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Aims and Scope

Phlebolymphology **is an international scientific journal entirely devoted to venous and lymphatic diseases.**

The aim of *Phlebolymphology* is to provide doctors with updated information on phlebology and lymphology written by well-known international specialists.

Phlebolymphology **is scientifically supported by a prestigious editorial board.**

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Content

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Editorial

Dear Readers,

In this special issue of *Phlebolymphology*, the content is as below:

Catheter-directed interventions for acute iliofemoral deep vein thrombosis have been increasingly used over the past decade to alleviate early symptoms and reduce the incidence and severity of postthrombotic syndrome. The article by **E. AVGERINOS *(Greece)* et al** addresses the advantages of early thrombus removal and how to perfect technical and clinical outcomes.

There are several factors associated with residual edema after venous interventions, and this edema can worsen with time. The article by **N. LABROPOULOS *(USA)* et al** analyzes when and why residual edema occurs after venous interventions from diverse perspectives while also discussing a patient case from real-life practice.

The article by **A. GASPARIS *(USA)* et al** also elaborates on the residual edema following venous intervention, particularly focusing on prevention and management to improve patient outcomes and quality of life.

In patients with chronic obstruction, despite the availability of various treatment modalities, improving clinical outcomes remains a challenging task for health care professionals. The article by **H. JALAIE *(Germany)* et al** aims to explore innovative strategies and evidence-based approaches to enhance the management and long-term outcomes of patients with chronic venous obstruction.

The last part of this special issue is dedicated to the abstracts presented at the **Venous Symposium – Europe**, which was held in **Athens, Greece on October 17-19, 2024** to share novelties and research in venous disease.

Enjoy reading this issue!

Editorial Manager
Dr. H. Pelin Yaltirik

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Advantages of early thrombus removal and how to perfect the technical and clinical outcomes

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ABSTRACT

Deep venous thrombosis (DVT) is a source of morbidity by way of short-term, disabling symptomatology and mid-long-term postthrombotic syndrome (PTS), particularly when involving the iliofemoral segment. Catheter-directed interventions for acute iliofemoral DVT have been increasingly used over the past decade to alleviate early symptoms and reduce the incidence and severity of PTS. To achieve these clinical benefits in a safe and durable way certain steps need to be applied involving patient selection, technique of thrombus removal, stenting (or not), and follow-up.

Keywords

acute deep vein thrombosis | intravascular ultrasound | mechanical thrombectomy | postthrombotic syndrome | thrombolysis | venous stent

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Introduction

Deep venous thrombosis (DVT) incidence keeps rising as our population is aging; the numbers of surgical procedures are growing; and our diagnostic strategies are improving.[1] Whereas associated pulmonary embolism (PE) can infer significant morbidity and mortality, it is not as frequent; the main clinical burden of a DVT involves the short-term disabling symptomatology and a mid-long-term postthrombotic syndrome (PTS), particularly when involving the iliofemoral segment.[2-4] Following an iliofemoral DVT, roughly 50% will develop PTS that can be a very debilitating condition with substantial health care costs.[2-7]

Catheter-directed interventions for acute iliofemoral DVT have been increasingly used over the past decade to alleviate early symptoms and reduce the incidence and severity of PTS.[8-11] Given that these procedures are generally offered to a younger population, unless they are successful in the long term, no actual benefit can be claimed, putting patients at risk and raising health care costs. To achieve the clinical benefits of an intervention in a safe and durable way, certain steps need to be applied involving patient selection, technique of thrombus removal, stenting (or not), and follow-up.

Patient selection

The conflicting results of existing randomized trials have been criticized on the basis of diverse patient-inclusion criteria (eg, femoropopliteal DVTs combined with iliofemoral DVTs) and technical variations (eg, stenting rates, timing of intervention, inflow optimization, etc).[11-18] There is little doubt though that these trials paved the way toward better patient selection to maximize benefits in terms of PTS severity reduction and quality of life (QOL) improvement, and this benefit can extend beyond 2 years after treatment.[12-15] The lytic trials confirmed this benefit in good-risk symptomatic patients with iliofemoral DVT, provided intervention is done early enough, ideally within a 2-week window.[11-15] Within this time window, thrombus is still noncollagenous (softer) and the valve function may be salvaged. Novel technologies have opened up this time window, but the actual benefit is yet to be seen. Based on these data, the European Society of Vascular Surgery and the International Union of Angiology in their most recent guidelines recommend early thrombus removal strategies in selected good-risk symptomatic patients with iliofemoral DVT.[4,8] Whereas a femoropopliteal DVT can also lead to high PTS rates, based on the available data, an intervention should generally not be considered.[4] Further work is needed, and an industry-sponsored randomized trial is under way.[19]

In our practice, treatment of the threatened-limb population is not delayed, but the symptomatic ones are observed for a couple of days on anticoagulation and compression before any decision to intervene, as conservative treatment may sometimes allow complete symptom resolution.[9,10,20] It is important to assess the symptoms on exertion, as at bedside patients rarely experience symptoms. For those whose symptoms persist, there is a good indication for intervention. Whereas the ideal timing is within 2-3 days, the traditional cut-off for intervention has been 2 weeks, but successful outcomes with newer-generation devices can also be achieved up to 1 month after the acute event.[21] In an ATTRACT study (Acute venous Thrombosis: Thrombus Removal with Adjunctive Catheter-directed Thrombolysis) subanalysis, catheter intervention (vs anticoagulation alone) was beneficial with regard to PTS severity and QOL at 2 years for those who had higher clinical severity at baseline.[22] So, for iliofemoral DVTs with no or mild symptoms an intervention cannot be clearly justified.

Technique

A sound technique that respects the principles of any deep venous intervention (inflow, outflow, conduit) is of paramount importance for a durable outcome. Suggestions for a required standard endovascular toolkit is summarized in *Table I*.

Before the decision to intervene, thrombus within the iliofemoral segment needs to be confirmed. Aside from a baseline duplex scan, a cross-sectional magnetic resonance (MR) venogram or computed tomography (CT) venogram (abdomen, pelvis, and upper leg) can facilitate operative planning by documenting the extent of the thrombus and uncovering unusual anatomies (eg, duplicated cava, inferior vena cava [IVC] aplasia, etc) or chronic venous obstruction. Decision-making and technique selection are summarized in *Figure 1*.

Inferior vena cava filter

A theoretical risk of a catheter intervention is iatrogenic PE related to the instrumentation of fresh thrombus. Although a

	Manufacturer	Size / Length
Wires		
Any standard access wire		0.035"
Glidewire Floppy	Terumo Radifocus	0.035"
Glidewire Stiff	Terumo Radifocus	0.035"
STARTER Rosen	Boston Scientific Corporation	0.035"
V-18 Control Guidewire	Boston Scientific Corporation	0.018"
Sheaths		
Any standard access sheath	Any	5-10Fr / 11cm
Triforce Crossing System	Cook Medical	4Fr / 55-90 cm
Catheters		
Angled	Terumo Radifocus	0.035" / 5Fr / 65-90cm
Quick Cross Support (low profile)	Spectranetics / Phillips	0.018"-0.035" / 4Fr / 65-90cm
Balloons		
Atlas	BD Medical	12-16mm
Stents		
Abre	Medtronic	
BeYond	Bentley	
Blueflow	Plus Medica	
Sinus-Venous	Optimed	
Sinus-Obliquus	Optimed	
Venovo	BD Medical	
Wallstent	Boston Scientific Corporation	
Thrombolytic catheters		
Cragg-McNamara	Medtronic	5Fr / 10-50 Infusion length
EKOS	Boston Scientific Corporation	6Fr
Unifuse	Angiodynamics	4Fr and 5Fr
Bashir Endovascular Catheter	Thrombolex	7Fr
IVUS Catheter	Philips and Boston Scientific Corporation	
Thrombectomy devices		
AngioJet Zelante	Boston Scientific Corporation	8Fr
AngioVac / AlphaVac	AngioDynamics	22Fr/18Fr
Indigo CAT 12	Penumbra	12Fr
ClotTriever	Inari	16Fr
Aspirex	BD Medical	10Fr
JETi	Abbott	8Fr

Table I. Suggested endovascular toolkit for the endovascular management of acute deep venous thrombosis. These are only a few suggested options based on the author's experience and can cover the vast majority of cases.

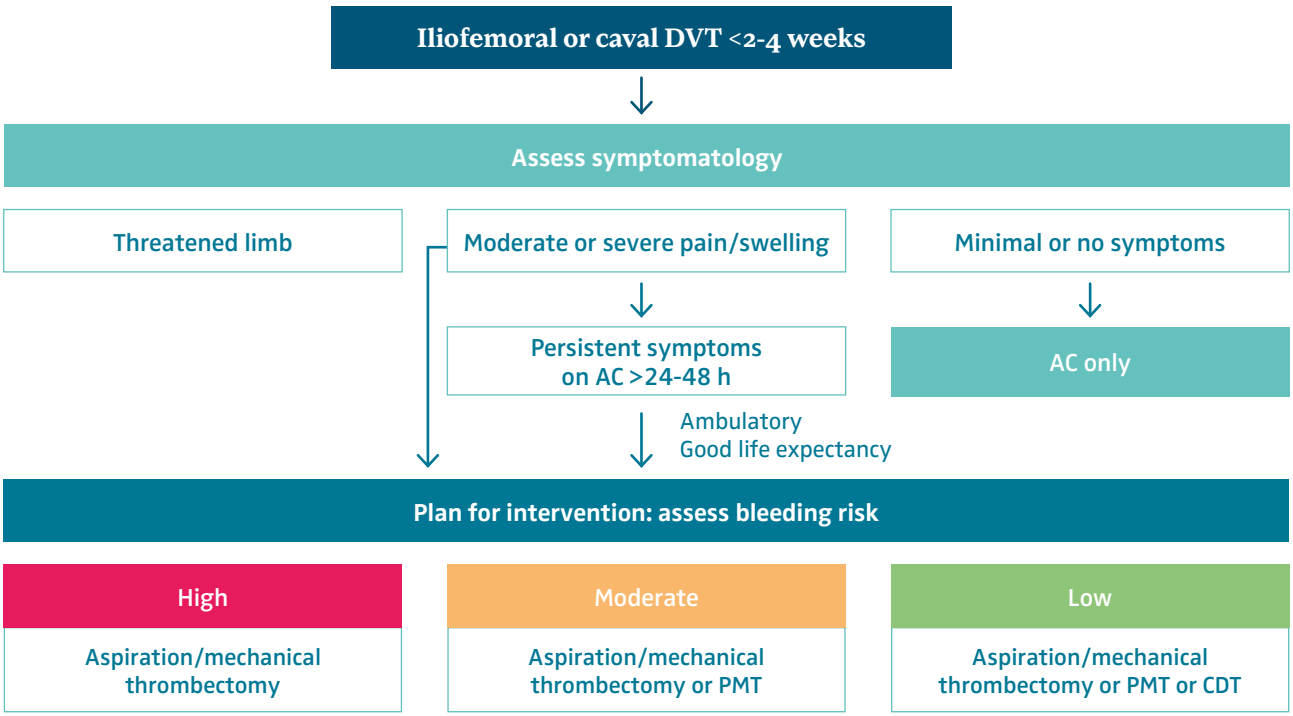

Figure 1. Patient and treatment selection for iliofemoral deep venous thrombosis.
Abbreviations: AC, anticoagulation; CDT, catheter-directed thrombolysis; DVT, deep venous thrombosis; PMT, pharmacomechanical thrombectomy.
Reprinted by permission from reference 9: Avgerinos and Jalaie. *Phlebolymphology*. 2023;30(3):118-124.

small randomized trial has indicated a higher rate of clinically significant PE in patients not receiving an IVC filter, there was no mortality difference, and subsequent contemporary studies recommend highly selective IVC filtration. PE can be unavoidable, but they are rarely clinically meaningful for otherwise good-risk patients, and placement of an IVC filter may introduce complexity and other potential risks.[23,24] In our experience, IVC filters are rarely used irrespective of the type of catheter intervention. Coexisting PE with significant thrombus burden and/or clinical instability (do these patients need DVT thrombectomy?) or mobile iliocaval thrombus can be acceptable indications.

Access

Treating an iliofemoral DVT will typically require low popliteal (or small saphenous) vein access with the patient in prone positioning. This will guarantee good control and imaging of the femoral bifurcation that is the gatekeeper of iliac vein patency. The presence of popliteal thrombus is not a contraindication to access the vein. Use of ultrasound and a micropuncture system is preferrable to minimize bleeding complications, particularly if thrombolytics are considered. If needed, the popliteal vein can accept large sheaths to accommodate the standard venous stent delivery systems (9 or 10 Fr) and even up to 16 Fr after serial dilatations for larger thrombectomy devices. Proximal tibial access can also be obtained and can accommodate 9- to 10-Fr sheaths. An ipsilateral mid-femoral puncture in the supine position can also be sufficient for isolated iliac or caval DVT.

A 5-Fr short sheath, a starter 0.035-inch wire, and a standard guiding catheter are typically enough to cross fresh thrombus and obtain images at the femoropopliteal and iliocaval segments. After establishing access and crossing the lesion, a baseline intravascular ultrasound (IVUS) can be performed to evaluate the extent of the thrombus burden, the chronicity, and the anatomy.

Thrombolysis versus thrombectomy

Contemporary practice offers multiple technical alternatives for thrombus removal, largely divided as thrombolytic and nonthrombolytic techniques, though many times a combination may be best. There is no ideal device or technique: aspiration thrombectomy can bail out a failed thrombolytic technique, and thrombolysis can bail out a failed aspiration thrombectomy. In principle though, thrombectomy techniques have recently evolved toward thrombolytic-free interventions, altering the safety profile and the complex hospital logistics (eg, need for an intensive care unit [ICU]). Contemporary practice has shifted toward a single-session mechanical intervention without ICU stay.

Thrombolytics, for patients at low bleeding risk, still remain relevant and should be considered in certain clinical scenarios, eg, establishing tibial inflow in an "ascending" thrombosis, IVC aplasia, extensive DVT to achieve a cleaner vein before embarking on mechanical thrombectomy, or if after debulking a large amount of thrombus with mechanical thrombectomy there is still significant residual thrombus.[9,10,20] Thrombolysis can be performed using a multi-sidehole standard catheter or the EKOS catheter that incorporates ultrasound probes to accelerate fibrin separation. It is essential to accommodate the entire infusion catheter segment (available in up to 50 cm) within the clot; otherwise, the lytic agent will escape

through the holes of least resistance into the blood stream. Contemporary thrombolysis protocols can vary in time between 6 to 12 hours, and dosage should typically range between 0.5 to 2 mg/hour. Patients will need to be transferred to the ICU for monitoring during the dripping and returned to the interventional suite for termination of the procedure.

Aspiration or mechanical thrombectomy (MT) can be performed with any of the novel available devices on the market *(Figure 2)* with which the practitioner feels comfortable. The ultimate target of a successful thrombus removal is >90% extraction and provides optimal inflow (through the femoral and deep femoral veins) to the iliac segment *(Figure 3)*. This will minimize the risk of early re-thrombosis or later PTS.[25-28]

Following thrombectomy, IVUS can be used to determine the completeness of thrombectomy and the need to place a stent, its diameter, and its length. IVUS has been shown in multiple studies to be superior for accurate lesion identification compared with plain venography, and its use improves long-term patency.[29]

Venous stenting

Several dedicated venous stents are available. Sufficient stenting of persistent lesions (chronic obstruction, residual thrombus, external compression) after thrombus removal seems to be a critical component of a clinically successful procedure.

Accumulating experience favors stenting, most likely exceeding 50% of intervened patients. The rationale is to treat the underlying DVT precipitating factor (typically an iliac vein compression—May Thurner lesion) or cover thrombotic-collagenous material that creates a significant stenosis (>50% IVUS area reduction, frequently corresponding to stenosis >70% of the diameter).[30-33] Note, however, that

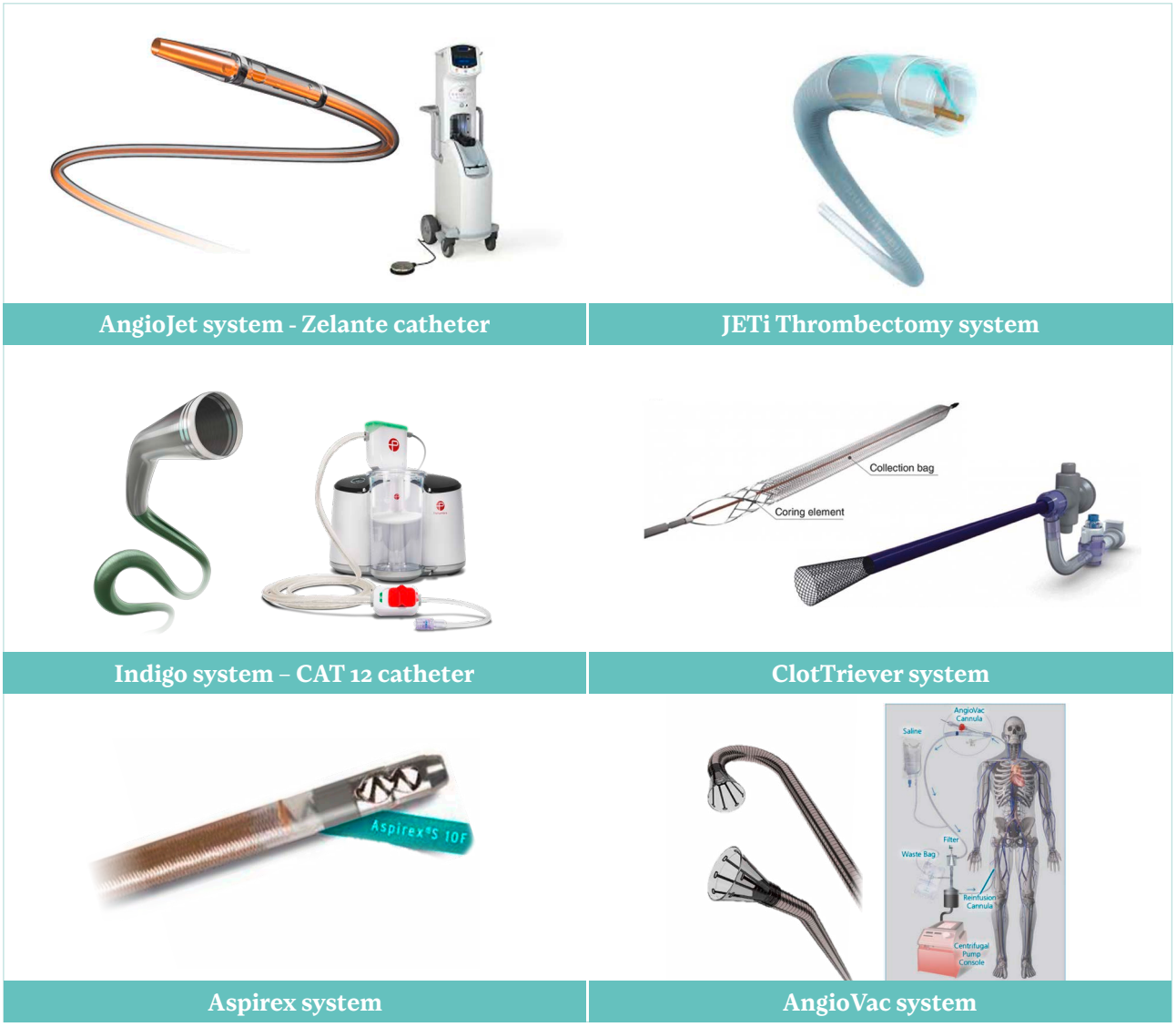

Figure 2. Contemporary mechanical thrombectomy devices: AngioJet (Boston Scientific Corporation), ClotTriever (Inari Medical), JETi (Abbott), Aspirex (BD Medical), Indigo CAT 12 (Penumbra), AngioVac (AngioDynamics).
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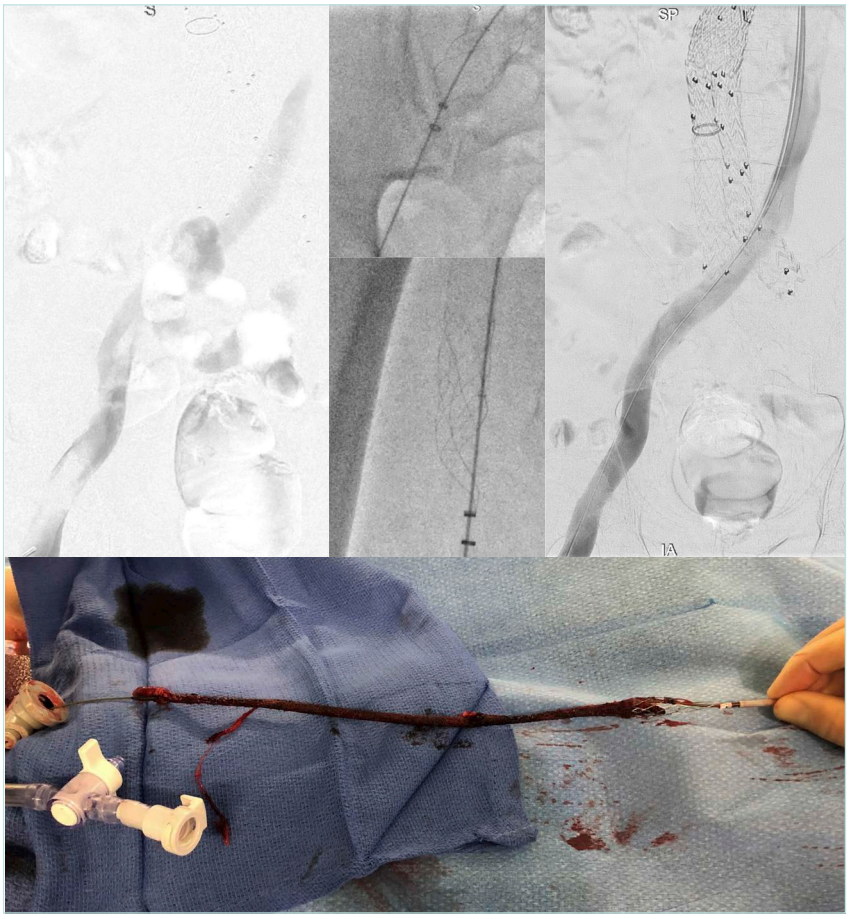

DVT itself causes inflammation, and along with the catheter manipulations, they can cause luminal stenosis that will eventually resolve, thus stents can be spared.[34] IVUS and appropriate expertise in the interpretation of the images will better guide the need for stent placement.[20]

When a stent will be deployed it needs to provide an adequate, well-expanded conduit and ensure good inflow and outflow. Consequently, in many cases, it may be necessary to stent from the iliocaval confluence down to the common femoral vein. Care should be taken to prevent jailing of the contralateral common iliac vein as well as jailing of the deep femoral vein when extending distally. The common iliac vein is typically stented with a 14- to 16-mm stent, and the external iliac/common femoral veins with a 12- to 14-mm stent. The length of the iliac stent should also be long enough (≥8 cm) to anchor at the external iliac segment, preventing migration and avoiding an acute angulated landing at the iliosacral curvature *(Figure 4)*.[35-39]

Figure 3. Iliofemoral deep venous thrombosis following endovascular aneurysm repair and heparin-induced thrombocytopenia. Mechanical thrombectomy using the ClotTriever device (Inari). No stent was required.

