Endovascular Treatment for Iliac Vein Compression Syndrome: a Comparison between the Presence and Absence of Secondary Thrombosis

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Objective: To evaluate the value of early identification and endovascular treatment of iliac vein compression syndrome (IVCS), with or without deep vein thrombosis (DVT).

Materials and Methods: Three groups of patients, IVCS without DVT (group 1, n = 39), IVCS with fresh thrombosis (group 2, n = 52) and IVCS with non-fresh thrombosis (group 3, n = 34) were detected by Doppler ultrasonography, magnetic resonance venography, computed tomography or venography. The fresh venous thrombosis were treated by aspiration and thrombectomy, whereas the iliac vein compression per se were treated with a self-expandable stent. In cases with fresh thrombus, the inferior vena cava filter was inserted before the thrombosis suction, mechanical thrombus ablation, percutaneous transluminal angioplasty, stenting or transcatheter thrombolysis.

Results: Stenting was performed in 111 patients (38 of 39 group 1 patients and 73 of 86 group 2 or 3 patients). The stenting was tried in one of group 1 and in three of group 2 or 3 patients only to fail. The initial patency rates were 95% (group 1), 89% (group 2) and 65% (group 3), respectively and were significantly different (p = 0.001). Further, the six month patency rates were 93% (group 1), 83% (group 2) and 50% (group 3), respectively, and were similarly significantly different (p = 0.001). Both the initial and six month patency rates in the IVCS patients (without thrombosis or with fresh thrombosis), were significantly greater than the patency rates of IVCS patients with non-fresh thrombosis.

Conclusion: From the cases examined, the study suggests that endovascular treatment of IVCS, with or without thrombosis, is effective.

Index terms:
Iliac vein compression syndrome
Deep vein thrombosis,
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Iliac vein compression syndrome (IVCS) is a clinical syndrome which causes lower extremity swelling, pain, varicosities and other symptoms resulting from pelvic and lower extremity venous flow obstruction caused by the compression of the iliac vein by the overlying iliac artery. McMurrich first discovered that the left leg swelling is caused by the left iliac vein compression in 1908. In 1956, May and Thurner described, for the first time, the anatomical features of this disease which was then named the May-Thurner syndrome (1, 2). In 1965, Cockett and Thomas reported the pathology and clinical features of this syndrome and named it the IVCS. Since then, many people have called this syndrome the Cockett syndrome. IVCS is not only the main cause of dysfunction in the deep venous valve and varicosities, but also the main cause of iliofemoral vein thrombosis and an important factor contributing to the higher number of deep-vein thrombosis (DVT) cases in the left extremity (3). The surgical treatment of IVCS has been progressing over the last 40 years (4, 5). For instance, researchers have put the Fogarty balloon embolectomy method into practice in subsequent thrombosis cases. Furthermore, over the last 20 years, the rapid development of vascular imaging and intravascular interventional therapy enabled the improvement of diagnosis and microinvasive treatment of the IVCS and secondary thrombosis (6, 7). We present our retrospective data from 125 patients to evaluate and compare the effects of the endovascular treatment of IVCS, with or without thrombosis.

MATERIALS AND METHODS

Patient Selection

One hundred twenty-five cases with IVCS (50 males, 75 females, age range 18−75 yrs, mean 52.5 yrs), with or without DVT, were enrolled in this study. The exclusion criteria included some other causes of DVT such as malignancy, recent limb trauma, recent surgery (except for great saphenous vein stripping) and estrogen therapy. IVCS is a condition defined by a greater than 50% stenosis or occlusion of the common iliac vein, accompanied with significant venous collateral vessels. We did not routinely measure venous pressure at our institution as we consider these measurements of lesser value for patients in the supine position. Contrast stasis and the predominant collateral vein indicated that the hemodynamic significance of iliac vein stenosis or obstruction. The duration of patient symptoms, including leg swelling, pain and varicose veins, ranged from one day to two months. The patient demographic data are itemized in Table 1.

Iliac vein compression syndrome without DVT was detected in 39 patients by means of venous duplex ultrasonography (n = 9), magnetic resonance venography (n = 7), computed tomography (n = 19) or venography (n = 4), and confirmed by a femoral venogram. In total, we diagnosed 12 patients before stripping the great saphenous vein or endovascular closure, whereas nine cases were diagnosed by a venography performed due to the aggravation of leg swelling after the stripping of the great saphenous vein. The remaining 18 diagnosed IVCS cases presented with isolated unilateral lower extremity edema. In total, 32 cases occurred on the patient's left side, whereas seven cases occurred on the right side (left : right = 4.6 : 1).

