other procedure-related adverse events or major complications in both groups. Minor complications presented as bleeding events occurred in 21.7% (5/23) patients of Solent group, and one (5.9%) patient in Zelante DVT group \( (p > .05) \). At 6-month, the frequency of PTS was 5.9% (1/17) in ZelanteDVT group compared with 17.4% (4/23) in Solent group \( (p > .05) \).

**Conclusion** Both catheters are safe and effective for the management of patients with proximal DVT, leading to improved clinical outcomes with low complication. Zelante-DVT catheter offered more powerful thrombectomy over Solent catheter, allowing for faster extraction of the DVT with shorter run time and lower adjunctive CDT.

Article Highlights

**Type of Research:** Single-center retrospective cohort study.

**Key Findings:** The main outcomes underlying different specifications of AngioJet catheters for proximal deep vein thrombosis (DVT) remain unclear. Commonly applied AngioJet catheters involve ZelanteDVT® catheter (8F) and Solent Omni® catheter (6F). Both catheters are safe and effective for the management of patients with proximal DVT, leading to improved clinical outcomes with low complication. ZelanteDVT catheter appears to offer more powerful thrombectomy over Solent catheter, allowing for faster extraction of the DVT with shorter run time and lower adjunctive thrombolysis.

**Take Home Message:** Both catheters are safe and effective for the management of patients with proximal DVT, leading to improved clinical outcomes with low complication. Zelante-DVT catheter offered
more powerful thrombectomy over Solent catheter, allowing for faster extraction of the DVT with shorter run time and lower adjunctive CDT.

Table of Contents Summary

This retrospective single-center study investigated the preliminary safety and efficacy of rheolytic thrombectomy (RT) using AngioJet ZelanteDVT catheter or Solent Omni catheter for 40 acute proximal deep vein thrombosis (DVT) patients. The study suggests that both catheters are safe and effective for the management of patients with proximal DVT, leading to improved clinical outcomes with low complication. ZelanteDVT catheter offered more powerful thrombectomy over Solent catheter, allowing for faster extraction of the DVT with shorter run time and lower adjunctive CDT.

Introduction

Acute proximal deep vein thrombosis (DVT), referred to the thrombosis emerges in the iliofemoral vein and/or popliteal vein with an incidence of 1/1000 in adults annually, has become the third most common vascular disease [1-3]. If without prompt treatment, it is at a high risk for developing its sequelae of pulmonary embolism (PE), as well can lead to substantial mortality. In recent years, many strategies have gained conversion and widely appealed towards the treatment of proximal DVT [2,3]. Traditionally, conservative therapies are mainly consisted of anticoagulation and compression stockings, however, approximately half of these patients develop venous dysfunction resulting in post-thrombotic syndrome (PTS) [1-4]. Gradually, a trend emergence of more aggressive endovascular therapies involved catheter-directed thrombolysis (CDT), percutaneous mechanical thrombectomy (PMT), percutaneous transluminal angioplasty (PTA), and stent placement have been widely applied, which is proven to achieve more superiority when compared to conservative anticoagulated therapy [2,3].

PMT using various devices for DVT have become a rapid option beside open surgical thrombectomy [2,3]. Mechanisms of thrombus removal mainly contain suction, rotation, rheolytic thrombectomy (RT), and ultrasound [1]. AngioJet device, presented as a main representative of RT, is based on a pharmacomechanical thrombectomy through active aspiration and pulsatile lytic delivery [1,5]. It can facilitate thrombus burden removal rapidly, decrease recurrence of DVT potentially, and reduce further severe PTS [2,3,5]. However, the main outcomes underlying different specifications of commonly applied AngioJet catheters remain obscured. More than half of the PEARL patients underwent single Solent® catheter experienced incomplete thrombus removal, adjunctive CDT was required. ZelanteDVT® catheter (8-French (F), Boston Scientific, Maple Grove, MN, USA) is a novel RT catheter, which is applied for DVT treatment over recent years [6,7]. However, relatively less published studies are known about the performance and complications between the two catheters.