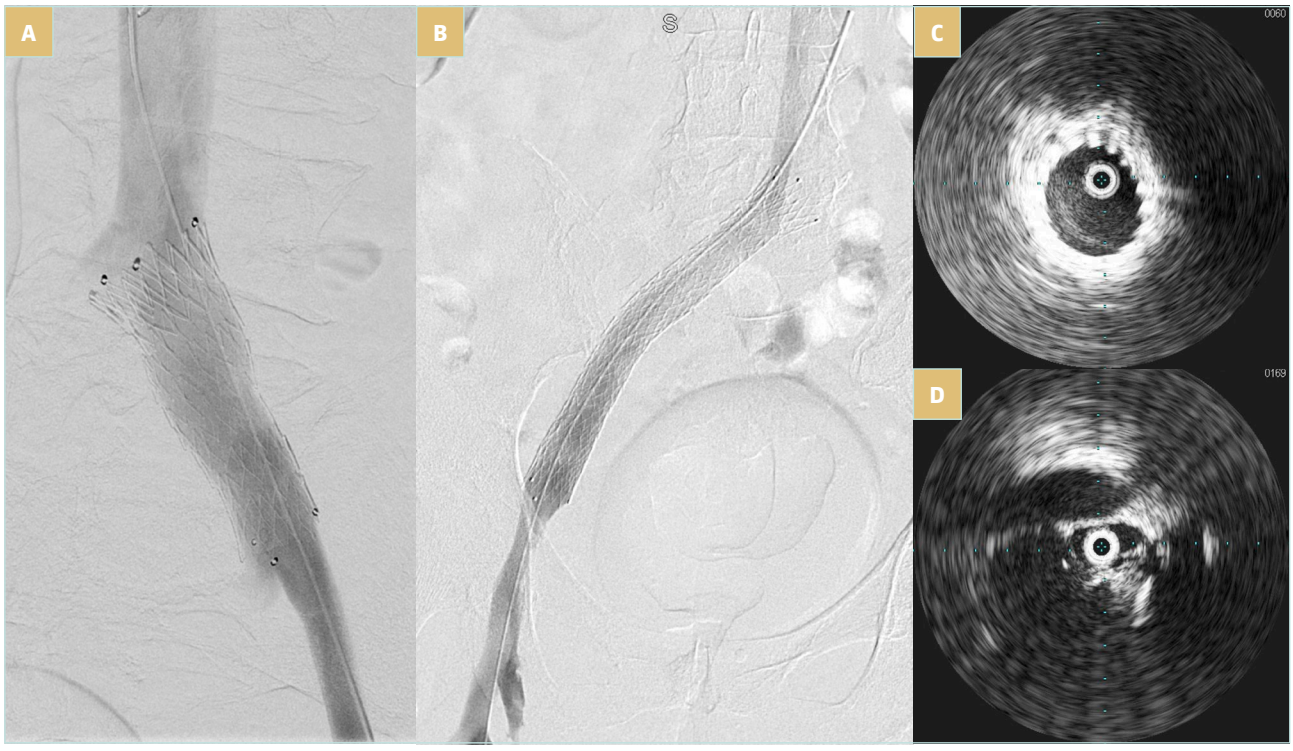

Figure 4. Venovo (BD Medical) stent placement after thrombectomy. A) Appropriate diameter of 16 mm, but short with a risk of migration; B) appropriate diameter of 16 mm and length of 120 mm; C) iliac vein compression after thrombectomy and before stenting as seen in intravascular ultrasound; D) well-expanded stent as seen in intravascular ultrasound.

Perioperative care and surveillance

The patient should remain on bed rest for 2 to 4 hours to allow for hemostasis; the index leg needs to be tightly wrapped; and after hospital discharge, thigh-high compression at 20 to 30 mm Hg should be encouraged for at least 1 month or until the swelling completely resolves. The patient should also be encouraged to drink plenty of fluids in order to minimize the effects of hemoglobinuria. Within 6 to 8 hours, the patient should be encouraged to ambulate.

Before discharge, a duplex ultrasound can identify early failures and need for reintervention. The patient should be discharged with a defined plan for anticoagulant therapy that is consistent with their risk of recurrence. For patients who received a stent, before initiating oral anticoagulation, low-molecular-weight heparin for 2 to 6 weeks is preferred owing to its anti-inflammatory effects. An antiplatelet agent for 6 months or indefinitely depending on the patient's risk profile can be considered. Appropriate referral to hematology is warranted in patients with an unprovoked DVT or possible thrombophilia. A follow-up office visit is recommended at 2 to 4 weeks, at 3, 6, and 12 months, and annually thereafter with duplex ultrasound.[40,41] Cross-sectional imaging can be needed on occasion in complex iliocaval reconstructions to evaluate patency.

Conclusions

Contemporary catheter interventions for symptomatic patients with acute iliofemoral DVT are generally safe and do not require prolonged hospitalization. As DVT rates are rising, awareness of these novel treatments and appropriate technical expertise within a multidisciplinary team can guarantee optimal results and ultimately a better QOL for our patients.

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References

1. Heit JA. Epidemiology of venous thromboembolism. *Nat Rev Cardiol*. 2015;12:464-474.
2. Kahn SR, Shbaklo H, Lamping DL, et al. Determinants of health-related quality of life during the 2 years following deep vein thrombosis. *J Thromb Haemost*. 2008;6:1105-1112.
3. Broholm R, Sillesen H, Damsgaard MT, et al. Postthrombotic syndrome and quality of life in patients with iliofemoral venous thrombosis treated with catheter-directed thrombolysis. *J Vasc Surg*. 2011;54(6 Suppl):18S-25S.
4. Kakkos SK, Gohel M, Baekgaard N, et al. Editor's Choice – European society for vascular Surgery (ESVS) 2021 clinical practice guidelines on the management of venous thrombosis. *Eur J Vasc Endovasc Surg*. 2020;61:9-82.
5. Magnuson EA, Chinnakondepalli K, Vilain K, et al. Cost-effectiveness of pharmacomechanical catheter-directed thrombolysis versus standard anticoagulation in patients with proximal deep vein thrombosis: results from the ATTRACT trial. *Circ Cardiovasc Qual Outcomes*. 2019;12(10):e005659.
6. Babigumira JB, Black SA, Lubinga SJ, Pouncey AL. Cost effectiveness of early endovenous thrombus removal for acute iliofemoral deep vein thrombosis in the United Kingdom. *Eur J Vasc Endovasc Surg*. 2024;67(3):490-498.
7. Jalaie H, Avgerinos E. Early deep vein thrombosis intervention is cost effective and can only get better. *Eur J Vasc Endovasc Surg*. 2024;67(3):499.
8. Nicolaides AN, Fareed J, Spyropoulos AC, et al. Prevention and management of venous thromboembolism. International Consensus Statement. Guidelines according to scientific evidence. *Int Angiol*. 2024;43(1):1-222.
9. Avgerinos E, Jalaie H. Progress in the management of early thrombus removal. *Phlebolymphology*. 2023;30(3):118-124.
10. Avgerinos ED, Bouris V, Jalaie H. The emerging role of mechanical thrombectomy in acute DVT management. *J Cardiovasc Surg (Torino)*. 2024;65(1):23-31.

11. Javed A, Machin M, Gwozdz AM, et al. Meta-analysis of lytic catheter-based intervention for acute proximal deep vein thrombosis in the reduction of post-thrombotic syndrome. *J Vasc Surg Venous Lymph Disord*. 2023;11(4):866-875.
12. Haig Y, Enden T, Grøtta NEK, et al. Post-thrombotic syndrome after catheter-directed thrombolysis for deep vein thrombosis (CaVenT): 5-year follow-up results of an open-label randomised controlled trial. *Lancet Haematol*. 2016;3:e64-e71.
13. Vedantham S, Goldhaber SZ, Julian JA, Kahn SR; for the ATTRACT trial. Pharmacomechanical catheter-directed thrombolysis for deep vein thrombosis. *N Engl J Med*. 2017;377(23):2240-2252.
14. Comerota AJ, Kearon C, Gu CS, et al. Endovascular thrombus removal for acute iliofemoral deep vein thrombosis: analysis from a stratified multicenter randomised trial. *Circulation*. 2019;139(9):1162-1173.
15. Notten P, de Smet AAEA, Tick LW, et al. CAVA (ultrasound-accelerated catheter-directed thrombolysis on preventing post-thrombotic syndrome) trial: long-term follow-up results. *J Am Heart Assoc*. 2021;10:e018973.
16. Avgerinos EA, Chaer RA. The ATTRACTiveness of catheter-directed thrombolysis. *J Vasc Surg Venous Lymphat Disord*. 2018;6(3):303.
17. Nana P, Avgerinos E, Spanos K, Giannoukas A, Labropoulos N. Gaps arising from randomized controlled trials on thrombolysis for proximal deep vein thrombosis of the lower limb. *J Vasc Surg Venous Lymphat Disord*. 2022;10(1):196-199.
18. Go C, Chaer RA, Avgerinos ED. Catheter interventions for acute deep venous thrombosis: who, when and how. *Vasc Endovasc Rev*. 2020;3:e07.
19. Inari Medical begins DEFIANCE randomized clinical trial of ClotTriever system in DVT. Published January 12, 2023. Endovascular Today. https://evtoday.com/news/inari-medical-begins-defiance-randomized-clinical-trial-of-clottriever-system-in-dvt
20. Avgerinos ED, Black S, van Rijn MJ, Jalaie H. The role and principles of stenting in acute iliofemoral venous thrombosis. *J Vasc Surg Venous Lymphat Disord*. 2024;12(5):101868.
21. Abramowitz SD, Kado H, Schor J, et al; CLOUT Investigators. Six-month deep vein thrombosis outcomes by chronicity: analysis of the real-world ClotTriever Outcomes Registry. *J Vasc Interv Radiol*. 2023;34(5):879-887.e4.
22. Thukral S, Salter A, Lancia S, Kahn SR, Vedantham S. Predictors of clinical outcomes of pharmacomechanical catheter-directed thrombolysis for acute iliofemoral deep vein thrombosis: analysis of a multicenter randomized trial. *J Vasc Interv Radiol*. 2022;33:1161-1170.
23. Sharifi M, Bay C, Skrocki L. Role of IVC filters in endovenous therapy for deep venous thrombosis: The FILTER-PEVI (filter implantation to lower thromboembolic risk in percutaneous endovenous intervention) trial. *Cardiovasc Intervent Radiol*. 2012;35:1408-1413.
24. Avgerinos ED, Hager ES, Jeyabaln G, Marone L, et al. Inferior vena cava filter placement during thrombolysis for acute iliofemoral deep venous thrombosis. *J Vasc Surg Venous Lymphat Disord*. 2014;2:274-281.
25. Aziz F, Comerota AJ. Quantity of residual thrombus after successful catheter-directed thrombolysis for iliofemoral deep venous thrombosis correlates with recurrence. *Eur J Vasc Endovasc Surg*. 2012;44(2):210-213.
26. Comerota AJ, Grewal N, Martinez JT, et al. Postthrombotic morbidity correlates with residual thrombus following catheter-directed thrombolysis for iliofemoral deep vein thrombosis. *J Vasc Surg*. 2012;55(3):768-773.
27. Avgerinos E, Saadeddin Z, Abou Ali AN, et al. Outcomes and predictors of failure of iliac vein stenting after catheter-directed thrombolysis for acute iliofemoral thrombosis. *J Vasc Surg Venous Lymphat Disord*. 2019;7(2):153-161.
28. Pouncey AL, Kahn T, Morris RI, Saha P, Thulasidasan N, Black SA. Risk factors and classification of reintervention following deep venous stenting for acute iliofemoral deep vein thrombosis. *J Vasc Surg Venous Lymphat Disord*. 2022;10:1051-1058.
29. Tran LM, Go C, Zaghloul M, et al. Intravascular ultrasound evaluation during iliofemoral venous stenting is associated with improved midterm patency outcomes. *J Vasc Surg Venous Lymphat Disord*. 2022;10(6):1294-1303.
30. Meissner MH, Gloviczki P, Comerota AJ, et al. 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;55:1449-1462.
31. Mahnken A, Thomson K, de Haan M, O'Sullivan G. CIRSE Standards of practice guidelines on iliocaval stenting. *Cardiovasc Intervent Radiol*. 2014;37(4):889-897.
32. Raju S, Neglen P. High prevalence of nonthrombotic iliac vein lesions in chronic venous disease: a permissive role in pathogenicity. *J Vasc Surg*. 2006;44(1):136-143.
33. Gagne PJ, Gasparis A, Black S, et al. Analysis of threshold stenosis by multiplanar venogram and intravascular ultrasound examination for predicting clinical improvement after iliofemoral vein stenting in the VIDIO trial. *J Vasc Surg Venous Lymphat Disord*. 2018;6:48-56.
34. Jayaraj A, Thaggard, Lucas M. Technique of stent sizing in patients with symptomatic chronic iliofemoral obstruction – the case for intravascular ultrasound-determined inflow channel stenting and associated long-term outcomes. J *Vasc Surg Venous Lymphat Disord*. 2023;11(3):634-641.
35. Raju S, Buck WJ, Crim W, Jayaraj A. Optimal sizing of iliac vein stents. *Phlebology*. 2018;33(7):451-457.
36. Sayed MH, Salem M, Desai KR, O'Sullivan GJ, Black SA. A review of the incidence, outcome, and management of venous stent migration. *J Vasc Surg Venous Lymphat Disord*. 2022;10:482-490.
37. Robertson B, Shapiro J, Muck A, et al. Venous stent patency is independent of total stented length in nonthrombotic iliac vein and post-thrombotic venous stenoses. *J Vasc Surg Venous Lymphat Disord*. 2023;11:339-345.
38. Murphy EH, Johns B, Varney E, Buck W, Jayaraj A, Raju S. Deep venous thrombosis associated with caval extension of iliac stents. *J Vasc Surg Venous Lymphat Disord*. 2017;5:8-17.
39. Cheng CP, Dua A, Suh GY, Shah RP, Black SA. The biomechanical impact of hip movement on iliofemoral venous anatomy and stenting for deep venous thrombosis. *J Vasc Surg Venous Lymphat Disord*. 2020;8(6):953-960.
40. Sebastian T, Barco S, Engelberger RP, et al. Duplex ultrasound investigation for the detection of obstructed iliocaval venous stents. *Eur J Vasc Endovasc Surg*. 2020;60:443-450.
41. Avgerinos ED, Labropoulos N. Duplex criteria for iliocaval stent obstruction: sounds of a cry for validated data. *Eur J Vasc Endovasc Surg*. 2020;60(3):451.

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Residual edema after venous interventions: when and why?

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ABSTRACT

Residual edema is often found after venous interventions. Although several reports mention residual edema, it has not been studied thoroughly and is frequently underreported. There are many reasons for which residual edema occurs and why it is often not emphasized. Such edema is obvious after the intervention, and it can worsen with time. One important reason is the treatment itself that can be inadequate, incomplete, or even inappropriate. Continuity of care, addressing remaining disease, and using compression and medication to reduce inflammation and edema play an important role too. Venous disease may have been long-standing, leading to phlebolymphedema, which is not fully reversible as the lymphatic vessels are permanently damaged. Systemic conditions that are associated with edema are also responsible. Furthermore, patient factors such as lack of physical activity, obesity, and musculoskeletal issues limiting mobility and impairing the muscle pump function contribute as well. Use of different types of medications that are responsible for causing edema should also be considered. The coexistence of lymphedema and lipedema with venous disease can explain the limited response of venous interventions. In a good number of patients, there is idiopathic edema that can be unrelated to venous disease. A good evaluation should be performed, and the practitioners should set the right expectations for patients treated for chronic venous disease.

Keywords

inadequate treatment | inappropriate treatment | musculoskeletal issues | new disease | obesity | physical activity | residual edema | systemic conditions | venous interventions

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Introduction

The various treatments for edema in patients with chronic venous insufficiency (CVI) focus mostly on the venous system for resolution. However, residual edema is often found after venous interventions. Although several reports mention residual edema, it has not been studied thoroughly and is frequently underreported. It is important to delve into factors that may contribute to residual edema after venous interventions that may in turn lead to better patient outcomes. CVI has been recognized as a leading cause of secondary lymphedema.[1] This is significant, as even after appropriately treating the venous disease, unabated venous hypertension can cause permanent lymphatic impairment, yielding residual edema.[2,3] Edema has different causes and clinical presentations. It may sometimes regress but in general if there is chronic cause it usually gets worse over time. Even in patients that are properly selected to undergo venous interventions the multitude of causes for edema that coexist with venous disease can make it harder to treat. These are very common, such as obesity, restricted mobility, lymphedema, lipedema, systemic organ failure, vein disease that has not been addressed and of course idiopathic edema where a cause cannot be identified.

CVI is a complex condition characterized by impaired venous return, leading to a spectrum of clinical manifestations. It includes CEAP (clinical-etiological-anatomical-pathophysiological classification) classes from C3 to C6.[4] Consequently, when treating such patients, it is crucial to reduce, and ideally eliminate, the edema.

Although addressing the underlying venous hypertension often leads to improvements in venous-related symptoms, such as claudication and venous ulcers, a notable proportion of patients with CVI may continue to experience persistent swelling. This ongoing edema may indicate the presence of untreated lower-extremity dysfunction. There are several factors associated with residual edema after venous interventions. This paper analyzes when and why residual edema occurs after venous interventions.

Clinical vignette

A 74-year-old female patient presented to our institution with symptomatic varicose veins in her right lower limb; they had been present over the previous 40 years.

Her past medical history included hypertension and hyperlipidemia, both of which were well controlled with medication. She had a body mass index (BMI) of 27, was a nonsmoker and had a maternal history of varicose veins. She had 3 children through normal pregnancies and deliveries. Varicose veins became gradually worse after the pregnancies. She developed discoloration about 10 years ago.

Her symptoms included swelling, itching, heaviness, skin discoloration, and pain, particularly after prolonged standing. The symptoms were most severe at the end of the day when the veins were most enlarged *(Figure 1)*. The left lower limb also had varicose veins, though they were only mildly symptomatic. Her only treatment to date had been compression therapy, though she had not been adherent to this treatment.

The patient came to the clinic because of a bleeding varicosity in the medial malleolus *(Figure 2)*. Discoloration was seen, particularly in the medial aspect of the limb extending from the foot to the upper calf. On palpation, the area in the lower calf and medial malleolus was hard, indicating chronic fibrosis. Clinical examination revealed equal thigh diameters, but the right calf and ankle were 3 cm larger in circumference compared with the left.

Figure 1. Large viscosities present in calf.

Figure 2. Bleeding point on varicose vein (arrow).

An ultrasound was performed, and the results are depicted in *Figures 3 and 4*. Ultrasound images from the great saphenous vein (GSV) and subcutaneous tissues are shown in *Figure 3*. The distribution and extent of reflux is depicted in *Figure 4*.

