

Endovascular Treatment of Post-thrombotic Venous Ilio-Femoral Occlusions: Prognostic Value of Venous Lesions Caudal to the Common Femoral Vein

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Abstract

Objectives To propose a scale of severity for post-thrombotic venous lesions (PTVLs) after ilio-femoral deep venous thrombosis and to compare the grade with the results of endovascular treatment of ilio-femoral PTVLs.

Methods In this retrospective monocentric observational study, we included 95 patients treated for ilio-femoral PTVLs. We proposed a four-grade scale evaluating the severity of PTVLs caudal to the common femoral vein based on CT phlebography and per-operative phlebography. For most patients, venous patency was assessed with color duplex ultrasonography and the clinical efficacy of the intervention using the Villalta and CIVIQ scores.

Results Recanalization was successful in 100% of patients with a morbidity rate of 4%. After a mean follow-up of 21 months, the overall primary patency was 75%, the assisted primary patency 82%, and the secondary patency 93%. Secondary patency was 100% for grade 0–1, 90% for grade 2, and 63% for grade 3 ($p < 0.002$). There was no correlation between the extension of stenting caudally of

the common femoral vein and venous patency. The mean improvements in the Villalta and CIVIQ-20 scores were, respectively, 4.6 ($p < 0.0001$) and 18 ($p < 0.0001$); scores were not correlated with the grade of PTVLs in the thigh. **Conclusion** Venous patency after endovascular treatment of ilio-femoral PTVLs was strongly linked to the severity of PTVLs caudal to the common femoral vein but not to the extent of stenting.

Keywords Deep venous thrombosis · Post-thrombotic syndrome · Inferior vena cava · Iliac vein · Stent

Introduction

Acute ilio-femoral deep vein thromboses have a low rate ($< 20\%$) of spontaneous recanalization [1]. In two-thirds of patients, the residual venous obstruction is associated with a poorly developed collateral pathway [2] that is responsible for insufficient venous flow and increased venous pressure [3, 4]. Extensive thrombosis of the ilio-femoral veins accounts for the high ($> 50\%$) 2-year incidence of post-thrombotic syndrome (PTS) [5, 6], reaching 55% in the control group of the CaVenT study despite optimal medical treatment [7]. Severe forms of PTS can induce venous claudication and trophic disorders [8]. PTS worsens patients' quality of life [9] and leads to a significant economic burden [10].

Numerous uncontrolled case series have reported the efficacy of endovascular treatment (EVT) for PTS [9, 11–19], and this intervention is more and more frequently performed. According to a systematic review by Seager and colleagues, the stent patency varies from 32 to

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98.7% for primary patency and 66 to 96% for secondary patency [20]. The variability in these results between one series and another is mainly related to a mix of post-thrombotic (PTVLs) and non-thrombotic iliac vein lesions (NIVLs) in the cohorts studied, but obviously also due to the severity and extent of PTVLs. Several authors [15, 21, 22] have reported that the extension of stenting across the inguinal ligament leads to a lower patency rate compared to stenting above this ligament. However, to our knowledge there is no study that has analyzed the relationship between the extent and severity of PTVLs caudal to the common femoral vein (CFV) and the hemodynamic and clinical results of EVT.

We report our experience of EVT of chronic PTVLs of the lower limbs. We propose a scale to grade the severity of PTVLs caudal to the CFV prior to EVT, and then we compare our hemodynamic and clinical outcomes with the grades of the lesions.

Materials and Methods

Inclusion Criteria

This study was a retrospective analysis of the management of PTS in a large tertiary care teaching hospital. All patients received detailed information about the intervention, and their informed consent was recorded. Study ethics approval was obtained on February 2018 (CECIC Rhône-Alpes-Auvergne, IRB 5891).

We included consecutive patients presenting PTVLs at least 6 months after treatment for acute caval or ilio-femoral deep venous thrombosis. Patients who presented NIVLs, venous occlusions on dialysis catheters, PTVL not affecting the ilio-femoral veins, and those with ongoing cancer, severe comorbidities, or less than 2 years life expectancy were not treated and/or not included.

Pre-EVT Assessment

Clinical symptoms were quantified using the Villalta score, and quality of life using the chronic venous insufficiency quality of life (CIVIQ-20) questionnaire [23].

The preoperative investigation systematically included a color duplex ultrasonography (CDUS) of the lower limb veins and a CT or MR phlebography with bilateral pedal injection of low concentration contrast media.

The aim of this morphological evaluation was to obtain a map of PTVLs, to search for anatomic abnormalities, to analyze the collateral venous pathways, and to search for deep and/or superficial venous valve reflux.

For PTVLs caudal to the CFV, their extension into the thigh was graded using the diameter of the veins, presence

of synechia inside the veins, and possibility for stenting with an expected good flow in the stents:

- Grade 0 (no PTVLs in the thigh): both femoral vein (FV) and deep FV (DFV) caudal to the CFV are normal.
- Grade 1 (minor PTVLs in the thigh): possibility for stenting a FV or DFV of ≥ 10 mm in diameter (Figs. 1A, 2A–C) or at the convergence of FV and DFV of 6–9 mm in diameter, with no or minimally obstructive lesions.
- Grade 2 (significant PTVLs in the thigh): capability to stent a FV or DFV of ≥ 10 mm in diameter or at the convergence of two veins (FV, DFV, or great saphenous vein [GSV]) but with highly obstructive venous lesions (Fig. 1B); or capability to stent only one vein of 6–9 mm in diameter (FV, DFV, or GSV) with no or only minor obstructive caudal venous lesions (Figs. 1C, 3A–D).
- Grade 3 (major PTVLs in the thigh): no normal vein ≥ 5 mm in diameter (FV, DFV, or GSV) that can be stented; or capability to stent only one vein of 6–8 mm in diameter, but with highly obstructive venous lesions (Figs. 1D, 4).

