Pitfalls and Bailouts of Endovascular Stenting for Iliac and Renal Vein Obstructions

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Conflict of Interest

None
Venous Stenting

Nonthrombotic iliac vein lesions (NIVL)

May-Thurner Syndrome

Chronic iliac (iliofemoral) vein thrombosis

Nutcracker Syndrome
Current Commercially Available Stents

Wallstent
Boston Scientific
Marlborough, MA
Current Commercially Available Stents

- Gianturco Z-Stent
  Wilson-Cook Medical
  Winston-Salem, NC

- Wallstent
  Boston Scientific
  Marlborough, MA

- Smart
  Cordis Endovascular
  Warren, NJ

- Luminexx
  Angiomed/Bard
  Karlsruhe, Germany

- Protégé
  ev3, Plymouth, MN
Two ongoing iliofemoral stent RCTs
To assess safety and efficacy

• The Veniti VIRTUS study
  VICI VENOUS STENT
  Symptomatic patients with non-malignant iliofemoral venous obstruction

• Zilver Vena VIVO Study
  Symptomatic patients with iliofemoral venous obstruction
Non-thrombotic obstruction of the iliac veins

May – Thurner Syndrome
May – Thurner Syndrome
Stenting of the venous outflow in chronic venous disease: Long-term stent-related outcome, clinical, and hemodynamic result

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Background: Stenting of chronic nonmalignant venous outflow obstructions is now available to perform long-term angioplasty as a minimally invasive intervention.

Materials: From 1997 to 2005, 982 chronic venous outflow obstructions were treated, 2.6:1, and left/right limb symptoms, 2.4:1. Cases were classified by primary/secondary etiology as 518:464. At follow-up (up to 5 years), clinical outcome, quality of life (CIVIQ), and hemodynamics were monitored. The cumulative patency rate was 98% at 2 years, 95% at 5 years, and 94% at 7 years. Of 982 patients, 94% reported no mortality (<30 days) and no morbidity (<30 days) and during later follow-up (up to 7 years). At 7 years, 7% were 79%, 100%, and 100% in nonthrombotic disease. Cumulative rate of severe in-stent restenosis was 3% in nonthrombotic limbs. The main risk factor for severe restenosis was prior intervention. The main risk factors for severe restenosis were prior intervention and history of thrombotic disease, thrombophilia by itself was not a significant risk factor. Severe leg pain (visual analog score > 7) was present postintervention in 11% and at 18% postintervention, respectively. In the first 3 months, 62% and 32%, respectively, and ulcer healing rate was 80% at 6 months. Mean hand-foot pressure difference was 21% in limbs with no concomitant reflux. The hemodynamics of severe restenosis were consistent with superficial reflux in subsets of patients with a significant in-stent restenosis.

Conclusions: Venous stenting can be performed successfully with a high patency rate of in-stent restenosis. It resulted in major improvements that were consistently reflected in any substantial hemodynamic benefit. Clinical outcome occurred regardless of presence of superficial or deep venous obstruction. (J Vasc Surg 2007;46:979-90.)
Reinterventions for nonocclusive iliofemoral venous stent malfunctions

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Background: Percutaneous iliofemoral venous stenting has been shown to be effective, safe, and durable in both nonthrombotic iliac vein lesion (NIVL) and postthrombotic disease. A small fraction of stented limbs require reintervention to correct stent malfunction. This manuscript examines the reasons for reintervention, types of procedures performed, and outcome.

Methods: Femoro-ilio-caval stenting was performed in 1085 limbs over a 10 year period from 1997 to 2007 (NIVL/postthrombotic limb ratio 1:1). Reinterventions were categorized into four types to correct inflow problems; (3) lesions encountered were different and had a greater incidence of pathologies of uncertain aetiology that occurred below the restenosis (ISR) occurred in both subsets of limbs. The low flow channel lined by thrombus within the stent independently, was resistant to dilatation and swelling at 18 months following initial for dermatitis/ulcer was 90% at 12 months.

Results: Median time of intervention after initial stenting was 15 months. Reinterventions required after initial stenting were performed on more than the limb.

Indications

- Stent abnormalities: 31%
- Recurrent symptoms: 69%

Reinterventions

- Single: 77%
- Multiple: 23%
16 studies, 2,586 stents in 2,373 patients

- **Persistent ulcer healing rates**: 56% - 100%
- **Primary patency**: 32% - 98.7%
- **Secondary patency**: 66% - 96%
- **Major complication rate**: 0 - 8.7%

The quality of evidence to support iliac vein stenting is weak.
Secondary interventions: 10% (50/490)

- Residual or new stenosis 50%
- Migration 8%
- Thrombosis 12%
- Contralateral jailing 12%
CLINICAL RESEARCH STUDIES