She underwent treatment with thermal ablation of the GSV and multiple phlebectomies to address the affected tributaries. The areas of skin damage were subsequently treated with ultrasound-guided foam sclerotherapy (UGFS).

She required additional treatment for the tributaries at 8 and 17 months. At a follow-up 2 years after the initial treatment, she reported symptomatic improvement, and the edema in her right limb was reduced. Before treatment, the right calf and ankle were 3 cm larger than the left in circumference. After the treatment, the right calf was 1.5 cm and the ankle was 2 cm larger than the left. Like many patients treated for CVI, our patient also has residual edema, despite receiving the appropriate care.

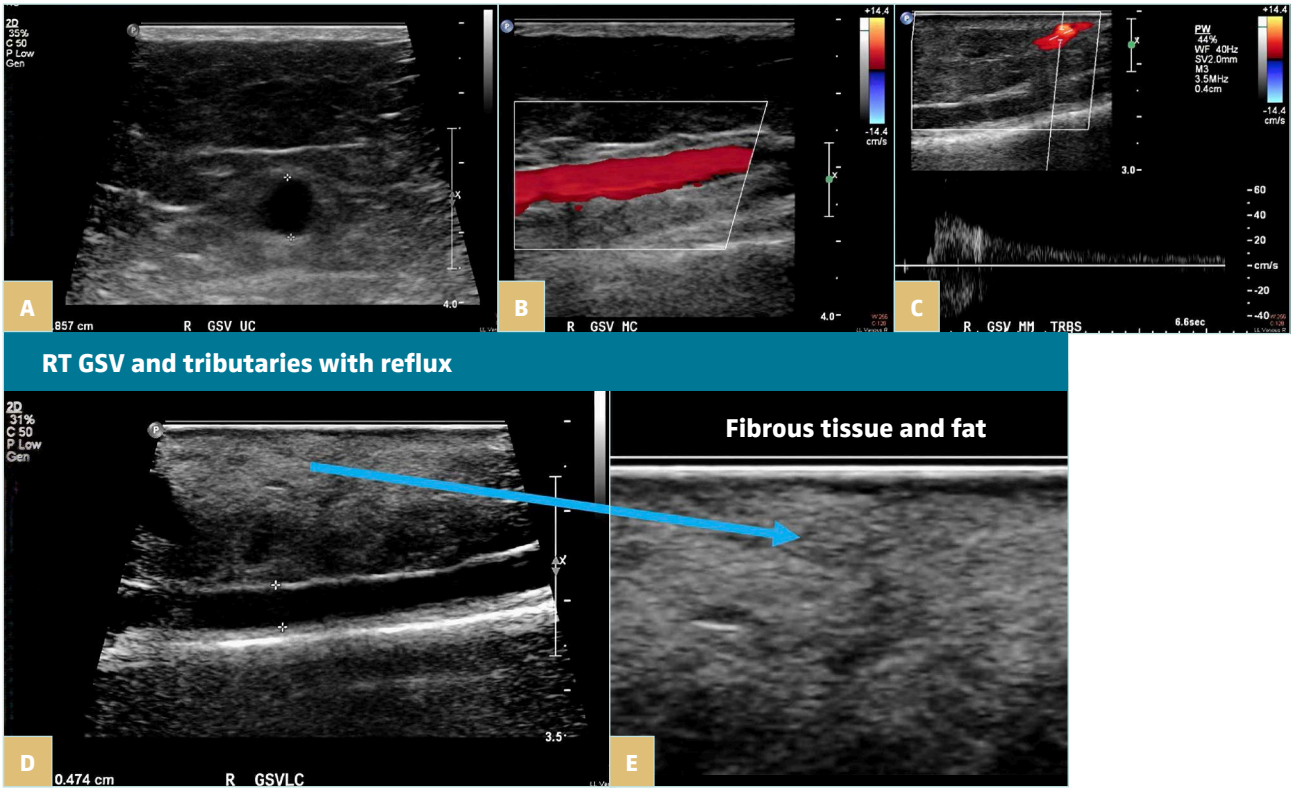

Figure 3. Ultrasound images of the great saphenous vein (GSV) and subcutaneous tissues. A) Enlarged GSV diameter in the upper cuff measuring 8.6 mm. The subcutaneous tissues have normal echotexture at this level. B,C) Reflux is shown in a GSV tributary at the medial malleolus. D) GSV in the distal calf was enlarged measuring 4.7 mm. The echotexture of the subcutaneous tissues here is abnormal, showing dense fibrosis. E) Magnified view of the subcutaneous tissues showing dense fibrous tissue and pockets of fat.

C1-4s Ep As Pr

High velocity reflux with duration >5s

High velocity reflux with duration >7s

High velocity reflux with duration >5s

SSV and deep veins were normal.
IVC and iliac veins were patent.

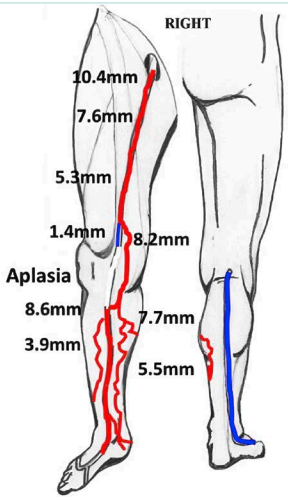

Figure 4. CEAP (clinical-etiological-anatomical-pathophysiological) classification, and duplex ultrasound findings. Red color indicates the vein segments with reflux. Blue color represents normal veins. The GSV diameter ranged between 4.7 mm and 8.6 mm. The GSV at the knee was found to be aplastic (white color). There was long duration of reflux in all vein segments exceeding 5 seconds. The deep veins in the abdomen, pelvis, and lower limb were normal.
Abbreviations: IVC: inferior vena cava; SSV: small saphenous vein.

Initial assessment

Lower-limb edema is common and has a wide range of possible causes. This often makes diagnosis challenging, particularly when multiple etiologies coexist. On initial evaluation, a thorough medical history should be taken, along with an assessment for systemic diseases. The laterality of symptoms can aid diagnosis. Unilateral symptoms may suggest causes such as thrombosis, venous insufficiency, or venous and lymphatic obstruction, while bilateral symptoms are more likely to indicate systemic conditions such as heart failure, renal or hepatic disease, thyroid disorders, or sleep apnea.[5-8]

A thorough review of medications is necessary to identify potential contributors such as antihypertensives (in particular calcium channel blockers), corticosteroids, nonsteroidal anti-inflammatory drugs (NSAIDs), hormonal therapy, and chemotherapy. The mechanism often involves retention of salt and water with increased capillary hydrostatic pressure or volume depletion seen with diuretics, which stimulates the renin-angiotensin system.[5]

Furthermore, a thorough physical examination should be performed. Assessment of the distribution, extent and severity of the swelling, including ankle, calf, and thigh circumferences, using a standardized method to monitor treatment response, is important. The time of onset and duration is also significant. It is necessary to separate recent onset from chronic swelling and determine their causes. For example, recent-onset swelling is often due to deep venous thrombosis (DVT), whereas postthrombotic changes would be responsible for chronic swelling.

Examination of the skin of the lower extremities can help identify the underlying cause of the edema. Indicators of venous insufficiency include varicose veins, hyperpigmentation, eczema, atrophy blanche, lipodermatosclerosis, and ulcers. Thin, shiny skin with bilateral edema and pretibial myxedema may indicate endocrine disorders. Obesity can also cause bilateral swelling with skin changes similar to venous insufficiency, even without venous disease.[8] The causes are discussed below.

Venous

Patients with persistent edema after venous interventions may have underlying venous etiologies related to *reflux*, *obstruction*, or *both*.

Residual edema after treating *reflux* disease may result from ineffective, incomplete, or even inappropriate treatments. In patients for whom conservative care of reflux disease is unsatisfactory, endovenous ablation therapies are recommended. Shutze et al, found that 75.8% of patients experienced a reduction in or resolution of swelling after endovenous laser ablation (EVLA) for saphenous vein reflux.[9]

Additionally, some patients may not report resolution of edema immediately after the intervention, but report a gradual reduction in swelling over time. Studies have shown that this improvement could continue for up to 2 years post treatment.[10,11] However, Proebstle et al demonstrated that when followed-up for up to 4 years, some patients begin to show worsening of symptoms.[11]

A possible explanation for the residual edema could be the presence of deep venous reflux as shown by Puggioni et al.[12] Another reason for residual edema is incomplete treatment

of saphenous tributaries, accessory, and nonsaphenous veins. For example, if the reflux involves the anterior accessory saphenous vein (ASV) instead of or in addition to the GSV, then performing laser ablation to the GSV may be inadequate.[13,14] Moreover, failure to identify central obstruction or postthrombotic vein disease, is a common cause for residual edema even when reflux is eliminated in all the superficial veins. In such cases, wrong expectations may be set for the patient.[14] Recanalized vein segments with reflux may also be responsible for the residual edema. Therefore, evaluation of patients for suspected vein disease both in the limbs and suprainguinal veins is warranted as often can be treated. Additionally, development of new disease may worsen existing edema.[9]

When treating patients with venous *obstruction*, common pitfalls resulting in residual edema include inappropriate selection of patients, incomplete treatment, failure to identify anatomical variants, and recurrence of disease. In patients with inferior vena cava (IVC) or iliac vein *obstruction*, the primary treatment strategy focuses on treating the obstruction. This intervention is targeted in patients for whom the edema is symptomatic, impacting their quality of life, and who do not effectively respond to conservative management. Anomalies of the IVC and its tributaries is reported to affect 0.3% to 10.14% of the population. Patients with IVC hypoplasia and aplasia are frequently associated with lower-limb edema. Such patients often develop DVT at a young age, which is an additional factor for edema. Through awareness and detection of such anomalies, one can alter treatment strategies to better manage the patient.[15] Patients with nonthrombotic obstruction often have positional iliac vein stenosis, and stenting of these patients is inappropriate.[16,17] Other cases of inappropriate treatment include placing stents in patients with primary lymphedema or in patients with systemic causes of edema such as heart failure. Furthermore, patients with poor inflow may not respond well when treated with stents, resulting in high failure rates. Even if central vein obstruction is appropriately treated, edema may persist due to chronic postthrombotic changes in the infrainguinal veins. It should be noted that errors in diagnosis and treatment strategies are common and thus the patients need to be carefully reevaluated to treat all the underlying causes.

Lymphedema

Although the treatment of underlying venous hypertension can lead to the alleviation of venous-related symptoms, such as claudication and venous ulcers, a considerable proportion of patients may experience residual edema, indicative of possible untreated lymphatic disease.[18]

Increased hydrostatic venous pressure results in the accumulation of fluid in the interstitial tissue that relies on lymphatics for drainage. Under normal conditions, the lymphatic vessels manage this fluid by maintaining higher interstitial pressure, compared with luminal pressure, facilitating drainage. Edema occurs when the accumulation of fluid surpasses the lymphatic system's drainage capacity.[19,20] In early stages, the edema can be reversible. However, when these conditions persist over time, as in CVI, irreversible lymph vessel damage may ensue. This condition is known as phlebolymphedema and is common in patients with long-standing CVI.

Previous reviews have demonstrated that up to 35% of patients with lower-extremity edema continue to experience residual persistent edema after venous stent placement. The implementation of lymphedema-specific treatment in these patients demonstrated significant benefits with improvement of symptoms and a decrease in lymphedema-associated complications.[18,21] Other studies observed that a delay in initiating lymphedema treatment after venous intervention suggested underrecognition of coexisting lymphedema and may explain the limited response of venous interventions.[18]

Lymphedema management should be considered for patients with residual edema that persists despite adequate venous therapy, particularly when accounting for other comorbidities. Further research is needed to determine the optimal treatment approach for patients with CVI-associated lymphedema (CVI-LED).

On some occasions, patients with primary lymphedema may have varicose veins. When the latter is treated, residual edema is present due to the former pathology.

Obesity

Obesity is increasingly recognized as a significant risk factor for lymphedema, as it can lead to damage of the lymphatic vasculature and impair lymphatic function.[22] The mechanisms behind this impairment include an increase in inflammatory cells around lymphatic vessels, elevated levels of T cells, and higher nitric oxide synthase activity.[23]

An increasing BMI is associated with a higher risk of developing lymphedema. Research suggests that there may be a specific threshold of BMI beyond which lymphatic dysfunction in the lower extremities becomes more prevalent.[24]

In a large-cohort study completed by van Rij et al, CVI was more severe in the obese, and ulcer disease was more frequent. In their smaller study group, weight correlated positively with the diameter of the femoral vein, ambulatory venous pressure, venous filling index, and calf pump ejection volume.[25] All of these would additionally contribute to the presentation of edema.

This is also evident in the outcomes of chronic venous disease (CVD) treatments. Research indicates that a progressive increase in BMI adversely affects treatment outcomes for CVD. Deol et al, found that outcomes, as measured by the revised venous clinical severity score (rVCSS) and CEAP classification (both of which assess edema), deteriorate significantly when BMI exceeds 35, and are markedly poor with a BMI above 46. The venous interventions in that study included endovenous thermal ablation (TA), phlebectomy, or UGFS.[26]

Consequently, weight loss strategies are often recommended as a preliminary approach before pursuing other treatment options.[26]

Musculoskeletal

Immobility and gait disturbances can contribute to lower-limb edema. A sedentary lifestyle, where the lower limbs remain stationary for extended periods without active movement, can lead to venous stasis.[27] Anatomical problems affecting the calf muscle pump can further increase venous hypertension. Dysfunction of the calf muscle pump is a recognized factor in CVI. Back et al[28] and Williams et al[29] found that limbs affected by CVI exhibit significantly reduced ankle range of motion (ROM), reduced calf muscle ejection fraction, and an increased venous filling index. This becomes more pronounced as CVI severity progresses. The increased swelling along with valvular incompetence, which result in reduced plantar flexion and dorsiflexion, are linked to impaired calf muscle pump function in CVI-affected limbs.[28,29]

Additionally, static foot disorders (SFD) can be an important risk factor that adversely affects CVI and edema. When the sole of the foot contacts the ground, the lateral plantar veins are emptied, returning blood up into the posterior tibial veins. Uhl et al, showed a significant relation between the severity of CVI and patients with SFD such as hollow and flat feet, highlighting the role of the foot venous pump which is crucial in patients with edema.[30]

Diagnostic investigations are often limited, and the condition is typically diagnosed by exclusion after ruling out anatomical venous issues.

Postoperative care

Several mechanisms have been proposed to explain the development of lower-limb edema following intervention. Post-operative care is crucial in reducing complications, including edema, and may even prevent the onset of new edema.

Graduated compression is universally recommended for both surgical and nonsurgical treatment of venous pathologies.[31] Most guidelines recommend posttreatment compression after venous interventions, such as high ligation and stripping, endovenous thermal ablation, and sclerotherapy. Weiss et al showed a decrease in the incidence of side effects including bruising, telangiectatic matting, hyperpigmentation, ulceration, and edema after sclerotherapy.[32,33] The degree and type of compression used have also been discussed as possible causes of persistent edema.

However, the optimal duration of compression therapy remains unclear. As venous interventions have become increasingly minimally invasive, the expected side effects have decreased, making the need for prolonged compression less certain. Nonetheless, studies suggest that compression therapy still provides benefits during the first week after most interventions.[34]

Overall, adherence to postoperative instructions—such as the use of compression stockings, leg elevation when feasible, participating in postoperative exercise programs, and adhering to antithrombotic therapy when appropriate—contributes to the management of edema.

Conclusion

Residual edema is often found after venous interventions. The diagnosis and evaluation of lower-extremity swelling require a comprehensive approach including a thorough patient history, physical examination, laboratory tests, and imaging workup. It is essential to employ efficient and accurate strategies to diagnose its underlying cause(s) and provide evidence-based treatment recommendations. This in turn may reduce the incidence of residual edema after an intervention.

It is vital to have open discussions with patients regarding the potential outcomes of CVD treatments. As discussed, the reason for residual edema is often multifactorial and it can be difficult to cure by treating only one underlying cause. Clinicians should set realistic expectations for patients undergoing such treatments.

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References

1. Piller N. Phlebolymphoedema/chronic venous lymphatic insufficiency: an introduction to strategies for detection, differentiation and treatment. *Phlebology*. 2009;24(2):51-55.
2. Dean SM, Valenti E, Hock K, Leffler J, Compston A, Abraham WT. The clinical characteristics of lower extremity lymphedema in 440 patients. *J Vasc Surg Venous Lymphat Disord*. 2020;8(5):851-859.
3. Mortimer PS, Rockson SG. New developments in clinical aspects of lymphatic disease. *J Clin Invest*. 2014;124(3):915-921.
4. Santler B, Goerge T. Chronic venous insufficiency - a review of pathophysiology, diagnosis, and treatment. *J Dtsch Dermatol Ges*. 2017;15(5):538-556.
5. Trayes KP, Studdiford JS, Pickle S, Tully AS. Edema: diagnosis and management. *Am Fam Physician*. 2013;88(2):102-110.
6. Ely JW, Osheroff JA, Chambliss ML, Ebell MH. Approach to leg edema of unclear etiology. *J Am Board Fam Med*. 2006;19(2):148-160. Erratum in: *J Am Board Fam Med*. 2008;21(1):86.
7. Tiwari A, Cheng KS, Button M, Myint F, Hamilton G. Differential diagnosis, investigation, and current treatment of lower limb lymphedema. *Arch Surg*. 2003;138(2):152-161.
8. Scherer K, Khilnani N. Evaluation and management of patients with leg swelling: therapeutic options for venous disease and lymphedema. *Semin Intervent Radiol*. 2021;38(2):189-193.
9. Shutze W, Shutze R, Dhot P, Ogola GO. Patient-reported outcomes of endovenous superficial venous ablation for lower extremity swelling. *Phlebology*. 2019;34(6):391-398.
10. Vasquez MA, Wang J, Mahathanaruk M, Buczkowski G, Sprehe E, Dosluoglu HH. The utility of the Venous Clinical Severity Score in 682 limbs treated by radiofrequency saphenous vein ablation. *J Vasc Surg*. 2007;45(5):1008-1014; discussion 1015.
11. Proebstle TM, Alm J, Göckeritz O, et al; European Closure Fast Clinical Study Group. Three-year European follow-up of endovenous radiofrequency-powered segmental thermal ablation of the great saphenous vein with or without treatment of calf varicosities. *J Vasc Surg*. 2011;54(1):146-152.
12. Puggioni A, Lurie F, Kistner RL, Eklof B. How often is deep venous reflux eliminated after saphenous vein ablation? *J Vasc Surg*. 2003;38(3):517-521.
13. Mühlberger D, Morandini L, Brenner E. Venous valves and major superficial tributary veins near the saphenofemoral junction. *J Vasc Surg*. 2009;49(6):1562-1569.
14. Adler C, Mousa A, Rhee A, Patel MD. Varicose veins of the lower extremity: Doppler US evaluation protocols, patterns, and pitfalls. *Radiographics*. 2022;42(7):2184-2200.
15. Kim H, Labropoulos N, Blake AM, Desai K. Prevalence of inferior vena cava anomalies and their significance and impact in clinical practice. *Eur J Vasc Endovasc Surg*. 2022;64(4):388-394.
16. van Vuuren TMAJ, Kurstjens RLM, Wittens CHA, van Laanen JHH, de Graaf R. Illusory angiographic signs of significant iliac vein compression in healthy volunteers. *Eur J Vasc Endovasc Surg*. 2018;56(6):874-879.
17. Krzanowski M, Partyka L, Drelicharz L, et al. Posture commonly and considerably modifies stenosis of left common iliac and left renal veins in women diagnosed with pelvic venous disorder. *J Vasc Surg Venous Lymphat Disord*. 2019;7(6):845-852.e2.
18. Genet M, Labropoulos N, Gasparis A, O'Donnell T, Desai K. The clinical and economic impact of chronic venous insufficiency-associated lymphedema and the prevalence of persistent edema after venous intervention. *Phlebology*. 2024;39(5):353-358.
19. Levick JR, Michel CC. Microvascular fluid exchange and the revised Starling principle. *Cardiovasc Res*. 2010;87(2):198-210.
20. Farrow W. Phlebolymphedema–a common underdiagnosed and undertreated problem in the wound care clinic. *J Am Col Certif Wound Spec*. 2010;2(1):14-23.
21. Raju S. Best management options for chronic iliac vein stenosis and occlusion. *J Vasc Surg*. 2013;57(4):1163-1169.
22. Mehrara BJ, Greene AK. Lymphedema and obesity: is there a link? *Plast Reconstr Surg*. 2014;134(1):154e-160e.
23. Labropoulos N et al. Clinical impact of severe obesity in patients with lymphoedema. *Eur J Vasc Endovasc Surg*. 2023;65(3):406-413.
24. Maclellan RA, Zurakowski D, Grant FD, Greene AK. Massive localized lymphedema: a case-control study. *J Am Coll Surg*. 2017;224(2):212-216.
25. van Rij AM, De Alwis CS, Jiang P, et al. Obesity and impaired venous function. *Eur J Vasc Endovasc Surg*. 2008;35(6):739-744.
26. Deol ZK, Lakhanpal S, Franzon G, Pappas PJ. Effect of obesity on chronic venous insufficiency treatment outcomes. *J Vasc Surg Venous Lymphat Disord*. 2020;8(4):617-628.e1.
27. Suehiro K, Morikage N, Murakami M, et al. A study of leg edema in immobile patients. *Circ J*. 2014;78(7):1733-1739.
28. Back TL, Padberg FT Jr, Araki CT, Thompson PN, Hobson RW 2nd. Limited range of motion is a significant factor in venous ulceration. *J Vasc Surg*. 1995;22(5):519-523.
29. Williams KJ, Ayekoloye O, Moore HM, Davies AH. The calf muscle pump revisited. *J Vasc Surg Venous Lymphat Disord*. 2014;2(3):329-334.
30. Uhl JF, Chahim M, Allaert FA. Static foot disorders: a major risk factor for chronic venous disease? *Phlebology*. 2012;27(1):13-18.
31. Dissemond J, Assenheimer B, Bültemann A, et al. Compression therapy in patients with venous leg ulcers. *J Dtsch Dermatol Ges*. 2016;14(11):1072-1087.
32. Kolh P. Reducing leg oedema after femoro-popliteal bypass surgery: a challenge. *Eur J Vasc Endovasc Surg*. 2010;40(5):643-644.
33. Weiss RA, Sadick NS, Goldman MP, Weiss MA. Post-sclerotherapy compression: controlled comparative study of duration of compression and its effects on clinical outcome. *Dermatol Surg*. 1999;25(2):105-108.
34. Rabe E, Partsch H, Hafner J, et al. Indications for medical compression stockings in venous and lymphatic disorders: an evidence-based consensus statement. *Phlebology*. 2018;33(3):163-184.

