Iliac Vein Stenting for Chronic Venous Insufficiency

Chronic venous insufficiency has devastating sequelae in terms of patients’ lifestyles and negative economic impact on society. Traditional surgical procedures have yielded variable patency results, and follow-up has not always been reported. This review summarizes the current applications, patency rates, stent selection, and complications of balloon angioplasty and stenting in the treatment of chronic venous outflow obstruction in the lower extremity. We conclude that endovenous stenting is the current method of choice in the treatment of chronic venous obstruction. (Tex Heart Inst J 2007;34:60-6)

Traditional therapy for acute lower-extremity deep venous thrombosis (DVT) has been directed toward limiting the progression of existing clots and preventing pulmonary embolism (PE) and recurrent thrombosis. Up to 90% of patients with a history of iliofemoral DVT develop significant symptoms of the post-thrombotic syndrome, which consist of swelling, pain, ulceration, and venous claudication of the lower extremities. Up to 15% of patients develop stasis ulcers, despite adequate treatment of the acute event with anticoagulation.1-2 The underlying pathophysiology is ambulatory venous hypertension that develops as a result of persistent venous obstruction and incompetent venous valves. The long-term clinical and hemodynamic consequences of chronic iliofemoral venous thrombosis have been well documented. It has been reported that nearly half (44%) of patients with a previous episode of iliofemoral DVT developed symptoms of venous claudication despite treatment of the acute event with standard anticoagulation.3

The rationale for early, active clot removal in patients with acute DVT is therefore 2-fold: elimination of acute and long-term venous obstruction, and preservation of venous valve function. Acute DVT may be treated with pharmacologic or mechanical clot-removal methods, combined with correction of any underlying or residual obstructive lesions. This report reviews the current methods for treating chronic venous insufficiency that results from iliofemoral DVT, with emphasis on the emerging use of endovascular techniques.

Current Treatment Methods for DVT

Historically, intravenously administered unfractionated heparin, followed by oral warfarin, was the treatment of choice for acute DVT. Randomized clinical trials have elucidated effective alternative anticoagulant regimens.4-7 As a result of clinical studies, the subcutaneous administration of low-molecular-weight heparin has become the standard of care for patients with acute DVT.8 Although available anticoagulants prevent thrombus propagation, PE, and recurrent venous thrombosis, they do not dissolve the occluding thrombus or reduce venous outflow obstruction. Furthermore, the inflammatory process may be unaffected by anticoagulants.9 Due to these limitations, alternative therapies that focus on clot removal and preservation of valvular competence have emerged. These alternative treatment methods include open surgical thrombectomy, thrombolytic therapy, percutaneous mechanical thrombectomy, and balloon angioplasty and stenting. This review will focus on the current status of this last endovascular approach in the treatment of chronic obstruction of venous outflow to the lower extremity.

Before the development of venous balloon dilation and stenting, obstructions of the venous circulation were corrected by surgical bypass reconstruction. Iliac vein obstruction was usually managed by a Palma femorofemoral bypass or a unilateral bypass between the femoral vein distal to the obstruction and the contralateral iliac
vein or inferior vena cava (IVC).10 These major surgical procedures usually necessitate lifelong anticoagulation and a temporary or continuous adjunctive arteriovenous fistula to keep the bypass patent. Due to the magnitude of the intervention, only patients with the most severe post-thrombotic syndrome were selected. Although reports on the crossover-bypass technique claim durable symptomatic relief;11,12 most studies lack consistent follow-up with venography.

Endovascular treatment is much less invasive, for it requires only percutaneous access with a 16G needle, followed by a 6F or 7F sheath. Upon completion of the procedure, hemostasis is achieved by manual compression. This approach has a high technical success rate, with minimal complications. The procedure can be performed as a 1-day (or less) admission, with the patient’s return to prior activity levels immediately after discharge.13 Furthermore, an endovascular approach is advantageous for several reasons: diagnostic venography enables direct evaluation of the degree of venous obstruction and collateralization; catheter-directed thrombolysis can clear a large acute thrombus burden, thus preserving valve function; angioplasty and stent placement can disrupt obstructive intravenous synechiae and webs (spurs); and the integrity of the compressed iliac vein can be restored without apparent long-term damage.