The purpose of present study is to investigate the preliminary outcomes of AngioJet ZelanteDVT catheter compared to conventional Solent Omni catheter (6-F, Boston Scientific, Fremont, Calif, USA) in the
treatment of acute proximal DVT in terms of degree of venous thrombus removal, clinical outcomes, as well potential complications.

**Materials And Methods**

**Study design and Patients**

The Institutional Review Board of our hospital approved this retrospective single-center study and waived the requirement for written informed consent for the use of electronic medical records and imaging data. Informed consents were obtained for all participating patients prone to endovascular treatment before therapy. Before August 2019, the option of AngioJet ZelanteDVT catheter was not available at our country, Solent catheter was the exclusive catheter for choice to use; ZelanteDVT was preferred from August 2019 since it became available.

From January 2019 to January 2021, 40 consecutive patients (mean age 58.9±18.5 years; 65% female) with proximal DVT involving popliteal, femoral, common femoral, and/or iliac veins (with or without other involved ipsilateral veins) underwent AngioJet RT using ZelanteDVT catheter (ZelanteDVT group) or Solent catheter (Solent group) were derived. RT was performed by two senior endovascular operators with >10 years of extensive experience in endovascular therapy in both groups. All patients were treated by the RT with the same type of AngioJet pump unit (Boston Scientific, Fremont, Calif, USA). Patients were included in this study if they met the following inclusion criteria: diagnosed with acute phase (had symptom onset <14 days) and with at least 180 days of follow-up; experienced proximal DVT; under-went ZelanteDVT or Solent catheter. The exclusion criteria for included patients were age <18 years, or estimated life expectancy <3 months.

**Management Strategies**

The initial diagnosis of proximal DVT in each treatment group was verified by medical history, physical examination, and then was objectively confirmed by compression ultrasound, if inconclusive, by supplementary venography. When DVT was identified, management strategies were instantly performed. The option of AngioJet ZelanteDVT catheter or Solent catheter was left to the discretion of the group of endovascular operators flexibly depending mainly on the available condition of catheters and clinical experience.

**AngioJet RT reperfusion:** Following popliteal access (required with use of ultrasound guidance) or femoral access with a 10-F sheath under the local anesthesia and strict sterile technique, RT using ZelanteDVT catheter or Solent catheter was performed for pharmacomechanical thrombus fragmentation, suction or aspiration. Briefly, first, advancing the RT catheter slowly through the thrombotic segment (only submerged in vessel diameter estimated >6 millimeter (mm)). For patients without contraindications of thrombolysis, then, 3mg of rt-PA [total injected volume 50 milliliters (ml)] was intraclot injected under the Power Pulse® model. Waiting 20 minutes dwell time, with the pump unit active during slow catheter passages (3 mm/s to 5 mm/s) round trip across the thrombotic segment in a
distal-to-proximal or adverse direction under fluoroscopic guidance. Each device activation run lasted at less than 20 seconds with breaks of 30 seconds in between the runs to avoid arrhythmia, the total run times were monitored and kept no more than 240 seconds.

**Adjunctive with reduced-dose CDT:** If residual thrombus (defined as absence of flow or thrombus removal grade ≤ I) was present, as well not meeting the exclusion criterion of thrombolytic contraindications, a continuous infusion of reduced-dose recombinant tissue plasminogen activator (rt-PA) (Alteplase; Boehringer-Ingelheim, Ingelheim am Rhein, Germany) was delivered subsequently via a multi-side hole catheter (Uni*Fuse, AngioDynamics, Boston Scientific, USA) embedding into the thrombus. Thrombolytic therapy was that 17 mg/20 mg alteplase was administered at an infusion rate of 0.01 mg/kg per hour following CDT; the maximum rate was no more than 1.0 mg/h and the total doses were less than 50 mg, as noted elsewhere [8]. CDT was discontinued when at least 80% clot lysis with restoration of flow or when a serious complication. Alteplase was administered only when the fibrinogen level >1.0 g/L.