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Residual edema following venous interventions: prevention and management

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ABSTRACT

Chronic venous disease (CVD) signs and symptoms include heaviness, aching, swelling, throbbing, and itching (HASTI). Advanced stages of CVD include swelling, hyperpigmentation, and venous ulcer. Treatment improves most of the signs and symptoms including healing of venous ulcers. Resolution of swelling is often not achieved and can be due to a variety of reasons. After venous intervention, inconsistent rates of reduction in swelling can be due to misdiagnosis, persistent venous disease, and burnout of the lymphatic system. Patients require comprehensive evaluation to identify potential treatment options. Failure to identify other causes of swelling after venous intervention should prioritize lymphatic health using conservative therapies like compression, exercise, and, potentially, venoactive drugs. The addition of lymphedema management techniques such as manual lymphatic drainage and intermittent pneumatic compression are recommended. Further research is needed to clarify the factors influencing swelling resolution, optimize treatment strategies, and establish evidence-based guidelines for post-intervention care, ultimately improving patient outcomes and quality of life.

Keywords

management | prevention | residual edema | venous interventions

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Introduction

Chronic venous disease (CVD) is caused by reflux or obstruction in the superficial or deep venous system, resulting in venous hypertension. In advanced stages (chronic venous insufficiency [CVI]), the pathology may cause lower-extremity edema, lipodermatosclerosis, and ulceration. Conservative treatment of CVD includes compression therapy, weight loss, exercise, and venotonic drugs. Persistent symptoms despite conservative therapy may lead to treatment of the underlying venous pathology.

Patients who present with disease of CEAP clinical score 3 (based on the clinical-etiological-anatomical-pathophysiological classification system) are often challenging, as resolution of their swelling is not always achieved after venous intervention. This can occur because of failure to identify the underlying cause of swelling, failure to carry out complete treatment of the venous pathology, a multifactor origin of the swelling, or a compromised lymphatic system due to overwhelm by long-standing venous hypertension.

Patients who have residual edema after venous interventions require reevaluation of the causes of leg swelling, careful investigation for residual or undiagnosed superficial or deep disease, and treatment of their lymphatic system.

Residual edema after venous interventions

Venous interventions are considered safe and have been shown to overall significantly improve clinical symptoms and quality of life.[1] There are limited data available on improvement of edema after venous intervention. Most papers that report on results of treatment for clinical symptoms of CVD include patients with disease graded as CEAP C2-C6, with the majority being CEAP C2. Improvement in edema in these studies is usually not a primary end point and not reported in an objective manner, therefore not well documented.

In evaluating outcomes after endovenous ablation in patients with leg swelling, Shutze et al[2] identified CEAP C3 patients in a database of 1634 limbs treated with endovenous ablation. There were 528 limbs that were treated for edema with an average follow-up of 1494 days (range, 562–2795 days). Patients were surveyed on the amount of edema (current and immediately post procedure), the use of compression stockings, and current satisfaction with the procedure. In this group, 40% of patients had residual swelling after endovenous ablation.[2] Korany et al[3] retrospectively reviewed 80 patients with edema and combined those with superficial reflux and segmental deep venous reflux who underwent endovenous ablation. On follow-up, all patients had no signs of residual superficial reflux, whereas deep venous segment reflux was corrected in 36 (45%) patients after treating the superficial reflux. Edema improved in 45%, whereas 55% showed no improvement after treatment. Similar results were seen at 3, 6, and 12 months. Adherence to compression stocking therapy was high up to 6 months postoperatively, at which point adherence began to drop.[3] This study suggests that patients with combined superficial and deep reflux may have a higher failure rate in resolving their edema even with use of compression therapy.

In patients with iliac vein obstruction, percutaneous venous stenting has been reported to reduce edema, although not significantly. Neglén et al[4] reported on 982 chronic nonmalignant obstructive lesions of the iliac vein that were stented. There was no improvement in swelling in 38% of the patients, 30% had partial relief, and only 32% had complete relief of swelling.[4] This group of patients with long-standing disease and high venous hypertension due to venous outflow obstruction seem to have the lowest improvement in swelling after intervention, with 68% having residual edema.

Given the poor results for improvement in swelling after venous interventions, it is paramount to discuss patient expectations prior to treatment. Patients with CVD may present with many clinical symptoms, and those who have a main clinical concern about swelling need to understand that improvement in swelling may or may not occur and that, in some instances, they may have no improvement. The severity, location, and duration of venous disease seem to have an impact on improvement in edema after intervention.[2-4] This may relate to burnout of the lymphatic system over time and its inability to recover even after the venous hypertension is addressed. If that is the case, early intervention in CEAP C3 patients may result in improvement in resolution of symptoms.

Potential reasons for residual leg swelling after venous interventions was nicely reviewed in a previous article in this issue and include residual venous disease in the superficial or deep veins, undiagnosed disease in the superficial or deep veins, nonvenous causes, and dysfunction of the lymphatics. A comprehensive evaluation of these patients is required to offer proper treatment.

Treatment of persistent edema after venous interventions

The first step in the evaluation of a patient with persistent swelling is to start from the beginning and do a complete history, physical, and evaluation. Whereas venous disease is a common cause of edema, the differential diagnoses are broad and may be multifactorial.[5] Below are potential causes of swelling and treatment approaches for each.

Systemic causes. Edema can be caused by systemic causes (eg, heart failure, cirrhosis, renal failure, and endocrine disorders). In this case, patients will have bilateral swelling, although rarely they may present with unilateral edema. Evaluation and treatment of systemic causes is critical in these patients to improve their edema. More often than not, the above conditions can be optimized but not cured. Therefore, some degree of edema will most often be present.

Medications. Medications are one of the most common causes of swelling, and such cases typically also present with bilateral edema. All patients with leg swelling should have their medications reviewed, looking for drugs that can cause leg swelling (eg, calcium channel blockers, nonsteroidal anti-inflammatory drugs [NSAIDs], and oral hypoglycemic agents). Discontinuation of such medications will improve their swelling.

Musculoskeletal causes. Immobility and gait disturbances can contribute to lower-limb edema. A sedentary lifestyle, where the lower limbs remain stationary for extended periods without active movement, can also contribute. Additionally, static foot disorders can be an important risk factor that adversely affects edema. Patients should be encouraged to walk, exercise, and undergo physical therapy, all of which help improve calf muscle pump function, enhance venous and lymphatic flow, and reduce edema.

Obesity. One of the major causes of leg swelling is obesity. Patients present with signs and symptoms of venous disease and bilateral swelling. They also tend to present with more advanced stages of venous disease.[6] This is due to underlying central venous obstructions from the high intra-abdominal pressure. Patients should be encouraged to follow a healthy diet, lose weight, and exercise. In cases of morbid obesity, patients may be candidates for medical or surgical weight loss interventions.

Venous disease. When the above potential causes of leg swelling have been excluded, detailed venous imaging should be done. If swelling after the intervention worsens, ultrasound should be done to evaluate for postoperative deep venous thrombosis. Imaging should also evaluate for residual untreated disease, new venous disease, or unrecognized deep venous disease.[7-9] Not all CEAP C3 patients with superficial disease undergo deep venous imaging, and a proximal obstruction may have been missed. Treatment of residual superficial venous disease or treatment of proximal obstruction can help improve residual swelling. Residual and recurrent vein disease are fairly common; thus, treatment of all possible pathology will further reduce edema. Patients with deep infrainguinal reflux or obstruction do not have many treatment options. However, they should be encouraged to be physically active, exercise, and wear elastic compression stockings.

Pharmacological interventions, such as venotonic drugs, may also be considered as part of the comprehensive management strategy. There are several studies that have shown venotonic drugs to improve signs and symptoms of venous disease and specifically to improve leg edema and circumference.[10-12]

Treatment of the lymphatic system

Effective postoperative management is crucial for addressing residual edema and optimizing patient comfort after venous interventions. In CVD patients who present with edema secondary to venous hypertension, treatment may or may not improve the edema. If CVD is the inherent cause of edema, early treatment of the venous pathology may improve the edema. However, if chronic venous hypertension is long-standing and damages the lymphatics, the edema may be irreversible. Patients with residual edema should be offered treatment of their lymphatics.

Patients with persistent swelling should be offered lymphedema treatment that includes lifestyle modifications and medical interventions. This is known as complete decongestive therapy, and it all starts with patient education. Patients are encouraged to elevate their legs and engage in regular leg exercises to promote calf muscle pump function. Maintaining a healthy diet and managing weight are crucial, as is promoting physical activity.

Compression therapy is a cornerstone in the management of these patients. Daytime compression therapy for lymphedema management typically involves custom-fitted or over-the-counter compression garments, wrap devices, or bandaging, with a preference for flat knit materials. For patients with stage 2 or 3 lymphedema, nighttime compression garments are also recommended. Manual lymphatic drainage (MLD) should be considered in case of advanced swelling, with transition

to self-MLD and intermittent pneumatic compression (IPC) devices, shown to significantly improve quality of life, reduce swelling, and complications.[13,14]

A recent Delphi consensus on the management of lymphedema strongly supports the use of compression garments, with 89% agreeing that regular use reduces disease progression; 70.2% agree that MLD is a mandatory component of patient care; and 92% recommend IPC for lymphedema patients.[15] In summary, with persistent edema after venous interventions, treatment should focus on the lymphatic system.

Conclusion

Improvement in swelling after venous interventions varies in the literature. This can be due to misdiagnosis, residual venous disease, or failure of the lymphatic system. Evaluation for other causes of swelling or treatment of residual venous disease is important. If swelling persists or no other causes are identified, treatment of the lymphatic system is necessary. Addressing patients' expectations ahead of venous interventions for leg swelling is critical given that swelling may persist in 40% to 70% of patients.

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References

1. Kim H, Cho S, Lee K, Labropoulos N, Joh JH. Clinical outcomes of nonthermal ablation, thermal ablation, and surgical stripping for varicose veins. *J Vasc Surg Venous Lymphat Disord*. 2024;12(6):101902.
2. Shutze W, Shutze R, Dhot P, Ogola GO. Patient-reported outcomes of endovenous superficial venous ablation for lower extremity swelling. *Phlebology*. 2019;34(6):391-398.
3. Korany AO, Ismail AM, ElAskary NA, Kassem AM. The effect of superficial venous incompetence treatment on combined segmental deep venous reflux. *Ann Vasc Surg*. 2024;100:184-189.
4. Neglén P, Hollis KC, Olivier J, Raju S. Stenting of the venous outflow in chronic venous disease: long-term stent-related outcome, clinical, and hemodynamic result. *J Vasc Surg*. 2007;46(5):979-990.
5. Gasparis AP, Kim PS, Dean SM, Khilnani NM, Labropoulos N. Diagnostic approach to lower limb edema. *Phlebology*. 2020;35(9):650-655.
6. Burian EA, Rungby J, Karlsmark T, et al. The impact of obesity on chronic oedema/lymphoedema of the leg – an international multicenter cross-sectional study (LIMPRINT). *Int J Obes (Lond)*. 2024;48(9):1238-1247.
7. Puggioni A, Lurie F, Kistner RL, Eklof B. How often is deep venous reflux eliminated after saphenous vein ablation? *J Vasc Surg*. 2003;38(3):517-521.
8. Mühlberger D, Morandini L, Brenner E. Venous valves and major superficial tributary veins near the saphenofemoral junction. *J Vasc Surg*. 2009;49(6):1562-1569.
9. Adler C, Mousa A, Rhee A, Patel MD. Varicose veins of the lower extremity: Doppler US evaluation protocols, patterns, and pitfalls. *Radiographics*. 2022;42(7):2184-2200.
10. Kakkos SK, Nicolaides AN. Efficacy of micronized purified flavonoid fraction (Daflon®) on improving individual symptoms, signs and quality of life in patients with chronic venous disease: a systematic review and meta-analysis of randomized double-blind placebo-controlled trials. *Int Angiol*. 2018;37(2):143-154.
11. Ulloa JH. Micronized purified flavonoid fraction (MPFF) for patients suffering from chronic venous disease: a review of new evidence. *Adv Ther*. 2019;36(Suppl 1):20-25.
12. Martinez-Zapata MJ, Vernooij RW, Simancas-Racines D, et al. Phlebotonics for venous insufficiency. *Cochrane Database Syst Rev*. 2020;11(11):CD003229.
13. Murray-Ramcharan M, Escurra MF, Donaldson B, Raza Rizvi SA. Patient-centered outcomes of a lymphedema pump in patients with symptomatic lower extremity edema. *Ann Vasc Surg*. 2024;108:333-337.
14. Lerman M, Gaebler JA, Hoy S, et al. Health and economic benefits of advanced pneumatic compression devices in patients with phlebolymphedema. *J Vasc Surg*. 2019;69(2):571-580.
15. Lurie F, Malgor RD, Carman T, et al. The American Venous Forum, American Vein and Lymphatic Society and the Society for Vascular Medicine expert opinion consensus on lymphedema diagnosis and treatment. *Phlebology*. 2022;37(4):252-266.

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Improving clinical outcomes in patients with chronic venous obstruction

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ABSTRACT

Chronic venous obstruction (CVO) is a debilitating condition affecting millions of individuals, leading to significant morbidity and reduced quality of life. This review aims to explore innovative strategies and evidence-based approaches to enhance the management and long-term outcomes of patients with CVO. Accurate diagnosis and assessment of CVO severity is crucial for guiding appropriate treatment. Noninvasive techniques like duplex ultrasonography, computed tomography (CT) venography, and magnetic resonance (MR) venography can provide detailed information about the venous system. Invasive venography remains the gold standard for evaluating the extent and severity of venous obstruction. Conventional conservative treatments, such as compression therapy, play a crucial role in CVO management. Compression stockings can improve venous return, reduce edema, and alleviate symptoms. Compression therapy has also been shown to enhance the effectiveness of other interventions, such as endovascular procedures. Emerging treatment modalities, including endovascular venous reconstruction and adjunct surgical endophlebectomy, offer promising alternatives for patients with CVO. Endovascular techniques, such as stenting and angioplasty, can effectively restore venous patency and improve clinical outcomes. Surgical endophlebectomy may be considered in complex cases where endovascular options are limited. Multidisciplinary care, involving vascular specialists, wound care experts, and physical therapists, is essential for optimizing patient outcomes. Ongoing research and clinical trials are further exploring innovative strategies to improve the management and long-term prognosis of individuals with CVO.

Keywords

chronic venous obstruction | clinical outcome | postthrombotic syndrome | venous recanalization | venous stenting

Introduction

Chronic venous obstruction (CVO) is a debilitating condition that affects millions of individuals worldwide, often leading to pain, swelling, venous claudication, and ulceration and therefore significant morbidity and reduced quality of life.[1] CVO represents a significant public health concern, affecting a substantial portion of the population. Whereas precise prevalence rates vary depending on the population studied and the diagnostic criteria used, estimates suggest that chronic venous insufficiency, a broader category encompassing CVO, affects approximately 20 to 25 million adults in the United States alone.[2] The incidence of CVO rises with age, and risk factors include family history, female gender, obesity, pregnancy, prolonged standing, and a history of deep venous thrombosis.[3] The impact of CVO extends beyond physical symptoms, significantly affecting patients' quality of life. The chronic pain, swelling, and limitations in mobility can hinder daily activities, work productivity, and social interactions. Moreover, venous ulcers are challenging to treat and can lead to infections, cellulitis, and a significant decline in functional status. Patients with CVO often experience emotional distress, social isolation, and a reduced overall sense of well-being.[4]

The management of CVO requires a comprehensive approach that addresses both the underlying venous obstruction and the associated symptoms. Treatment options can be broadly categorized into conservative measures, such as compression therapy, wound care, and lifestyle modification, such as exercise and weight loss, and more invasive interventions, including endovascular venous reconstruction and in rare cases, adjunct surgical endophlebectomy.[5]

Despite the availability of various treatment modalities, improving clinical outcomes in these patients remains a challenging task for health care professionals. This review aims to explore innovative strategies and evidence-based approaches to enhance the management and long-term outcomes of patients with chronic venous obstruction.

Thorough diagnosis and severity assessment

Accurate diagnosis and assessment of CVO severity are crucial for guiding appropriate treatment strategies and improving the clinical outcomes. Various diagnostic tools are available, each with unique strengths and limitations. Duplex ultrasonography is a widely used noninvasive technique that can assess venous patency, reflux, and obstruction, with a reported sensitivity and specificity of 90% to 95%. According to European guidelines, duplex ultrasound should be the first-line diagnostic modality for evaluating CVO due to its high accuracy, availability, and noninvasive nature.[6] Computed tomography (CT) venography and magnetic resonance (MR) venography are advanced imaging techniques that can provide detailed anatomical information about the venous system, with sensitivities and specificities ranging from 80% to 95%. The 2022 European guidelines by De Maeseneer et al recommend considering CT venography and MR venography when additional anatomical information is needed, such as in complex cases or for treatment planning *(Figure 1)*.[6,7]

Invasive techniques, such as venography, remain the gold standard for evaluating the extent and severity of venous obstruction, with a sensitivity and specificity approaching

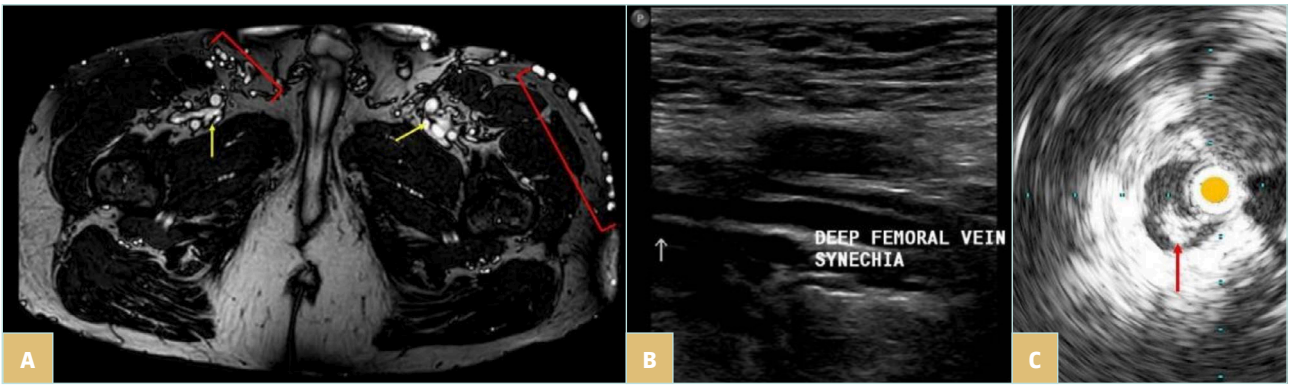

Figure 1. Multimodal imaging of chronic venous obstruction (CVO).
A) Magnetic resonance venography (MRV) highlighting bilateral CVO. Yellow arrows indicate the presence of postthrombotic synechiae in the common femoral veins. Red brackets show the extensive collaterals developed due to the bilateral CVO. B) Duplex ultrasound displaying postthrombotic synechiae within the deep femoral vein in a patient with CVO extending below the inguinal ligament. C) Intravascular ultrasound (IVUS) of common femoral vein following the recanalization. The yellow dot marks the position of the IVUS catheter, and the red arrow points to the postthrombotic synechiae inside the vein.

100%. The choice of diagnostic modality should be based on clinical presentation, resource availability, and health care provider expertise.