Iliac Vein Compression Syndrome
In some patients with DVT, there is underlying venous disease. Left common iliac vein stenosis frequently occurs where the vein crosses beneath the right common iliac artery. Chronic, repetitive compression at this site causes fibrosis of the vein, with synechiae and spurs that result in stenosis or even occlusion of the lumen. This condition, which is becoming increasingly recognized, is called iliac vein compression syndrome, or May-Thurner syndrome.14

Iliac vein compression syndrome may present in 3 distinct clinical patterns. Patients may present with sudden leg swelling and pain associated with iliofemoral venous thrombosis, with the anatomic defect discovered after the clot has been removed by thrombolysis or surgical thrombectomy. This acute presentation is found most commonly in women in the 3rd or 4th decades of life. Iliac vein compression may also be discovered in patients with chronic leg complaints that are suggestive of chronic venous insufficiency, including stasis ulceration, in the absence of acute thrombosis. In these patients, a short-segment stenosis or occlusion of the proximal left common iliac vein is discovered. Last, patients may present—months or years after a known episode of iliofemoral DVT—with extensive occlusion of the left common and external iliac veins, in which instance venous drainage of the leg occurs mainly via collateral vessels that arise from the common femoral vein. Patients with mild degrees of iliac vein compression may manifest some leg swelling, left-leg varicosities, and valvular incompetence in both superficial and deep systems. We are increasingly interrogating the iliac system when treating patients with severe left-leg varicosities, in order to look for iliac vein compression.

There are insufficient clinical data, however, to currently recommend this for routine clinical practice. One must maintain a high index of suspicion to recognize iliac vein compression. With the widespread use of venography in patients who are undergoing percutaneous procedures, it is now possible to identify a culprit lesion in some patients. Once identified, these lesions can usually be treated with percutaneous venoplasty and stenting.15-17 Endoluminal reconstruction of the compressed iliac vein by means of a stent is a simpler and perhaps more elegant solution than surgery, especially for application to a young and otherwise healthy patient.

Bypass Procedures.
The indications for surgical treatment of iliac vein compression (May-Thurner syndrome) are a mean resting pressure difference of >2 mmHg between the right and left common femoral veins; or a variation in pullback pressures from the IVC to the external iliac vein; or venous claudication with a 3-fold increase, upon exercise, in the venous pressure of the affected limb, compared with that of the healthy limb.15,18-20 Multiple surgical treatment options have been advocated. These include vein-patch angioplasty with excision of intraluminal bands; division of the right common iliac artery and relocation behind the left common iliac vein or vena cava; and contralateral saphenous vein graft bypass to the ipsilateral common femoral vein with creation of a temporary arteriovenous fistula (Palma’s crossover).18

Unfortunately, there are no randomized comparative trials, and it is difficult to compare 1 technique with another. The reported patency rates of bypass procedures are variable, and follow-up has been inconsistent. Overall, the reported long-term success rate, defined primarily as patency of the left common iliac vein or venous bypass, ranges from 40% to 88%.11,12 The necessity for long-term anticoagulation makes surgery even less attractive to patients. Recently, combined surgical and endovascular management of iliofemoral DVT has been described. Mickley and associates18 reported their experience with surgical thrombectomy in 77 patients with acute iliofemoral DVT. Among the 61 patients with left iliofemoral DVT, venography suggested the presence of a spur in 30 patients. Twenty-two of these 30 patients were treated by thrombectomy alone, followed by anticoagulation; 16 of the 22 had acute rethrombosis despite adequate anticoagulation. The remaining 8 of the 30 patients underwent placement of an endovascular stent after thrombectomy. Only 1 of these patients had acute rethrombosis, which was attributed to a malpositioned stent.
**Iliac Vein Obstruction and Occlusion**

The treatment of outflow obstruction has been hampered by difficulty in identifying hemodynamically significant obstruction, a problem that was compounded by the sole availability of invasive surgical techniques. Several authors have reported the results of endovascular management, including balloon angioplasty and stent placement, to recanalize obstructed iliac vein segments. Most series include a preponderance of left-sided interventions, presumably representing cases of iliac vein compression; and stents are placed in nearly all patients, due to the elastic recoil typical of venous lesions.

