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# Reconstruction of the femoro-ilio-caval outflow by percutaneous and hybrid interventions in symptomatic deep venous obstruction

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**WHAT THIS PAPER ADDS**

This paper describes the mid-term clinical outcome and patency rates in a large cohort after percutaneous and hybrid interventions in patients with deep venous obstructions.

**Objective/Background:** Deep venous obstruction is relatively prevalent in patients with chronic venous disease. Endovascular treatments and hybrid interventions can be used to relieve venous outflow obstructions. This paper assesses mid-term clinical outcomes and patency rates in a large cohort after percutaneous and hybrid interventions.

**Methods:** This was a prospectively analysed cohort study. Patients with symptomatic deep venous obstruction who presented at a tertiary referral hospital were divided into three groups: patients who underwent percutaneous stenting for non-thrombotic iliac vein compression syndrome (IVCS group); patients with post-thrombotic syndrome (PTS) treated by percutaneous stent placement (P-PTS group); and PTS patients with obstruction involving the veins below the saphenofemoral junction in which a hybrid procedure was performed, combining stenting with open surgical disobliteration (H-PTS group). Patency rates, complications, and clinical outcomes were analysed.

**Results:** A total of 425 lower extremities in 369 patients were treated. At 60 months, primary patency, assisted primary patency, and secondary patency rates were 90%, 100%, and 100% for IVCS, and 64%, 81%, and 89% for the P-PTS group, respectively. The H-PTS group, showed patency rates of 37%, 62%, and 72%, respectively, at 36 months. Venous claudication subsided in 90%, 82%, and 83%, respectively. At the 24 month follow-up, mean Venous Clinical Severity Score decreased for all patients and improvement in Villalta score was seen in post-thrombotic patients. The number of complications was related to the extent of deep venous obstruction in which patients in the H-PTS group showed the highest complication rates (81%) and re-interventions (59%).

**Conclusion:** Percutaneous stent placement to treat non-thrombotic iliac vein lesions, and post-thrombotic ilio-femoral obstructions are safe, effective, and showed patency rates comparable with previous research. Patients with advanced disease needing a hybrid procedure showed a lower patency rate and more complications. However, when successful, the clinical outcome was favourable at mid-term follow-up and the procedure may be offered to selected patients.



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## INTRODUCTION

Minimally invasive endoluminal interventions have revolutionised many facets of modern medicine. Since the 1990s great advances have been made in the treatment of iliac and vena cava obstructions where endovascular treatment options frequently surpass conservative therapy and open surgery.[1–5]

Caval and ilio-femoral venous obstructive disease is common in patients with chronic venous insufficiency and is caused by either post-thrombotic vein damage,

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extraluminal vein compression, or a combination of both. This post-thrombotic vein damage with vein wall fibrosis, intraluminal scarification, and valvular damage can result after a deep venous thrombosis (DVT), presenting as the so called post-thrombotic syndrome (PTS). [6,7]Clinically, this is associated with the same symptoms and clinical signs as other types of chronic venous disease, for example pain (especially during ambulation), oedema, and venous ulceration.

As mentioned, the second most common cause of chronic venous obstruction is related to extraluminal vein compression of which iliac vein compression syndromes (IVCS) are the best known. IVCS consist of symptoms associated with chronic venous disease due to compression of the iliac vein by an extraluminal structure (usually an overlying artery).[8] Additionally, there can be some degree of spurs or webs due to chronic local vein wall irritation in about 30% of cases.[9,10] In this subgroup, a smooth vessel wall and focal indentation will be seen during recanalisation, indicating compression without post thrombotic vein damage.[11] Both the post-thrombotic and IVCS obstruction impede ambulatory venous outflow of the lower extremity and lead to venous hypertension. Venous outflow of the leg seems most dependent on the iliac tract, which explains the significantly higher incidence of PTS after an ilio-femoral DVT when compared with calf level DVTs.[6,12] PTA and stenting of iliac lesions have been shown to improve outflow of affected legs.[1–4] Moreover, stenting is performed and has been proven to be more effective in patients with a common femoral vein (CFV), external iliac vein, common iliac vein (CIV), or inferior vena cava (IVC) obstruction.[2–4] Because stenting distal to the CFV has a higher risk of early failure due to low flow, this is generally not offered and is avoided.[1,13–15] In addition, there is currently no evidence suggesting any clinical benefit from stenting below the common femoral confluence, which is where the deep femoral vein (DFV) and femoral vein (FV) merge into the CFV.