**Other comprehensive therapy:** A temporary filter was inserted via the non-affected femoral or jugular vein into the inferior vena cava (IVC) prior to next procedure for patients with an extensive thrombus in the proximal vein that evaluated as potentially life-threatening, and was retrieved after the proximal DVT was removed and potentially life-threatening condition were relieved. In accordance with local routines that based on published guidelines [9], anticoagulant treatment was initiated immediately when DVT was identified, with the use of subcutaneous low molecular weight heparin (LM WH) at a bolus dose of 100 units/kg twice daily. PTA and/or stent placement was encouraged for lesions that were causing 50% or greater diameter narrowing of the iliac and/or common femoral vein, robust collateral filling, and/or a mean pressure gradient of more than 2 mmHg. At the end of LMWH, oral rivaroxaban was directly commenced at a dosage of 15 mg twice a day over the subsequent 21 days and 20 mg once a day thereafter for at least 6 months. In addition, the use of compression stockings (ankle pressure was approximately 30-40 mmHg) for more than one year was recommended.

**Outcomes and Safety**

The primary outcome was defined as the success of thrombus removal, two experienced interventional physicians independently calculated the thrombus score degree through preprocedural, at completion of RT and/or post-CDT venography imaging, evaluated as grade III (100% lysis with no residual clots), grade II (50%-99% lysis), and grade I (<50% lysis). Thrombus removal grades II and III (i.e., ≥ 50%) were considered as a successful outcome [10]. Technical success was defined as the successful use of AngioJet RT. The primary RT success was classified based on preprocedural and at completion of RT thrombus scores evaluated as grade II and grade III. The secondary success was classified based on preprocedural and at the end of adjunctive CDT thrombus scores evaluated as grade II and grade III. The requirement of necessary adjunctive PTA and/or stent placement to treat coexisting stenosis to obtain sufficient flow within the same hospital stay was recorded but not considered failure.

The safety outcomes were consisted of procedure-related and CDT-related complications. The former included the vessel perforation or damage (such as an extravasation or retention of contrast agent in the
vessel wall), bradycardia, arrhythmias or acute kidney injury (AKI). With adherence to the Society of Interventional Radiology (SIR) [11], the latter were divided into major CDT-related complications, defined as intracranial bleeding or bleeding severe enough to result in death, surgery, cessation of therapy, or blood transfusion; and minor complications, defined as less severe bleeding manageable with local compression, sheath upsizing, and/or alterations of thrombolytic agent dose, anticoagulant dose [11]. The SIR classification of complications was listed in Supplementary Table.

**Follow-up**

The data on the resolution of symptoms were evaluated at 6-month follow-up via re-examination or telephone by Villalta PTS Scale [12] on a 4-point scale (0=none, 1=mild, 2=moderate, 3= severe). Short-term outcomes were defined as data of 6 months follow-up including recurrent DVT, hospital readmission, or death.

**Statistical analysis**

The SPSS statistical software package (version 23.0; SPSS statistical software, Chicago, Illinois, USA) was used to perform all statistical analyses in this study. Continuous variables are expressed as the mean ± standard deviation. t-tests were used to assess the correlation between preprocedural and postprocedural variables and between groups. Qualitative variables are presented as numbers and percentages. The significance of qualitative variables was tested with a Fisher’s exact test. Findings with a p value less than 0.05 were deemed statistically significant.

**Results**

**Baseline demographics and clinical characteristics**

A total of 40 patients were included in this study, with 17 patients in ZelanteDVT group and 23 patients in Solent group. Demographics and characteristics of these 40 patients are summarized in Table I. No significant differences regarding age, gender, onset time, limb characteristic, and risk factors were detected between the two groups (all p >.05).

**Procedure details and outcomes**

The use of antithrombotic and compression treatments had not significant differences (p >.05). All 40 patients underwent AngioJet RT successfully, the technical success rates were both 100%. All patients in the two groups received recoverable IVC filters prior to RT treatment, and all filters were successfully retrieved after the proximal thrombus was proven to have been removed and the potentially life-threatening condition was relieved. The intraoperative procedures and treatment details are shown in Table II.

