Successful recanalization was defined as restoration of antegrade iliac venous flow after angioplasty alone or angioplasty and placement of additional stents.

Results: Percutaneous recanalization of chronically occluded iliac venous stents using the PowerWire was successful in 10 patients. Cumulative 6-month patency rate was 62%. Cumulative 12-month patency rate was 43%. There were two complications that occurred with use of the PowerWire. One patient had transient footdrop of the ipsilateral limb that was successfully recanalized. One patient had self-limited perforation of the left common iliac artery during unsuccessful recanalization.

Conclusions: The PowerWire is an effective and relatively safe device for recanalizing chronically occluded iliac venous stents.

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Impact of Presence of Inferior Vena Cava Filter on Iliocaval Stent Outcomes

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Objective: The impact of presence of an inferior vena cava (IVC) filter in patients undergoing stenting for symptomatic femoroiliocaval obstruction has not been explored in detail. This study attempted to fill this gap by evaluating clinical and stent-related outcomes in such patients. The incidence of deep venous thrombosis (DVT) in this setting was also analyzed.

Methods: A retrospective review of contemporaneously entered electronic medical record data on initial iliocaval stents placed in patients with an indwelling IVC filter (or placed after stenting) during a 15-year period from 2000 to 2015 was performed. A separate cohort that underwent initial stenting during the time frame but that did not have an IVC filter was used as the control group. Clinical outcomes were evaluated through use of the Venous Clinical Severity Score (VCSS). The incidence of DVT was reviewed in both groups. Kaplan-Meier analysis was used to assess stent patency after intervention, whereas paired *t*-test was used to examine preintervention and postintervention outcomes within and between groups.

Results: A total of 57 patients underwent placement of a femoroiliocaval stent in the setting of a pre-existing (46) or post-stent (11) IVC filter (filter group). The control group had 359 patients. There was no difference in VCSS at baseline between the two groups. During a median follow-up of 59 months, VCSS went from 5 to 2 at 12 months ($P = .84$) in the filter group and from 5 to 3.5 in the control group ($P < .01$). However, there was no statistically significant difference in the VCSS between the two groups at 12 months ($P = .09$). The incidence of ipsilateral DVT in the filter group was 7%, and that in the treatment group was 3% ($P = .10$). There were no contralateral DVTs in either group. Median primary, primary assisted, and secondary patencies in the filter/control groups were 116/64 ($P < .01$), 137/58 ($P < .01$), and 29/30 months ($P = .77$).

Conclusions: Presence of an IVC filter does not appear to affect clinical outcomes after femoroiliocaval stenting. However, counterintuitively, they appear to confer better primary and primary assisted stent patencies.

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Improvement in Quality of Life After Iliac Vein Stenting in a Prospective Clinical Study of a Nitinol Venous Stent

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Objective: Stenting of the iliofemoral venous outflow tract is recommended to treat patients with significant limb symptoms related to obstruction. However, it remains unclear which patients benefit most from iliac vein stenting. In this prospective clinical trial studying the performance of a nitinol stent designed for the treatment of venous obstructive disease, quality of life (QOL) measures were related to patient and procedural characteristics to determine which patients benefit most from venous stenting.

Methods: There were 170 patients with chronic iliofemoral venous obstruction enrolled in a prospective pivotal trial studying the effectiveness of a nitinol venous stent (Veniti, Inc, Fremont, Calif). Before intervention, QOL was measured with the Venous Clinical Severity Score (VCSS) and Chronic Venous Insufficiency Questionnaire (CIVIQ-2) score. Venography was performed, and the presence of vessel stenosis of >50% was required for study inclusion. Intravascular ultrasound (IVUS) was also performed before and after stent insertion to allow calculation of lumen diameter and area. QOL was measured with VCSS and CIVIQ-2 at 1 month, 6 months, and 12 months after stenting, and repeated venography and IVUS were performed at 12 months.

Results: Of the cohort, 140 had QOL measures performed before stenting and at 12 months of follow-up. Of these, 133 had IVUS measurements at the time of stent insertion and 94 had IVUS at 12 months. Both VCSS and CIVIQ-2 score improved significantly at 1 month and 12 months after stenting as noted in the Table. Improvement in VCSS was similar in patients treated for nonthrombotic (5.2 ± 5.6 points) and post-thrombotic (4.0 ± 3.9 points) disease. Patients who experienced significant improvement in VCSS (≥3 points; n = 91) had a significantly higher mean maximal area stenosis on IVUS before stenting (70.1% ± 20%) than 32 patients who had <2 points of improvement on VCSS (57.2% ± 25.9%; $P = .007$). VCSS improvement at 12 months did not correlate with the maximal percentage diameter or percentage area stenosis on IVUS at 12 months.