Clinical venous and Villalta scores are key tools for assessing CVO severity. The venous clinical severity score (VCSS) focuses on obstruction and reflux, whereas the Villalta score evaluates postthrombotic syndrome (PTS) symptoms. A Villalta score of 10 to 14 signifies moderate PTS, and 15 or higher indicates severe PTS. These scores, correlating with obstruction extent, guide decisions regarding endovascular venous recanalization and are useful for evaluating symptoms improvement after venous recanalization.[8]

The CEAP classification, ranging from C0 (no visible signs) to C6 (active ulceration), assesses chronic venous disease severity. Higher classes indicate more advanced disease. This system comprehensively evaluates clinical, etiological, anatomical, and pathophysiological aspects, guiding treatment and monitoring progression.[9]

Conservative management

Compression therapy

Compression therapy is a well-established and crucial component in the management of CVO. Compression stockings apply external pressure on the lower extremities, which helps improve venous return, reduce edema, and alleviate symptoms like pain and heaviness. Studies have demonstrated that the use of compression stockings can significantly enhance the clinical outcomes of patients with CVO, including decreasing the risk of ulcer formation and recurrence. Furthermore, compression therapy has been shown to enhance the effectiveness of other interventions, such as endovascular venous stenting, by facilitating improved venous outflow and reducing the risk of postprocedural complications.[10] Adhering to long-term compression therapy is essential, as it can help prevent the progression of the disease and improve the overall quality of life for patients with CVO.

Wound care and local therapies

Proper wound care is essential for the management of venous leg ulcers, which often develop as a result of CVO. The primary goals of wound care are to promote healing, prevent infection, and address any underlying factors contributing to the ulcer formation. Strategies for effective wound management include regular debridement, moisture-retentive dressings, and the use of advanced therapies like negative pressure wound therapy and bioengineered skin substitutes.[11,12] Additionally, local therapies such as intermittent pneumatic compression and topical medications like pentoxifylline or aspirin can be used to enhance the healing process and reduce the risk of recurrence.[13]

Anticoagulation and antithrombotic agents

Besides compression therapy, the use of anticoagulation and antithrombotic medications is a crucial component of the conservative management of CVO. Anticoagulation, particularly with vitamin K antagonists or direct oral anticoagulants (DOACs), has been shown to reduce the risk of recurrent thrombosis and the development of PTS.[14]

According to the 2022 European guidelines by De Maeseneer et al, DOACs are recommended as the preferred anticoagulant option for patients with CVO.[6] DOACs have been found to be effective in reducing the risk of PTS and are associated with a lower risk of bleeding than are vitamin K antagonists. The guidelines suggest using DOACs for at least 6 months to 1 year, with the potential for longer-term anticoagulation depending on the individual patient's risk factors and response to treatment.

In contrast, the evidence supporting the use of antiplatelet agents in the management of CVO is limited. Whereas antiplatelet drugs such as aspirin or clopidogrel may have a role in the prevention of arterial thrombosis, their efficacy in reducing the risk of PTS or improving clinical outcomes in patients with CVO has not been conclusively demonstrated.[15] The 2022 European guidelines do not recommend the routine use of antiplatelet agents for the management of CVO as the potential benefits are outweighed by the risk of bleeding and other adverse events.[6]

Exercise and lifestyle modifications

Regular physical activity and healthy lifestyle choices can provide significant benefits for individuals with CVO.[16] Exercise, such as walking, swimming, or other low-impact activities, has been shown to alleviate symptoms, reduce edema, and enhance overall quality of life in this patient population.[6,17] Similarly, maintaining a healthy body weight and adopting an active lifestyle can play a crucial role in managing the long-term consequences of CVO.[15,18] Jayaraj et al investigated the impact of body mass index (BMI) on initial presentation and outcomes of endovascular venous recanalization and stenting in 464 patients with CVO.[19] Their findings suggest that whereas a higher BMI is associated with more severe venous hypertension symptoms, there were no significant differences in postprocedural clinical, stent patency, or quality-of-life–related outcomes between patients with normal, overweight, and obese BMI.[19]

Endovascular interventions for chronic venous obstruction

Endovascular interventions have emerged as a crucial component in the management of CVO, offering a minimally invasive approach to address the underlying anatomical abnormalities and improve clinical outcomes. Endovascular venous recanalization, such as angioplasty and stenting, is recommended for symptomatic patients with iliofemoral venous outflow obstruction.[20,21] The procedure is considered when conservative treatment options, such as compression therapy and medication, have proven insufficient in managing the symptoms of CVO.[16,22-24] This minimally invasive approach aims to restore venous patency, improve venous outflow, and alleviate symptoms associated with CVO *(Figure 2)*.[23-26] Several studies have demonstrated the effectiveness of endovascular interventions in improving clinical outcomes, reducing the risk of ulceration, and enhancing the quality of life for patients with CVO.[27-29]

Implications of inflow disease on treatment outcomes

A range of underlying and technical factors influence the long-term success of endovascular interventions for CVO. Whereas technical aspects like stent design, material, and reconstruction technique can be optimized to improve long-term patency, it is crucial to recognize the impact of concurrent inflow disease on treatment outcomes.[20,22,30] The femoral vein and deep femoral vein play a vital role in inflow, providing the major return of blood from the lower extremities to the stented tract.[22] The quality of inflow in these veins can be affected by factors such as vessel diameter, the degree of obstruction, and the extent of the pathology. Clinical evidence underscores the significance of inflow quality in determining stent outcomes. Several studies have investigated the impact of inflow on treatment success, revealing that patients with better inflow quality tend to experience more favorable long-term outcomes after stent implantation.[22,31]

The International CVO Classification Study Group developed an inflow grading system (Jalaie classification) to assess the quality of venous inflow and inform appropriate treatment strategies.[30] This inflow classification is based on preoperative Doppler ultrasound findings of the abdominal, pelvic, and lower-extremity veins, which must be confirmed by at least 1 complementary imaging modality such as CT venography or MR venography to determine the extent of pathology. Patients are then categorized into one of 5 classification types according to the anatomical distribution of venous involvement *(Figure 3)*.[30] This classification delineates 5

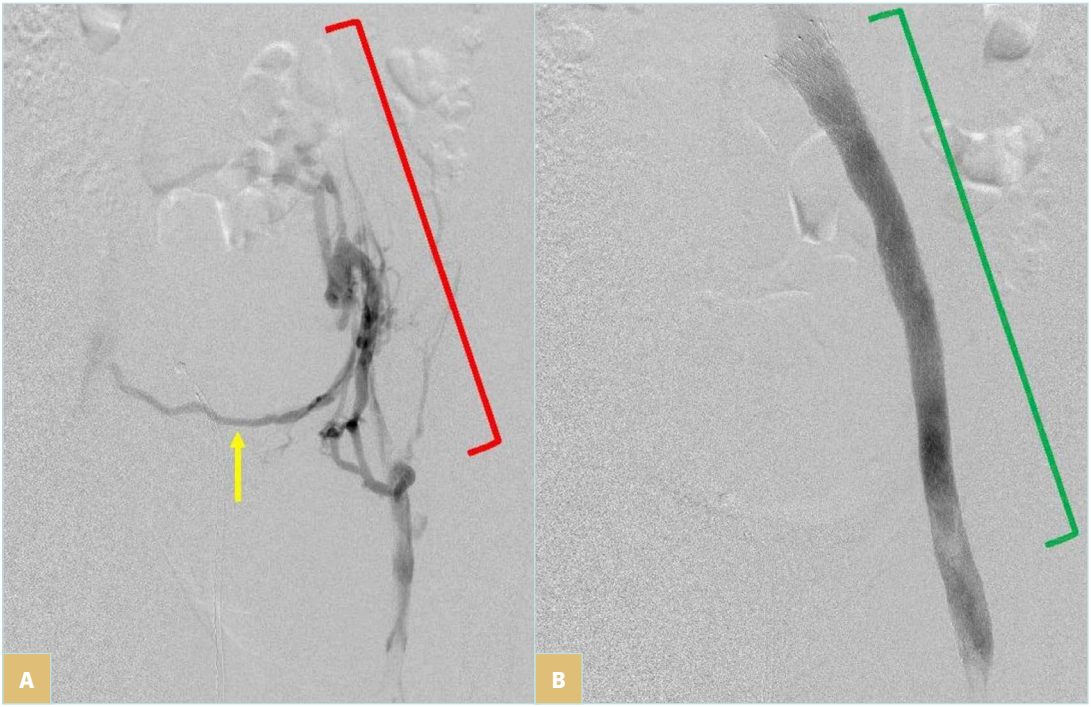

Figure 2. Phlebographic evaluation before and after stent deployment in left femoroiliac vein occlusion. A) Initial intraoperative phlebography illustrating the occlusion of the left femoroiliac veins, indicated by a red bracket. A spontaneous palmar collateral to the right side is highlighted with a yellow arrow. B) Final phlebography after stent deployment demonstrating an unobstructed washout of contrast through stents (green bracket). Notably, the previously visible collaterals have vanished, indicating successful alleviation of the venous obstruction and restoration of normal venous flow.

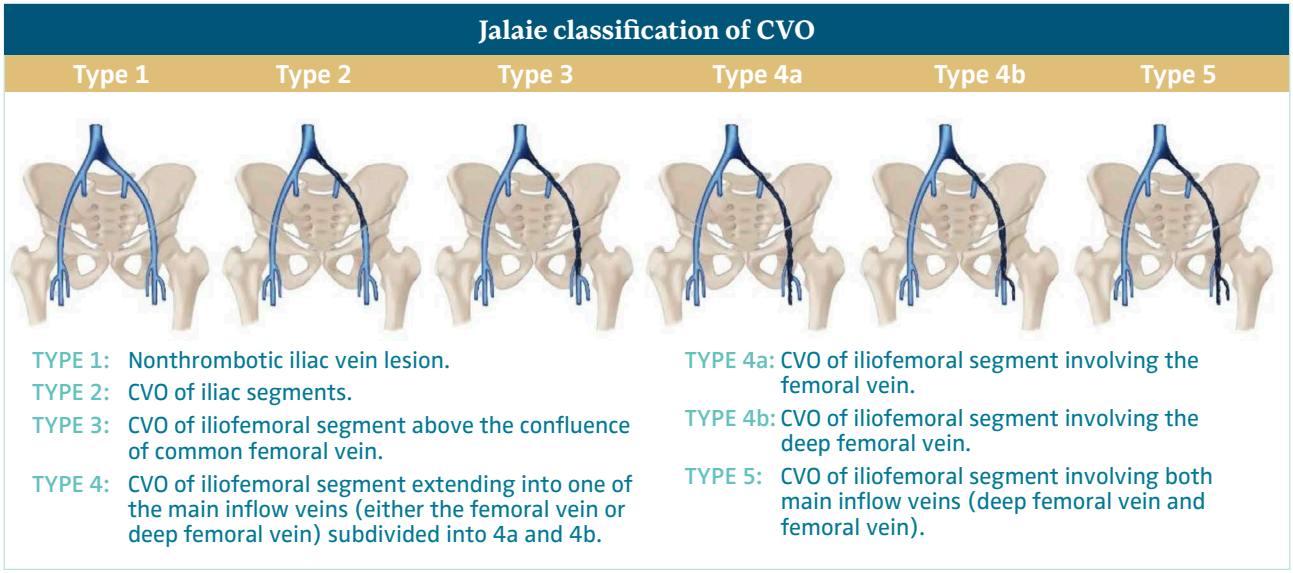

Figure 3. Classification system for chronic venous obstruction (CVO) of femoroiliac tract.
This classification delineates 5 distinct categories based on the anatomical location and extent of the obstruction.
After reference 30: Jalaie et al. *Eur J Vasc Endovasc Surg*. 2024:S1078-5884(24)00873-6. © 2024, The Author(s). Published by Elsevier B.V. on behalf of European Society for Vascular Surgery.

distinct categories based on the anatomical location and extent of the obstruction.

The analysis of the CVO classification system revealed that type 4 and 5 lesions, characterized by compromised venous inflow, exhibited significantly lower long-term stent patency rates than type 1 to 3 lesions, even after successful endovascular recanalization.[30,32] Specifically, the 2-year primary patency rate for endovenous recanalization and stenting in patients with type 2 CVO was reported to be 85.9%, whereas type 4 and 5 lesions were associated with substantially poorer outcomes, with primary patency rates around 50% and 30%, respectively. Additionally, the longer diseased segment extending below the inguinal ligament along with obstruction of the common femoral vein (CFV) in type 3 CVO impedes inflow from the great saphenous vein and other tributaries, reducing blood drainage into the CFV. This combination of stent extension below the inguinal ligament and prolonged CFV obstruction may contribute to the reduced inflow and decreased stent patency observed in type 3 CVO compared with type 2.[30] Importantly, the available evidence suggests that the additional involvement of the inferior vena cava has a relatively minor impact on the decision-making and outcomes of these interventions.[33-36] Therefore, a thorough assessment of the venous inflow quality and appropriate classification of the CVO is crucial for optimizing patient selection and improving the long-term outcomes of endovascular interventions for CVO.[22,30]

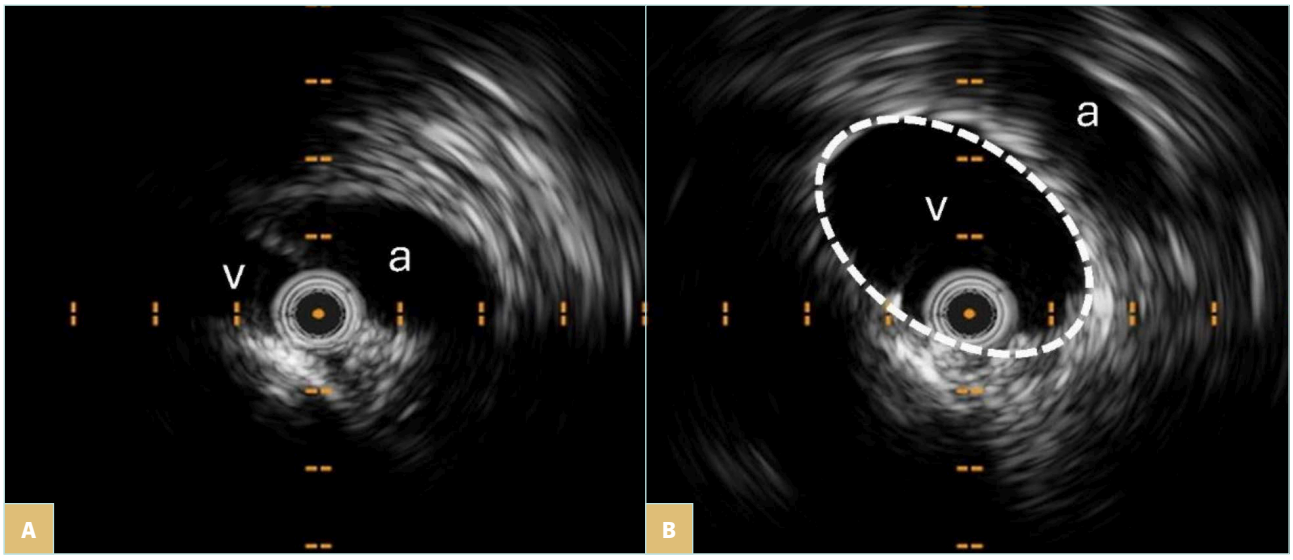

Figure 4. Intravascular ultrasound (IVUS) imaging of May-Thurner syndrome before and after stent placement.
A) IVUS before stent implantation illustrates the left common iliac vein (v) being compressed by the overlying right common iliac artery (a), leading to a narrowed passage. B) IVUS after stent implantation: a stent (white dots) has been placed in the left common iliac vein (v) to relieve the compression by the right common iliac artery (a).

Therapeutic guidance with intravascular ultrasound

Intravascular ultrasound (IVUS) has become an indispensable tool in the management of CVO, playing a crucial role in both the diagnostic and therapeutic phases of endovascular venous recanalization and stenting.[37] Unlike conventional venography, which provides a two-dimensional luminal view, IVUS offers a real-time, cross-sectional visualization of the venous anatomy.[37] This detailed imaging modality allows for a comprehensive assessment of the location, extent, and severity of venous stenosis or occlusion, venous wall characteristics, and precise identification of external compression points, such as May-Thurner syndrome, which may contribute to venous obstruction *(Figure 4A)*.[10,38]

The use of IVUS during endovascular interventions significantly enhances procedural accuracy and effectiveness.[39] IVUS guidance is particularly valuable for deciding on the optimal landing zones and stent sizing, eg, precise stent length selection based on accurate measurements of the venous lumen.[10] Furthermore, IVUS allows for accurate stent placement by ensuring optimal stent positioning *(Figure 4B)*, spanning the entire length of the obstruction and minimizing the risk of stent malapposition or migration.

Moreover, IVUS enables the evaluation of the postintervention result, confirming the adequacy of the venous recanalization and the absence of residual stenosis, stent deformation, or procedural complications. Studies have demonstrated that the use of IVUS during endovascular venous recanalization and stenting is associated with improved clinical outcomes. IVUS-guided procedures have shown higher primary and secondary patency rates than venography-guided interventions.[39] The precise stent sizing and placement facilitated by IVUS minimize the need for reintervention. Last but not least, patients undergoing IVUS-guided interventions often experience greater improvement in symptoms, such as pain, swelling, and ulcer healing.[10,22]

Emergence of dedicated stents

Dedicated venous stents offer several advantages over other stents commonly used for endovascular venous stenting.[40,41] These specialized stents are engineered specifically for the venous system, accounting for the unique anatomical and physiological characteristics of veins. Unlike stents primarily designed for the arterial system, dedicated venous stents exhibit enhanced flexibility and higher radial force, which aids in accommodating the natural compression and pulsatility inherent to the venous vasculature. Additionally, venous stents typically feature a longer length to address the extensive nature of venous obstructions.[42] These design features contribute to improved conformability, decreased risk of venous wall injury, and enhanced long-term patency compared with the off-label use of arterial stents in the venous system.[41-43]

Endophlebectomy for chronic venous obstruction

For patients with extensive type 4 and 5 CVO characterized by postthrombotic trabeculation involving the CFV and extending into the main inflow veins, the management remains challenging due to the impaired venous inflow.[44] In a highly selected subgroup of individuals with type 4b CVO, endophlebectomy, a specialized surgical intervention, may be considered. This procedure aims to remove the obstructive trabeculation from the CFV and the orifice of its tributaries, particularly the deep femoral vein *(Figure 5)*.[45,46] When implemented in conjunction with iliac vein stenting, endophlebectomy can help provide adequate venous inflow by securing supply from the major side branches of the CFV, thereby mitigating the risk of early stent thrombosis.[6]

However, endophlebectomy is associated with a high rate of complications, such as bleeding and infection, which puts limits on its use in clinical settings.[6]

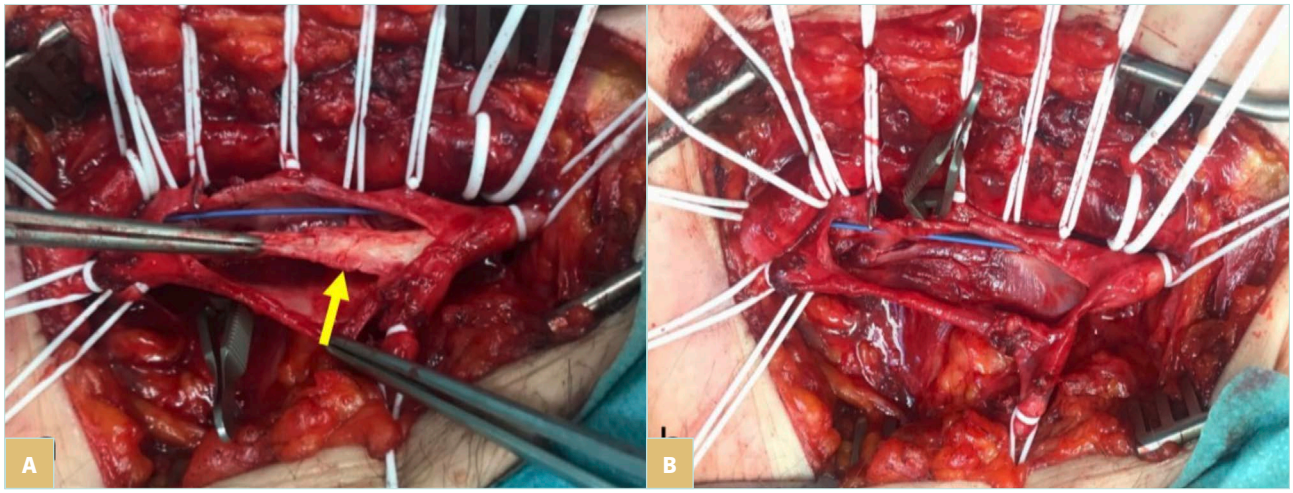

Figure 5. Intraoperative visualization of dissection of synechiae and postendophlebectomy clearance.
A) Dissected intraluminal synechiae (yellow arrow) and B) the cleared vein after endophlebectomy. The presence of the guidewire in situ indicates successful recanalization.
After reference 46: de Wolf et al. *Br J Surg*. 2017;104(6):718-725. **Images provided courtesy of H. Jalaie.**

