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Arterial Compression of Left Iliac Veins: Five-Year Patency Rates of Endovascular Treatment

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Abstract

Endovascular angioplasty and stenting have become a treatment of choice for severely symptomatic left iliac veins under external, arterial compression. Patency rates of stented iliac veins based on ultrasonographic (US) findings were estimated. Retrospective analyses of gender, age, deep venous thrombosis (DVT) prior to stenting, stent location at common and/or external iliac veins, and patency rates from 1 month to 5 years were performed. Patients treated were mostly women (72 of 79, 91%), aged 51 ± 16 (25-89) years. Patency rates were 96% at 1 month, 89% at 1 year, and 85% at 3 to 5 years, best for common iliac, 95%, than for external iliac vein stents, subgroup with prior DVT, with secondary patency rates of 75%. US demonstrated acceptable patency rates for iliac vein stenting showing good performance for common iliac vein stents but a decreased performance with stent extending to the external iliac vein or stents placed in patients with prior iliac DVT.

Keywords

iliac vein compression syndrome, May-Thurner syndrome, endovascular procedures, vascular patency, ultrasonography

Introduction

Venous extrinsic compression has been evaluated during noninvasive, ultrasonographic (US) examination for deep venous thrombosis (DVT), chronic venous insufficiency, renal dysfunction, and pelvic or lower extremity varicose veins.[1-4] Compression of the left common iliac vein by the right common iliac artery is commonly referred to as May-Thurner or Cockett syndrome based on classical references.[5-8] Pelvic vein thrombosis, lower extremity signs, and symptoms of chronic venous insufficiency and anatomic variations have been highlighted.[5-8] One anatomic variation is compression by the left common iliac vein extending distally. Initially, veins distal to the extrinsic compression dilate causing leg pain and swelling. Signs are mostly unilateral affecting the left lower extremity; a relative increase in thigh or calf circumference may be noticeable. A significant stenosis alters venous flow from phasic with respiration to continuous. Iliofemoral or extensive DVT of lower extremity and/or pelvic veins is a serious consequence. Severe skin changes and venous ulcers may develop as the stages of chronic venous insufficiency advance.[9] Increased collateralization has been noted around the obstructed iliac veins.

Anticoagulation and venous/arterial surgical techniques have produced debatable results.[8,10,11] Staged pharmacological thrombolysis, mechanical thrombectomy, retrievable vena cava filter, and angioplasty/stenting of the left iliac vein have been described as treatment for patients with extensive DVT.[7,9,12] Simple balloon dilatation and stenting may be enough to treat extrinsic compression without DVT.[13,14]

US has been used to diagnose DVT and extrinsic compression,[1-3,15,16] to guide medical procedures,[17-25] and to follow the patients post invasive or minimally invasive treatment. Attention to (1) common femoral venous flow absence of phasicity with respiration and (2) collateral venous flow has been emphasized as a means to suspect proximal stenosis or obstruction.[26] US diagnosis and follow-up post thrombolysis and stenting have been demonstrated.[27] Extensive, bilateral DVT has been related to extrinsic tumoral compression of the distal inferior vena cava and proximal common iliac veins.[28] Venous claudication of the left lower extremity has been associated with extrinsic compression of the left iliac vein; symptoms have been relieved by stenting.[29]

Short- and long-term post procedural US are recommended to document venous patency and extremity viability and to consider complementary treatment. This report focused primarily on 1-month to 5-year patency rates of iliac veins treated

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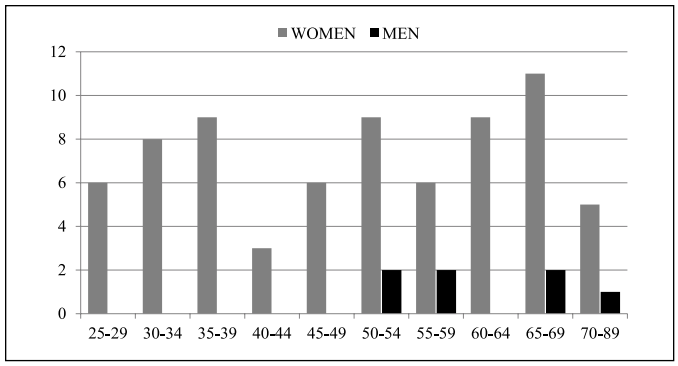

Figure 1. Age distribution showing number of women and men who had endovascular treatment of left common and/or external iliac vein with stents and ultrasound follow-up in the vascular laboratory.

with stenting. The patient population, follow-up by duplex-Doppler color flow imaging, and results based on the "life-table" method are described below.

