Stenting for obstructive iliac vein lesions

Arjun Jayaraj, Seshadri Raju
The RANE Center for Venous & Lymphatic Diseases, St. Dominic Hospital, Jackson, MS, USA

Abstract

Endovenous stenting has supplanted open surgery as the treatment of choice for ilio-caval obstruction. This review provides a brief overview of such obstructive pathology and an in-depth assessment of femoro-ilio-caval stenting.

Introduction

Obstructive iliac vein lesions can result from primary or non-thrombotic and secondary or post-thrombotic pathology. The latter is responsible for a majority of all obstructive iliac vein lesions because of post-thrombotic syndrome (PTS) development in 20 to 50% of patients who present with lower extremity deep venous thrombosis (DVT). Among non-thrombotic iliac vein lesions (NIVL), May-Thurner syndrome (MTS)/iliac vein compression syndrome (IVCS) is the most frequent etiology. While obstruction is seen primarily of the left common iliac vein, the right common iliac or either external iliac vein can also be involved in MTS/IVCS. Other less common causes of NIVL include retroperitoneal fibrosis; iatrogenic, blunt and penetrating trauma; congenital venous anomalies or benign/malignant tumors. Endovenous interventions have supplanted open surgery as the treatment of choice in patients with non-malignant obstructive iliac vein lesions. For patients with malignancy, venous stenting is used only when excision of the tumor/open reconstructive surgery is not possible and the goal of therapy is palliation. Adjunctive procedures such as femoral vein endophlebectomy/creation of arteriovenous fistula are added to venous stenting to provide improved inflow.

Diagnosis

Clinical manifestations of chronic venous insufficiency arising from obstructive lesions of the femoro-ilio-caval tract include swelling; varicosity; hyperpigmentation; venous claudication (pelvic, thigh or hip pain that develops after exercise); skin and subcutaneous inflammatory changes (eczema, lipodermatosclerosis, induration and venous ulcerations) of the affected limb. Of these, swelling has been noted to be the most common symptom followed by venous claudication in one review. In this study the incidence of active ulcers was approximately 19%. Diagnostic testing is focused on confirming the presence of an obstructive femoro-ilio-caval lesion and determining etiology. Additionally, inflow and outflow patterns should be ascertained. Such testing includes venous duplex scanning, which should be used as a screening tool and performed in all patients with clinical presentation suggestive of obstructive venous pathology. Duplex scanning helps define location, etiology (obstructive vs. obstructive with concomitant valvular incompetence), and severity of the underlying problem. Air plethysmography can help evaluate global leg hemodynamics by measuring obstruction, reflux and calf pump function. Cross-sectional imaging including magnetic resonance (MR) venography and computed tomographic (CT) venography will identify obstructive pathology and provide sufficient information in most patients with regard to venous anatomy, collateral circulation and occlusion/stenosis. Ascending venography helps defines the site(s) of obstruction, collateral venous circulation and patterns of preferential flow. This is done by cannulation of the dorsal vein of the foot to assess the veins of the leg and through separate access of the common femoral vein to assess the ilio-caval system. Ambulatory venous pressure measurement by venous cannulation in the foot helps quantify venous hypertension. Intravascular ultrasound (IVUS) is used to assess degree of iliac vein stenosis before stenting; to assess apposition of stent to vein wall post-stenting and to evaluate stent/flow status during follow-up of patients with recurrent symptoms. IVUS is generally considered the gold standard from a diagnostic and therapeutic standpoint.

Treatment

Conservative management

Initial management of femoro-ilio-caval obstruction is usually conservative, including frequent leg elevation, use of graduated compression stockings (30 to 40 mm Hg), and local wound care. Compression garments require strict compliance, which can be an issue due to a variety of reasons, including warm weather and a sense of tightness of the limb. Benefits attributed to graduated compression stockings arise from their ability to impact venous hemodynamics, skin circulation, and calf muscle pump function. Patients with persistent disabling symptoms not responding to conservative measures should be considered for endovascular intervention.