From the American Venous Forum

Deep venous thrombosis associated with caval extension of iliac stents

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ABSTRACT

Background: It is generally difficult to place an iliac vein stent precisely at the iliocaval junction with venographic control or even with intravascular ultrasound guidance. Furthermore, mechanical properties of the Wallstent (Boston Scientific, Marlborough, Mass) can predispose precisely placed stents to distal displacement or stent collapse. Our center has thus advocated extending Wallstents 3 to 5 cm into the inferior vena cava to prevent complications of missed proximal lesions or stent migration. This technique has gradually been accepted, and concerns of jailed stent flow were not initially recognized. We analyzed deep venous thrombosis (DVT) incidence following ilio caval stenting with two alternative techniques: (1) Wallstents with 3- to 5-cm extension into the inferior vena cava and (2) a modified Z-stent (Cook Medical, Bloomington, Ind) technique, in which overlapping Wallstents end at the iliac curvature and caval extension is performed with a Z-stent placed at the top of the stack. The function of the Z-stent is to provide improved radial force at the iliocaval confluence and to prevent jailing of contralateral flow with larger stent interstices.

Methods: There were 755 limbs with consecutive Wallstent caval extensions (2006-2010) and 982 limbs with Z-stent extensions (2011-2015) analyzed for DVT incidence postoperatively.

Results: Demographics were similar for both groups. Mean age was 56 and 56 years in the Wallstent and Z-stent groups, respectively. There was a female predominance (Wallstent, 69%; Z-stent, 67%) and a higher incidence of left-sided disease (Wallstent, 66%; Z-stent, 56%) in both groups. There was a slightly higher incidence of post-thrombotic disease in the Z-stent subgroup (Wallstent, 53%; Z-stent, 68%). Cumulative freedom from contralateral DVT was 99% and 90% in the Z-stent and Wallstent groups, respectively (P < .001) during the 5 years following stent placement. However, all three patients with DVT contralateral to a Z-stent actually had high placement of the Wallstent across the confluence. Thus, no patients with proper Z-stent technique had a contralateral DVT. Cumulative freedom from ipsilateral DVT was 99% and 62% in the Z-stent and Wallstent groups, respectively (P = .001) during the 5 years following stent placement. The decrease in incidence of ipsilateral DVT appeared to be attributable to decreased missed distal lesions with increased operator experience and not attributable to the Z-stent itself.

Conclusions: Contralateral DVT incidence was significantly lower with the Z-stent modification. In addition, the Z-stent modification provides greater radial strength at the iliac-caval confluence and simplifies simultaneous or sequential bilateral stenting. Use of proper technique and intravascular ultrasound is essential to limit the incidence of ipsilateral DVT. (J Vasc Surg Venous and Lymph Dis 2017;5:8-17.)

Endovascular stenting has become the first-line treatment for patients with symptomatic iliofemoral stenosis or occlusion. Excellent clinical outcomes and patency can be achieved with adherence to the basic vascular principle of establishing adequate inflow and outflow. In most cases, the outflow component requires stenting of the proximal common iliac vein (ICV), which is a typical location of densely fibrotic venous lesions and is considered an anatomic choke point.

Proper stenting of the proximal ICV can be challenging for two primary reasons: (1) the difficulty in accurately locating the iliac vein confluence on venography; and (2) the limitations of current stent technology, which can lead to either cranial stent collapse with coning or downward stent migration when stents are positioned exactly at the confluence.

To mitigate the difficulties of landing stents at the confluence, it has been recommended to deploy Wallstents (Boston Scientific, Marlborough, Mass) 3 to 5 cm into the inferior vena cava (IVC). Initial concerns that crossing the contralateral ICV could cause contralateral deep venous thrombosis (DVT) were not immediately recognized. Over time, however, we observed patients
Comparison of Contralateral DVT Occurrence Among WallStent and Z-Stent Patients

Z-Stent vs. WallStent Curves
Log-Rank (Mantel-Cox) Test:
P-Value < .0001

*Curve represents freedom from DVT not stent patency.
Cumulative Comparison of DVT Occurrence Among WallStent and Z-Stent Patients

Z-Stent vs. WallStent Curves
Log-Rank (Mantel-Cox) Test:
P-Value < .0001

"Curve represents freedom from DVT not stent patency."
Open surgical removal of iliac vein Wallstents with excision of pseudointima obstructing the contralateral iliac vein

Animesh Rathore, MD, Peter Gloviczki, MD, and Haraldur Bjarnason, MD, Rochester, Minn

Persistent pain after iliac vein stenting is rare. Surgical removal of two oversized (20-mm) iliac vein stents was performed in a 36-year-old woman because of severe back pain of 2½ years’ duration. Clamping or venotomy were not required for stent removal, which was done by extraction of each wire of the stent through small puncture wounds in the vein wall. Duplex scanning confirmed residual pseudointima obstructing the orifice of the right common iliac vein. The pseudointima was surgically removed. The patient recovered without complications, and her pain completely resolved. (J Vasc Surg: Venous and Lym Dis 2016;4:525-9.)
36 y/o female 2 ½ year after left iliac vein stenting with back pain, left hip and thigh pain
Right common iliac artery