Methods

The main objective was to determine patency rates of left iliac veins treated with stents at 1, 3, and 6 months and 1, 2, 3, 4, and 5 years. This report describes inclusion criteria, patient population, peripheral venous US, and descriptive and "life-table" statistics. Although data collection has been prospective, data analysis was retrospective. The recommendations of the Helsinki declarations were followed by the authors and collaborators.

Inclusion Criteria

Patients were selected from the vascular laboratory database. Patients who had (1) stents placed in the left common and/or external iliac veins and (2) US follow-up study documenting patency or occlusion of such veins were included in this study.

Patient Population

A total of 79 patients, 72 (91%) women and 7 men (9%), were included. Average age was higher for men (mean ± SD: 60 ± 9 years, range: 50-73) than for women (51 ± 16 years, range 25-89) ($P = .036$ for unequal variances). Figure 1 shows a distribution of women's and men's ages. The number of women aged 25 to 49 years was 32 (44% of 72).

Data regarding evidence of DVT prior to treatment was available from 77 patients. Left iliac DVT was present in 40 (52% of 77) of the extremities. All but 2 had documented DVT extending to the femoropopliteal venous segment. Femoropopliteal DVT sparing the iliac veins was noted in 12 (16% of 77) extremities. Patent iliopopliteal veins were noted in 25 (32% of 77) extremities. The overall incidence/prevalence of major lower extremity DVT in patients with left iliac vein compression was 68% (52 of 77). Pelvic vein examination was performed in 14 women; pelvic varicose veins were noted in 8 (57% of 14, 10% of 79) patients. Pelvic varicose veins did not necessarily correlate with presence or not of iliopopliteal DVT (n = 3 of 8, 38%), femoropopliteal DVT (1 of 8, 13%) or absence of iliopopliteal DVT (4 of 8, 50%).

Stents were placed at the common iliac vein in 42 (53% of 79) patients, 39 in women and 3 in men. Stenting included both the common and external iliac veins in 37 (47% of 79) patients, 33 women and 4 men. Gender distribution did not reach statistical significance as a function of external iliac vein stenting ($P = .57$ by chi-square). Age was not a factor related to anatomical stent positioning ($P = .53$ by t test).

Thrombolysis included pulse spray Alteplase, and AngioJet aspiration and localized pulse spray. Thrombolysis usually lasted for about 3 hours. Wallstent was then placed at the common iliac vein and extended to the external iliac vein as perceived appropriate by the vascular surgeons.

Venous US

Duplex-Doppler, color flow US was performed at a private vascular laboratory in Vitória, Espírito Santo, Brazil, by experienced, certified physicians. Ultrasound System-Philips IU22 Intelligent unit and linear and sector transducers with frequencies selectable from 1 to 12 MHz were used. A curvilinear, 1- to 5-MHz transducer was specifically used to image the iliac veins and their stents. A 5- to 9-MHz transvaginal probe was used to image pelvic veins with varices. Patients were requested not to smoke and to have only light meals before testing. Early morning or late afternoon timing for examination was adequate to avoid US artifacts.

Scanning related to this report included the distal inferior vena cava, common and external iliac veins, and femoropopliteal venous segments. A complete examination included deep and superficial veins of the lower extremity. Figures 2 to 6 show examples of US images describing effects of extrinsic compression by the right common iliac artery over the proximal left common iliac vein, patent iliac vein stents, iliac vein stent with floating thrombus, occluded iliac vein stents, and occluded left external iliac stented vein.

Statistics

Descriptive statistics with relative comparisons have already been included in the "patient population" section. "Life-table" analysis was performed to estimate stent patency from 1 month to 5 years. Each interval patency was calculated based on the number of patients (1) at risk, (2) who withdrew at each interval, and (3) with documented occlusion of the stented venous segments. Analyses comparing populations with versus without stent occlusion included age using t test, stent extent, and presence of DVT by chi-square, and "life-table" results for common iliac versus common and external iliac stenting.