This grading of PTVL was established consensually by the two interventional radiologists, on the basis of preoperative CT phlebography and intra-operative phlebography.

Venous Recanalization

The intervention was realized in an interventional radiology unit with deep analgesic sedation during angioplasty and stenting. The recanalization was routinely performed using a right internal jugular approach ($n = 73$, 76%), and less frequently through femoral, great saphenous, or popliteal vein routes (Table 1). Introducer sheaths were 7–10 French in diameter and 10–80 cm in length.

PTVLs were crossed with a stiff hydrophilic guidewire, with an angled or straight tip (Terumo, Tokyo, Japan). For difficult-to-cross lesions, various devices were used, most often an Approach CTO[®] stiff recanalization guidewire (Cook, Bloomington, USA) and Trailblazer[®] (Covidien, Minnesota, USA) or Cxi[®] (Cook, Bloomington, USA) support catheters.

Once the occlusion was crossed, a bolus of 50 UI/kg of unfractionated heparin was injected and then progressive pre-dilation was done, up to 10–14 mm for ilio-femoral veins and 14–20 mm for the inferior vena cava (IVC).

Then, a phlebographic image was obtained to define the lower and upper extremities of the channel to be stented. We used mainly open-cell Cook Zilver[®] (Cook, Bloomington, USA) and Optimed Sinus Flex XL[®] (Optimed, Ettlingen, Germany) stents. In the few cases of residual

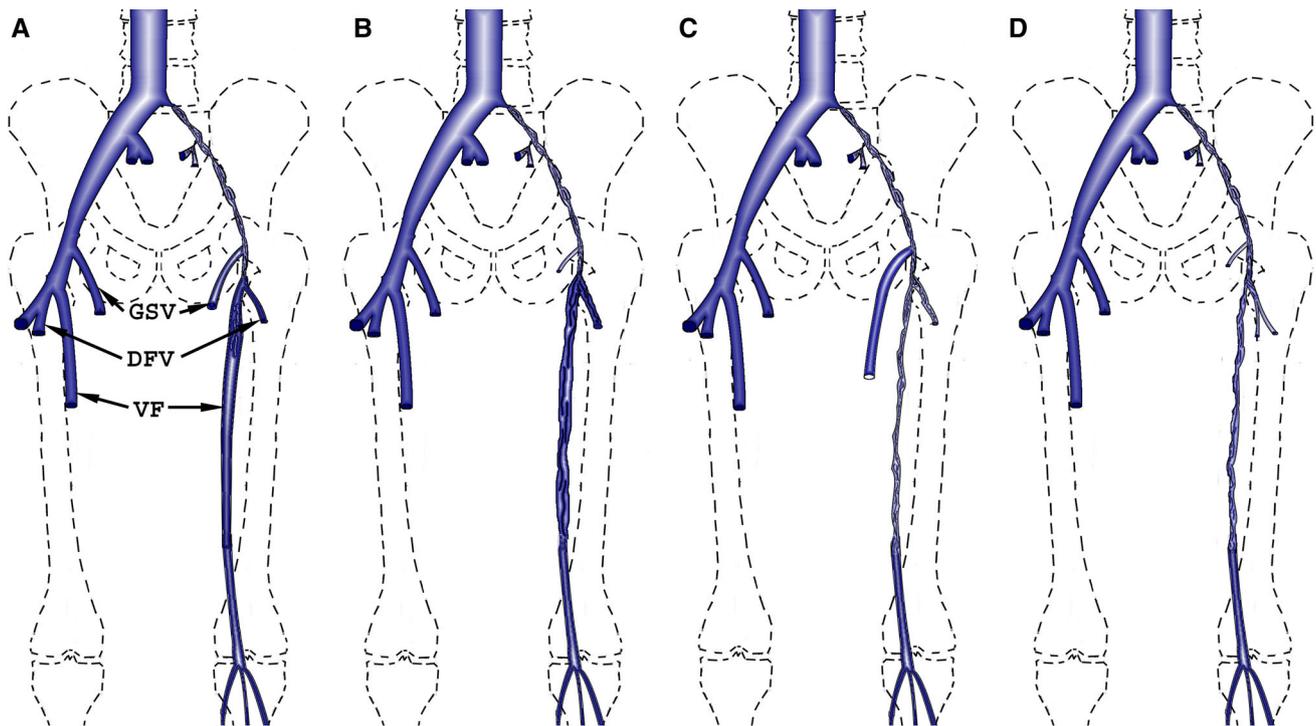


Fig. 1 Illustration of the grading of PTVLs in the thigh. **A** Grade 1 with one femoral vein ≥ 10 mm in diameter with obstructive lesions limited to the upper third of the vein. **B** Grade 2 with the femoral vein (FV) and deep femoral vein (DFV) of 6–9 mm in diameter with obstructive

lesions. **C** Grade 2 with two occluded and atretic femoral veins but an enlarged great saphenous vein (GSV). **D** Grade 3 with all main veins occluded and atretic. Only two tributaries of the deep femoral vein and the GSV are patent, and these are less than 5 mm in diameter

compression or stent plication, a Wallstent[®] (Boston Scientific Corporation, Marlborough, USA) was required ($n = 8$) to reinforce nitinol stents.

The technical result was considered satisfactory when the phlebographic control showed rapid intra-stent flow and the disappearance of the collateral drainage, without accumulation of the contrast agent.

Medical Treatment and Follow-Up

Once the patient returned in the care unit, an injection of LMWH or fondaparinux was administered and he/she was prompted to walk as soon as possible. Class 2 or 3 venous compression stockings were systematic. For patients with reduced mobility or in the case of low venous flow after recanalization, an intermittent pneumatic compression device was used the following night.