There was no significant difference of mean procedural time between the two groups (1.61±.15 h vs. 1.72±.22 h; p >.05), but ZelanteDVT group had a shorter RT duration time (47.65±14.37 s vs. 73.91±18.52
As calculated, the thrombus scores pre-RT in ZelanteDVT group and Solent group were similar (9.65±2.15 vs. 9.57±1.90; p >.05). After RT procedure, the thrombus scores of ZelanteDVT group had significant decrease (9.65±2.15 vs. 2.71±2.64; p <.05). The ZelanteDVT group seemed to have a higher primary RT success than that of the Solent group. The percentage of patients who had adjunctive CDT was significantly lower in ZelanteDVT group than that in Solent group (29.4% vs. 79.3%; p =.010). Total adjunctive CDT time and agent dosages were no significant difference (all p >.05). The ultimately thrombus scores at the end of adjunctive CDT in two groups were similar (2.00±1.40 vs. 1.65± 1.46; p >.05). ZelanteDVT group had a shorter hospitalization time than that of Solent group (7.99±2.09 d vs. 9.91±3.00 d; p =.030).

At complete, 64.7% (11/17) patients underwent PTA in ZelanteDVT group, and 56.5% (13/23) patients in Solent group. The stents used in ZelanteDVT group of 35.3% (6/17) seemed to have a slightly higher than that in Solent group of 17.4% (4/23), but without significant difference (p >.05). At the time of discharge, the successful outcome for the ZelanteDVT group was 100% (17/17) and for the Solent group was 95.7% (22/23), were both high in the two groups; the difference was not statistically significant (p >.05). At 6-month, the frequency of PTS was 5.9% (1/17) in ZelanteDVT group compared with 17.4% (4/23) in Solent group, all patients presented with mild PTS, none was detected moderate or severe PTS.

Complications

Except for transient macroscopic hemoglobinuria occurred at the first 24 hours post-RT in all patients (40/40), no other procedural-related adverse events including arrhythmia, symptomatic/fatal PE, and AKI were recorded in both groups. The indexes of creatinine clearance rate and blood urea nitrogen in ZelanteDVT group (69.9±27.1 μmol/L and 5.0±1.9 mmol/L) were slightly higher than those in Solent group (68.2±20.7 μmol/L and 4.5±2.0 mmol/L) conversely, but without statistically significant (both p >.05). There were no major adjunctive CDT-related complications occurred in both groups (rates of major complications including SIR C, D, E, and F categories were all 0%). In Solent group, minor complications presented as bleeding events (SIR B category) occurred in 21.7% (5/23) patients, including two of small hematoma at the access site, two of superficial ecchymosis, one of epistaxis, 5.9% (1/17) patient with superficial hematoma (SIR B category) was recorded in Zelante DVT group, difference was not statistically significant (p >.05). All recovered with conservative treatment, and no life-threatening bleeding events, recurrent DVT, or 30-day death were observed.

Discussion

Dopheide et al. [6] firstly reported the utility of Zelante DVT catheter for the treatment of proximal DVT. This novel RT catheter of ZelanteDVT has been updated designed compared to Solent catheter with the features as follows: a) an 8-F larger catheter lumen instead of a 6-F lumen, b) modified structure at the treatment segment with one larger proximal suction window and one smaller distal outflow window, and c) a rotational hub to accomplish directional thrombus removal [6,7]. Although two AngioJet models using different catheters work from the same mechanistic platform, whether this novel catheter of
ZelanteDVT has an improvement of the critical points such as safety and competitive catheter performance when compared to Solent in clinical practice remains obscure, owing to an absence of comparation between [2]. Better knowledge of these catheter characteristics might lead to optimize a differentiated selection, and therefore to a reduction of complications and an improved long-term venous patency.

The present study found that the ZelanteDVT group had a significantly lower rate (29.4%) of adjunctive CDT when compared to the Solent group, in which 73.9% of the patients treated by Solent catheter required adjunctive CDT to restore venous patency. The observed higher primary RT success without the need for prolonged adjunctive CDT may likely be attributed to that this novel catheter provides a stronger biological suction effect (-600 mmHg) and a large lumen at the tip of catheter, which has been previously proven in the study published by Kwon et al. [13], reported more effective remodeling of a large thrombus due to the more powerful negative pressure. The reduced requirement for sequential CDT findings as well indicated that ZelanteDVT seems to has shorter hospitalization time, lower total dose of rt-PA, and reduced incidence of bleeding complications, although the latter two did not differ significantly in present study.