Conclusions: The majority of patients treated with venous stenting for symptomatic iliofemoral venous obstruction experience significant reduction in symptoms that is durable to 12 months of follow-up. QOL improvement was significantly more frequent in patients stented for more severe venous obstruction.

Author Disclosures: W. Marston: honorarium Veniti; **M. Razavi:** Honorarium Veniti, Boston Scientific.

Relevance of Thrombophilia Testing in Patients Undergoing Iliofemoral Venous Stenting for Post-Thrombotic Occlusion

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Objective: Inherited and acquired thrombophilias increase the risk of venous thromboembolism (VTE), and the antiphospholipid antibody syndrome (APS), an acquired thrombophilia, is associated with a high risk of recurrent VTE. Postoperative anticoagulation therapies remain tailored, with APS patients requiring long-term vitamin K antagonists (VKAs) compared with direct oral anticoagulants for patients with inherited thrombophilia. As such, iliofemoral venous stenting in patients with thrombophilia is controversial. The aim of this study was to examine the association of thrombophilia with cumulative patency and reintervention rates after stenting for post-thrombotic occlusion.

Methods: Consecutive patients (2012-2017) receiving a nitinol venous stent for post-thrombotic disease with a minimum of 1-year follow-up were included for analysis. Thrombophilia testing was performed when VTE occurred at a young age with weak provoking factors, strong family history, or recurrence. Patients with strong risk factors for VTE were not tested and were excluded from analysis. All patients were given therapeutic dose low-molecular-weight heparin divided twice daily for 2 weeks after the procedure, followed by a VKA for 6 months. Patients with APS continued on long-term VKA therapy at 6 months, whereas all other patients were transitioned to direct oral anticoagulants. Stent

Table. Venous Clinical Severity Score (*VCSS*) and Chronic Venous Insufficiency Questionnaire (*CIVIQ-2*) score at 1 month and 12 months

	Before stenting	1 month after stenting	12 months after stenting	*P* value before vs 1 month	*P* value before vs 12 months
VCSS	9.9 ± 5.0	6.3 ± 4.3	5.7 ± 4.3	<.00001	<.000001
CIVIQ-2	0.44 ± 0.24	0.30 ± 0.25	0.27 ± 0.25	<.00001	<.00001

Table. Outcome of thrombophilia testing in patients without strong provoking factors for venous thromboembolism (VTE)

Thrombophilia type	Patients tested for thrombophilia (n = 138), No. (%)
Thrombophilia negative	79 (57)
Inherited	30 (22)
Factor V Leiden	22 (16)
Prothrombin gene mutation	0 (0)
Protein C	2 (1)
Protein S	2 (1)
Antithrombin	4 (3)
Acquired (antiphospholipid antibody syndrome)	29 (21)

patency was assessed using duplex ultrasound 24 hours, 2 weeks, 6 weeks, 3 months, 6 months,1 year, and yearly after intervention. Reinterventions were performed when there was a reduction in stent diameter of >50% or occlusion.

Results: Of 205 patients treated, 138 (67%) were tested for thrombophilia, of which 59 of 138 (43%) had an inherited (30/59 [51%]) or acquired (29 [49%]) thrombophilia (Table). Cumulative patency was 88% in patients with thrombophilia and 89% in patients without (median follow-up, 1.7 years; range, 52-258 weeks). In addition, 64 of 138 (46%) patients required reintervention to maintain patency, of which 28 of 59 (47%) occurred in patients with thrombophilia and 36 of 79 (45%) in patients without. Inherited or acquired thrombophilia was not associated with cumulative patency loss ($P = .402$) or higher risk of reintervention ($P = .255$).

Conclusions: Thrombophilia assessment for APS should be performed in patients undergoing iliofemoral venous stenting without strong provoking factors for VTE as prolonged anticoagulation with VKAs is advised in this group of patients because of their increased risk of VTE recurrence. Furthermore, patients with inherited or acquired thrombophilia should not be excluded from iliofemoral venous stenting as patency outcomes are good in conjunction with appropriate postoperative anticoagulation therapy.

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Single- Versus Multiple-Stage Catheter-Directed Thrombolysis Does not Affect Iliac Vein Stent Length or Patency Rates

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Objective: Incomplete venous thrombolysis and residual nonstented iliac vein disease are known predictors of recurrent deep venous thrombosis (DVT). Controversy exists as to whether the number of thrombolysis sessions affects total stent treatment length or stent patency. The goal of this study was to evaluate the outcomes of patients who underwent single vs multiple catheter-directed lysis sessions with regard to stent extent and patency.