After patient discharge, for the first month anticoagulation treatment included antiplatelet treatment (aspirin 75–100 mg daily) and an oral anticoagulant [warfarin or direct oral anticoagulant (Apixaban[®], Rivaroxaban[®])]. Oral anticoagulation was prescribed for 3–6 months post-interventional treatment.

Patients were monitored clinically and with a CDUS at day 1, months 1 and 6, years 1, 3, and 5. The Villalta and CIVIQ-20 scores were obtained at every follow-up visit

from the sixth postoperative month onwards. If necessary, a CT phlebography was scheduled, typically for complex stent reconstructions and in the event of unsatisfactory clinical and/or hemodynamic evolution.

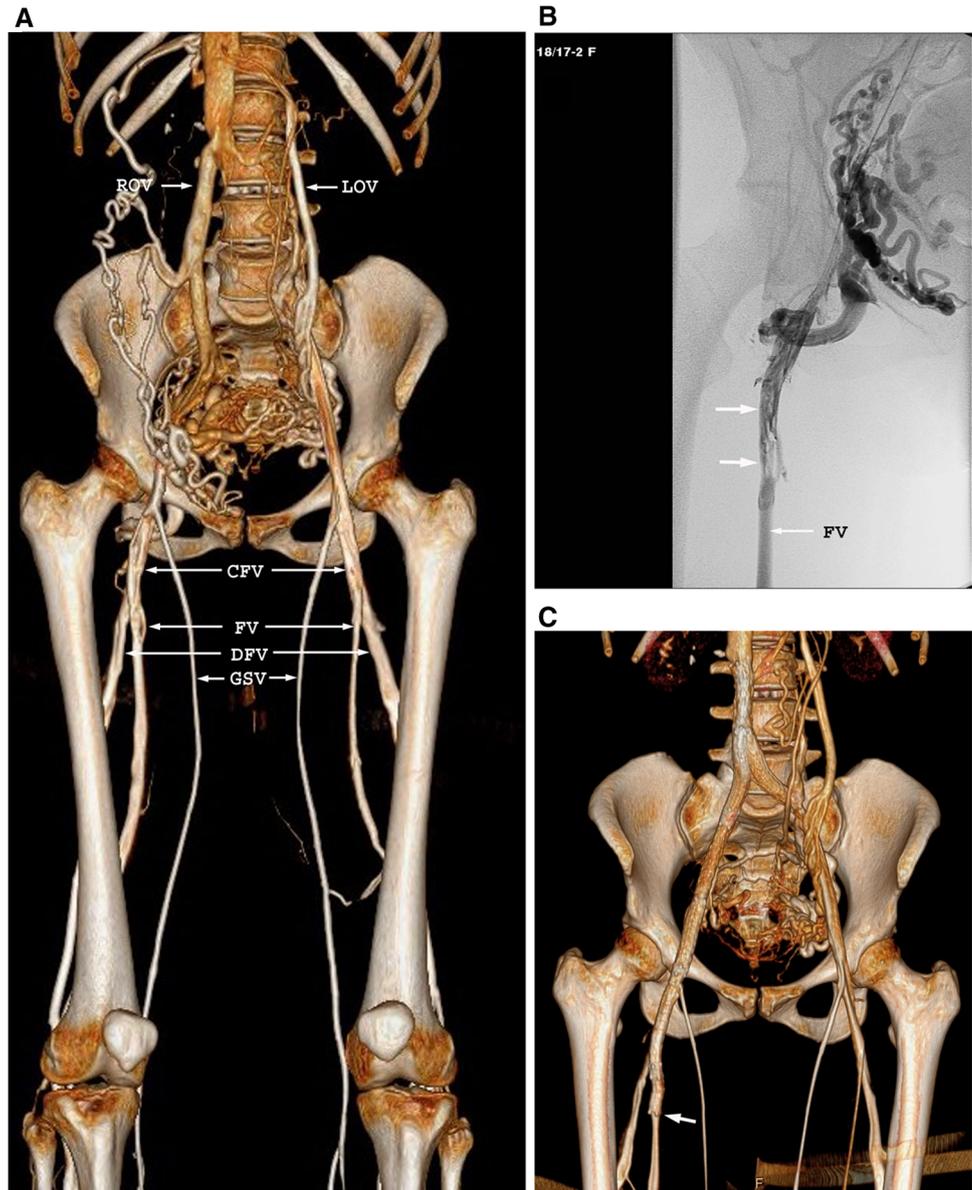
Statistical Analysis

Technical success, primary and secondary patency, clinical results, and complications were reported according to the CIRSE standards of practice guidelines [24]. The goal of the treatment was to restore venous patency, and this was assessed at follow-up on CDUS criteria. Treatment failure was defined as re-occlusion of the treated venous segments.

An overall description of the population was made (Table 1), giving frequencies of different categories of qualitative variables. Quantitative data are reported with mean and standard deviation.