Iliac vein compression syndrome was confirmed in 86 DVT patients by a venography after the aspiration or mechanical thrombectomy, in which, 71 cases occurred on the patient's left side, whereas 15 cases occurred on the right side (left : right = 4.7 : 1). Of the 86 diagnosed cases of DVT, 26 were of the central type (involving the common iliac, external iliac and common femoral vein) and 60 were of the mixed type (involving the entire lower extremity deep vein).

Stenosis of the iliac vein was observed in 43 cases, whereas iliofemoral vein occlusion, which included common iliac vein occlusion (33 cases) and occlusion of the common and external iliac vein (49 cases), was observed in 82 cases (65.6%). Contrast stasis and emptying delay was observed in 122 cases (97.6%) by venography. Moreover, 124 cases (99.2%) had collateral circulation.

Interventional Treatment

We treated 39 IVCS patients without DVT as follows: we accessed the femoral via local anesthesia and the subsequent insertion of a F4-F5 sheath. Next, we passed a H1 catheter (Cordis Corporation, Miami, FL), and guide wire (Terumo Corporation, Tokyo, Japan) through the stenosis lesion and advanced them up to the inferior vena cava. In addition, we exchanged the H1 catheter with a multi-sidehole catheter (Cook, Bloomington, IN) followed by performing a venography of the iliac vein and inferior vena cava to assess the location and severity of the iliac vein stenosis or occlusion and ensure that the catheter was positioned in the real lumen. A F6-F7 sheath was exchanged in an 8−12 mm diameter balloon catheter (C.R. Bard, Murray Hill, NJ) was inflated for 20−30 seconds at the usual 6−10 ATM, to treat the iliac vein stenosis or occlusion. For patients with more than 30% residual stenosis, a 10−16 mm diameter self-expandable stent (Luminexx, C.R. Bard, Murray Hill, NJ) should be placed for patients with 3-4 mm of the cephalad end of the stent placed into the inferior vena cava. We performed post-stenting dilatation for patients with intra-stent stenosis.

Of the 125 cases of IVCS, 86 employed an alternative strategy according to their course, features and position of the DVT as well as the angiograms of the femoral popliteal veins. The definition of fresh thrombus consisted of the intraluminal-filling defect and double track sign in a venography. In addition, the aspirated thrombus was soft

Table 1. Demographic Data of Patients (n = 125)

Factors	No. of Patients (% Total)
Female gender	75 (60.0%)
Age $\geq$ 40 years	72 (57.6%)
Immobilization	13 (10.4%)
Postpartum	7 (5.6%)
Lower extremity swelling	115 (92.0%)
Pain	101 (80.8%)
Varicose vein	31 (24.8%)
Without thrombosis	39 (31.2%)
With fresh thrombosis	52 (41.6%)
With non-fresh thrombosis	34 (27.2%)

and red, or less than 14 days of symptoms.

According to the DSA road map or ultrasound guidance, followed by other procedures described above, 11 central type DVT cases (> 2 weeks, without fresh thrombosis) experienced a punctured popliteal vein. Next, a self-expandable stent was implanted. The distal end of the stent was higher than the femoral vein.

In the 23 mixed DVT cases (> 2 weeks, without fresh thrombosis), the femoral vein in the normal side or the right internal jugular vein was accessed for the implantation of the catheter into to iliofemoral vein, followed by a percutaneous transluminal angioplasty (PTA) in the lesion. In 13 of the 23 cases, which experienced higher blood flow in femoral or external iliac vein, a self-expandable stent was implanted. The remaining 10 cases with lower blood flow in the femoral vein, we only performed a PTA to treat the iliofemoral vein.

If fresh thrombus was found in central DVT patients (15 case), a retrievable filter (n = 8) was inserted in patients with less than 14 days of symptoms or a permanent filter (n = 7) in patients with more than 14 days of symptoms via the contralateral femoral vein, jugular vein or antecubital vein. After accessing the popliteal vein, we advanced the H1 catheter and guide wire through the stenosis lesion, up to the inferior vena cava. In addition, we exchanged in a long sheath or guiding catheter, through which we suctioned the thrombosis in the iliac and femoral veins. When a relatively large quantity of thrombosis was present, we performed a mechanical thrombectomy via a Clot Buster Thrombectomy Device (ev3, Plymouth, MN) or a Straub Rotarex system (SRS, Straub Medical AG, Switzerland). Next, we performed PTA and self-expandable stenting in the iliac vein.