Postprocedural care and surveillance

Postoperative care focuses on preventing in-stent thrombosis and ensuring long-term procedural success. Regular follow-ups are essential to promptly detect and address any in-stent thrombosis or stenosis.[6]

Anticoagulation regimens after endovascular intervention

Adequate anticoagulation is essential after endovascular treatment for CVO. The procedure can induce a hypercoagulable state postoperatively, increasing the risk of early in-stent thrombosis, which is the most common early complication.[47] This underscores the critical importance of providing sufficient therapeutic anticoagulation both during and immediately after the procedure.[48] Maintaining appropriate anticoagulation in the initial 6 to 12 months is crucial to prevent thrombotic complications in the newly recanalized venous segments. Low-molecular-weight heparins are recommended for the first 2 weeks due to their anti-inflammatory and anticoagulant properties.[49] Subsequently, low-molecular-weight heparins are often replaced by DOACs. In cases of ineffective anticoagulation or recurrent thrombosis with DOACs, a switch to vitamin K antagonists with a target international normalized ratio between 2.5 and 3.5 is recommended.[6,50] There is no consensus regarding the use of antiplatelet therapy yet.[51]

Compression therapy

Postoperative adjunctive compression therapy, along with early mobilization, plays a crucial role in maintaining early and long-term patency. Patients are advised to use class 2 open-toe compression stockings for at least 1 year postoperatively. Additionally, intermittent pneumatic compression devices may be utilized to support venous return. Compression therapy helps improve venous return, reduce edema, and prevent the development of PTS. It is an essential component of the comprehensive management approach for patients with CVO, complementing other interventions such as anticoagulation and endovascular procedures.[6,52,53]

Follow-up and surveillance

Close postoperative surveillance with clinical examination and duplex ultrasound is essential to monitor stent patency and detect any complications in a timely manner, as recommended by the 2022 European guidelines on CVO.[6] Thrombotic complications tend to occur early in the postoperative period, making it crucial to act quickly. The golden period to rescue a thrombosed stent using mechanical aspiration thrombectomy and thrombolysis is the first 2 weeks. Therefore, according to the guidelines, it is of utmost importance to perform the first duplex ultrasound control prior to discharge and within 2 weeks of the recanalization procedure. Subsequent follow-ups should be scheduled at 6 weeks, 3 months, 6 months, and then annually to ensure ongoing monitoring and timely intervention if needed, as guided by the recommendations.[54]

Conclusion

The management of CVO requires a multifaceted approach, combining conservative treatments like compression therapy, anticoagulation, and lifestyle modifications with targeted endovascular interventions. Endovascular techniques, including stent placement, play a pivotal role in improving clinical outcomes by restoring venous patency and enhancing venous return. Ensuring adequate venous inflow is also essential for successful endovascular interventions. Furthermore, the use of IVUS is crucial in defining the appropriate landing zones for stent placement, optimizing procedural outcomes. However, these procedures present challenges, and careful patient selection based on the proposed inflow classification, tailored anticoagulation regimens, and close postoperative surveillance are crucial to optimize long-term results. A comprehensive strategy integrating both conservative and interventional approaches is essential for achieving optimal outcomes in patients with CVO.

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References

1. Vedantham S, Sista AK. How I use catheter-directed interventional therapy to treat patients with venous thromboembolism. *Blood*. 2018;131(7):733-740.
2. Attaran RR, Carr JG. Chronic venous disease of the lower extremities: a state-of-the art review. *J Soc Cardiovasc Angiogr Interv*. 2022;2(1):100538.
3. Cosmi B, Stanek A, Kozak M, et al. The post-thrombotic syndrome-prevention and treatment: VAS-European Independent Foundation in Angiology/ Vascular Medicine position paper. *Front Cardiovasc Med*. 2022:9:762443.
4. Barbati ME, Gombert A, Toonder IM, et al. Iliocaval skip stent reconstruction technique for chronic bilateral iliocaval venous occlusion. *J Vasc Interv Radiol*. 2020;31(12):2060-2065.
5. Drescher FS, Sirovich BE, Lee A, Morrison DH, Chiang WH, Larson RJ. Aspirin versus anticoagulation for prevention of venous thromboembolism major lower extremity orthopedic surgery: a systematic review and meta-analysis. *J Hosp Med*. 2014;9(9):579-585.
6. De Maeseneer MG, Kakkos SK, Aherne T, et al. Editor's Choice - European Society for Vascular Surgery (ESVS) 2022 clinical practice guidelines on the management of chronic venous disease of the lower limbs. *Eur J Vasc Endovasc Surg*. 2022;63(2):184-267.
7. Lindquist CM, Karlicki F, Lawrence P, Strzelczyk J, Pawlyshyn N, Kirkpatrick IDC. Utility of balanced steady-state free precession MR venography in the diagnosis of lower extremity deep venous thrombosis. *AJR Am J Roentgenol*. 2010;194(5):1357-1364.
8. Strijkers RHW, Wittens CHA, Kahn SR. Villalta scale: goals and limitations. *Phlebology*. 2012;27(Suppl 1):130-135. doi:10.1258/phleb.2011.012s02
9. Lurie F, Passman M, Meisner M, et al. The 2020 update of the CEAP classification system and reporting standards. *J Vasc Surg Venous Lymphat Disord*. 2020;8(3):342-352.
10. Jayaraj A, Thaggard D, Lucas M. Technique of stent sizing in patients with symptomatic chronic iliofemoral venous obstruction—the case for intravascular ultrasound-determined inflow channel luminal area-based stenting and associated long-term outcomes. *J Vasc Surg Venous Lymphat Disord*. 2023;11(3):634-641.
11. Leaper DJ, Schultz G; Carville K, Fletcher J, Swanson T, Drake R. Extending the TIME concept: what have we learned in the past 10 years?(*). *Int Wound J*. 2012;9 Suppl 2(Suppl 2):1-19.
12. Franks PJ, Barker J, Collier M, et al. Management of patients with venous leg ulcers: challenges and current best practice. *J Wound Care*. 2016;25(Suppl 6):S1-S67.
13. Norman G, Westby ML, Rithalia AD, Stubbs N, Soares MO, Dumville JC. Dressings and topical agents for treating venous leg ulcers. *Cochrane Database Syst Rev*. 2018;6(6):CD012583.
14. Midulla M, Chevallier O, Comby PO, et al. Endovascular management of the deep venous thrombosis: a new challenging role for the endovascular specialist in 2020. *Catheter Cardiovasc Interv*. 2021;98(4):748-755.
15. Vedantham S. Thrombectomy and thrombolysis for the prevention and treatment of postthrombotic syndrome. *Hematology Am Soc Hematol Educ Program*. 2017;2017(1):681-685.
16. Schleimer K, Barbati ME, Grommes J, et al. Update on diagnosis and treatment strategies in patients with post-thrombotic syndrome due to chronic venous obstruction and role of endovenous recanalization. *J Vasc Surg Venous Lymphat Disord*. 2019;7(4):592-600.
17. Jasionowska S, Turner BRH, Machin M, et al. Systematic review of exercise therapy in the management of post-thrombotic syndrome. *Phlebology*. 2022;37(10):695-700.
18. Kahn SR, Comerota AJ, Cushman M, et al. The postthrombotic syndrome: evidence-based prevention, diagnosis, and treatment strategies: a scientific statement from the American Heart Association. *Circulation*. 2014;130(18):1636-1661.
19. Jayaraj A, Powell T, Raju S. Effect of body mass index on initial presentation and outcomes after stenting for quality of life–impairing chronic iliofemoral venous obstruction. *J Vasc Surg Venous Lymphat Disord*. 2022;10(2):325-33.e1.
20. Bakas JM, Moelker A, van Montfrans C, Kruip M, Verhagen HJM, van Rijn MJE. Long term follow up, causes for re-intervention, and consequences for surveillance after stenting for proximal deep vein obstruction. *Eur J Vasc Endovasc Surg*. 2023;66(3):389-396.
21. Razavi MK, Black S, Gagne P, Chiacchierini R, Nicolini P, Marston W; VIRTUS Investigators. Pivotal study of endovenous stent placement for symptomatic iliofemoral venous obstruction. *Circ Cardiovasc Interv*. 2019;12(12):e008268.
22. Barbati ME, Avgerinos ED, Baccellieri D, Doganci S, Lichtenberg M, Jalaie H. Interventional treatment for post-thrombotic chronic venous obstruction: progress and challenges. *J Vasc Surg Venous Lymphat Disord*. 2024;12(5):101910.
23. Stuck AK, Reich T, Engelberger RP, Sebastian T, Kucher N. Endovascular treatment of post-thrombotic and non-thrombotic iliofemoral venous outflow obstructions with self-expanding nitinol stents. *Vasa*. 2018;47(4):319-325.
24. Vedantham S, Weinberg I, Desai KR, et al. Society of Interventional Radiology position statement on the management of chronic iliofemoral venous obstruction with endovascular placement of metallic stents. *J Vasc Interv Radiol*. 2023;34(10):1643-1657.e1.
25. Elshinawy WE, Abdo EM, Farouk N, et al. Effectiveness of venous stenting for the treatment of lower extremity chronic thrombotic venous obstruction. *Ann Vasc Surg*. 2023;92:142-148.
26. Stuck AK, Kunz S, Baumgartner I, Kucher N. Patency and clinical outcomes of a dedicated, self-expanding, hybrid oblique stent used in the treatment of common iliac vein compression. *J Endovasc Ther*. 2017;24(1):159-166.
27. Bakas JM, van Montfrans C, Moelker A, et al. Quality of life after venous stenting for post-thrombotic syndrome and the effect of inflow disease. Vasc Endovascular Surg. 2024;58(5):469-476.
28. Falcoz M-T, Falvo N, Aho-Glélé S, et al. Endovascular stent placement for chronic post-thrombotic symptomatic ilio-femoral venous obstructive lesions: a single-center study of safety, efficacy and quality-of-life improvement. *Quant Imaging Med Surg*. 2016;6(4):342-352.
29. Shekarchian S, Van Laanen J, Esmaeil Barbati M, et al. Editor's Choice - Quality of life after stenting for iliofemoral venous obstruction: a randomised controlled trial with one year follow up. *Eur J Vasc Endovasc Surg*. 2023;66(5):678-685
30. Jalaie H, Barbati ME, Piao L, et al; International CVO Classification Study Group. Prognostic value of a classification system for iliofemoral stenting in patients with chronic venous obstruction. *Eur J Vasc Endovasc Surg*. 2024:S1078-5884(24)00873-6.
31. Coelho A, O'Sullivan G. Usefulness of direct computed tomography venography in predicting inflow for venous reconstruction in chronic post-thrombotic syndrome. *Cardiovasc Intervent Radiol*. 2019;42(5):677-684.
32. Chen R, Feng R, Jiang S, et al. Stent patency rates and prognostic factors of endovascular intervention for iliofemoral vein occlusion in post-thrombotic syndrome. *BMC Surg*. 2022;22(1):269.
33. Erben Y, Bjarnason H, Oladottir GL, McBane RD, Gloviczki P. Endovascular recanalization for nonmalignant obstruction of the inferior vena cava. *J Vasc Surg Venous Lymphat Disord*. 2018;6(2):173-182.
34. Kayili‌oğlu SI, Köksoy C, Alaçayir I. Diagnostic value of the femoral vein flow pattern for the detection of an iliocaval venous obstruction. *J Vasc Surg Venous Lymphat Disord*. 2016;4(1):2-8.
35. Sebastian T, Dopheide JF, Engelberger RP, Spirk D, Kucher N. Outcomes of endovascular reconstruction of the inferior vena cava with self-expanding nitinol stents. *J Vasc Surg Venous Lymphat Disord*. 2018;6(3):312-320.

36. Sebastian T, Lichtenberg M, Schlager O, et al. Early clinical outcomes for treatment of post-thrombotic syndrome and common iliac vein compression with a hybrid Oblique self-expanding nitinol stent-the TOPOS study. *Vasa*. 2020;49(4):301-308.

37. Gagne PJ, Tahara RW, Fastabend CP, et al. Venography versus intravascular ultrasound for diagnosing and treating iliofemoral vein obstruction. *J Vasc Surg Venous Lymphat Disord*. 2017;5(5):678-687.

38. Secemsky EA, Aronow HD, Kwolek CJ, et al. Intravascular ultrasound use in peripheral arterial and deep venous interventions: multidisciplinary expert opinion from SCAI/AVF/AVLS/SIR/SVM/SVS. *J Soc Cardiovasc Angiogr Interv*. 2024;3(1):101205.

39. Tran LM, Go C, Zaghloul M, et al. Intravascular ultrasound evaluation during iliofemoral venous stenting is associated with improved midterm patency outcomes. *J Vasc Surg Venous Lymphat Disord*. 2022;10(6):1294-1303.

40. De Wolf MAF, De Graaf R, Kurstjens RLM, Penninx S, Jalaie H, Wittens CHA. Short-term clinical experience with a dedicated venous nitinol stent: initial results with the sinus-venous stent. *Eur J Vasc Endovasc Surg*. 2015;50(4):518-526.

41. Powell T, Raju S, Jayaraj A. Comparison between a dedicated venous stent and standard composite Wallstent–Z stent approach to iliofemoral venous stenting: intermediate-term outcomes. *J Vasc Surg Venous Lymphat Disord*. 2023;11(1):82-90.e2.

42. Badesha AS, Black SA, Khan G, et al. A meta-analysis of the medium- to long-term outcomes in patients with chronic deep venous disease treated with dedicated venous stents. *J Vasc Surg Venous Lymphat Disord*. 2024;12(3):101722.

43. Badesha AS, Siddiqui MM, Bains BRS, Bains PRS, Khan T. A systematic review on the incidence of stent migration in the treatment of acute and chronic iliofemoral disease using dedicated venous stents. *Ann Vasc Surg*. 2022;83:328-348.

44. Piao L, Barbati ME, Shekarchian S, et al. Comparison of endovascular strategy versus hybrid procedure in treatment of chronic venous obstructions involving the confluence of common femoral vein. *J Vasc Surg Venous Lymphat Disord*. 2022;10(2):334-341.

45. Alhewy MA, Abdelhafez AA, Metwally MH, et al. Femoral vein stenting versus endovenectomy as adjuncts to iliofemoral venous stenting in extensive chronic iliofemoral venous obstruction. *Phlebology*. 2024;39(6):393-402.

46. de Wolf MA, Jalaie H, van Laanen JH, et al. Endophlebectomy of the common femoral vein and arteriovenous fistula creation as adjuncts to venous stenting for post-thrombotic syndrome. *Br J Surg*. 2017;104(6):718-725.

47. Marston WA, Browder SE, Iles K, Griffith A, McGinigle KL. Early thrombosis after iliac stenting for venous outflow occlusion is related to disease severity and type of anticoagulation. *J Vasc Surg Venous Lymphat Disord*. 2021;9(6):1399-1407.e1.

48. Drabkin MJ, Bajwa R, Perez-Johnston R, et al. Anticoagulation reduces iliocaval and iliofemoral stent thrombosis in patients with cancer stented for nonthrombotic venous obstruction. *J Vasc Surg Venous Lymphat Disord*. 2021;9(1):88-94.

49. Avgerinos ED, Black S, van Rijn MJ, Jalaie H. The role and principles of stenting in acute iliofemoral venous thrombosis. *J Vasc Surg Venous Lymphat Disord*. 2024;12(5):101868.

50. van Vuuren TMAJ, de Wolf MAF, Arnoldussen CWKP, et al. Editor's Choice – Reconstruction of the femoro-ilio-caval outflow by percutaneous and hybrid interventions in symptomatic deep venous obstruction. *Eur J Vasc Endovas Surg*. 2017;54(4):495-503.

51. Milinis K, Thapar A, Shalhoub J, Davies AH. Antithrombotic therapy following venous stenting: International Delphi Consensus. *Eur J Vasc Endovasc Surg*. 2018;55(4):537-544.

52. Mosti G, Wittens C, Caggiati A. Black holes in compression therapy: a quest for data. *J Vasc Surg Venous Lymphat Disord*. 2024;12(2):101733.

53. Rabe E, Partsch H, Hafner J, et al. Indications for medical compression stockings in venous and lymphatic disorders: an evidence-based consensus statement. *Phlebology*. 2018;33(3):163-184.

54. Black SA, Alvi A, Baker SJ, et al. Management of acute and chronic iliofemoral venous outflow obstruction: a multidisciplinary team consensus. *Int Angiol*. 2020;39(1):3-16.

Abstracts

OCTOBER 17-19, 2024
Athens, Greece

Abstract Venous Symposium Europe 2024

01 Direct oral anticoagulants for treatment of heparin-induced thrombocytopenia (HIT) and associated thromboembolism (HITT) – a systematic review and meta-analysis

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BACKGROUND/AIM

Heparin-induced thrombocytopenia (HIT) is a medical condition associated with a high risk for thrombotic complications. The role of direct oral anticoagulants (DOACs) is still emerging, and data are limited considering efficacy and safety among patients with HIT. The aim of this review is to evaluate current data on DOACs as primary or secondary treatment among patients with HIT.

METHODS

This is a systematic review utilizing PubMed, SCOPUS, and Embase online databases. Eligible studies were studies published up to July 2024 evaluating DOACs as primary or secondary treatment among patients with HIT and/or associated thrombosis (HITT). Primary outcomes that were evaluated included new thrombosis rate (NTR) and new bleeding rate (NBR) during follow-up.

RESULTS

A total of 45 publications were included (30 case reports, 5 case studies, and 10 cohort studies [n >10 patients]). Regarding treatment, 19 articles evaluated only rivaroxaban, 8 articles only apixaban, 11 articles only dabigatran, and 7 articles more than one regimen). A total of 353 patients were included. Overall, 190 patients (53.8%) were given DOAC as primary treatment whereas 163 patients were given a parenteral treatment first and continued with a DOAC. Mean nadir platelet count was 63 000/μL. HITT rate was 190/353 (53.8%; 8% had arterial thrombosis). Mean follow-up was 7.6 months. New thrombosis rate (NTR) was 20/353 (pooled proportion, 0.067 [95% confidence interval [CI], 0.044-0.094]) (30% of new thrombosis without initial thrombosis), and new bleeding rate (NBR) was 9/353 (pooled proportion, 0.041 [95% CI, 0.024-0.064]). Finally, there was no difference found regarding NTR and NBR among different DOACs.

CONCLUSIONS

DOACs seem to have a satisfying efficacy and safety when given for patients with HIT or HITT, either as primary or secondary treatment. Outcomes seem to be similar among the different regimens. However, data are still limited, and further investigation is needed to draw safer conclusions.

Keywords

direct oral anticoagulants | heparin-induced thrombocytopenia (HIT) | heparin-induced thrombocytopenia and associated thrombosis (HITT)

Abstract **Venous Symposium Europe 2024**

02 Association of postthrombotic changes with disease severity in patients presenting with symptomatic calf vein thrombosis

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BACKGROUND/AIM

This prospective study was designed to evaluate the natural history of isolated calf deep vein thrombosis (DVT) in relation to their patterns and distribution.

METHODS

One hundred seventeen limbs in 104 patients, with isolated symptomatic calf vein thrombosis were included in the study. These were objectively diagnosed with ultrasound. The distribution and extent of the initial DVT was recorded in detail. Patients with a documented episode of prior DVT or those having thrombus in the popliteal vein or higher were excluded. Follow-up at 3 to 48 months was performed with clinical examination and ultrasound. Ultrasound examination was done with the patient in the standing position to ensure optimal testing for detecting postthrombotic changes. Affected venous segments were classified as having an occlusion, complete recanalization, partial recanalization, with or without reflux.

RESULTS

At 1 year, out of 98 limbs analyzed, most (99%) had recanalization of their calf vein thrombosis; 53% (n=52) had complete, 46% (n=45) had partial, and 1% (n=1) had no recanalization. Ultrasound studies of those limbs showed reflux (R) in 22% (n=22), obstruction (O) in 9% (n=9), R + O in 33% (n=32), and normal findings in 36% (n=35) of limbs. Only 17% of limbs had signs of edema (CEAP 3, according to the clinical-etiological-anatomical-pathophysiological classification system), 2% had skin changes (CEAP 4) and 0% had any signs of ulcers (CEAP 5,6). Of these findings, only 14 patients experienced persistent symptoms at 1 year.

CONCLUSIONS

Patients with symptomatic calf vein DVT generally have good clinical outcomes, with most being asymptomatic, and having mild disease. While small deterioration is seen up to 4 years, few limbs developed skin changes. The presence of reflux in calf veins does not appear to be a significant predictor of severe disease development in the medium term.

Keywords

calf deep vein thrombosis | natural history | postthrombotic changes.

Abstract Venous Symposium Europe 2024

03 Oral sirolimus in capillary-lymphatic venous malformations and associated syndromes: a case series of 3 patients

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BACKGROUND/AIM

Capillary-lymphatic-venous malformations (CLVMs) are congenital vascular anomalies that can present with debilitating manifestations. Sirolimus, previously used as an immunosuppressive and antiproliferative agent, has emerged as a complimentary if not first-line treatment of CLVM.