Comparisons of the means were tested with the Mann–Whitney test for binary variables, and comparison of two measures for quantitative variables for the same patients was realized with the Wilcoxon test. Survival curves are shown as Kaplan–Meier analysis and tested with Cox model analysis. The threshold for statistical significance was conventionally set at 5%. Statistical data were analyzed using the Statview software package, version 5.0

Fig. 2 Grade 1 PTVLs. A thirty-six-year-old woman who 5 years previously presented with deep venous thrombosis of both legs and of the inferior vena cava. **A** 3D CT phlebography before treatment: occlusion of the infra-renal inferior vena cava (IVC), the left common iliac vein (CIV), and the right iliac vein. The right common femoral vein (CFV) and the upper parts of the femoral vein (FV) and deep femoral vein (DFV) are patent but with an irregular shape due to intra-luminal synechia. The right and left ovarian veins (ROV and LOV) are enlarged, draining the venous flow into the suprarenal IVC. The femoral vein is ≥ 10 mm, free of synechia and thus suitable for restoring venous drainage. **B** Per-operative venography showing multiple intra-luminal synechia limited to the top quarter of the FV (arrows). **C** Postoperative CT phlebography showing the stents with the inferior edge of the stents in the upper part of the right FV (arrow). Disappearance of the right collaterals, but persistence of the left collaterals (i.e., the LOV) due to occlusion of the stent in the left ICV. At 6-year follow-up the stenting is patent



(SAS Institute Ins Cary NC), and IBM SPSS version 25 for the survival analysis.

Results

Study Cohort

From 2010 to 2015, 95 patients were treated by EVT in our hospital for chronic PTVL of the lower limbs. Their demographic characteristics are given in Table 1.

All patients were treated for PTS, except 4 who were asymptomatic. These 4 patients were treated to restore venous access before treatment of: cardiac arrhythmia ($n = 1$), percutaneous pulmonary valve implantation

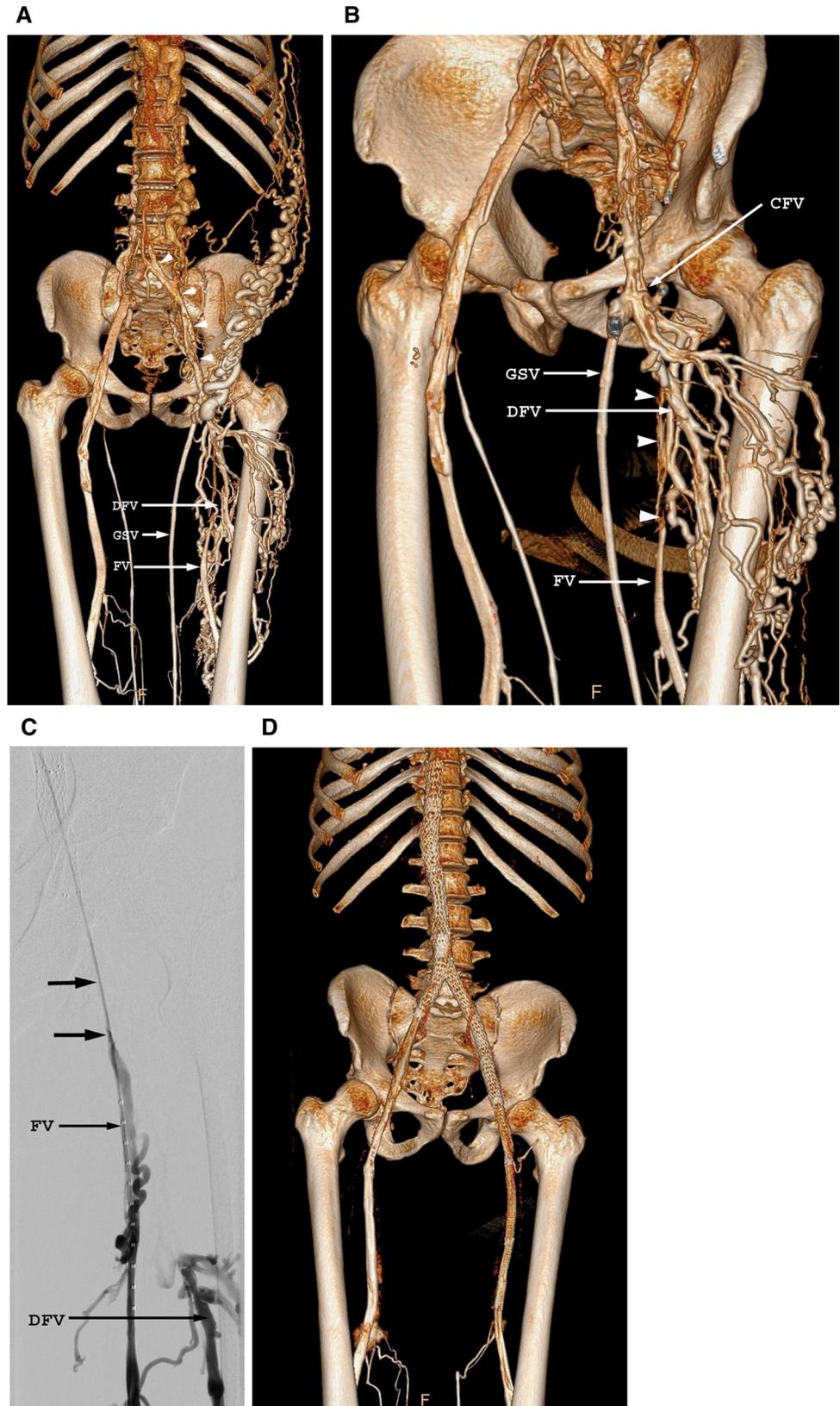
($n = 1$), lung transplantation ($n = 1$), or for another reason (subcutaneous abdominal varices, $n = 1$); they did not complete clinical score evaluations.

Assessment of PTVLs and Procedural Data

CT phlebography was realized for 90 patients and MR phlebography for 5 (included at the beginning of the study). The distribution of PTVLs is given in Table 1.

Procedural data are displayed in Table 2. Only one patient had angioplasty alone, without stenting. For the 94 other patients, 1–8 stents were used (average 3.4).