Pharmacomechanical catheter-directed thrombolysis (PCDT) with Solent catheter in the treatment of proximal DVT led to an apparent efficacy [3,5]. Few RCT studies, such as ATTRACT trial found Solent PCDT strategy to provide >50% thrombus removal in 96% of treated patients [3], which was consistent with that reported by the multicenter PEARL trial [5]. As well, a relatively high >50% thrombus removal result was also found as did in the use of the ZelanteDVT in Dopheide et al. [8] study. However, studies mentioned above were limited to without comparation between provided catheters. Our present work showed that although the ultimately >50% thrombus removal rates were indifferent for both catheters, the stand-alone use of ZelanteDVT catheter was detected with a pronounced rate of primary RT success than Solent catheter, which suggests that ZelanteDVT seemed to has an advantage in rapidly and efficiently restoring proximal vein patency. During the early follow-up period of 6 months, only one of these patients developed PTS, which might be consistent with the recently experimental study [14], demonstrated that the benefits of restoration of blood flow are time-sensitive. In particular, earlier restoration of blood flow reduces thrombus burden, vein wall fibrosis will reduce the clinical incidents of PTS. Herein, we speculated that it may achieved a promising long-term efficacy. However, the present study was limited to translate early efficacy into later benefits.

A range of adverse events were plausibly associated with the use of AngioJet [2-4]. In PEARL trail, AngioJet-related events, such as PE, renal failure, low hemoglobin, and bradycardia were recorded [5]. In this study, except for transient macroscopic hemoglobinuria in both groups at the first 24 hours post-intervention, no other side effects of bradycardia and low hemoglobin were recorded. AKI is a well-known complication of RT, probably due to hemolysis caused by the high-pressure saline jets of the RT system as well as the nephrotoxic contrast agents used for venography [2]. According to the mechanism of AngioJet RT, ZelanteDVT catheter posing a stronger suction effect seems to has a higher potential risk of AKI. However, patients in present study with previous existing severe renal dysfunction were excluded and
there were limits on RT activation time, aspiration volume, and pre-procedure hydration, the indexes of kidney function showed did not differ significantly. The hemorrhagic complications were likely associated with rt-PA and anticoagulation treatments [2]. PCDT in ATTRACT was less frequent than in other large CDT studies, perhaps due to the reduced rt-PA dose and infusion times [2-4]. As did in present study, due to a lesser use of adjunctive CDT, ZelanteDVT catheter reduced the risk of bleed complication when compared to Solent catheter. If future refinements can enable stand-alone AngioJet RT to be achieved more often, safety might be further enhanced.

It remains controversial for patients undergoing PMT or CDT to employ IVC filter routinely. Lee et al. [15] demonstrated that the filter should be considered for preventing PE related morbidity. The incidence of symptomatic and fatal PE in patients underwent stand-alone CDT treatment were (0-1.3) % and (0-0.2) % [2-5], but the rates increased when endovascular procedures were taken [2-4, 16]. Hence, mechanical endovascular procedure seems to increase the risk of PE events, which may be likely associated with multiple risk factors, such as non-blocking iliac vein, massive proximal floating thrombus, and invasive endovascular procedure. In present study, all patients underwent IVC filters inserted routinely, as a result, some filling defects into the filters were observed during repeat venography, and disappeared after thrombolysis. No PE related events were recorded during procedure and adjunctive CDT. Iliac vein stenosis was one of the anatomical factors for DVT [2], in order to decrease distal venous hypertension, relieve clinical symptoms, prevent DVT recurrence, and improve the prognosis, 64.7% patients were exposed segmental (>50 %) residual stenosis at the end of ZelanteDVT procedure with successful thrombus removal and sufficient restored blood inflow, this outflow obstruction was resolved by one-stage PTA and/or following stent placement, which were conducted after CDT in 56.5% patients underwent Solent catheter. The use of stent placement in ZelanteDVT group were slightly higher than that in Solent group, which was associated with a slight high thrombus removal, ensuring sufficient blood inflow passages, and creating a condition for stents placement.