Methods: Consecutive patients who underwent thrombolysis and stenting for acute iliofemoral DVT between 2007 and 2018 were identified and divided into two groups based on number of treatments performed (one vs multiple sessions). Operative notes and venograms were reviewed to determine the number of lytic sessions performed and stent information including size, location, total number, and length treated. End points include total stented length and 30-day and long-term outcomes. The χ^2 comparisons, logistic regression, and survival analysis were used to determine outcomes.

Results: Seventy-nine patients underwent lysis and stenting (6 bilateral interventions; mean age, 45.9 ± 17 years; 48 female). Ten patients (12 limbs) underwent single-stage treatment with pharmacomechanical thrombolysis and the remaining 69 (73 limbs) two to four treatments combining pharmacomechanical thrombolysis and catheter-directed lysis. Patients who underwent a single-stage procedure were older and more likely to have a malignant neoplasm. These patients also received less tissue plasminogen activator compared with the multiple-stage group (17.2 ± 7.0 mg vs 27.3 ± 11.7 mg; $P = .010$). Average stent length was 8.8 ± 5.2 cm for the single-stage group vs 9.2 ± 4.6 cm for the multiple-stage group ($P = .764$). In dividing patients into one or two treatments (52 patients) vs three or four (27 patients), there was no significant difference in total stent length ($P = .489$). Patients who underwent a single-stage procedure had no difference in average length of stay than those who underwent multiple sessions (8.5 days vs 5.9 days; $P = .269$). The overall 30-day rethrombosis rate was 14.8%. Three-year patency was 72.2% and 74.8% for the single and multiple stages; respectively. The major predictor for loss of primary patency was incomplete lysis (hazard ratio, 7.69; $P < 0.01$) but not number of procedures (hazard ratio, 1.01; $P = .994$). The overall rate of post-thrombotic syndrome (Villalta score ≥5) was 9.3% at 5 years.

Conclusions: Single- vs multiple-stage thrombolysis for DVT is not associated with a difference in extent of stent coverage. Patency rates remain high for iliac stenting irrespective of the number of lytic sessions, provided lysis is complete and the diseased segments are appropriately stented. Preoperative factors including the patient's age and comorbidities may contribute to the decision to proceed with single vs multiple lysis sessions and deserve further investigation.

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In-Stent Restenosis After Iliocaval Stenting—Characteristics and Outcomes

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Objective: With increasing use of iliocaval stenting, complications of such stenting have also become more common. In-stent restenosis (ISR), an outcome that is responsible for a majority of reinterventions, is one that has not been studied in detail. Characteristics of ISR in addition to outcomes after reintervention are evaluated.

Methods: A retrospective review of contemporaneously entered electronic medical record data on 372 limbs with initial unilateral iliocaval stents (247 left and 125 right) placed during a 3-year period from 2015 to 2017 was performed. ISR was estimated from stent and flow channel diameters measured using duplex ultrasound. Characteristics evaluated included onset of ISR after stent placement and progression over time. Regression analysis was performed to evaluate risk factors for development of ISR. Outcomes after reintervention for ISR were also appraised. Kaplan-Meier analysis was used to assess stent patency afater intervention; paired *t*-test was used to examine preintervention and postintervention outcomes.

Results: There were 361 limbs that underwent stenting for stenotic lesions, whereas 11 underwent stenting for chronic native vein occlusions. ISR was noted as early as postintervention day 1. It progressed to a maximal value by 6 months and stabilized thereafter. The overall median ISR across stented common femoral, external iliac, and common iliac segments at 12 months was 43.75%. The segment most commonly affected by ISR was the external iliac vein (77.5%). Up to 89% of stents can have some degree of ISR at 12 months. Variables evaluated as predictors for ISR included age, sex, thrombophilia, thrombotic or nonthrombotic lesion, inflow, stent compression, shear rate, and flow rate. Of these, only lack of stent compression was a significant predictor of ISR at 6 and 12 months. During a median follow-up of 13 months, 50 of 372 (13%) limbs underwent reintervention for ISR and 12 (3%) underwent reintervention for stent occlusion (8 acute [<30 days] and 4 chronic [>30 days]). After reintervention, the Venous Clinical Severity Score improved from 6 to 4 for the ISR cohort ($P < .001$). Median primary, primary assisted, and secondary patencies after reintervention for ISR were 37, 38, and 17 months, respectively.

Conclusions: ISR occurs early after iliocaval stenting but stabilizes around 6 months. Progression of ISR to stent occlusion is rare. No statistically significant, modifiable predictor for ISR was noted. After reintervention for ISR, good clinical outcomes and stent patencies can be expected.