However, open surgical disobliteration, may be a solution for selected patients with post-thrombotic changes at and below the CFV.[16–18]

The goal of this study is to report on the experience, clinical outcome, and stent patency in patients treated for IVCS and post-thrombotic femoral, iliac, and caval obstructive lesions by percutaneous and hybrid techniques.

## METHODS

In this cohort study data were collected prospectively and analysed retrospectively. All patients eligible for treatment at the authors' tertiary referral care centre (vascular surgery department) were included. Between September 2009 and January 2016, 369 consecutive patients were treated. All patients showed signs of chronic caval, iliac, or femoral vein obstruction on diagnostic imaging and demonstrated symptoms of venous hypertension like pain interfering with daily activities, and/or clinical signs classified according to the CEAP classification as C3 (edema) or C4a—C6 (skin changes). [19]Additionally, venous claudication was a symptom indicating treatment and was defined as the onset or worsening of pain during routine exercise, which subsides during rest, especially while sitting or lying down.[14]

Patients who received stents after catheter directed thrombolysis for an acute DVT were excluded from this study. Non-fully grown adolescents (bone age analysed if applicable) with a DVT $<$ 1 year previously, and patients with a life expectancy of $<$ 1 year were not eligible for treatment. Also, patients with an occlusion extending far into the FV and DFV were not eligible for treatment as it is impossible to re-establish the inflow to the stent. Furthermore, treatment was not offered to those patients who were intolerant of anticoagulant therapy since this was obligatory after the intervention.

Patients had magnetic resonance venography (MRV) and duplex ultrasonography (DUS) imaging at baseline, and conventional multiplanar venography during intervention.

IVCS was defined as clinical complaints related to a $>$ 50% lumen diameter reduction on DUS or MRV in combination with compression and a collateral network on venography. Intraluminal synechiae outside the compressed segment, with formation of collaterals, was considered a sign of post-thrombotic obstruction.

On the basis of findings, three groups were created in which interventions were performed. The IVCS patients with non-thrombotic syndrome had percutaneous stent placement alone. Percutaneous stent placement (P-PTS group) patients, had a percutaneous stent placement when obstruction was limited to segments central to the saphenofemoral junction (SFJ) in the CFV or when a trabeculation free landing zone in the CFV between the SFJ and the DFV and FV confluence was identified. The inflow from the FV, DFV, and/or collaterals was minimally impaired.

The third group (H-PTS) consisted of patients with PTS and obstruction below the SFJ, especially when the CFV was occluded or when there was a risk that stent placement could displace intraluminal tissue and obstruct FV or DFV inflow. Also, when the orifices of the FV and/or the DFV were occluded patients were included in the H-PTS group.

Furthermore, endophlebectomy and arteriovenous fistulae (AVF) were performed as a second stage in some patients treated in the P-PTS group with stent thrombosis and clinical complaints interfering with daily activities.

Clinical scores, stent patency rates, complication rates, and number of re-interventions are presented per leg for all three groups.

### *Clinical assessment before intervention*

At baseline, CEAP classification and the Venous Clinical Severity Score (VCSS) were scored for all patients. PTS was diagnosed using the Villalta score. With increasing clinical experience, the importance of venous claudication was recognised and a separate scoring for this item was added to the baseline and follow-up data collection. For this reason, not all venous claudication scores were present at baseline. The number of entered data is described in the text. Consequently, scores were inconsistently entered into

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