If fresh thrombus was found in the mixed DVT patients (37 cases), a retrievable filter (n = 9) was inserted in patients with less than 14 days of symptoms, or a permanent filter (n = 28) in patients with more than 14 days of symptoms via contralateral femoral vein. We used a C3 catheter (Cordis Corporation, Miami, FL) through the filter carrier sheath to find the mouth of the affected common iliac vein. Once the catheter attained the external iliac vein, a H1 catheter was exchanged in and advanced down to the femoral-popliteal vein, followed by exchanging in an 8 Fr long sheath (Arrow International Inc., Reading, PA), through which thrombosis suction was performed in the popliteal, femoral and iliac vein using the 8 Fr guiding catheter (Cordis Corporation, Miami, FL). If excessive residual thrombus was present, we performed a mechanical thrombectomy (such as Clot Buster thrombectomy device or SRS). Next, we performed a PTA and self-expandable stenting for the residual stenosis found in the iliac vein.

All patients were observed using a blood coagulation function monitor when practicing anticoagulation and thrombolytic therapy. We injected the patients with low molecular heparin (Nadroparin, GlaxoSmithKline, Tianjin, China) twice a day for 3–5 days (4,100 IU abdominal subcutaneous injection) as well as Warfarin (1.25–5.00 mg orally) once per day for 1–6 months. We treated patients implanted with a permanent filter with warfarin for a longer time than patients with temporary filters. For patients with fresh thrombus who were undergoing thrombus aspiration or mechanical thrombectomy, we kept a multi-sidehole catheter for 3–5 days of thrombolysis and/or 5–7 days of antegrade thrombolysis. We administered a daily urokinase dose of approximately 250,000–1,000,000 units. In addition, the patient took a 75–300 mg daily dose of Aspirin for 6–12 months. We also monitored for blood coagulation to provide evidence for adjustments in medication dose.

Assessment of Effect

Seventy-eight cases had follow-up data. Each patient was followed by clinical symptom (edema and pain) at 1, 3, 6 and 12 months after discharge and annually thereafter. At six months after discharge, we performed a venography. The average follow-up period was 10.2 ± 0.3 months (range: 0.5–3.0 yrs). We lost 47 cases to follow-up. Based on the comparison of the symptoms and the venography performed prior to and six months after discharge, the clinical effect was graded into four classes as follows: Excellent: disappearance of edema and pain; blood flow completely restored on venography; disappearance of collateral vein; no contrast stasis; and the vessel wall was smooth. Good: edema and/or pain; blood flow completely restored on venography; no collateral vein remained; no contrast stasis; and the vessel wall was smooth. Moderate: edema and/or pain; blood flow partially restored (greater than 50% patency rate in stent) on venography; collateral vessels remained; contrast stasis or the vessel wall was not smooth. Poor: no improvement of symptoms; no recovery of blood flow on venography; collateral vein was the main route of blood flow.

Group 1 included IVCS patients without thrombosis, whereas group 2 included IVCS patients with fresh thrombus and group 3 included IVCS patients with non-fresh thrombus and the effect of the procedure was assessed for each group, respectively.

Definition

We defined a technical success as the restoration of continuous inline flow with the abolition of collaterals through the femoral and iliac vein segment into the inferior vena cava. We defined an effective case as a complete or a greater than 50% patency rate for the stenting, and included patients classified as excellent, good and moderate. Patency was defined as the inline flow through the implanted stent segment, into the inferior vena cava, without contrast stasis and emptying delay, and including patients classified as "excellent" and "good".

We performed all statistical calculations using the SPSS software package, version 13.0 (SPSS Software Inc, Chicago, IL). We used the χ^2 test to determine the presence of a statistical difference. For the three groups, we used a *p*-value of less than 0.05 as a threshold for statistical significance, and a *p*-value of less than 0.05 to indicate a statistical difference between the two groups.

RESULTS

The overall technical success rate of the treatment was 97% (121 of 125 cases). Moreover, the balloon diameter ranged from 8 to 12 mm, with a length ranging from 20 to 40 mm. The stent diameter ranged from 10 to 16 mm, with a length ranging from 60 to 90 mm.

Among the 39 IVCS cases belonging to group 1, 38 (97.4%) had stenting in the iliac vein stenosis (n = 20) and occlusion (n = 18) (Fig. 1), either at pre-stent balloon dilatation (n = 21) or post-stent dilatation (n = 6). In one case, the catheter and wire failed to pass the lesion, which rendered PTA and stenting impossible. The clinical evaluations before discharge were classified as: "Excellent" – 21 (53.8%), "Good" – 16 (41.0%), "Moderate" – one (2.6%), and "Poor" – one (2.6%). Overall, the effective rate was 97% (38 of 39 cases), and the patency rate was 95% (37 of 39 cases). In 27 of 39 cases (69.2%), patients were kept for obtaining follow-up data. The assessment of the effect at six months after discharge was as follows: 16 (59.3%) patients were "Excellent"; nine (33.3%) patients were "Good"; one (3.7%) patient was "moderate" and 1 (3.7%) patient was "poor". The effective rate was 96% (26 of 27 cases) and the patency rate was 93% (25 of 27 cases).