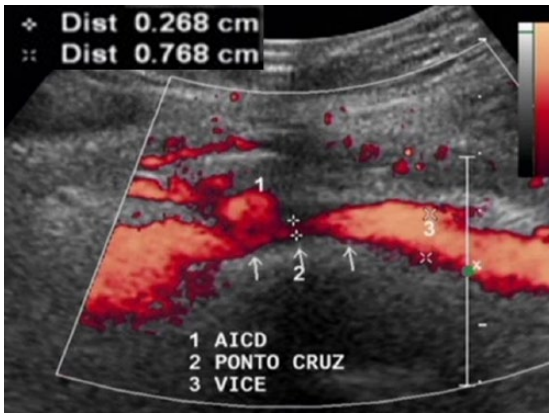

Figure 2. Ultrasonographic documentation of compression of left common iliac vein by right common iliac artery.
Note. The narrowed lumen was 35% (2.7/7.7 mm) of the lumen distal to a 65% compression. AICD = right common iliac artery at the crossing (ponto cruz); VICE = left common iliac vein.

Results

Table 1 presents the general results including all 79 patients. The patency rates represent primarily data from women. Short-term, "30-day" patency rate was 96%, decreasing to 89% at 1 year and 85% at 5 years. There were 10 occlusions besides one moving thrombus that was detected early and treated successfully. Age was not a factor related to failure; average age of patients who had stent failure was 49 ± 13 (26-68) years.

Stenting extending to the left external iliac vein was a factor affecting patency. Eight of the 10 failures were noted in patients with external iliac vein stenting. Overall proportion of failures, therefore, was 22% (8 of 37) for cases of external iliac vein stenting versus 5% (2 of 42) for common iliac vein stenting (P = .025 by chi-square). Patency rates were recalculated comparing the 2-stenting extensions (Table 2).

Iliopopliteal DVT was a factor in 90% (9 of 10) occlusions. The other occlusion was not associated with iliopopliteal DVT. The incidence of occlusion represented 23% (9 of 40) or 4% (1 of 25) of patients with or without iliopopliteal DVT, respectively; the difference of such incidences was significant (P = .044 by chi-square). Table 2 also includes patency rates for the subgroup with DVT prior to stenting.

Detailed Information About Failures

a. 1 month: 3 failures were detected, all in women with stents extending to the left external iliac artery; one had a moving thrombus was treated and was reincluded as a patent stent at 1 year based on US; the 2 occlusions were noted in women 31 and 40 years old;
b. 3 months: 3 failures were detected, all in women 26, 52, and 68 years old, being 2 left common iliac stents and 1 common-external iliac stent;
c. 6 months: 3 failures were detected, with 2 common plus external iliac vein occlusion in one 50-year-old man and one 59-year-old woman; another failure was restricted to the external iliac vein occlusion in one 52-year-old woman with patent common iliac segment;
d. 1 year: no new occlusions were detected at this time period;
e. 2 years: 1 failure was detected in one 53-year-old woman with common plus external iliac vein stent;
f. 3 years: 1 failure of left external iliac vein stent but patent common iliac segment in one 55-year-old woman; and
g. 4 years or more: there were no failures detected.

Discussion

US has been used to (1) diagnose DVT and left iliac venous segments suffering extrinsic compression by iliac arteries, (2) guide venous access, and (3) monitor results of iliac venous stenting. Furthermore, intravascular ultrasound (IVUS) has been used to grade and monitor iliac vein stenosis caused by extrinsic compression. This work focused on follow-up of patients who had left iliac venous stenting. This discussion emphasizes results based on (1) lack of DVT, (2) acute DVT or (3) chronic DVT, and (4) distal extension of stents beyond the left common iliac vein.