Raju and colleagues have reported their experience with recanalization of the iliac vein in 38 limbs. In 28 of 38 limbs, the stent was extended below the groin crease into the common femoral vein segment. Large-caliber (14 or 16 mm for the iliac vein), flexible, self-expanding stents were used. Stents were routinely extended for a short distance into the IVC to forestall development of ilio caval stenosis. The median length of the recanalized segment was 22 cm, and multiple stents (median, n=3) were necessary in most patients. Actuarial primary, primary-assisted, and secondary patency rates of stents at 24 months were 49%, 62%, and 76%, respectively. There was a significant symptomatic improvement in the stented group, with minimal morbidity. In another review, the same group reported excellent results with iliac vein interventions, including stents placed in 455 limbs with chronic, nonmalignant obstruction (stenosis or occlusion). At 3 years, primary patency was 75%, primary-assisted patency was 92%, and secondary patency was 93%. Nonthrombotic limbs had better primary patency than thrombotic limbs (89% vs 65%, respectively).

These studies illustrate that, although surgical strategies exist, ilio caval occlusion can more often than not be successfully recanalized by angioplasty and stenting. Patients who experience venous claudication due to chronic isolated iliac vein occlusion often experience immediate relief after such recanalization.

**Balloon Angioplasty and Stenting for May-Thurner Syndrome**

Patel and colleagues reported on their endovascular treatment of acute extensive iliofemoral deep venous thrombosis due to May-Thurner syndrome. During a 1-year period, 10 symptomatic women were referred for treatment. After ascending venography, an infusion catheter system was placed, and urokinase was infused locally into the thrombus burden. After nearly complete clot dissolution or lytic stagnation, the residual narrowing of the left common iliac vein was treated by means of angioplasty or placement of a Wallstent endoprosthesis (Boston Scientific, Inc.; Natick, Mass). Initial clinical success was 100%, with complete resolution of symptoms in all patients. During a mean follow-up of 15.2 months, all but 1 patient were asymptomatic. That patient, who was hypercoagulable and was receiving chemotherapy for metastatic adenocarcinoma, had recurrent, symptomatic, acute DVT 1 month after therapy. She responded to repeated lysis. Patel and associates concluded that underlying left common iliac vein lesions invariably need to undergo stent placement.

In another study, Binkert and coworkers reported the use of self-expanding stents in 8 patients who had been diagnosed with iliofemoral DVT and pelvic venous spur. The mean follow-up period was 32 months. The primary patency rate was 100%, with immediate symptomatic relief in all patients. O'Sullivan and coworkers reported a retrospective analysis of 39 patients who had venous outflow obstruction resulting from May-Thurner syndrome. Nineteen of these patients presented with acute DVT, and the remaining 20 presented with chronic symptoms. In the acute DVT group, all patients were treated with catheter-directed thrombolysis, followed by angioplasty and stent placement. In the chronic DVT group, patients were treated with angioplasty and stenting alone or in combination with thrombolysis. Thirty-five of the 39 patients received stents. Patients were then followed up with duplex ultrasonography and a quality-of-life evaluation. Initial technical success was achieved in 87%, patency at 1 year in >90%, and symptomatic relief in 85%. Collectively, these data support the use of endovascular therapy for chronic venous outflow obstruction.