Among the 86 IVCS cases with iliofemoral vein thrombosis, we performed a thrombosis aspiration or mechanical thrombectomy in 83 cases (96.5%). Further, we performed PTA (n = 67) and stenting (n = 73) in cases of stenosis or occlusion of the iliac vein (Fig. 2), both at pre- and post-stent dilatation (post-stent performed in one patient). The catheter and wire failed to pass the occlusion in three cases. This rendered the mechanical thrombec-

Table 2. Effective Rate and Patency Rate Comparison at Discharge (n = 125)

	Assessment of Effect				Total	Effective Rate (%)	Patency Rate (%)
	Excellent	Good	Moderate	Poor			
Group 1	21	16	1	1	39	97.4	94.9
Group 2	20	26	5	1	52	98.1	88.5
Group 3	8	14	10	2	34	94.1	64.7
χ^2						1.114	13.617
P						0.573	0.001

Note.— Group 1 = iliac vein compression syndrome without thrombosis, group 2 = iliac vein compression syndrome with fresh thrombosis, group 3 = iliac vein compression syndrome with non-fresh thrombosis. No significant difference in patency rates were observed between group 1 and group 2 (χ^2 = 0.483, *p* = 0.487). Conversely, significant difference was observed for patency rate between group 1 and group 3 (χ^2 = 10,664, *p* = 0.001) and between group 2 and group 3 (χ^2 = 7,010, *p* = 0.008).

Table 3. Effective Rate and Patency Rate Comparison at Six Months Follow-up (n = 78)

	Assessment of Effect				Total	Effective Rate (%)	Patency Rate (%)
	Excellent	Good	Moderate	Poor			
Group 1	16	9	1	1	27	96.3	92.6
Group 2	9	15	4	1	29	96.6	82.8
Group 3	6	5	7	4	22	81.8	50.0
χ^2						4.750	13.274
P						0.093	0.001

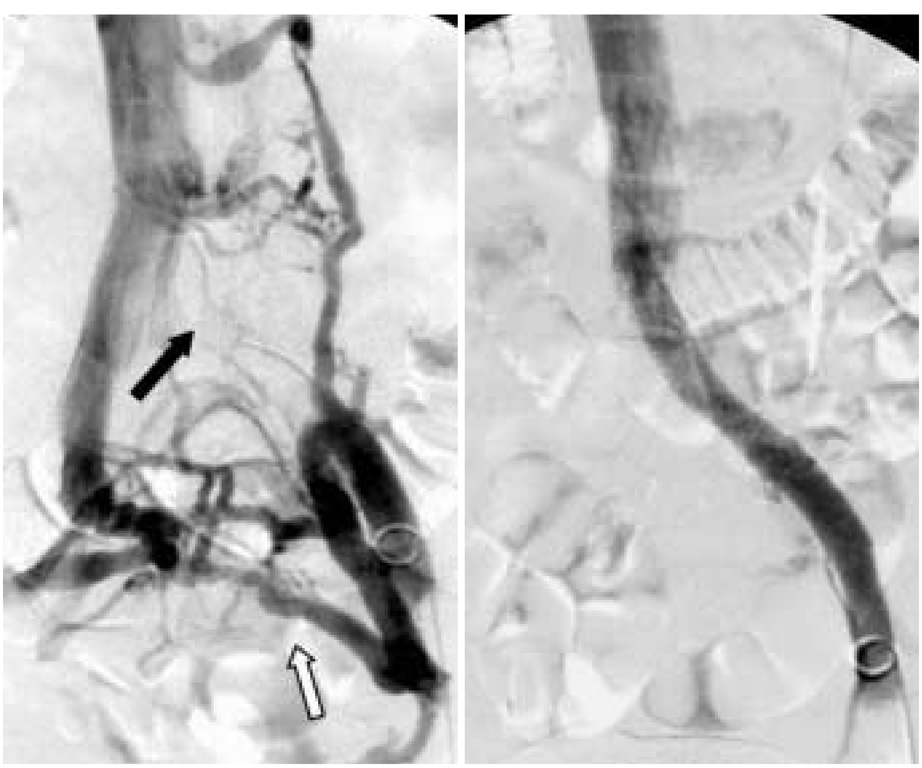
Note.— Group 1 = iliac vein compression syndrome without thrombosis, group 2 = iliac vein compression syndrome with fresh thrombosis, group 3 = iliac vein compression syndrome with non-fresh thrombosis. No significant difference was observed for patency rates between group 1 and group 2 (χ^2 = 0,501, *p* = 0.479). Conversely, significant difference was observed for patency rates between group 1 and group 3 (χ^2 = 11,282, *p* = 0.001) and between group 2 and group 3 (χ^2 = 6,235, *p* = 0.013).