Our analysis indicated that only 1 out of 25 stents failed if patients did not have prior DVT. Neglén et al and Raju et al documented 100% patency up to 6 years for cases of stents placed for nonthrombotic obstruction and venous diameter stenoses of about 70%, regardless of stent extension.[30-32] Their primary patency at 6 years was 79%, increasing to 100% with appropriate secondary treatment. Lou et al reported a 93% patency at 6 months for patients without previous DVT.[33] Meng et al had 92% patency at 10 years for symptomatic left iliac vein stenosis.[34] Prevalence of left iliac vein compression in asymptomatic patients, however, can be high: 24% and 66% for stenoses greater than 50% and 25%, respectively.[35] In summary, stenting of left iliac vein stenosis has been a reliable treatment performed specifically in patients with significant signs and symptoms.[7]

Patients with DVT prior to surgical thrombectomy, thrombolysis, or mechanical thrombectomy followed by dilatation and stenting may present a slightly lower patency rate. Our patency rate for patients with prior DVT was comparable with Lou et al at 6 months, 83%, and still similar to Oguzkurt et al and Neglén et al past 3 years.[30-31,33,36] Neglén et al patency actually rose from 57% to 86% at 6 years post additional treatments to maintain the stent open. Zhu et al reported 96% primary and 100% patency at 1 year post manual aspiration thrombectomy and stenting.[37]

Stent patency rates for treatment of chronic DVT have varied significantly. For example, Kölbel et al reported 70%/80% primary/secondary patency rates at 5 years versus 50% patency rate reported by Lou et al at 6 months.[33,38] Characteristics of chronic venous obstruction require better quantification for appropriate comparisons.

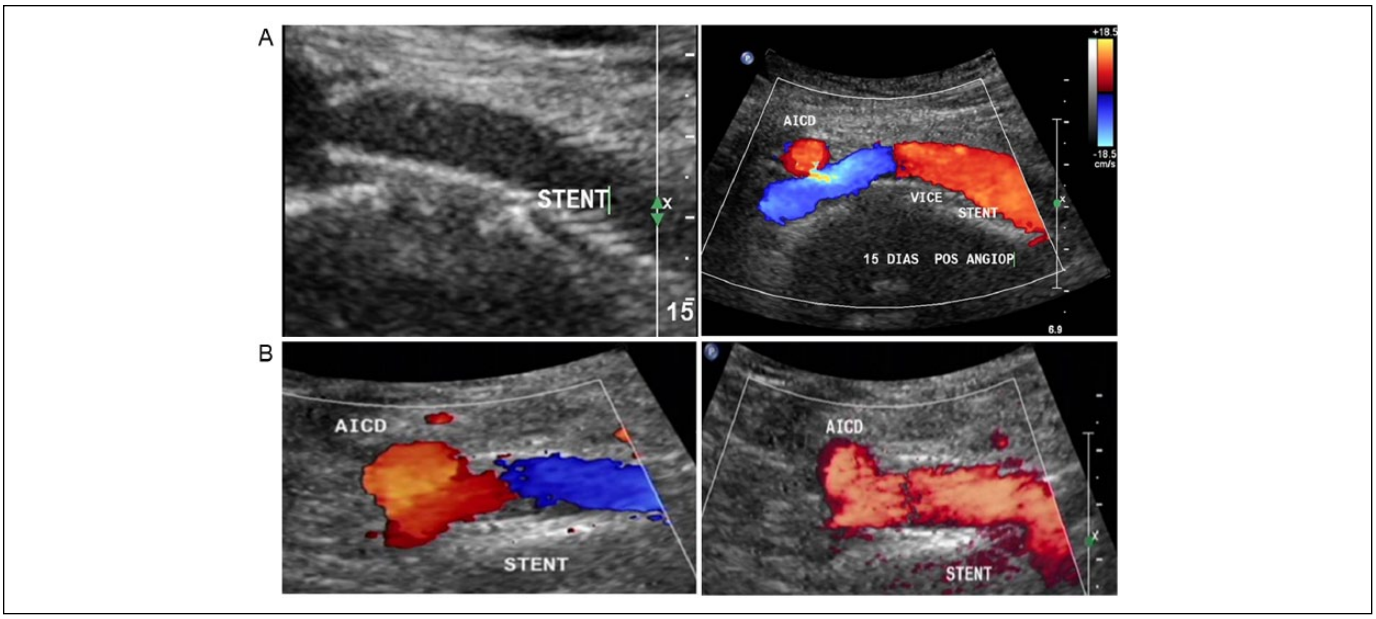

Figure 3. Patent left common iliac vein post stent placement in patients with left lower extremity signs and symptoms compatible with external venous compression: (A) A 45-year-old woman without deep venous thrombosis and (B) a 52-year-old woman with pelvic varicose veins.
Note. AICD = right common iliac artery; VICE = left common iliac vein.