Fig. 3 Grade 2 PTVLs. A fifty-four-year-old man who presented with bilateral CFIV deep venous thrombosis of the lower legs and IVC 28 years previously. **A, B** 3D CT phlebography before treatment, frontal view (**A**) and anterior left oblique view (after removing the subcutaneous variceal collaterals) (**B**): occlusion of the IVC, and the right CIV; severely obstructive synechia of the left iliac vein (arrowheads), CFV, FV, and DFV; enlarged left GSV; the inferior third of the FV is patent and 6–9 mm in diameter, the upper two-thirds of the FV is occluded (arrowheads). Only the inferior part of the FV and the GSV (6–9 mm in diameter) are suitable for drainage. **C** Per-operative venography with injection into the popliteal vein after balloon dilation of the FV, showing that the angioplasty alone did not restore femoral vein patency (arrows). **D** 3D CT phlebography 6 months after treatment, frontal view: the stents extend from the left FV up to the retro-hepatic IVC. Disappearance of the collateral drainage demonstrating stent patency. At 1-year follow-up the stenting is patent



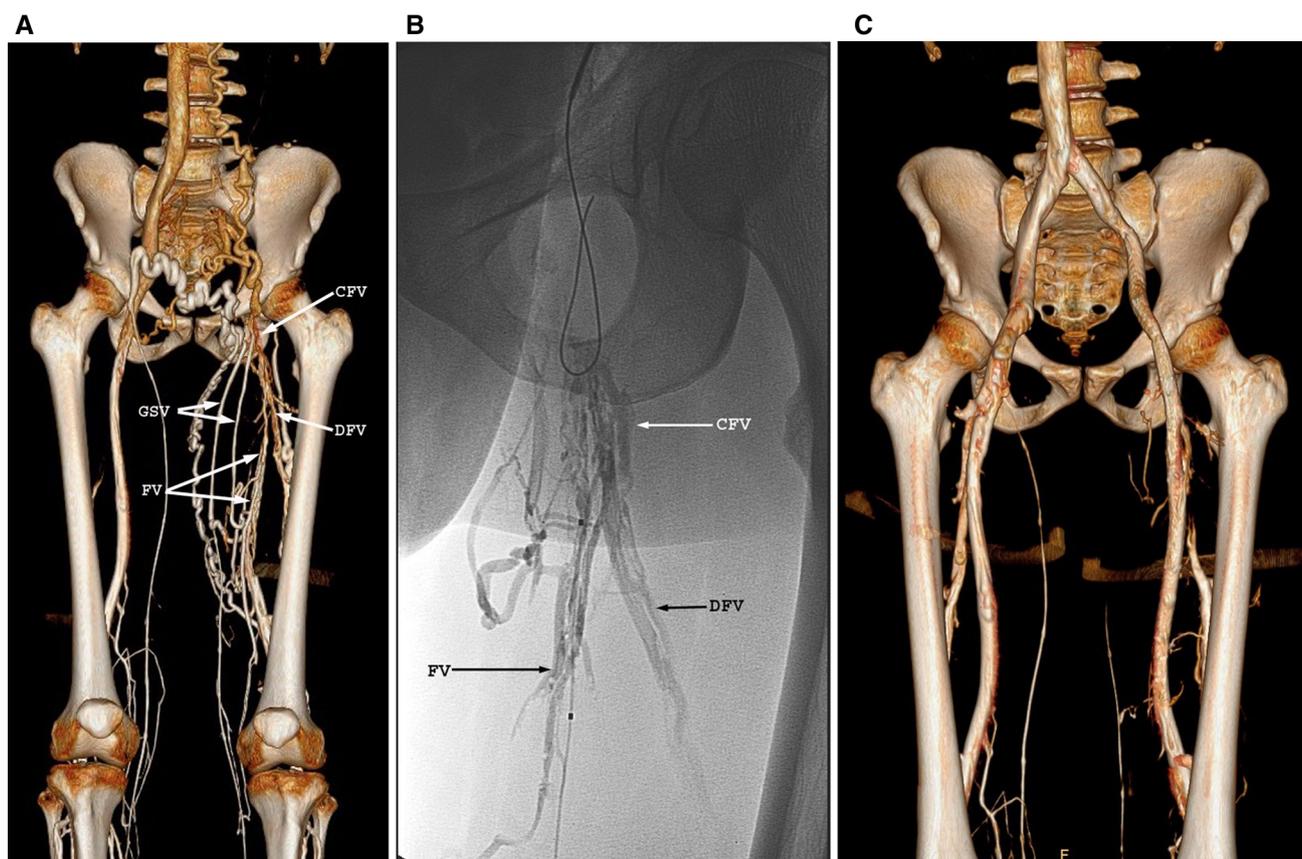


Fig. 4 Grade 3 PTVLs. A twenty-three-year-old man who presented with extensive deep venous thrombosis of the left lower leg 2 years previously. **A** 3D CT phlebography before treatment: the FV and DFV are occluded. Only small veins are patent but less than 5 mm and not suitable for drainage. **B, C** Per-operative venography of the

confluence of the femoral veins (**B**) and of the popliteo-femoral junction (**C**): severely obstructive PTVLs of the FV and DFV. **C** Postoperative CT phlebography: stenting extending from the left popliteal to the left common iliac vein with disappearance of collaterals. At 6-year follow-up the stenting is patent

Technical Success and Complications

All 95 patients were successfully recanalized with restitution of a patent vein immediately following EVT; thus, the technical success rate was 100%.

No death, major hemorrhage, or pulmonary embolism occurred during the intervention or afterward.

One patient presented a false aneurysm due to accidental puncture of the femoral artery and was treated by local injection of thrombin, without prolongation of hospitalization. In another patient, a Wallstent was used to treat underlying May–Thurner syndrome and was incorrectly positioned protruding into the right wall of the IVC. An attempt to retrieve it failed, but fortunately the contralateral iliac vein remained patent on follow-up. In another patient, a hematoma occurred in the right psoas 3 weeks after discharge despite oral anticoagulation, but did not require additional treatment. One patient presented a subcutaneous abscess on the jugular access route, which was treated by incision and antibiotics.