tomy, PTA and stenting impossible, and consequently, thrombus aspiration only was performed for these three patients. Twelve of the 17 retrievable filters were retrieved within 10 days of the procedure, whereas the other five filters were kept inside because the thrombus lot was found in the iliac vein.

Of the clinical evaluations of patients belonging to group 2 (n = 52) performed before discharge, 20 (38.5%) were in "excellent" condition, 26 (50.0%) were in "good" condition, five (9.6%) were in "moderate" condition, and one (1.9%) patient was in "poor" condition. The effective rate was 98% and the patency rate was 89%. Moreover, 29 of the 52 (55.8%) patients belonging to group 2 were followed-up. At six months after being discharged, nine (31.0%) patients were in "excellent" condition, 15 (51.7%) were in "good" condition, four (13.8%) were in "moderate" condition and one (3.4%) patient was in "poor" condition. The effective rate was 97% and the patency rate was 83%. The clinical evaluation of the patients belonging to group 3 (n = 34) before discharge found that eight (23.5%) patients were in "excellent", 14 (41.2%) were in "good" condition, 10 (29.4%) were in "moderate" condition and two (5.9%) were in "poor" condition. The effective rate was 94% and the patency rate was 65%. Of the 34 patients belonging to group 3, 22 (64.7%) possessed follow-up data. The six month follow-up indicated that six (27.3%) patients were in "excellent" condition, five (22.7%) were in "good" condition; seven (31.8%) were in "moderate" condition and four (18.2%) were in "poor" condition. The effective rate was 82% and the patency rate was 50%. A detailed assessment is recorded in Tables 2, 3.

The initial effective rate between the three groups revealed no significant difference (p = 0.573). However, the difference in the initial patency rates between groups were found to be statistically significant (p = 0.001). Moreover, the initial patency rates of group 1 (94.9% vs. 64.7%, p = 0.001) or group 2 (88.5% vs. 64.7%, p = 0.008) was greater than the patency rate recorded in group 3. No significant difference was found for the initial patency rate between group 1 and group 2 (94.9% vs. 88.5%, p = 0.487). Consistently, the results from the six month follow-up period were similar, with no significant difference in the effective rate between the three groups (p = 0.093). Further, a more favorable patency was observed in group 1 (92.6% vs. 50.0%, p = 0.001) and group 2 (82.8% vs. 50.0%, p = 0.013).

No complications (i.e. bleeding and hematoma, stent migration, acute thrombosis) occurred during the stenting procedure. Moreover, no cases of pulmonary embolism (PE) were recorded for all 125 patients (in hospital) and the 78 patients from the procedure to the 6-month follow-up period. We observed one case of inferior vena cava obstruction from a patient with an inferior vena cava filter