Endovascular treatment

Femoro-ilio-caval stenting has become the primary treatment for obstructive venous pathology. Open approach is reserved for patients who are not candidates for or who have failed an endovascular approach. Endovascular intervention is usually performed under general anesthesia (some interventionalists prefer moderate intravenous sedation) given the frequent severe intraoperative pain/discomfort associated with balloon angioplasty. Access to the mid-thigh femoral vein is obtained under ultrasound guidance. This allows angioplasty/stenting of the common femoral vein if needed, without being impeded by the sheath. A 0.035” Glide wire (Terumo Medical Corp, Somerset, NJ) is passed into the inferior vena cava and a short (10 cm) 11 Fr sheath is placed. An ascending venogram of the ilio-femoral segments and inferior vena cava is performed. In patients with renal dysfunction, the venogram is skipped. Intravascular ultrasound [Volcano, San Diego, CA] is then performed using the 0.035” catheter and planimetric measurements of the luminal areas of the common femoral vein (CFV), external iliac vein (EIV) and common iliac vein (CIV) are made. 125 mm², 150 mm² and 200 mm² are used as normal luminal area cutoffs in the CFV, EIV and CIV respectively. Any decrease in luminal
areas below the reference values shown in Table 1 in a symptomatic patient is consid-
ered abnormal, meriting angioplasty and stenting.5

It is important avoid using any particu-
lar threshold value of stenosis for treatment
because unlike the arterial system, elevated
peripheral venous pressure is the driving
force behind clinical symptoms/signs. In
this regard, even a minor stenosis of around
30% or so can significantly elevate venous
pressure in postthrombotic limbs. The basis
of CVI is venous hypertension and the aim
of stenting is to relieve the same. Predilation of the stenosis is performed
using an 18×60 mm Atlas angioplasty bal-
loon (Bard Peripheral Vascular, Tempe,
AZ). Stenting is then carried out using 18-
20 mm Wallstents (Boston Scientific,
Marlborough, MA) with landing zones
determined by IVUS - defined bony land-
marks. The proximal landing zone is typi-
cally 1-2 cm above the iliac confluence
that can be related to the corresponding verte-
bral body (upper, middle or lower border).
The distal landing zone is an area of ade-
quate inflow in the CFV and can be related

to a body landmark of the pubic ramus,
femoral head or lesser trochanter. Attention
must be paid to the vein at the level of the
inguinal ligament since this is often an area
of compression. Stenting across the inguinal
ligament must be performed in these cases
and can be done with good results (Figure 1).6

Given the relatively low radial strength
of the Wallstent, a Gianturco Z stent (Cook
Medical, Bloomington, Indiana) is used to
provide additional strength across the con-
fluence with an extension of the Gianturco
sten t beyond the Wallstent proximally into
the IVC. The Gianturco Z stent should be
oversized relative to the Wallstent with an
overlap of the lower half of the Z stent with-
in the Wallstent to prevent stent emboliza-
tion. An overlap of 3 cm or so between each
Wallstent in the stack is required to com-
pen sate for foreshortening during post-dila-
tion. Post-dilation is performed using the
18×60 mm angioplasty balloon. Completion IVUS is performed to ensure
adequacy of the luminal area. Any residual
narrowing on IVUS interrogation is over-
come by repeat dilation using sustained
inflation or, if necessary, a larger caliber
angioplasty balloon (20 mm). Completion
venogram is then performed. The 11Fr
sheath is subsequently withdrawn to just
outside the vein and a Surgicel Fibrillar
patch (Ethicon, Somerville, NJ) is intro-
duced via the sheath to aid in local hemosta-
sis. Manual pressure is maintained to com-
plement the hemostatic effect. A retrograde
access through the right internal jugular
vein is also used if the obstruction cannot be
crossed from the femoral access. Kurlinsky
et al. reported their experience with stenting
91 post-thrombotic iliac or iliofemoral
veins. Primary, primary assisted and sec-
ondary patencies at 3 years were 71%, 90%
and 95%, respectively.7 In the largest single
institutional study, 6-year follow-up data of
982 stents placed for chronic nonmalignant
obstructive lesions of the femoro-ilio-caval
vein demonstrated primary, primary assist-
ed and secondary patency rates of 79%,
100%, and 100% in nonthrombotic disease
and 57%, 80%, and 86% in post-thrombotic
disease, respectively.8