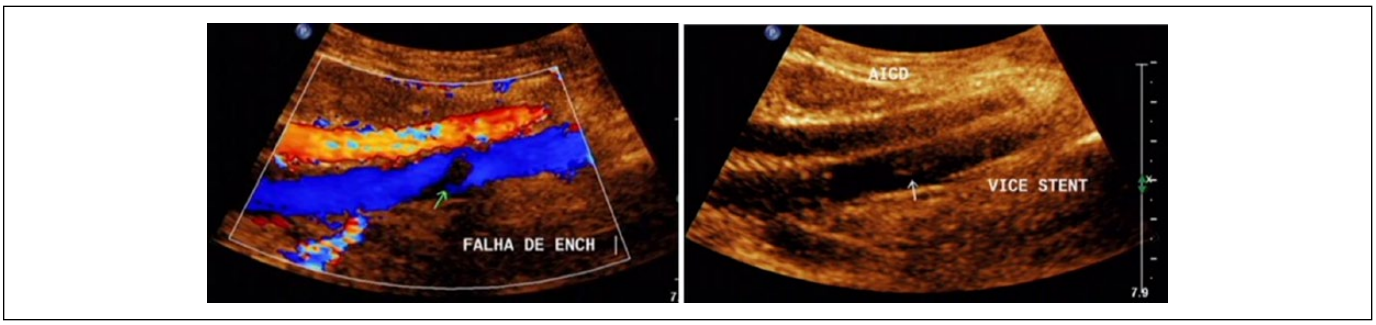

Figure 4. Floating thrombus inside left iliac vein post stent placement demonstrated during short-term (less than 30 days) ultrasonography follow-up.
Note. The 38-year-old woman presented initially with iliofemoral-popliteal thrombosis and arterial compression of the iliac venous segment. Anticoagulation was successful, and 1-year, long-term US follow-up demonstrated venous patency without thrombus.

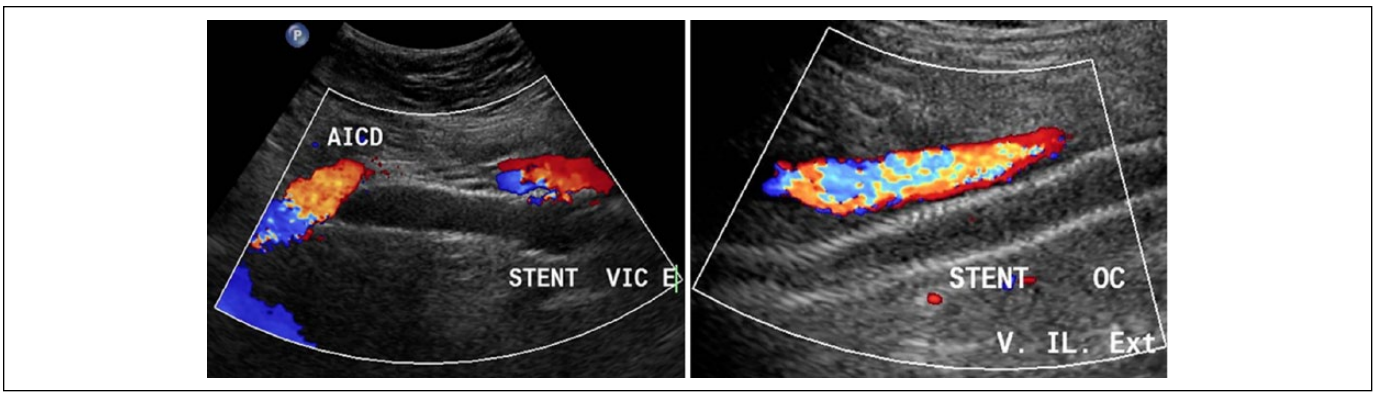

Figure 5. Occluded left iliac veins post stent placement.
Note. Two distinct cases. Occluded left common iliac vein (VICE) detected 2 years post treatment in a 53-year-old woman initially presented with iliofemoral-popliteal thrombosis and pelvic varicose veins; and occluded iliac veins with stent extending to the distal left external iliac vein in a 26-year-old woman who presented with iliofemoral-popliteal thrombosis.