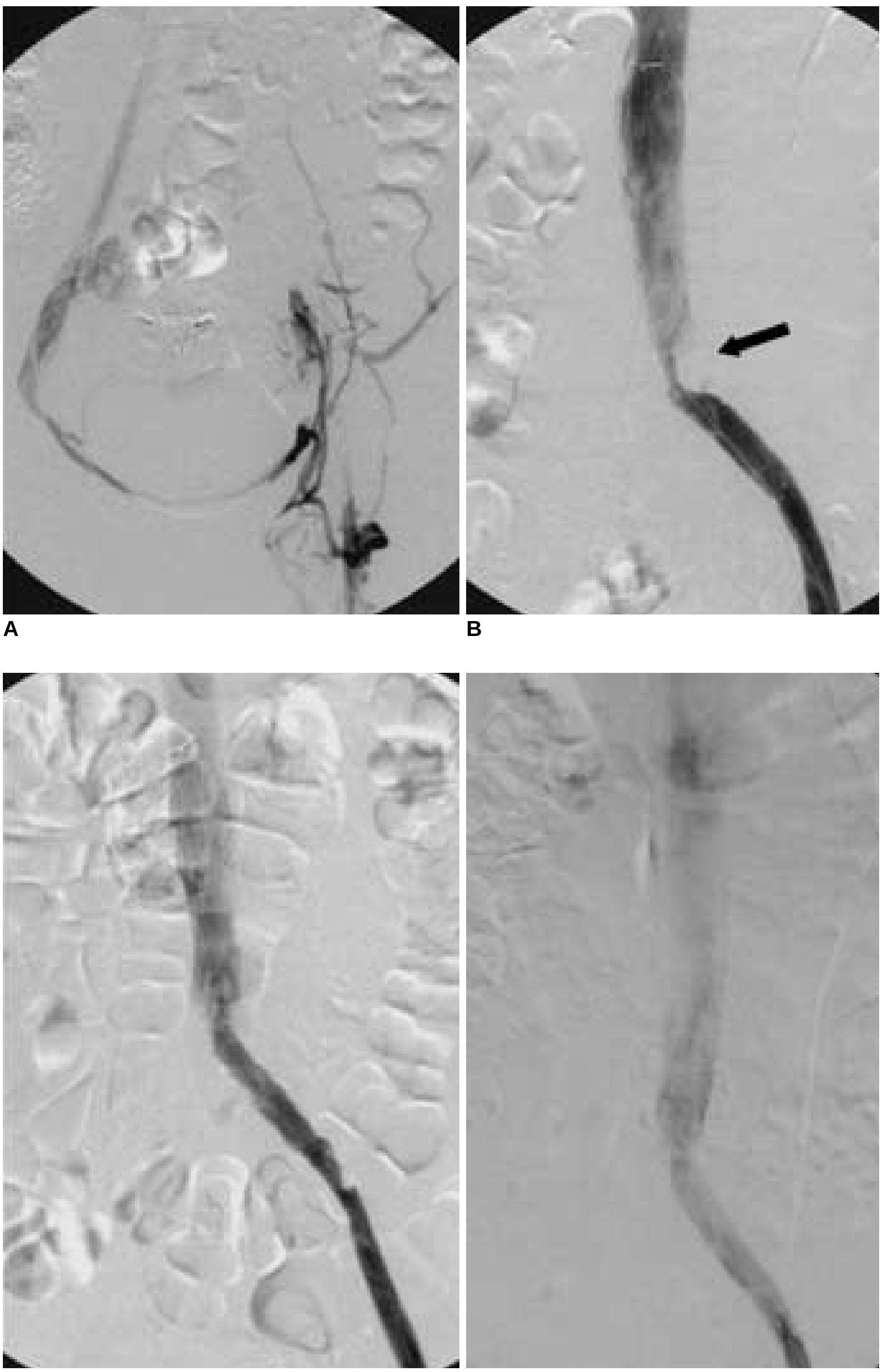


A B

Fig. 1. Treatment of iliac vein compression syndrome without deep vein thrombosis.
A. Venography showing compressed left common iliac vein (black arrow) and contralateral venous drainage via pelvic venous collaterals (white arrow).
B. Venography after stenting showing widely patent left common iliac vein.

6-month post-treatment angiogram results). However, we restored the inferior vena cava blood flow following aspiration and a mechanical thrombectomy. In two IVCS patients with recurrent DVT present (3 and 6 months after discharge follow-up evaluation showing the in-stent obstruction), blood flow was successfully restored in one case by PTA and not in the other due to the inability to pass the catheter and wire beyond the obstruction.

Of the 12 patients with a confirmed IVCS during a preoperative examination for the stripping or endovascular closure of the great saphenous vein symptoms were relieved in four cases within 3−6 months. The other eight cases experienced no remarkable improvement. We performed five laser and radiofrequency closures in the great saphenous. For the follow-up period, all 12 patients were free of the symptoms associated with DVT. Leg



A B C D

Fig. 2. Treatment of iliac vein compression syndrome with deep vein thrombosis.
A. Venography showing thrombosis (fresh thrombus and 8 days after onset) and occlusion of left iliofemoral vein as well as contralateral venous drainage via pelvic venous collaterals.
B. Venography after thrombectomy and stenting showing patent left femoral vein and in-stent stenosis due to iliac vein compression (black arrow).
C. Venography after intra-stent percutaneous transluminal angioplasty showing widely patent left common iliac vein.
D. Venography one year after retrieval of filter showing remaining patent inferior vena cava and left iliofemoral vein.

swelling was diminished after PTA and stenting in nine cases in which IVCS was found by venography because of aggravation of symptoms after great saphenous vein surgery. The remaining 18 cases with isolated IVCS showed an improvement in symptoms in 16 cases.