Our study had several limitations. First, the present study used a fixed-length catheter (105 cm of ZelanteDVT and 120 cm of Solent Omni) designed for AngioJet RT, thus, whether the length would affect the RT technique as well was difficult to evaluate. The diameters of deep veins may also affect the results, which should be identified in the future study. Second, different grades except 6F and 8F of catheters were not used, as other diameters were not available at the time. Third, utility of different catheters was not random but was mainly based on the available condition of catheters and clinical experience at our center in different phases, which may have an impact of selected biased on the evaluation of the outcomes of each catheter. Fourth, limited to an early follow-up period of 6-month, and the available long-term outcomes remained to be recorded at 1 years. Fifth, the classifications of complications were not completely strict to the standard of SIR, because nearly all complications occurred during hospitalization, we categorized them mainly on which therapy was required and the prognosis. More-over, the present study was a single-center, retrospective, nonrandomized controlled study; conclusions of the present study were limited as a result of the small numbers of cases and should be interpreted with caution. In the future, a prospective, randomized controlled study with longer follow-up period overcome these limitations will be needed to further confirm the conclusions.
Conclusion

The present study found that both catheters are safe and effective for management of patients with proximal DVT, leading to improved outcomes with a low complication rate. ZelanteDVT catheter offered more powerful thrombectomy over the previous Solent catheter, allowing for faster extraction of the DVT with shorter run time, lower adjunctive CDT, higher primary thrombus removal, and shorter hospitalization time. It seems to be a more purpose-built catheter allows for greater ease in extraction of proximal vein thrombus.

Declarations

Not applicable.

Ethical approval and consent to participate

The study protocol was reviewed and approved by the institutional review board (IRB) of the Nanjing First Hospital, Nanjing Medical University (Nanjing, China). In addition, the study was performed in accordance with the Declaration of Helsinki and the Ethical Guidelines for Clinical Studies.

Consent to publish

Not applicable

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available, as the experimental data are related to other experiments that are progressing but are available from the corresponding author upon reasonable request.

Competing interests

The authors of this manuscript declare no relationships with any companies whose products or services may be related to the subject matter of the article. The content of the manuscript is original, and it has not been published or accepted for publication. Funding

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Authors’ contributions

MFG contributed to this project development, manuscript writing/editing. GQF, ZLL contributed to data collection, manuscript associated editing. YYZ and JK contributed to data analysis. BXZ, WSL and JPG contributed to manuscript editing. XH contributed to project development, manuscript editing. All authors contributed to the article and approved the submitted version.
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### Tables

Table I. Demographics, Presentation, Lesion Characteristics, and Risk Factors of DVT Patients.
| Characteristic                      | ZelanteDVT Group (n=17) | Solent Group (n=23) |
|------------------------------------|------------------------|---------------------|
| Age, years, mean ± SD              | 55.4±21.5              | 60.4±15.4           |
| Female, gender, n (%)              | 10 (58.8)              | 16 (69.6)           |
| Onset of Symptoms at presentation, n (%) |                       |                     |
| ≤ 7 days                           | 11 (64.7)              | 16 (69.6)           |
| ≥ 7 days and ≤14 days              | 6 (35.3)               | 7 (30.4)            |
| Thrombus Segment                   |                        |                     |
| Isolated iliofemoral DVT           | 11 (64.7)              | 15 (65.2)           |
| With popliteal/calf DVT            | 6 (35.3)               | 8 (34.8)            |
| Thrombus Limbs                     |                        |                     |
| Left                               | 9 (52.9)               | 16 (69.6)           |
| Right                              | 8 (47.1)               | 7 (30.4)            |
| Bilateral                          | 0 (0)                  | 0 (0)               |
| Risk Factors, n, (%)               |                        |                     |
| Major surgery history              | 3 (17.6)               | 5 (21.7)            |
| Immobilization                     | 2 (11.8)               | 3 (13.0)            |
| Hospitalization                    | 2 (11.8)               | 4 (17.4)            |
| Recent trauma                      | 4 (23.5)               | 3 (13.0)            |
| May-Thurner syndrome               | 1 (5.9)                | 4 (17.4)            |
| Childbirth                         | 1 (5.9)                | 1 (4.3)             |
| Malignant disease history          | 1 (5.9)                | 3 (13.0)            |
| Autoimmune diseases                | 1 (5.9)                | 2 (8.7)             |
| Previous DVT or PE                 | 4 (23.5)               | 3 (13.0)            |
| Family history of venous thromboembolism | 1 (5.9)              | 2 (8.7)             |
| Unknown factors                    | 4 (23.5)               | 4 (17.4)            |