MATERIAL/METHODS

We present 3 cases of patients with CLVMs, each associated with a different clinical syndrome. We retrospectively reviewed the clinical presentation, diagnostic imaging, and management strategies for 3 adult patients with confirmed CLVMs. In all 3 patients, oral sirolimus was approved as palliation therapy.

CASE DETAILS/RESULTS

The first case is a 53-year-old male patient with blue rubber bleb nevus syndrome (Bean syndrome), presenting with multiple symptomatic body hemangiomata including life-threatening enlarging masses in the cervical and supraclavicular space. The patient has been on oral sirolimus for 3 years with an ongoing shrinking of the masses and a decrease in pain and spontaneous bleeding events. The second case is a 42-year-old patient with lymphangiomata of the pelvis, left lower extremity, and scrotum, presenting with a heavy-feeling left leg, severe sciatica pain, hematuria and bleeding during intercourse. He has been on sirolimus therapy for 2 years and despite no profound imaging shrinkage his symptoms have completely resolved. The third case involves a patient with Klippel-Trenaunay syndrome and an associated above-the-knee amputation of the left leg, along with amputation of the toes on the right leg. The patient presented with lymphorrhea and edema of the left stump. He has been on sirolimus for 3 months with substantial improvement of his symptoms and quality of life. All 3 patients experience minor side effects and will continue the medication indefinitely, with close monitoring.

CONCLUSIONS

CLVMs, particularly when associated with complex syndromes pose significant therapeutic challenges. Sirolimus is a novel treatment that appears safe and effective in alleviating symptoms and improving quality of life.

Keywords

capillary-lymphatic-venous malformations (CLVMs) | blue rubber bleb nevus syndrome (Bean syndrome) | Klippel-Trenaunay syndrome (KTS) | Parkes Weber syndrome (PWS) | sirolimus

04 Influence of body position on venous reflux assessment: a duplex ultrasound study

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BACKGROUND/AIM

Venous reflux is commonly assessed using duplex ultrasound in the standing position. However, there is a lack of strong evidence to support this practice. This study aimed to evaluate the impact of body position on the detection of venous reflux.

METHODS

Duplex ultrasound evaluations were conducted on 67 limbs from 36 patients (20 women, 16 men; mean age 56.4 years) to assess the great saphenous vein (GSV) and small saphenous vein (SSV) in both standing and supine positions. Venous diameters and the presence of reflux were recorded and compared across positions.

RESULTS

In the standing position, the mean diameters of the proximal thigh GSV, mid-thigh GSV, distal thigh GSV, below-knee GSV, and SSV were 6.0 mm, 5.5 mm, 4.7 mm, 4.5 mm, and 3.9 mm, respectively. In the supine position, these measurements were 5.6 mm, 4.5 mm, 4.4 mm, 3.9 mm, and 3.2 mm (P=0.080, P<0.01, P=0.005, P<0.001, and P=0.007, respectively). Venous reflux in the deep vein system was detected in 11 limbs (16.4%) in the supine position and in 9 limbs (13.4%) in the standing position. The study also found 3 false-positive and 2 false-negative results in the deep vein system when assessing in the supine position. Additionally, 9 false-negative results were identified in the GSV, and 3 in the SSV in the supine position.

CONCLUSIONS

The findings suggest that venous reflux assessment using duplex ultrasound in the supine position is less reliable due to a higher incidence of false positives and negatives, as well as smaller superficial vein diameters.

Keywords

duplex ultrasound | great saphenous vein | venous reflux | small saphenous vein | supine position

Abstract Venous Symposium Europe 2024

05 Recanalization of occluded IVC filter and iliocaval obstruction, postphlebitic

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BACKGROUND

Endovascular intervention is now considered the first-line therapy for stenotic or occluded iliofemoral veins with low morbidity and high clinical success.

METHODS

A case report / challenging case:

Case details: A 46-year-old male patient with a history of recurrent deep venous thrombosis (DVT) and inferior vena cava (IVC) filter insertion 8 years prior presented with significant lower-limb edema in the thigh and leg, pronounced venous claudication, and severe lower-limb heaviness and pain that restricts his daily activities.

Technique: Ultrasound-guided venous access was conducted on the common femoral veins bilaterally under general anesthesia. A 0.018 guidewire (GW) was utilized to traverse the lesion, facilitated by crossing within the IVC filter at the same anatomical point on both sides. This was accomplished using a 0.018 GW, followed by an exchange to a 0.035 hydrophilic GW over a supporting catheter.

Predilation was performed using a 5 mm × 80 mm balloon within the IVC filter, subsequently followed by the dilation of a venous-specific balloon measuring 14 mm × 100 mm (Atlas Gold, Bard) to pressures ranging from 16 to 18 atm concurrently. The IVC filters were laterally displaced. The dilatation of the obstructed iliocaval segment was carried out using the same 14 mm balloon. Following this, venoplasty and stenting were executed with a total of 4 stents: 2 stents measuring 14 mm × 140 mm (Vonovo, Bard) and 2 additional stents measuring 14 mm × 90 mm, composed of braided stainless steel (Wallstents; Boston Scientific, Natick, Massachusetts, USA). All diseased segments, as identified by intravascular ultrasound (IVUS), were comprehensively covered by the stent to ensure adequate inflow and outflow.

RESULT

Patent IVC, improvement of symptoms, and no complications.

CONCLUSIONS

Endovascular recanalization of occluded IVC and filter is possible with marked improvement in pain and quality of life and low risk of mortality. A composite dedicated venous stent and eligiloy Wallstent is feasible with overlapping 2-3 mm.

Figure 1. Before and after recanalization of occluded inferior vena cava filter.

Keywords

inferior vena cava | IVC occluded filter | IVC occlusion | postphlebitic

06 Comparison of glue vs open surgery in elderly patients

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BACKGROUND/AIM

Regarding elderly patients with chronic venous disease, there aren´t specific treatment guidelines. The aim of this study was to assess the efficacy and safety of interventional treatment of elderly patients and to compare glue occlusion with open surgery.

MATERIAL/METHODS

Enrolled patients were ≥70 years old with symptomatic varicose veins C3-C6 treated between 2020-2022. They were subdivided in 2 groups: one treated with glue occlusion (GO) and the other open surgery (OS). Primary outcomes were treatment success: vein obliteration at 52 weeks and venous clinical severity score (VCSS) at 12 weeks.

RESULTS

Of 107 patients treated, 37 were included (24 treated by OS; 13 by GO). A total of 48 procedures were performed (30 OS and 18 GO). The mean age was 75.4 years old; 64.9% were women. In the GO group, patients were older.

The interventional treatment in this population was effective in reducing VCSS, AVVQ (Aberdeen Varicose Vein Questionnaire), and EQ-5D scores at 12 weeks ($P<0.001$). The efficacy of both methods had similar changes in VCSS, AVVQ, and EQ-5D scores after 12 weeks. However, GO is associated with a shorter length of recovery with statistically significant difference There was also a tendency to a lower grade of pain in patients treated with glue (3.8 vs 4.8). There was no clinically significant recanalization in the GO group, but 2 cases had small areas of partial recanalization. In the OS group, there was 1 case of varicose vein relapse.

CONCLUSIONS

Our results show that it is safe and effective to treat old patients with both techniques. GO is associated with shorter recovery days, even in patients with higher age.

Keywords

chronic venous disease | elderly | glue occlusion | open surgery

Abstract

Venous Symposium Europe 2024

	All (n=37)	Glue (n=13)	Surgery (n=24)	*P* value
Age - mean ±SD Min-Max	75.4±4.9 70-90	79.0±6.3 70-90	74.0±3.3 70-80	0.017
Sex - n (%) Female Male	 24 (64.9) 13 (35.1)	 10 3	 14 10	0.305
Technique - n (%) Glue Surgery	 13 (35.1) 24(64.9)	 - -	 - -	
Vein treated - n (%) GSV SSV GSV+SSV	 21 (67.7) 6 (19.4) 4 (12.9)	 9 2 2	 12 4 2	0.862
Laterality - n (%) unilateral bilateral	 14 (45.2) 17 (54.8)	 8 5	 6 12	0.119
CEAP - n (%) C3 C4 C5 C6	 14 (37.8) 18 (48.6) 1 (2.7) 4(10.8)	 5 5 0 3	 9 13 1 1	0.289
EQ5D before median (IQR)	6 (2)	6 (2)	6 (2)	0.254
VCSS before median (IQR)	7 (4)	7 (4)	7.5 (4)	0.672
AVVQ before median (IQR)	6 (4)	5(8)	6.5(4)	0.960
EQ5D after median (IQR)	5 (0)	5 (0)	5 (0)	0.750
VCSS after median (IQR)	0 (1)	0 (1)	0 (2)	0.639
AVVQ after median (IQR)	0 (1)	0 (1)	0 (2)	0.872
EQ5D difference median (IQR)	-1.0 (2.0)	-1(2)	-0.8(2)	0.230
VCSS difference median (IQR)	-6.5 (3.8)	-7 (4)	-7 (3.3)	0.810
AVVQ difference median (IQR)	-5.5 (5.8)	-5 (7)	-7 (12)	0.810
Pain after surgery mean ±SD	4.5±2.4	3.8±2.3	4.8±2.3	0.266
Satisfaction median (IQR)	10 (2)	10 (2)	10 (2)	0.999
Complications - n (%)	2 (5.4)	1 (7.7)	1(4.2)	0.999
Recovery days median (IQR)	7 (10)	7(7)	7(8)	0.050
Would you repeat the treatment?	33 (91.7)	11 (91.7)	22(91.7)	0.999
Vein occlusion at 1 year = n (%)	-	12 (100.0)	-	

Table I. Interventional treatment by glue occlusion or open surgery in elderly patients (>70 years); data from study population.
CEAP, clinical-etiological-anatomical-pathophysiological classification; GSV, great saphenous vein; IQR, interquartile range; SD, standard deviation; SSV, small saphenous vein.

Abstract **Venous Symposium Europe 2024**

07 Looks like a DVT, walks like a DVT... and it's not a DVT –venous adventitial cystic disease – case report

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BACKGROUND/AIM

Deep vein thrombosis (DVT) is a common diagnosis in the emergency department (ED). It's fundamental to be aware of its differential diagnosis, as different pathologies present with similar symptoms. The current study reports on a rare case of adventitial cystic disease (ACD) involving the femoral vein.

CASE DETAILS

A 45-year-old female patient comes to the ED due to edema of the left lower limb for about 5 months. She was anticoagulated with rivaroxaban for a probably misdiagnosed femoral DVT. There was a clear asymmetric swelling of the left lower limb. Doppler ultrasound (DUS) showed an encapsulated hypoechoic mass protruding to the wall of the femoral vein, leading to abnormal blood drainage. Computed tomography angiography (CTA) confirmed a hypodense, well-defined mass having a compressive effect on the femoral vein. Surgical exploration identified a cystic structure in continuity with the femoral vein's wall. Lesion resection was performed, and reconstruction of the vein wall was done. Histological examination confirmed that the mass was a venous cyst.

DISCUSSION

ACD of the venous system is rare, with few cases described in literature. Diagnosis can be suspected through clinical and imaging findings; however, it's often made during or after surgery. The first imaging method should probably be DUS due to its availability, low cost, and absence of radiation. Computed tomography seems to be an adequate method for the evaluation of this pathology as it can help in the surgical strategy and allows the percutaneous drainage of the lesion. Given the small number of cases described, ideal treatment is still unknown, but most authors advocate resection of the cyst and its wall to prevent recurrence. Venous ACD is rare, but it should be suspected in patients with symptoms of DVT, especially when the diagnostic investigation indicates an extrinsic mass. Close follow-up is necessary to prevent recurrence.

Keywords

femoral vein | venous adventitial cystic disease

Abstract Venous Symposium Europe 2024

08 Major vascular complications after varicose veins conventional surgery

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BACKGROUND
Iatrogenic vascular injuries during varicose vein surgery (VVS) are rare (0.0017%-0.3%).

CASE DETAILS
Clinical case 1. 45-year-old women, submitted to VVS of lower limb (LL) 2 weeks earlier presented with foot pain and paresthesias. She had thigh hematoma, paler foot, and no pulses. On Doppler ultrasound, there was visualized femoral-bifurcation hematoma and superficial femoral artery (SFA) thrombosis. Computed tomography angiography (CTA): SFA partial avulsion. Thrombectomy and great saphenous vein (GSV)-femoro-femoral interposition graft were performed. At 1 year, she is asymptomatic and with feet pulses.

Clinical case 2. 4-year-old male, submitted to VVS with reported massive bleeding controlled by local compression, transferred 6 days after to our department with severe edema of LL. Doppler and angioCT confirmed extensive thrombosis with partial loss of integrity of the venous femoroiliac segment. She was submitted to an IVC filter, thrombectomy, and femoroiliac interposition graft. At 6 months follow-up, there was no edema and graft was patent.

Clinical case 3. A 29-year-old man was sent with massive bleeding due to common femoral vein avulsion during VVS. A femoral-external iliac vein interposition graft was performed. Fifteen years after, he remains asymptomatic with permeable graft.

Clinical case 4. A 51-year-old woman with history of VVS complicated with right femoral vein thrombosis. At the time, the patient was hypocoagulated and wore elastic stockings. Fifteen years later, she went to consultation with complaints of severe LL edema. Doppler ultrasound showed stenosis of the femoral vein. She underwent phlebography with angioplasty and stenting of femoral vein. The patient is asymptomatic at 1 month.

CONCLUSION
Although VVS is associated with low morbidity, sequelae of major vascular complications have a great impact on lives of a young and active population.

Keywords

varicose veins surgery | vascular complications

Abstract **Venous Symposium Europe 2024**

09 Patterns of recurrent varicose veins after surgery (REVAS): a systematic review and network meta-analysis of randomized trials.

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BACKGROUND/AIM

Recurrence of superficial venous incompetence is common following interventional treatment, and a classification system (Recurrent Varices After Surgery, REVAS) has been developed. However, it is not known whether specific, predictable patterns of reflux occur following treatment or how these may vary by treatment modality. This study aimed to explore varicose vein recurrence patterns according to procedural technique.

METHODS

Following PRISMA guidelines and a registered protocol (CRD42023455512), MEDLINE, Embase, and ClinTrials.gov were searched for randomized clinical trials (RCTs) on surgical or endovenous treatment of primary saphenous vein insufficiency with at least 1-year follow-up and assessment of recurrence patterns. The primary outcome was reflux recurrence as per the REVAS classification. A random-effects network meta-analysis was conducted in R, calculating risk ratios and 95% confidence intervals (CIs).

RESULTS

The 3467 records identified yielded 23 unique RCTs, investigating 8 different modalities. Recurrence rates varied by anatomical section: saphenofemoral junction (SFJ) showed 23.6% cumulative recurrence; thigh perforators, 7.6%; and lower-leg perforators, 4.7% recurrence. Endovenous laser ablation (EVLA) and foam sclerotherapy (FS) had higher risk of SFJ recurrence compared to high ligation and stripping (HLS) with a risk ratio of 2.29 (1.40 – 3.76) and 2.09 (1.20 – 3.62) (I2 = 47.7%). EVLA was associated with a reduced risk of thigh perforator recurrence compared to HLS (0.45 [0.21 – 0.93]) (I2=0%). FS was associated with higher risk of recanalization compared to HLS (4.05 [2.23 – 7.35]) and EVLA (3.14 [1.82-5.41]). Both EVLA and FS were associated with lower risk of neovascularization, compared to HLS; 0.28 (0.16-0.41) and 0.18 (0.08-0.40), respectively (I2=0%).

CONCLUSIONS

Recurrence patterns varied by treatment modality, with HLS showing lower SFJ and anterior accessory saphenous vein (AASV) recurrence, while endovenous methods had less neovascularization and thigh perforator recurrence. Concerningly, only 13% of RCTs reported recurrence using REVAS. Improved reporting of varicose vein recurrence to delineate reflux sources will allow better technical outcome assessment and enhanced patient care.

Keywords

recurrent varicose vein after surgery (REVAS) classification | varicose veins recurrence patterns

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10 Role of tumescent fluid infiltration during saphenous stripping and ligation operation of varicose veins to reduce postoperative complications

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BACKGROUND/AIM

Saphenous stripping and high ligation is the traditional operation for varicose veins globally. Postoperative complications like pain, subcutaneous ecchymosis, hematoma, and wound dehiscence are possible. The study assesses the role of ultrasound-guided tumescent fluid infiltration through saphenous fascia to reduce these complications.

METHODS

Single arm prospective cohort study conducted on 300 cases between February 2020 and February 2022 at Ain Shams University Hospital and Shebin Elkoom Teaching Hospital.

RESULTS

300 patients received saphenous stripping and high ligation operation, associated with ultrasound-guided infiltration of tumescent solution through saphenous fascia. Pain was assessed by visual analog scale (VAS) score between day 1 and 1 week, which showed significant improvement. Ecchymosis was assessed based on ecchymosis score between 1 week and 4 weeks with significant improvement. Subcutaneous hematoma and wound complications were also observed at 1 week and 4 weeks without significant improvement.

CONCLUSIONS

Ultrasound-guided tumescent solution infiltration along saphenous fascia possibly improved postoperative pain score and ecchymosis, but not for hematoma and wound complications.

Keywords

saphenous stripping | stripping and high ligation | tumescent solution | varicose veins

Abstract **Venous Symposium Europe 2024**

11 Novel mechanical thrombectomy techniques for upper-extremity DVT

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BACKGROUND/AIM

Upper extremity deep vein thrombosis (UEDVT) has been traditionally managed with anticoagulation and in selected active symptomatic patients with catheter-directed thrombolysis (CDT) targeting prompt venous recanalization towards a subsequent rib resection when venous compression is identified. CDT requires prolonged dripping, intensive care unit (ICU) stay, and carries a risk of bleeding while more chronic material may not be lysed. Novel mechanical thrombectomy devices can potentially simplify the safety, the efficacy, and the logistics of the procedure.

METHODS

Three young patients with symptomatic UEDVT underwent percutaneous mechanical thrombectomy utilizing 3 different devices, the ClotTriever system (Inari Medical, Irvine, CA), the Aspirex Mechanical Aspiration Thrombectomy System and the Penumbra System (Penumbra Inc, Alameda, California, USA). The technical results and clinical outcomes were reviewed

RESULTS

Percutaneous thrombectomy through basilic vein access was performed and successfully completed in all 3 patients with greater than 90% thrombus resolution. Low-dose local on-table thrombolytics were used to address thrombi in the collateral vessels. Balloon venoplasty was performed at the area of compression when identified. No major adverse events were noted, and patients were discharged within 24 hours. Two out of the 3 patients underwent subsequent first rib resection. Additional venous stent reconstruction was not required. At 2-year follow up, all patients had resumed full athletic activity without UEDVT recurrence.

CONCLUSIONS

For the management of symptomatic UEDVT, mechanical thrombectomy using novel technologies is feasible with excellent technical and clinical success.

Keywords

mechanical thrombectomy | upper extremity deep vein thrombosis

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12 Treatment of varicose veins with steam: PROMs analysis

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BACKGROUND/AIM

The aim of the present study was to assess the efficacy and safety of steam thermal ablation in lower-extremity varicose vein treatment.

MATERIAL/METHODS

Adults with varicose veins of clinical grade C2 to C6 according to the clinical-etiological-anatomical-pathophysiological (CEAP) classification, treated with steam between 2020 and 2022, were enrolled in the study.

Primary outcomes were treatment success: vein obliteration at 52 weeks and changes in venous clinical severity score (VCSS) at 12 weeks. Secondary outcomes were pain, satisfaction with treatment, and days lost from daily activities, changes in Aberdeen Varicose Vein Questionnaire (AVVQ) and EQ-5D scores after 12 weeks, and postoperative complications.

RESULTS

Of the 40 patients treated, 22 were included in the study.

The mean age of the patients was 47.1 years old; 77.3% of the patients were women. Ninety-one percent of the patients were C3 or C4.

A total of 29 procedures were performed: 26 great saphenous veins (GSVs) and 3 small saphenous veins (SSVs).

Changes in VCSS after 12 weeks were -5.3; in AVVQ after 12 weeks were -5.2; and in EQ-5D after 12 weeks were -1. *(Table I)*

The interventional treatment in this population was effective in reducing VCSS, AVVQ, and EQ-5D scores at 3 weeks ($P<0.001$).

CONCLUSIONS

Steam ablation is a thermal endovascular technique that is effective and safe. The research on this technique should be continued in order to confirm these results, and comparison with other techniques is also important in order to be more widely used.