**Imaging for Iliac Vein Obstruction**

Visualization of the iliac veins in the pelvis can be difficult due to overlying pelvic organs and bowel gas. In addition, Doppler waveforms in the common femoral veins can display normal spontaneous flow and respiratory variation due to large collateral vessels around the site of proximal obstruction. Hurst and associates reported false-negative scans in 5 of 18 patients with iliac vein obstruction. In the setting of unilateral lower-extremity pain and edema, especially after a normal lower-extremity venous duplex scan, direct imaging of the pelvic veins should be considered. Magnetic resonance venography has proved helpful as an alternative to conventional contrast venography. Others have used computed tomographic angiography as an alternative to reveal iliac vein stenosis due to compression.

At this time, there is no gold standard for the selection of patients who need treatment for iliac outflow obstruction. Venographic evidence of collateral vessels certainly strengthens the case for intervention, but significant lesions can be present without collateralization. Intravascular ultrasound (IVUS) investigation is highly accurate and should probably be used more liberally, especially in patients in whom there is clinical suspi-
tion of outflow obstruction, with symptoms of pain and swelling and a history of DVT. Trabeculation and axial collateral vessels show up well on the IVUS image, and accurate measurements of venous diameter for stent sizing is also provided. The IVUS accurately displays postdilation flaps or venous wall irregularities and confirms that the stent has completely conformed to the venous wall.

**Stent Selection**

The mid-term patency of stents in the iliocaval venous system has been considerably higher than that of self-expanding stents in other medium-sized veins, such as the subclavian vein. The possible reasons for this include the relatively immobile nature of pelvic placement, compared with stent placement in the freely mobile subclavian vein, in addition to the absence of adjacent bony structures, such as the clavicle or the 1st rib, which might compress a stent. We acknowledge that the inguinal ligament is a relatively firm, immobile structure, yet extending stents below this level did not affect patency, as we have said above. Perhaps this is because during hip flexion, the point of maximum flexion of the femoral vein is several centimeters inferior to the inguinal ligament.

As we have gained more experience in treating iliac vein compression, we have switched from balloon-expandable stents to the more flexible self-expanding stents. Self-expanding stents have the advantages of longer lengths, large diameters, flexibility at the groin, and less susceptibility to permanent deformation by the pulsatile arterial and the inguinal ligament. Hartung and coworkers reported similar mid-term results as in May-Thurner syndrome, appears to be safe.27 The use of infrainguinal venous stents is currently controversial. Although it may seem important to keep the stented area to a minimum, stent implantation should extend to cover all identified stenoses, leaving no residual lesion if possible. Because the Wallstent is flexible, it is considered safe to cross the inguinal ligament. However, given the relatively poor patency of infrainguinal stents compared with suprainguinal stents, they should be reserved for patients who have severe, extensive disease with very poor outflow.

**The Procedure**

The procedure is usually performed in the operating room or angiography suite with the patient under local anesthesia and intravenous sedation. Ultrasound-guided cannulation of the common femoral or popliteal vein is performed, followed by insertion of a 6-mm Pinnacle sheath (Terumo Medical Corporation; Somerset, NJ). Antegrade venography is performed to determine the degree, length, and site of obstruction, and the presence of collateral vessels. Once the area of concern has been traversed with a guidewire (Terumo Medical Corporation), we routinely cross the stenosis or occlusion with a stainless-steel, titanium-alloy, self-expanding stent, 10 to 16 mm × 9 cm (Wallstent, Boston Scientific/Meditech). Upon completion, a venogram is mandatory. If significant stenosis remains, postdilation with a 12- to 20-mm × 4- to 6-cm balloon (Meditech XXL, Boston Scientific/Meditech) is carried out (Fig. 1). Finally, the sheath is removed and light pressure is applied. Table I lists the supplies that are required to perform balloon angioplasty and stenting.