DISCUSSION

Iliac vein compression is a frequent anatomic variant. The right common iliac artery crosses over the left common iliac vein and then reaches the outside of right iliac vein, where it continues to the right external iliac artery, which is parallel to the right external iliac vein, behind the left iliac vein there are sacral promontory or the fifth lumbar vertebra. The causes of IVCS include the combination of compression and vibratory pressure in the right iliac artery on the iliac vein, which results in the pinching of the iliac vein between the artery and the pelvic bone. The two walls of the vein rub against each other, which lead to irritation of the endothelium. Moreover, this irritation led to the proliferation of the endothelium, synechiae or spurs and the formation of a partition in the lumen. Further, it may cause chronic symptoms of left-side venous hypertension including edema, leg heaviness, skin discoloration, pain, varicose veins or ulceration. In addition, it may frequently lead to thrombosis when the stenosis of the iliac vein is greater than 50%. IVCS and subsequent thrombosis occurs more commonly on the left side. In our study, IVCS occurred 4.6 times more frequently on the left side than the right side, whereas IVCS with thrombosis occurred 4.7 times more frequently on the left side than the right, This difference in frequency suggests that the results are consistent with the published literature (1−3).

It is difficult to find isolated iliac vein compression without thrombosis in a clinical setting, but it does not indicate the low incidence of iliac vein compression. Recent imaging reports have demonstrated that at least a 25% compression of the left iliac vein at the arterial crossover point may be present in 66% of the asymptomatic patient population (8). This correlates with nearly a 50% reduction in the total cross-sectional areas of the vein. Previous reports have suggested that this anatomic variant may predispose the formation of deep venous thrombosis. Virchow's Triad describes an increased risk of venous thrombosis with stasis, hypercoagulability and vessel intimal injury, the first of which is present with any venous obstruction disease including IVCS. There is evidence to suggest that intimal injury may also take place in the form of a spur when the compression occurs over time. These will increase the risk for the development of DVT. Raju and Neglen (9) proposed that the development is probably a slow, progressive condition. Fluid balance in the limb is on the edge during orthostasis; however, many patients remain asymptomatic until the progressive hemodynamic deterioration across a certain critical threshold including surgery as well as pregnancy and prolonged immobilization had been mentioned as contributory factors contributing to patients with asymptomatic lesions and should be educated and followed-up on closely for the early identification of acute occlusion. From the accounts above, we emphasize that the evaluation of the iliac vein in the patients presenting with unilateral lower extremity edema and/or varicose veins, especially in the preoperative examination of the great saphenous stripping and early recognition of iliac vein compression, which may prevent a DVT and provide symptomatic relief.

The successful treatment of IVCS would involve a combination of several interventional techniques to remove as much of the iliofemoral vein thrombosis as possible. Thus, deep vein blood flow can be restored and the course can be shortened. Also, it can prevent or reduce the valve dysfunction of the popliteal and calf vein, as well as reduce the incidence of post thrombosis syndrome. A clot Buster thrombectomy device and SRS work well with the acute thrombus present in iliofemoral vein (10−14). SRS is also effective in dealing with subacute iliofemoral thrombosis. An endovascular mechanical thrombectomy, combined with guiding catheter suction, can substitute most of the surgical embolectomy. However, neither the Clot Buster thrombectomy device nor the SRS can be used to deal with DVT bellow popliteal vein, which needs embolectomy from posterior tibial vein incision.

The use of an inferior vena cava filter to prevent fatal PEs is still controversial, Decousus et al. (15) published the only randomized study for vena cava filters in 1998. The results indicated that a significant decrease in the incidence of PE compared with anticoagulation alone (1.1% vs. 4.8%, p = 0.03) at 8 to 12 days of follow-up. After two years, this difference was no longer statistically significant (3.4% vs. 6.3%, p = 0.16). In contrast, vena caval filters were associated with significantly more recurrent DVT than anticoagulation alone (20.8% vs. 11.6%, p = 0.02). If there are large amounts of fresh thrombus in the iliofemoral vein before PTA, an inferior vena cava filter should be inserted to prevent of thrombus shedding, which may lead to a fatal PE (16−18). There are many different types of inferior vena cava filters; the retrievable filter may be the best choice for acute thrombosis since it can be retrieved after thrombolysis or a thrombectomy to prevent the filter related complication.