These 4 complications account for a rate of minor complications of 4%.

Venous Patency and Factors Impacting Patency

Results of venous patency immediately following EVT, at 1 and 3 years, and at the end of follow-up are given in Table 3; when the patency was obtained during the first year, it persisted over time as demonstrated by similar secondary patency rates at 1 and 3 years. At the end of the follow-up, 88 out of 95 patients had patent veins. Among the seven treatment failures, all had grade 2 or 3 PTVLs in the thigh, one had severe thrombophilia, and another suffered from systemic lupus disease.

Patency rate correlations with the grade of PTVLs in the thigh are shown in Table 4 and Fig. 5; primary, assisted primary, and secondary patency rates, and thus the number of re-interventions were strongly linked to the severity of PTVLs in the thigh (Table 4). For patients who had no or minor PTVLs in the thigh, the patency was 100% at the end of the follow-up, while this patency fell to, respectively,

Table 1 Baseline characteristics

Demographic characteristics		Post-thrombotic venous lesions	
Mean age in years (range)	41 (17–86)	Localization	
Gender		IVC	14 (15%)
Male	60 (63%)	Left leg	79 (83%)
Female	35 (37%)	Right leg	29 (31%)
Mean delay before EVT in years (range)	8.9 (0.5–50)	Both legs	13 (14%)
Anatomic abnormality		Extent	
May–Thurner	61	Ilio-CFV or IVC	46 (48%)
Congenital atresia of the IVC	9	Caudal to the CFV	49 (52%)
Postsurgical venous lesion	5	Grade	
Central venous catheter in childhood	2	Grade 0	46 (48%)
Vena cava filter thrombosis	2	Grade 1	17 (18%)
Klippel–Trenaunay with iliac vein atresia	1	Grade 2	24 (25%)
Associated comorbidity		Grade 3	8 (9%)
Behcet disease	3		
Ankylosing spondylitis	1		
Systemic Lupus Erythematosus	1		
Alport's syndrome	1		
Hypercoagulation disorders			
Leiden factor V	10		
Prothrombin gene mutation	5		
Protein S deficiency	3		
Protein C deficiency	3		

Table 2 Procedural data

Venous access (95 patients)		Segments stented (94 patients)	
Single	64 (67%)	IVC	13 (14%)
Right internal jugular vein	42	CFV and/or cephalad to it	58 (62%)
Femoral vein	21	Caudal to the CFV	36 (38%)
Popliteal vein	1	In the deep FV	19
Double	28 (30%)	In the FV	13
Triple	3 (3%)	Down to the popliteal vein	4

Table 3 Overall venous patency rates at follow-up

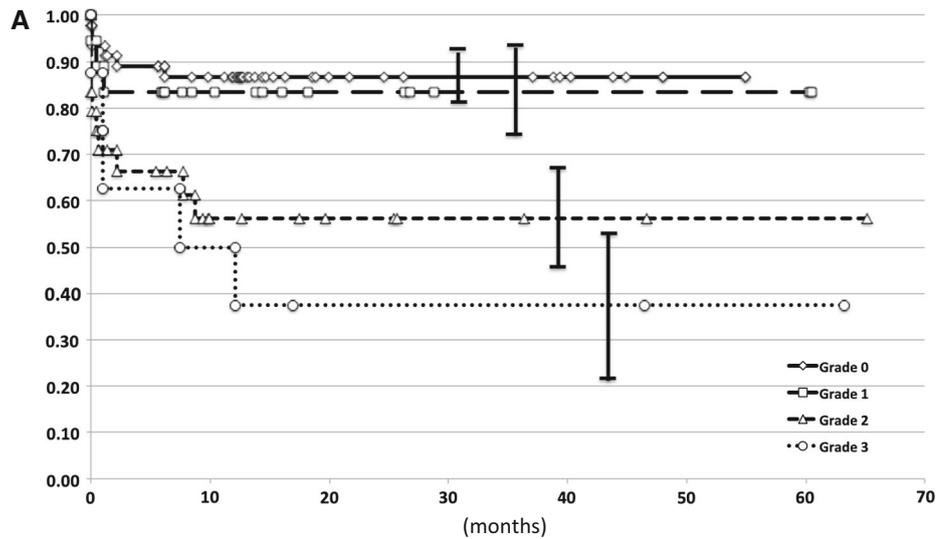
Follow-up	Primary patency	Assisted primary patency	Secondary patency
Hospital discharge ($n = 95$)	(85/95) 89%	(89/95) 94%	(94/95) 99%
1 year ($n = 76$)	(56/76) 74%	(60/76) 79%	(69/76) 91%
3 years ($n = 36$)	(24/36) 67%	(27/36) 75%	(33/36) 92%
End of follow-up (21 months)	(71/95) 75%	(78/95) 82%	(88/95) 93%

Table 4 Venous patency at the end of follow-up and grade of PTVLs in the thigh

Grade	PP ($p = 0.0017$)	Assisted PP ($p = 0.0012$)	SP ($p = 0.0006$)
Grade 0 ($n = 46$)	(40/46) 87%	(43/46) 93%	(46/46) 100%
Grade 1 ($n = 17$)	(14/17) 82%	(15/17) 88%	(17/17) 100%
Grade 2 ($n = 24$)	(14/24) 58%	(16/24) 67%	(20/24) 90%
Grade 3 ($n = 8$)	(3/8) 38%	(4/8) 50%	(5/8) 63%