Chronic total occlusion

Recanalization of chronic total occlu-
sion (CTO) is most commonly done
through the use of an 0.035” Glidecath
(Terumo Medical Corp, Somerset, NJ) and
0.035” Glidewire. A mid-thigh femoral vein
approach is satisfactory in most instances
with a short entry to lesion length, allowing
greater pushability of instruments. Access
of the profunda femoris vein or the popliteal
vein may sometimes be required depending
on inflow. The internal jugular vein
approach is sometimes necessary when the
antegrade approach fails. A body floss tech-

Table 1. Luminal area values.

| Vein      | Luminal area (mm²) | Diameter (mm) |
|-----------|--------------------|---------------|
| CFV       | 125                | 12            |
| EIV       | 150                | 14            |
| CIV       | 200                | 16            |

CFV, common femoral vein; EIV, external iliac vein; CIV, common

Figure 1. Stenting across the inguinal ligament using Gianturco Z stent/Wallstent combi-
nation. Stenting can be carried out safely across the inguinal ligament without compromis-
ing stent outcomes.

Figure 2. Trabeculae in chronically throm-
bos ed vein segment. Successful recanaliza-
tion requires localization and subsequent
threading of guidewire through such tra-
beculae.
Clinical severity scores improving from 66% and 41% respectively, with the venous cumulative relief of pain and swelling in primary assisted, and secondary patency of 82% at the 2-year mark, was 84%. Raju et al reported cumulative stent patency of 74% and 51% respectively was noted at 42 months follow-up. The cumulative rate of postthrombotic disease and not presence of a filter.

**Bilateral ilio-caval stenting**

There is a limited role for simultaneous bilateral femoro-ilio-caval stenting, except for bilateral recanalization procedures. Typically, the more affected leg is stented, giving adequate time for the less affected leg to improve from off-loading of cross collaterals. In patients with persistent symptoms in the contralateral lower extremity, contralateral stenting can be pursued. In the presence of a prior Gianturco Z stent, the fluoroscopic technique is used wherein the cranial nylon suture of the new Gianturco Z stent is cut so as to allow the struts to flower out and allow it to mesh with the older contralateral Gianturco Z stent (Figure 4).

If the contralateral stent is a Wallstent then a fenestrum needs to be created by wire access across the wall stent interstice and dilation of same using an 18x60 mm angioplasty balloon. Stenting across this fenestrum is accomplished using a combination of Wallstent and Gianturco ‘crown’ as previously described. The wide struts of the Gianturco Z stent lining the fenestrum allow free flow in the contralateral stent across the fenestrum (Figure 5).

The authors’ preference is to use a bilateral Wallstent/Gianturco Z stent combination for management of the iliac confluence as opposed to the apposition, double barrel or fenestrum techniques. Raju et al reported 2-year cumulative primary and secondary patency of 69% and 93% respectively in 273 limbs intervened on by using the Z stent technique.

**Hybrid treatment**

Venous stents are combined with femoral vein endophlebectomy/patch angioplasty or arteriovenous fistula (AVF) creation or both to improve inflow into the stents. The stent is typically placed proximal to the patch or can be extended into the patch. The common femoral or superficial femoral artery can be used for inflow to create the fistula, which is typically fashioned using a 4 to 6 mm externally supported PTFE graft. Acceptable outcomes following endophlebectomy and AVF creation have been reported.

**Anticoagulation**

For perioperative thromboprophylaxis, the authors use enoxaparin 40 mg given subcutaneously preoperatively, in addition to bivalirudin 75 mg given intravenously in the operating room prior to the start of the procedure. The authors use this combination of direct and indirect thrombin inhibitors to reduce early stent complications including thrombosis. Following ilio-caval stenting, in patients with thrombophilic post-thrombotic syndrome therapeutic anticoagulation is continued. Those in whom thrombophilia workup is negative and who have non-thrombotoxic femoro-ilio-caval lesion, aspirin 81 mg with cilastazol 50 mg twice daily is typically used unless contraindicated. The latter is used for its suppressive effect on neointimal hyperplasia. Presence of significant in-stent restenosis, but with no symptom recurrence is an indication to switch to apixaban 2.5 mg on a twice-daily basis. Recurrence of symptoms is an indication for repeat IVUS interrogation and possible angioplasty.