**Clinical Outcomes after Endovascular Venous Interventions**

The most extensive experience has been reported by Raju and colleagues, who described their results after the treatment of 304 limbs with symptomatic chronic venous insufficiency. Their actuarial primary and secondary stent patency rates at 24 months were 71% and 90%, respectively. The median degree of swelling and pain was significantly reduced: the pain level recorded on a visual analogue scale from 0 to 10 declined from a median level of 4 to 0 (P <0.001). Complete pain relief was achieved in 71% of patients, up from 17% before stenting. Stasis dermatitis or ulceration was present in 69 of 304 limbs. The cumulative recurrence-free ulcer healing rate was 62% at 24 months. Quality of life was also significantly improved.

Hartung’s group reported similar mid-term results of endovascular treatment of symptomatic, chronic, nonmalignant, iliocaval venous occlusive disease. A high technical success rate was achieved. Thrombotic occlusion occurred in 5% of patients (2/44), with cumulative primary and secondary patency rates of 73% and 90%, respectively, at 36 months; and an in-stent restenosis (reduction of luminal diameter by >50%) rate of 13% was observed. Respectively, the median Venous Clinical Severity and Venous Disability scores were 8.5 (range, 4–18) and 2 (range, 2–3) before surgery, and 2 (range, 0–9) and 0 (range, 0–2) at the end of the follow-up period. These remarkable clinical results, together with improved quality of life, make adoption of this method even more appealing.

In patients with venous valvular reflux, the timing of repair procedures is open to discussion. Raju and Hardy showed that surgical correction of the reflux by, for example, valve repair or subfascial endoscopic interruption (ablation of the perforated vein) can be performed with excellent results despite the presence...
of outflow obstruction. However, the relief of pain and swelling after endovascular treatment of venous stenosis has been so obvious that patients may experience more symptomatic resolution when stenting is performed before reflux procedures. The lack of improvement in reflux after stenting suggests that reflux control will be required later in many of these patients, especially those with advanced venous insufficiency. If Raju and Har-

do’s preliminary results are sustained for a long-term period, stent placement for the correction of iliac vein stenoses will be a useful adjunct in the management of chronic venous insufficiency with resultant valvular incompetence.

**Potential Complications of Venous Stenting Procedures**

In most series, venous stenting carries no risk of death, pulmonary embolism, or major bleeding. Acute iliac vein rethrombosis (<24 hr) that required reintervention was observed by O’Sullivan and coworkers in 2 of 39 patients.27 The procedural success rate has been exceptional.13,16,27,32 In 2000, Neglen and Raju13 reviewed their experience in treating 102 limbs of patients who had probable iliac vein obstruction. The early (<30-day) complication rate was low (10%). One patient developed retroperitoneal bleeding from a high cannulation site and was treated conservatively with blood transfusion. Another sustained an arterial injury during cannulation, which required open repair with an interposition graft. These injuries were subsequently minimized with the use of ultrasound-guided venous puncture. In another patient, the guidewire was caught in the stent, which was pulled to the femoral vein and then successfully removed through a groin incision. One patient developed postoperative swelling of un-
known cause; the stent was patent on venography, and the swelling subsided within weeks. Thrombosis of the stented area was encountered in 5 limbs (6%), all within 3 weeks of the surgery in patients with post-thrombotic disease.

Overall, balloon angioplasty and stenting is safe and effective, and the complication rate is likely to decrease as technology evolves and our experience increases.

**Conclusion**

Endovascular treatment is a minimally invasive approach to venous lesions that has a high technical success rate and an acceptable complication profile. Balloon dilation and stenting is a safe and effective treatment for chronic benign obstruction of the iliac vein. Hemodynamically significant venous lesions should always be stented, and the stent should be inserted well into the IVC when an iliocaval junction stenosis is treated. There is currently no acceptable standard for evaluating patients for endovascular therapy. Although mid-term results are good, only longer follow-up will determine whether the hyperplasia observed in the stented area will progress to late recurrent venous obstruction and whether early symptomatic improvement is maintained. The procedure can be performed during a 23-hour hospital stay, followed by immediate return to regular activity after the patient’s discharge. Balloon dilation and stenting appear to be superior to conventional surgical treatment and should be considered the 1st line of therapy for many patients suffering from chronic iliocaval venous obstruction.

**References**