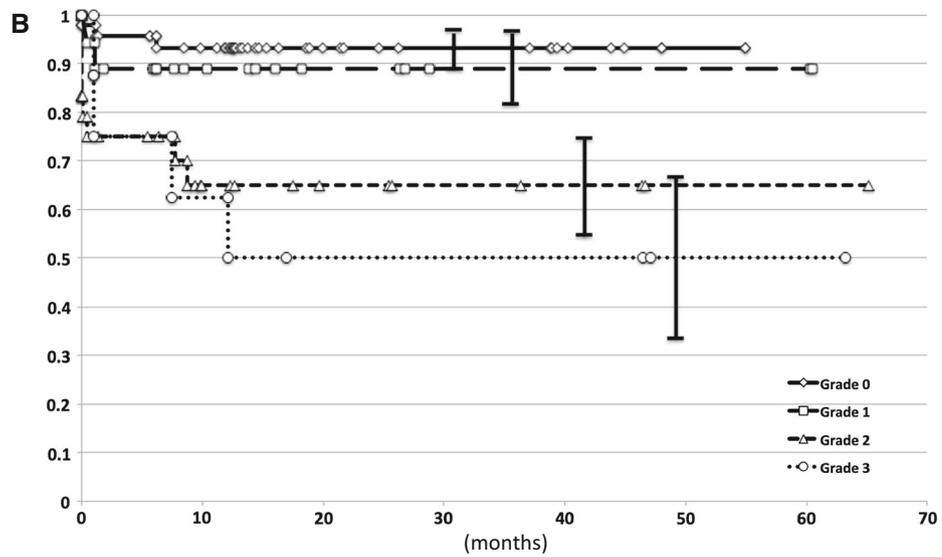
Grade 0, no PTVLs; grade 1, minor PTVLs; grade 2, severe PTVLs; grade 3, major PTVLs
 Primary patency (PP), secondary patency (SP)

Fig. 5 Venous patency according to the grade of PTVLs. **A** Primary patency. **B** Assisted primary patency. **C** Secondary patency



Patients at risk

	0	12 months	24 months	36 months	48 months
Grade 0	46	31	12	10	4
Grade 1	17	9	5	2	2
Grade 2	24	8	5	3	1
Grade 3	8	4	2	2	1



Patients at risk

	0	12 months	24 months	36 months	48 months
Grade 0	46	33	13	11	4
Grade 1	17	9	5	2	2
Grade 2	24	10	6	4	1
Grade 3	8	5	3	3	1

90% and 63% for significant (grade 2) and major (grade 3) PTVL in the thigh.

Twenty-four patients had more than one intervention (total 54, mean 2.25); re-interventions were more frequent when the grade of PTVL in the thigh was high.

Conversely, there was no correlation between the extension of stenting caudal to the CFV and patency for equal grades of severity (Table 5).

Clinical Evaluation

Nine patients presented with chronic venous ulcers at admission. After EVT, 6 ulcers healed, 2 improved, and 1 remained unchanged.

The Villalta score was obtained before and at 6 months after treatment for 75 patients (Table 6). The mean improvement was 4.6 points ($p < 0.0001$).

The CIVIQ score was obtained before and at 6 months after treatment for 71 patients (Table 7). The mean improvement was 18 points ($p < 0.0001$) and the median 19.

There was no correlation between the clinical scores and the grade of PTVL in the thigh, except for grade 3 due to a higher failure rate in this group of patients.

Discussion

Our series confirms the reliability of EVT of chronic femoro-iliac PTVL. The high rate of technical success despite extensive lesions (52% caudal to the CFV) is partly due to the transjugular approach (76%) that allows a better pushability of catheters for recanalization. The high rate of venous patency at mid-term follow-up (93%) and the low rate of morbidity (4%) are comparable to those reported in previous studies [11–18, 21]. Clinical improvement was significant with mean gains of 4.6 for the Villalta and 18 for the CIVIQ score.

The secondary patency reached 99% at patient discharge, 91% at 1 year, and 92% at 3 years. When venous patency was obtained at 1 year, it persisted long term as demonstrated by the actuarial patency curves (Fig. 5). Venous patency was excellent (100%) at mid-term (mean follow-up 21 months) when the veins caudal to the CFV in the thigh were patent before treatment.

PTVLs caudal to the CFV were frequent in our population (52%). There was a strong link between the patency rate and the severity of PTVL in the thigh, expressed by the grade in our classification. Patency rates were 100% for grades 0 and 1, but fell to 90% for grade 2 and 63% for

grade 3. Furthermore, the more severe the grade, the higher the rate of re-intervention, as demonstrated by the primary and secondary patency rates of, respectively, 87 and 100% for grade 0, and 38 and 63% for grade 3 patients. Conversely, unlike Néglen [20], Ye [21], and Yin [17], we found no association between the extension of stenting caudal to the CFV and venous patency for an equal grade of lesions (Table 5). Interestingly, clinical improvement was not correlated with the extension of PTVLs in the thigh.

This highlights the need for an evaluation and quantification of PTVLs caudal to the stents that will presage the quality of inflow into the newly created channel and would help us to give better information on probability of success to the patient. However, it appears very difficult to establish a rigorous and reproducible classification for several reasons: the anatomy of the venous pathway in the leg is highly variable (femoral veins may be absent, duplicated, or divided into several channels); it is difficult to estimate the severity of synechia in the veins and its impact on venous flow, especially when the diameter of the vein appears to be preserved. Furthermore, PTVLs have a variable extension (i.e., they can extend as far as the popliteal and sural veins), but as it is uncommon to extend stenting as far as the popliteal vein, we based our classification on the therapeutic objective of revascularization in the thigh. For grade 1, it is possible to recanalize one or two veins with almost no residual venous lesions caudal to the stents and sufficient diameter (Figs. 1A, 2A). For grade 2, only one vein with near normal flow can be stented, but its diameter is reduced (6–9 mm) (Figs. 1C, 3A), and/or one large vein or at least two smaller veins can be treated but have major obstructive lesions caudal to the stents (Fig. 1B), and thus the establishment of venous patency may be more uncertain. For grade 3, only very small patent veins or veins of 6–9 mm with severely obstructive lesions are visible (Figs. 1D, 4A, B) and venous inflow in the stents will therefore be very uncertain.