**Follow-up**

Venous duplex ultrasound is performed on post-operative day one to obtain baseline post-procedure metrics, including stent patency, and to assess stent compression and/or in-stent restenosis. These parameters are again evaluated by repeat duplex ultrasound in addition to assessing symptom relief at clinic visits 2 weeks and 4 weeks post-procedure. Three to six monthly follow-up is required subsequently, which is gradually reduced to annual follow up depending on symptoms and status of stents. More frequent follow-up is typically required for PTS and recanalization patients.
Figure 3. A-G) Recanalization - Iliocaval occlusion with IVC filter (A and B: right and left venogram demonstrating bilateral CTO with occluded IVC filter; C and D: IVC filter crush with 24 mm angioplasty balloon and subsequent stenting across filter; E: Stenting up to hepatic vein confluence to provide good outflow using Gianturco Z stent across renal veins; F: Iliocaval confluence stenting using Gianturco Z stent/ Wall stent technique; G: completion venogram).
Complications of iliac stenting and their management

Femoro-ilio-caval stenting can be performed with minimal mortality and low morbidity. Reintervention is required at times. Raju et al. noted a reintervention rate of 13% following femoro-ilio-caval stenting in 1085 limbs. Median time to reintervention after the initial procedure was 15 months. Post-reintervention the group reported cumulative improvement in pain and swelling of 67% and 72%, respectively, at 18 months follow-up. Complete cumulative healing of venous dermatitis/ulcer at 12 months' post-reintervention was 90%.19 Some of the potential complications that can be encountered are considered in the following paragraphs.

Access site-related

Such complications can be reduced by use of ultrasound guidance for access. Clinically significant hematoma/arterial injury/pseudoaneurysm/nerve injury is extremely rare (<0.1%). In most cases access site hematomas can be effectively managed with compression and delayed start of anticoagulation. Pseudoaneurysm, when indicated, is best managed by ultrasound-guided thrombin injection. Patients who sustain nerve injuries attain symptom relief over time. However, counseling and setting realistic expectations are key.

Vein injury/rupture

Frank rupture of the intervened vein is uncommon due to relatively low pressure and significant periadventitial fibrosis around the vein. When rupture occurs use of a stent graft can help exclude the site of extravasation.20

In-stent restenosis

In-stent restenosis (ISR) arises from either thrombus buildup or neointimal hyperplasia within the stent. The authors note an incidence of up to 25% in their experience. Patients presenting with recurrence of symptoms require reintervention with angioplasty. This often involves use of an angioplasty balloon larger than the rated size of the stent used (e.g., for a 20 mm stent we can use a 22 mm angioplasty balloon). This is termed hyperdilation as opposed to isodilation, which is dilation with use of an angioplasty balloon of the same rated diameter as the stent. Therapeutic anticoagulation and use of cilastazol immediately after index stent procedure may help reduce occurrence.

Stent compression

Stent compression occurs due to extrinsic compression of the stent due to fibrotic tissue build up. This is a phenomenon unique to the venous system. Incidence is significantly lower than ISR, with treatment being hyperdilation in symptomatic patients. Larger caliber balloons may have to be used to overcome the stent compression (22-24 mm) than in ISR.

Stent thrombosis

Layering of thrombus within the stent occurs can occur due to poor inflow, poor outflow or mechanical effects of an inadequate stent stack with potential for stent thrombosis. The overall incidence of stent thrombosis is approximately 3.5% in the authors experience, with chronic thrombosis more common than acute.21 Contributing factors to an inadequate stent stack include use of undersized stent and understenting (not covering all areas of disease). Lack of perioperative use of anticoagulation/antiplatelet agent(s) can also contribute to stent thrombosis. Restenting after fracturing the previously placed undersized stents with large caliber angioplasty balloons or extension of stent stack proximally or distally as the case may be is required for undersized stent and under stenting, respectively. For acute/subacute occlusions treatment is with pharmacomechanical thrombectomy +/- balloon maceration (no pulmonary embolisms in the authors experience). For more chronic occlusions (CTO), recanalization can be pursued as described earlier. Acceptable results have been noted in both situations. Laser recanalization or radiofrequency wire recanalization has also been used as a last resort in occluded stents with modest success.
Contralateral iliac vein thrombosis

This is a rare event occurring from jail- ing of contralateral common iliac vein by ipsilateral stent. It can be overcome by use of Wallstent-Gianturco Z stent (Boston Scientific, Marlborough, MA- Cook Medical, Bloomington, IN) combination and limiting extension into IVC. The latter technique reduces the risk of contralateral thrombosis by up to 85%.