DVT=Deep vein thrombosis; PE= Pulmonary embolism

Continuous data are presented as the means ± standard deviations; categorical data are given as the counts (percentage).
Table II. Procedure Characteristics by Treatment Catheters and Outcomes

| Procedure Characteristics by Treatment Catheters and Outcomes |  
|---------------------------------------------------------------|

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| Characteristics                                                                 | ZelanteDVT Group (n=17) | Solent Group (n=23) | p-value |
|---------------------------------------------------------------------------------|-------------------------|---------------------|---------|
| Success of thrombus removal, n (%)                                              |                         |                     |         |
| With RT intervention only                                                       | 12 (70.6)               | 6 (26.1)            | .010    |
| Including adjuvant CDT                                                          | 17 (100)                | 22 (95.7)           | 1.000*  |
| Adjuvant other endovascular methods, n (%)                                      |                         |                     |         |
| Balloon angioplasty                                                             | 11 (64.7)               | 13 (56.5)           | .747    |
| Stent placement                                                                 | 6 (35.3)                | 4 (17.4)            | .274    |
| Duration of operation procedure, (h, mean ± SD)                                 | 1.61±.15                | 1.72±.22            | .086    |
| RT procedure                                                                    |                         |                     |         |
| Patients used PP model, n (%)                                                   | 14 (87.5)               | 20 (86.9)           | 1.000   |
| Mean RT duration time, (s, mean ± SD)                                          | 47.65±14.37             | 73.91±18.52         | .000    |
| Adjuvant CDT procedure                                                          |                         |                     |         |
| Mean duration time, d                                                           | 2.00±1.22               | 3.00±1.27           | .136    |
| rt-PA dose, mg                                                                  | 18.20±11.10             | 27.35±12.19         | .149    |
| Thrombus scores-Venograms                                                       |                         |                     |         |
| Pre-RT                                                                          | 9.65±2.15               | 9.57±1.90           | .899    |
| RT-completion                                                                   | 2.71±2.64               | 4.35±2.31           | .043    |
| CDT-completion                                                                  | 2.00±1.40               | 1.65±1.46           | .637    |
| Clinical success outcome, n (%)                                                 |                         |                     |         |
| Grade I                                                                         | 0 (0)                   | 1 (4.3)             | 1.000   |
| Grade II                                                                        | 10 (58.8)               | 13 (56.5)           | 1.000   |
| Grade III                                                                       | 7 (41.2)                | 9 (39.1)            | 1.000   |
| Complications, n (%)                                                            |                         |                     |         |
| Minor (SIR A, B: nominal or no therapy, no consequence)                         | 1 (5.9)                 | 5 (21.7)            | .216    |
| Major (SIR C, D, E: requires therapy or permanent sequelae)                    | 0 (0)                   | 0 (0)               | -       |
| Major-death (SIR F: death)                                                      | 0 (0)                   | 0 (0)               | -       |
| Procedure-related PE, n (%)                                                     | 0 (0)                   | 0 (0)               | -       |
| In-hospital length of stay, d                                                   | 7.99±2.09               | 9.91±3.00           | .030    |
PTS at 6-month follow-up, n (%)  

|          |       |       |       |
|----------|-------|-------|-------|
|          | 1 (5.9) | 4 (17.4) | .546 |

DVT=Deep vein thrombosis; CDT=Catheter-directed thrombolysis; RT=Rheolytic thrombectomy; PP=Power pulse

Continuous data are presented as the means ± standard deviations; categorical data are given as the counts (percentages).

**Supplementary Files**

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