Even though venous patency is low for grade 3 PTVLs in the thigh, nevertheless it can reach 63%. This implies that in almost all cases the recanalization of severely obstructive lesions should be attempted in experienced centers. Precise preoperative assessment of lower limb veins by CT phlebography and CDUS is an efficient strategy for these patients so as to plan the recanalization

Table 5 Patency rate association between the grade of PTVLs in the thigh and the extent of stenting below the common femoral vein (CFV)

Grade	Stenting caudal to the CFV ($n = 36$)	Stenting of and cephalad to the CFV ($n = 59$)
0–1	Venous patency 100% ($n = 15/15$)	Venous patency 100% ($n = 48/48$)
2–3	Venous patency 76% ($n = 16/21$)	Venous patency 82% ($n = 9/11$)

Table 6 Evolution of the Villalta score during treatment of post-thrombotic syndrome

Villalta	Median/IQR	Score < 5	Score 5–14	Score > 14
Before treatment	10/6	(n = 5) 7%	(n = 57) 76%	(n = 13) 17%
After treatment	3/5	(n = 48) 64%	(n = 24) 32%	(n = 3) 4%

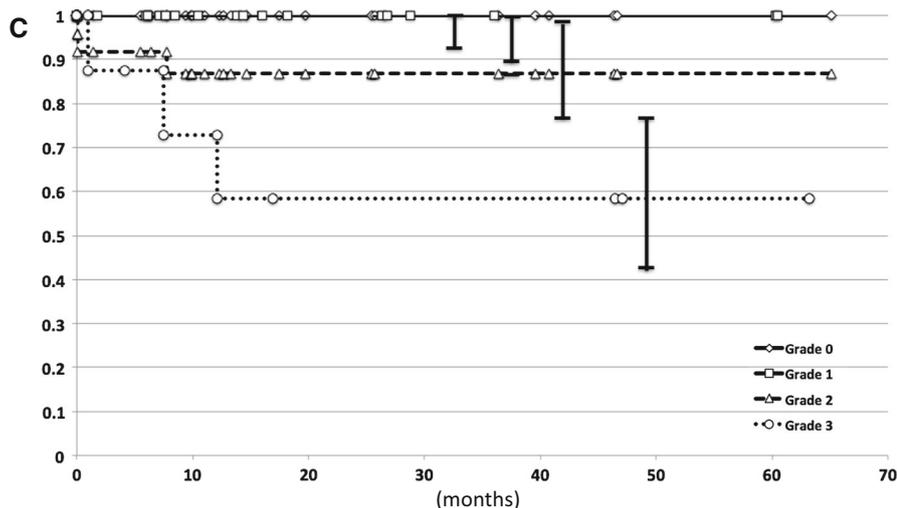
IQR interquartile range

Table 7 Evolution of the CIVIQ-20 quality of life score during treatment of post-thrombotic syndrome

	Median/IQR	20–29	30–59	60–100
Before treatment	53/21	(n = 4) 6%	(n = 44) 62%	(n = 23) 32%
After treatment	27/17	(n = 40) 56%	(n = 21) 30%	(n = 10) 14%

IQR interquartile range

Fig. 5 continued



	0	12 months	24 months	36 months	48 months
Grade 0	46	36	14	12	5
Grade 1	17	10	6	3	2
Grade 2	24	16	8	6	1
Grade 3	8	7	4	3	1

and select the most suitable main vein to be stented and the tributaries (i.e., GSV or DFV or collaterals) that should be desobstructed and drained into the stents.

The main limitations of this study are its retrospective nature, the small cohort of patients and thus low number in each of the different grades of lesions, and the absence of interobserver agreement to validate the reproducibility of our grading system. These results need to be validated in a larger cohort of patients, however, since this study this grading system has helped us in our daily practice to predict the chances of success of recanalization and thus to give the patient more accurate information prior to EVT.

Conclusion

In our experience of EVT of chronic PTVLs of the ilio-femoral veins and IVC, venous patency achieved was high, morbidity low, and clinical improvement was significant. There was a strong correlation between the venous patency and the severity of PTVLs in the thigh caudal to the CFV. In general, venous patency was excellent for patients who had no or only minor venous lesions and decreased with the severity of the lesions. Moreover, the severity of PTVLs in the thigh is a major factor influencing in-stent re-thrombosis due to insufficient inflow. The evaluation and grading of these lesions by CT phlebography and CDUS is thus essential during the preoperative assessment of post-thrombotic syndrome. It allows the interventional radiologist to select the best veins to be recanalized and the

landing zones for stenting. In this way, stenting caudal to the CFV does not preclude a good hemodynamic and clinical result.

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Compliance with Ethical Standards

Conflict of interest F. Thony and M. Rodiere have received grants from the following companies: Cook, Bloomington, USA, and Optimed, Ettlingen, Germany, to organize postgraduate training sessions.

Ethical Approval Study ethics approval was obtained in February 2018 (CECIC Rhône-Alpes-Auvergne, IRB 5891).

Informed Consent Informed consent was obtained from all subjects (patients) in this study.

Consent for Publication Consent for publication was obtained for every individual with personal data included in the study.

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