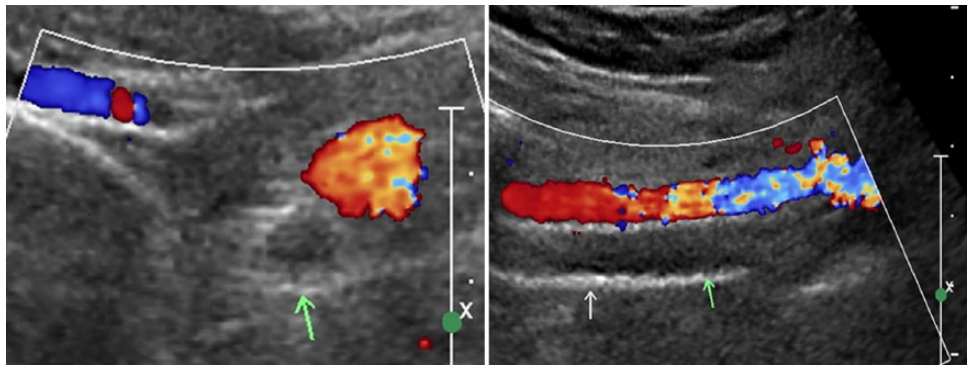

Figure 6. Occluded left external iliac vein post stent placement.

Table 1. Left Iliac Vein Patency Post Stenting to Treat External Arterial Compression.

Time period	Withdraw	At risk	Occluded	Interval patency	Patency
1 month all	0	79	3	0.9620	0.9620
Women	*0*	*72*	*3*	*0.9583*	*0.9583*
3 months all	−1	75	3	0.9600	0.9235
Women	*−1*	*68*	*3*	*0.9559*	*0.9160*
6 months all	*0*	*72*	*3*	*0.9583*	*0.8850*
Women	*0*	*65*	*2*	*0.9692*	*0.8878*
1 year all	−3 + 1 = −2[a]	67	0	1.0000	0.8850
Women	*−3 + 1 = −2*[a]	*61*	*0*	*1.0000*	*0.8878*
2 years all	−12	55	1[b]	0.9818	0.8689
Women	*−12*	*49*	*1*[b]	*0.9796*	*0.8697*
3 years all	−13	41	1	0.9756	0.8477
Women	*−10*	*38*	*1*	*0.9737*	*0.8468*
4 years all	−9	31	0	1.0000	0.8477
Women	*−6*	*31*	*0*	*1.0000*	*0.8468*
5 years all	−8	23	0	1.0000	0.8477
Women	*−8*	*23*	*0*	*1.0000*	*0.8468*

[a]Documented patency of stented iliac veins, considered a failure at 1 month due to a moving thrombus detected by ultrasonography.
[b]Iliac stent occluded at 2 years but considered patent for half of the period (1 year).

Stenting of the common iliac vein alone had better results than if the stenting was extended to the external iliac vein, with patency rates of 95% and 75% at 3 to 5 years, respectively. All external iliac vein stent occlusions in our series had previous DVT. A similar message was presented by Neglén et al when comparing stents cephalad versus caudal to the inguinal ligament, 90% versus 84% patency rates at 4 to 5 years.[30]

In principle, the results obtained with minimally invasive procedures and stenting compare favorably with what was obtained with open surgery and anticoagulation.[10,11] Average patency for surgical procedures related to the inferior vena cava and iliac veins was reported as 62% in 3 years.[11] The best results were obtained with the crossover saphenous bypass known as the Palma procedure, with a 4-year patency rate of 83%. The advent of potential surgical complications further favors minimally invasive endovascular procedures.

The US role in the follow-up of such endovascular procedures is remarkable. Color flow has played an important part in demonstrating stent patency. We utilized a high-quality scanner to visualize the inferior vena cava and the iliac veins. The quality of portable devices is improving, but each instrument should be tested to determine its ability to perform the necessary imaging. It is recommended that the US be performed 1 and 30 days, 6 months, 1 year post endovascular procedure, and yearly thereafter.[7] One also should consider an US examination if any sudden or gradual changes in signs and symptoms are noted.