Left common iliac vein stent
Challenges of Iliac Vein Stenting

- Avoid stenting with poor inflow, consider other solutions (femoral endovenectomy + stent, Palma procedure)
- Avoid excessive oversizing of stents
- Avoid stenting into the IVC
Nutcracker Syndrome

- Aorta
- SMA
- LRV
Treatment of nutcracker syndrome with open and endovascular interventions

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Objective: Nutcracker syndrome (NS) is a rare cause of hematuria, flank pain, and renal venous hypertension. Compression of the left renal vein (LRV) and the superior mesenteric artery. To evaluate open surgery and endovascular intervention experience.

Methods: A retrospective review of clinical data treated at our institution with an interven on January 1, 1994, and February 28, 2014. Primary outcomes were morbidity and mortality. Outcomes included late complications, pat ent reintervention, and resolution of symptoms.

Results: Thirty-seven patients (30 female, mean age of 27 years [range, 14-62 years]). Most frequent symptom was flank pain (frequent sign was hematuria (68%)). Non-duplex ultrasound scanning with measurement of velocities (87%), with or without magnetic resonance venography contrast venography with measurement (93%). Initial treatment was open surgery, endovascular in 1. Distal transposition into the inferior vena cava (IVC) was performed. Adjuvant procedures to optimize venous outflow included great saphenous vein cuff in six patients, great saphenous vein patch in four, and both cuff and patch in four. Three patients had patch alone; two had transposition.

37 Patients

36 OS

1 ENDO

31 LRV transposition

3 GSV patch

2 LGV transposition

6 GSV cuff

4 GSV patch

4 GSV cuff & patch

Improvement patency, the safety and durability of current available stents need to be established. (J Vasc Surg: Venous and Lym Dis 2015;1:1-8.)
59 of 61 had good to excellent results

- hematuria resolved in 60%
- one stent migration – open heart surgery
- one conversion

Conclusions: Based on our long-term followup endovascular stenting is a safe, effective procedure in select adults. We recommend endovascular stenting as primary option for nutcracker syndrome.
Objective: To retrospectively assess the therapeutic value of endovascular stenting for treatment of the nutcracker syndrome (NCS) in long-term follow-up and to explore the selection of the size of stents in Chinese patients with NCS.

Methods: From January 2004 to August 2010, 30 patients (two women and 28 men) between 13 and 32 years old (mean, 18.2) who were diagnosed with NCS were admitted for endovascular treatment. Each patient received one self-expanding metallic stent (14-mm diameter, 60-mm long) in the compressed portion of the left renal vein during the operation, and three patients with severe left-sided varicoceles received left gonadal vein embolization. The postoperative follow-up was 12 to 80 months (median, 36.0 months).

Results: The diameters at the ostium of left renal vein measured by the ultrasonic examination before treatment were 11.8 ± 1.8 mm. Technical success of operation was achieved in all patients. No perioperative complications occurred. Two cases of stent migration occurred at 12 months: both stents prolapsed into the inferior vena cava, with uneventful follow-up (49 and 56 months). At 1-month follow-up, patients improved, including two patients who had persistent but less microscopic symptoms after treatment. The clinical symptoms related to NCS almost disappeared at 2 months, and no secondary intervention was needed.

Conclusions: Endovascular stenting for NCS is feasible. All patients improved (median follow-up of 36 mo).
Stent Complications

- Stent fracture, +/- residual stenosis
- Stent migration (IVC, Heart, Lung)
- Maldeployment, with kink of renal vein
Stent complication

Endovenous removal of dislodged left renal vein stent in a patient with nutcracker syndrome

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HYBRID REPAIR
Transposition with patch and stent
Conclusions

- Open LRV transposition, with a patch or cuff, remains the first line of treatment of Nutcracker syndrome.
NUTCRACKER SYNDROME

Conclusions

• Open LRV transposition, with a patch or cuff, remains the first line of treatment of Nutcracker syndrome

• Stent migration, fracture, restenosis and formation of occlusive pseudointima in the IVC continue to be a problem
New designs for venous stents are urgently needed!
New designs for venous stents are urgently needed!

- High radial force at compression sites
- Flexible to accommodate curves of iliac and renal vein
- Prevents migration
- Multiple lengths and diameters
Sinus obliquus stent (Optimed)

- High radial force at compression site
- Oblique upper end (35°) to avoid obstruction of the contralateral iliac vein
- Open stent design of the mid and distal part for high flexibility
Bifurcated Iliocaval Stent
THANK YOU!