	Steam (n=22)
Age - mean ±SD	47.1±10.8
Sex - n (%)	
Female	17 (77.3)
Male	5 (22.7)
Vein treated - n (%)	
GSV	18 (85.7)
SSV	0
GSV+SSV	3 (14.3)
Laterality - n (%)	
unilateral	13 (61.9)
bilateral	8 (38.1)
CEAP - n (%)	
C3	1 (4.5)
C4	10 (45.5)
C5	10 (45.5)
C6	1 (4.5)
EQ5D before median (IQR)	6 (1)
VCSS before median (IQR)	5.91±2.1
AVVQ before median (IQR)	5 (5)
EQ5D after median (IQR)	5 (0)
VCSS after median (IQR)	0 (0)
AVVQ after median (IQR)	0 (0)
EQ5D difference median (IQR)	-1 (3)
VCSS difference median (IQR)	-5.3±2.4
AVVQ difference median (IQR)	-5.2±3.3
Pain after surgery meant (IQR)	5±2.8
Satisfaction median ±SD	10 (1)
Would repeat the surgery n-%	15 (2)
Complications (minor) - n (%)	3 (13.6)
Recovery days median ±SD	18.1±11.6
Vein occlusion at 1 year - n (%)	20 (90.9)

Table I. Steam thermal ablation in lower-extremity varicose vein treatment; data from study population.
GSV, great saphenous vein; IQR, interquartile range; SD, standard deviation; SSV, small saphenous vein.

Keywords

efficacy | lower-extremity varicose vein | safety | steam thermal ablation

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13 Aethoxysklerol foam sclerotherapy for persisting seroma after EVLA

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BACKGROUND/AIM

Seromas are rare complications after varicose vein surgery; they manifest clinically as palpable masses or swelling at the site of the wound. Aethoxysclerol is an approved sclerosing agent for varicose veins in several countries in Europe. The aim of our case was to show the therapeutic effect and the safety of use of ultrasound-guided aethoxysclerol foam sclerotherapy in a small postoperative seroma after endovenous laser ablation (EVLA) with phlebotomies.

MATERIALS/METHODS

87-year-old female, CEAP 4 (by clinical-etiological-anatomical-pathophysiological classification). Medical history: diabetes mellitus type 2, arterial hypertension, hypercholesterolemia, thyroidopathy, pacemaker, under insulin and antiplatelet treatment. We treated a postoperative seroma after EVLA that was refractory to conventional treatments including compression dressings, repeated needle aspiration, and manual lymph drainage. Ultrasound-guided drainage was carried out with 21G needle and foam sclerotherapy towards fascia gap.

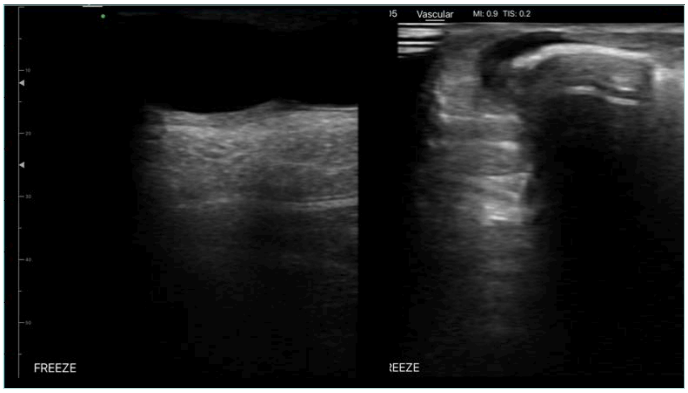

Figure 1. Left) Seroma at ultrasound. Right) Ultrasound-guided foam sclerotherapy.

DISCUSSION

Although seromas after phlebotomy are a rare complication, they can cause a significant impairment of the patients' quality of life. Since no sclerotherapy agent has yet been approved in the treatment of seromas, those treatments can only be offered as off-label therapy.

Time after o/r	Vol drained	Compression	Vol of foam
2 mo	6 mL	Yes	-
2.5 mo	6 mL	Yes	-
3 mo	6 mL	Yes	-
3.5 mo	6 mL	Yes	3 mL
4 mo	6 mL	Yes	4 mL
4.5 mo	6 mL	Yes	4 mL
5 mo	6 mL	Yes	6 mL

Table I. At the patient's first 3 visits, at 2, 2.5, and 3 months accordingly, 6 mL of serum was aspirated from the seroma, while no foam sclerotherapy was injected. Compression stockings were applied during the 5 month period. The volume of foam injected during the next 4 visits did not reduce.

Keywords

endovenous laser ablation | seroma | ultrasound-guided aethoxysclerol foam sclerotherapy

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14 Novel AlphaVac F18 aspiration catheter for mechanical thrombectomy of an intermediate-high risk acute pulmonary embolism

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BACKGROUND
Novel large-bore aspiration thrombectomy (LBAT) systems are on the rise, with promising results, for use in patients with moderate high-risk or even in high-risk pulmonary embolism patients. AlphaVac F1885 (AngioDynamics Inc, Latham, New York) is a novel 18Fr 85o angled aspiration catheter based on the AngioVac platform but without the need for extracorporeal circuit. It has recently received a CE mark and we herein present our first case to describe its use in evacuating large pulmonary embolism thrombi.

METHODS
A 58-year-old patient presented in the emergency department with shortness of breath and acute onset lower-extremity edema. Ultrasound Doppler revealed a recent deep venous thrombosis (DVT) in left lower extremity. Computed tomography pulmonary angiogram (CTPA) showed large bilateral pulmonary embolism in main branches. On exam, the patient presented hemodynamically stable with sats on 93% on low-flow oxygen. Laboratory testing revealed elevated troponin and pro–brain natriuretic peptide (proBNP). Cardiac echo showed right ventricular strain with right ventricle dilation (right to left ventricle ratio, RV/LV 1.4). The patient was categorized in moderate high-risk PE and admitted to ICU for observation without improvement on anticoagulation for the next 12 hours. We decided to intervene with a novel mechanical thrombectomy device (AlphaVac) due to immediate risk for deterioration.

RESULTS
Mechanical thrombectomy was performed under local anesthesia with mild sedation. Access was obtained using a 22Fr sheath. The AlphaVac catheter was used for aspiration in both pulmonary arteries retrieving large amounts of clot. The pulmonary artery pressures decreased from 85/27 mm Hg to 25/16 mm Hg on the table. Blood loss was 350cc. Procedure time: 25 min. The postoperative course was notable for complete symptom improvement and repeat echocardiogram showed an RV/LV ratio of 0.8.

CONCLUSIONS
This case highlights the efficacy and safety of AlphaVac in managing life-threatening pulmonary embolism (PE).

Keywords

AlphaVac catheter | mechanical thrombectomy | pulmonary embolism

Abstract Venous Symposium Europe 2024

15 Endovascular thrombectomy of port-induced superior vena cava syndrome using the INARI FlowTriever device

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BACKGROUND/AIM

Superior vena cava (SVC) syndrome is a result of obstruction of blood flow through the SVC, secondary to a thrombus, malignancy, or chest infection. The two predominating causes of SVC syndrome include malignant tumors (around 60% of cases) and thrombosis due to central lines, indwelling catheters, and pacemakers (30%-40% of cases). The cases due to thrombosis are rising due to the increasing usage of indwelling intravenous catheters and pacemakers, placing these patients in hypercoagulopathy. The aim of this study is to report a case of successful endovascular thrombectomy of port-induced superior vena cava syndrome using the INARI FlowTriever system.

METHODS

A 73-year-old male patient underwent distal gastrectomy due to gastric cancer, post neoadjuvant chemotherapy. On the first postoperative day, the patient presented with diffuse facial and bilateral upper-extremity edema, along with dyspnea and shortness of breath. The patient rapidly presented upper-airway obstruction and was immediately intubated and transferred to the intensive care unit (ICU).

RESULTS

The computed tomography demonstrated complete SVC, right subclavian, and left jugular vein thrombosis, indicating the diagnosis of SVC syndrome. The patient was transferred to the operating theater, where left femoral vein access was gained. The INARI FlowTriever was advanced over the wire to the SVC where multiple aspirations of the thrombus were performed. These aspirations withdrew several fragments of red tissue, indicating a fresh thrombus. Post-thrombectomy venography revealed restoration of antegrade flow with a small degree of residual stenosis, and a Sinus Venous 16 x 120 mm (Optimed) was deployed, followed by balloon angioplasty. The patient was transferred to the ICU with complete resolution of clinical signs, and he was extubated on postoperative day 10.

CONCLUSIONS

The FlowTriever system has proven to be a successful alternative treatment for patients with pulmonary embolism (PE). Other studies have also shown success of the FlowTriever system outside the scope of PE, such as this case in the setting of SVC syndrome.

Keywords

endovascular thrombectomy | FlowTriever device | superior vena cava syndrome

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16 Iliocaval reconstruction in a patient with chronic deep vein thrombosis caused by retroperitoneal fibrosis

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BACKGROUND

Retroperitoneal fibrosis (RPF) is a rare condition characterized by excessive fibrotic tissue growth in the retroperitoneum, often leading to vascular and ureteral compression. Chronic deep vein thrombosis (DVT) resulting from RPF can cause significant venous outflow obstruction and debilitating symptoms. Endovascular venous stenting has emerged as a minimally invasive and effective treatment option for restoring venous patency and alleviating symptoms in these complex cases.

METHODS

A 26-year-old female patient was admitted to our clinic with complaints of bilateral lower-extremity swelling and visible abdominal wall vessels. Twenty months earlier, she experienced acute-onset abdominal pain. Imaging revealed a retroperitoneal mass around the inferior vena cava (IVC) and abdominal aorta at the renal level. A biopsy confirmed RPF. Two months after the diagnosis, she developed acute bilateral lower-extremity swelling and pain. Ultrasound and computed tomography venography (CTV) showed acute DVT extending from the level of the fibrosis to the iliac veins. She was treated with low-molecular-weight heparin and oral anticoagulants, but her symptoms did not improve. She also experienced venous claudication after walking 100 meters. Magnetic resonance venography revealed chronic thrombosis of the infrarenal IVC, right common and external iliac veins, right common femoral vein, and left common iliac vein (*Figure 1*).

RESULTS

We planned to perform endovascular iliocaval reconstruction. Using bilateral femoral vein access, we conducted venography, which revealed numerous collateral veins filling the proximal IVC and azygos veins (*Figure 2*). We successfully crossed the lesions from both sides. After aggressive predilation, an 18 mm x 120 mm Abre venous stent was placed in the IVC. Subsequently, a 14 mm x 150 mm and a 12 mm x 120 mm Abre venous stent were implanted from the right common iliac vein to the femoral vein, and a 14 mm x 120 mm Abre venous stent was implanted in the left common iliac vein using the kissing technique. After postdilation, control venography showed that the collaterals had disappeared and the flow was very satisfactory (*Figure 2*). The venous stents remained patent on the first-year CTV scan.

CONCLUSIONS

Iliocaval reconstruction is a viable and effective option for the management of chronic DVT caused by RPF. This approach not only addresses the underlying venous obstruction but also alleviates symptoms, improves venous outflow, and enhances the quality of life for affected patients. Proper patient selection, meticulous preoperative imaging, and individualized surgical planning are essential to optimize outcomes.

Keywords

chronic deep vein thrombosis | endovascular iliocaval reconstruction | retroperitoneal fibrosis | venous stenting

Abstract

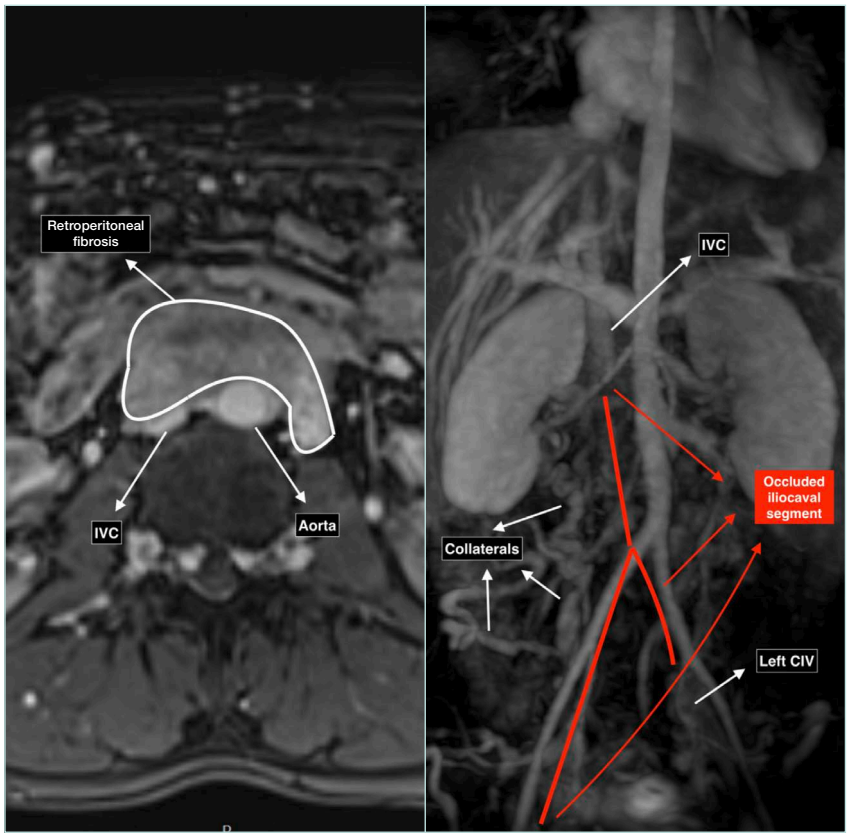

Figure 1. Preoperative magnetic resonance venography showing compression of the vena cava by retroperitoneal fibrosis and iliocaval venous occlusion.
CIV, common iliac vein; IVC, inferior vena cava.

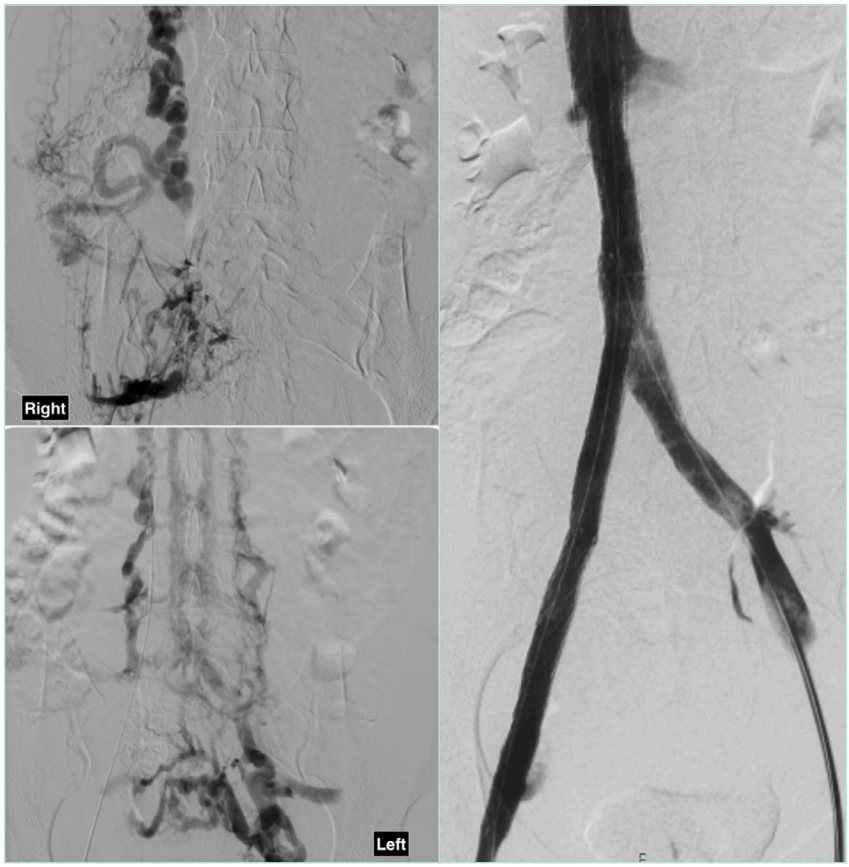

Figure 2. Intraoperative venography images showing occlusion of the bilateral iliac veins and vena cava, and post-stenting control venography demonstrating successful iliocaval reconstruction.

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17 Superior vena cava syndrome, acute thrombosis on top of chronic lesion

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BACKGROUND

Superior vena cava (SVC) syndrome is a collection of clinical signs and symptoms resulting from either partial or complete obstruction of blood flow through the SVC. This obstruction is most commonly a result of thrombus formation or tumor infiltration of the vessel wall. The most common signs and symptoms include face or neck swelling, upper-extremity swelling, dyspnea, cough, and dilated chest vein collaterals.

METHODS

A case report.

CASE REPORT

This case report discusses a 65-year-old male diagnosed with small cell carcinoma of the lung, who presented with an acute onset of facial and neck puffiness, swelling, and dyspnea while in a supine position, persisting for 2 weeks. A venous duplex ultrasound revealed acute thrombosis of the proximal segment of the right subclavian vein. The patient had a history of Port-Cath insertion for chemotherapy infusion, which was identified as a potential provocative factor. Following an oncology consultation, it was determined that there were no further treatment options available, either chemotherapy or radiotherapy, for the small cell carcinoma, as the patient had completed his chemotherapy regimen.

The initial treatment approach included full-dose anticoagulation, removal of the catheter, head elevation, and computed tomography venography with contrast, which subsequently confirmed the presence of SVC thrombosis.

Following the unsuccessful conservative treatment over 1 week, the patient was scheduled for catheter-directed thrombolysis (CDT).

Intervention steps: Access to the right femoral vein was established initially, after which an attempt was made to advance a guide wire (GW) to the SVC, which was unsuccessful. Subsequently, ultrasound-guided access of the right basilic vein was performed above the cubital fossa. The GW successfully traversed the thrombosed SVC, and was positioned at the inferior vena cava (IVC). Intraoperative angiography confirmed the presence of SVC thrombosis *(Figure 1)*. We initiated catheter-directed thrombolysis (CDT) by infusing 50 cc of acetylase (tPA) at a rate of 2 mg/hour for 24 hours. Following the complete lysis of the SVC thrombosis, we primarily dilated the chronic lesion in the SVC using a high-pressure balloon measuring 10 x 40 mm, followed by dilation with an XXL esophageal balloon measuring 18 mm x 4 cm x 75 cm (Boston Scientific). Stent placement was not deemed necessary *(Figure 2)*.

RESULT

SVC has cleared angiographically of thrombosis, with no significant stenosis or occlusion. The patient improved dramatically after the operation, the dyspnea was relieved, and facial and neck swelling improved *(Figures 3 and 4)*.

CONCLUSIONS

Catheter-directed thrombolysis followed by balloon dilatation has a safe and effective role in the management of SVC syndrome due to acute in-top thrombosis of chronic lesions.

Keywords

SVC syndrome | acute SVC thrombosis | SVC infiltration

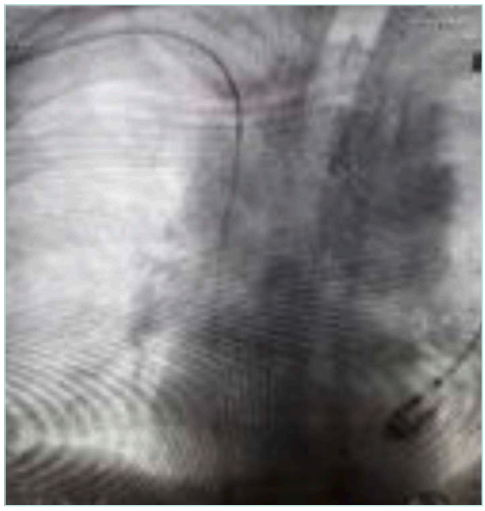

Figure 1. Guidewire pass through superior vena cava.

Figure 2. Thrombus load at superior vena cava.

Figure 3. Balloon dilatation for the lesion.

Figure 4. Postdilation angiography.

18 Successful management of a venous ulcer with foam sclerotherapy of the great saphenous trunk and ligation of a large incompetent perforating vein in the thigh

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BACKGROUND
In cases of chronic venous ulcers, elimination of the great saphenous vein reflux is recommended to accelerate venous healing and reduce the risk of recurrence. Yet, there is only scarce evidence supporting the need for simultaneous management of incompetent perforators.

METHODS
We describe the case of a 40-year-old female presenting with a painful chronic venous ulcer complicating great saphenous vein insufficiency emerging below its confluence to a large (7 mm) mid-thigh perforator communicating directly with the femoral vein. The saphenous diameter in the tibia was 6 mm. On the contrary, the saphenous segment proximal to the perforator presented normal diameter and adequate competence. Preoperative duplex ultrasound precluded any deep vein pathology.

RESULTS
After ultrasound-guided mapping, open ligation of the perforator was performed, followed by foam sclerotherapy (polidocanol 3%) of the saphenous trunk through a 5F sheath 11 cm placed at the knee level. Class II elastic compression was applied immediately after the intervention and during follow-up. The 1-week follow-up revealed an occluded saphenous trunk distal to the ligated perforator with no flow and a diameter reduced from 6 mm preoperatively to 4 mm. There was successful healing of the ulcer with gradual remission of pain. In 1-year follow-up there was neither ulcer nor pain recurrence.

CONCLUSIONS
Management of saphenous trunk reflux combined with large perforator reflux elimination facilitates ulcer healing with sustainable results after 1 year.

Keywords

chronic venous ulcer | great saphenous vein | incompetent perforators

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