US technology can make appropriate diagnosis of iliac stenoses and thromboses caused by extrinsic compression.[1] B-mode imaging, color flow, and Doppler waveforms contribute to the diagnosis. For example, B-mode allows for venous diameter measurements and interextremity comparisons. Classification of thrombus age is paramount with B-mode imaging. Color flow not only identifies major channels but also detects collateral veins in the pelvic region, valuable information to grade degree and time history or chronicity of the iliac vein obstruction. Doppler waveforms inform about flow phasicity or lack of it, and could provide data about venous flow volume.

Table 2. Left Iliac Vein Patency Post Stenting to Treat External Arterial Compression: Stents at the common iliac vein (CIV) or common and external iliac vein (CEIV) or placed in veins with iliac deep venous thrombosis (DVT).

Time period	Withdraw	At risk	Occluded	Interval patency	Patency
1 month CIV	0	42	0	1.0000	1.0000
1 month CEIV	0	37	3	0.9189	0.9189
1 month DVT	0	40	3	0.9250	0.9250
3 month CIV	0	42	2	0.9524	0.9524
3 month CEIV	*−1*	*33*	*1*	*0.9697*	*0.8911*
3 month DVT	*−1*	*36*	*2*	*0.944*	0.8736
6 month CIV	*0*	*40*	*0*	*1.0000*	0.9524
6 month CEIV	*0*	*32*	*3*	*0.9063*	*0.8076*
6 month DVT	0	34	3	0.9118	0.7965
1 year CIV	−2	38	0	1.0000	0.9524
1 year CEIV	*−1 + 1 = 0*[a]	*29*	*0*	*1.0000*	*0.8076*
1 year DVT	−2 + 1 = −1[a]	30	0	1.0000	0.7965
2 year CIV	−4	34	0	1.0000	0.9524
2 year CEIV	*−8*	*21*	*1*[a]	*0.9524*	*0.7691*
2 year DVT	−7	23	1	0.9565	0.7619
3 year CIV	−8	26	0	1.0000	0.9524
3 year CEIV	*−4*	*16*	*1*	*0.9375*	*0.7210*
3 year DVT	−4	18	1	0.9444	0.7196

[a]Documented patency of stented iliac veins, considered a failure at 1 month due to a moving thrombus detected by ultrasonography. Secondary patency rate increased from 72% to 75%.
[b]Iliac stent occluded at 2 years but considered patent for half of the period (1 year).
[c]Statistics usually not calculated if <10 at risk.
[d]No failures at 4 and 5 years resulted in patency rates equal to the 3-year patency rate.

Finally, we present some comments about US-guided punctures and procedures. Most experts searching for veins and arteries to be punctured now admit that even the best could improve timing and precision by using US imaging.[17] Thrombolysis, mechanical thrombectomy, and stent placement would benefit from US guidance, either using IVUS or even transcutaneous equipment. Examples of vascular procedures performed with US guidance using IVUS or transcutaneous US have been reported.[19-25] In particular, saphenous vein treatment with US guidance is common.[18] IVUS or transcutaneous US guidance could be performed if inferior vena cava filters become part of the procedure to open the iliac vein.[24-25] Furthermore, Raju et al have implanted iliac vein stenting under IVUS guidance.[32] Proper perspective, training, and adequate equipment facilitate US guidance during deep vessel applications.

Summary

US documented flow conditions of stented iliac veins demonstrating patency rates of 96% at 1 month, 89% at 1 year, and 85% at 3 to 5 years. Occlusion of external iliac venous stents in patients with DVT prior to stenting contributed to decrease in patency rates when compared with common iliac vein stenting, 75% versus 95% at 3 to 5 years.

Asymptomatic compression of left common iliac vein by right common iliac artery is commonly not treated. Symptomatic patients with stenoses fare better than patients who presented with DVT prior to treatment. Apparently, the treatment of choice nowadays is an endovascular procedure that includes thrombolysis or mechanical thrombectomy followed by angioplasty and stenting.[39-41]

US is a noninvasive, cost-effective imaging modality for diagnosis and treatment follow-up. Additional training and high-performance instrumentation are recommended if a medical team wants to perform US-guided procedures.

Declaration of Conflicting Interests

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