Stent migration

Occurs due to the choke point effect of the iliac confluence. It is imperative to extend the stent stack proximal to the confluence to overcome this effect. Furthermore, use of the Gianturco Z stent (Cook Medical, Bloomington, IN) helps provide additional radial force and checks migration.

Mortality

Worldwide experience has proven venous stenting to be a low-risk procedure with negligible morbidity and mortality.

References

1. 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;130:1636-61.
2. Raju S, Neglen P. High prevalence of nonthrombotic iliac vein lesions in chronic venous disease: a permissive role in pathogenicity. J Vasc Surg 2006;44:136-43; discussion 44.
3. Titus JM, Moise MA, Ben J, et al. Iliofemoral stenting for venous occlusive disease. J Vasc Surg 2011;53:706-12.
4. Garg N, Gloviczki P, Karimi KM, et al. Factors affecting outcome of open and hybrid reconstructions for nonmalignant obstruction of iliofemoral veins and inferior vena cava. J Vasc Surg 2011;53:983-90.
5. Raju S, Brawley WR, Jayaraj A. Optimal sizing of iliac vein stents. Phlebol Venous Forum R Soc Med 2017 [In press].
6. Neglen P, Tackett TP, Jr., Raju S. Venous stenting across the inguinal ligament. J Vasc Surg 2008;48:1255-61.
7. Kurklinsky AK, Bjarnason H, Friese JL, et al. Outcomes of venoplasty with stent placement for chronic thrombosis of the iliac and femoral veins: single-center experience. J Vasc Interv Radiol 2012;23:1099-15.
8. Neglen 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;46:979-90.
9. Kolbel T, Lindm M, Akesson M, et al. Chronic iliac vein occlusion: mid-term results of endovascular recanalization. J Endovasc Ther 2009;16:483-91.
10. Fatima J, AlGaby A, Ben J, et al. Technical considerations, outcomes, and durability of inferior vena cava stenting. J Vasc Surg 2015;3:380-8.
11. Raju S, Hollis K, Neglen P. Obstructive lesions of the inferior vena cava: clinical features and endovenous treatment. J Vasc Surg 2006;44:820-7.
12. Murphy EH, Johns B, Varney E, Raju S. Endovascular management of chronic total occlusions of the inferior vena cava and iliac veins. J Vasc Surg Venous Lymph Disord 2017;5:47-59.
13. Neglen P, Oglesbee M, Olivier J, Raju S. Stenting of chronically obstructed inferior vena cava filters. J Vasc Surg 2011;54:153-61.
14. Raju S, Ward M, Jr., Kirk O. A modification of iliac vein stent technique. Ann Vasc Surg 2014;28:1485-92.
15. de Wolf MA, Jalaie H, van Laarhoven 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;104:718-25.
16. de Wolf MA, Arnoldussen CW, Wittens CH. Indications for endophlebectomy and/or arteriovenous fistula after stenting. Phlebol Venous Forum R Soc Med 2013;28 Suppl 1:123-8.
17. Comerota AJ. Venous thrombectomy and arteriovenous fistula versus anticoagulation in the treatment of iliофemoral venous thrombosis. J Vasc Surg 1992;15:887-9.
18. Comerota AJ, Grewal NK, Thakur S, Assi Z. Endovenectomy of the common femoral vein and intraoperative iliac vein recanalization for chronic iliофemoral venous occlusion. J Vasc Surg 2010;52:243-7.
19. Raju S, Tackett P, Jr., Neglen P. Reinterventions for nonocclusive iliофemoral venous stent malfunctions. J Vasc Surg 2009;49:511-8.
20. Adams MK, Anaya-Ayala JE, Davies MG, Bismuth J, Peden EK. Endovascular management of iliac vein rupture during percutaneous interventions for occlusive lesions. Ann Vasc Surg 2012;26:575e5-9.
21. Jayaraj ACW, Murphy EH, Raju S. Occlusion following ilio caval stenting-characteristics and outcomes. J Vasc Surg 2016;63:53S-4S.
22. Murphy EH, Johns B, Varney E, et al. Deep venous thrombosis associated with caval extension of iliac stents. J Vasc Surg Venous Lymph Disord 2017;5:8-17.
23. Raju S. Best management options for chronic iliac vein stenosis and occlusion. J Vasc Surg 2013;57:1163-9.