Recent reports have shown that stenting of the iliac vein obstruction and venous spur is feasible and safe, and may improve the long-term outcome of patients after a thrombectomy or thrombolysis of left-side acute DVT (19−23). In this series, both the initial and six month patency rates in IVCS patients, without thrombus or with fresh thrombus, had significantly greater patency rates than IVCS patients with non-fresh thrombus. This demonstrates that the early recognition and management of iliac vein compression would achieve a more favorable outcome. In addition, we mentioned that some patients did not experience complete symptomatic relief, even though the patient achieved complete patency for the iliofemoral vein. We believe that this may be attributed to an increase in venous reflux after iliofemoral stenting (24, 25). Delis et al. (24) reported successful patency results after stenting, despite the deterioration of reflux and improved venous claudication associated with successful stent recanalization in the limbs, which normalizes venous outflow, enhances the calf muscle pump function and leads to a significant improvement in clinical outcome. We suggest that the enhanced postoperative stocking is pivotal in preventing disease progression and outcome improvement.

The limitations of this study involve its retrospective nature, the limited number of isolated iliac vein compression patients evaluated, and the relatively short follow-up period. These lower the relevance among iliac vein compression, incidence of deep venous thrombosis due to iliac vein compression, and the success of early treatment in relation to the longer-term outcome. Thus, we need to perform a prospective control study with a large sample size.

In conclusion, the data obtained from the evaluated patients suggest that endovascular treatment for IVCS, with or without thrombosis, is safe and effective. This study shows a superior patency rate in IVCS patients without thrombosis and with fresh thrombosis when compared to IVCS patients with non-fresh thrombosis. We suggest the reconstruction of the evaluation for the occurrence of iliac vein compression in patients with unilateral lower extremity edema and preoperative examinations indicating the presence of varicose veins. Early recognition and endovascular treatment of iliac vein compression could prevent a DVT and an improvement in the symptoms.

References

1. O'Sullivan GJ, Semba CP, Bittner CA, Kee ST, Razavi MK, Sze DY, et al. Endovascular management of iliac vein compression (May-Thurner) syndrome. *J Vasc Interv Radiol* 2000;11:823-836
2. Patel NH, Stookey KR, Ketcham DB, Cragg AH. Endovascular management of acute extensive iliofemoral deep venous thrombosis caused by May-Thurner syndrome. *J Vasc Interv Radiol* 2000;11:1297-1302
3. Bulger CM, Jacobs C, Patel NH. Epidemiology of acute deep vein thrombosis. *Tech Vasc Interv Radiol* 2004;7:50-54
4. Juhan C, Miltgen G, Barthélémy P, Ayuso D. Treatment of iliofemoral venous thromboses with surgical thrombectomy. *Bull Acad Natl Med* 1991;175:643-649
5. Plate G, Eklöf B, Norgren L, Ohlin P, Dahlström JA. Venous thrombectomy for iliofemoral vein thrombosis-10-year results of a prospective randomized study. *Eur J Vasc Endovasc Surg* 1997;14:367-374
6. Grossman C, McPherson S. Safety and efficacy of catheter-directed thrombolysis for iliofemoral venous thrombosis. *AJR Am J Roentgenol* 1999;172:667-672
7. Mewissen MW, Seabrook GR, Meissner MH, Cynamon J, Labropoulos N, Haughton SH. Caterter-directed thrombolysis for lower extremity deep venous thrombosis: report of a national multicenter registry. *Radiology* 1999;211:39-49
8. Kibbe MR, Ujiki M, Goodwin AL, Eskandari M, Yao J, Matsumura J. Iliac vein compression in an asymptomatic patient population. *J Vasc Surg* 2004;39:937-943
9. Raju S, Neglen P. High prevalence of nonthrombotic iliac vein lesions in chronic venous disease: a permissive role in pathogenicity. *J Vasc Surg* 2006;44:136-144
10. Sharafuddin MJ, Gu X, Han YM, Urness M, Gunther R, Amplatz K. Injury potential to venous valves from the Amplatz thrombectomy device. *J Vasc Interv Radiol* 1999;10:64-69
11. Delomez M, Beregi JP, Willoteaux S, Bauchart JJ, Janne d'Othée B, Asseman P, et al. Mechanical thrombectomy in patients with deep venous thrombosis. *Cardiovasc Intervent Radiol* 2001;24:42-48
12. Vedantham S, Vesely TM, Parti N, Darcy M, Hovsepian DM, Picus D. Lower extremity venous thrombolysis with adjunctive mechanical thrombectomy. *J Vasc Interv Radiol* 2002;13:1001-1008
13. Frisoli JK, Sze D. Mechanical thrombectomy for the treatment of lower extremity deep vein thrombosis. *Tech Vasc Interv Radiol* 2003;6:49-52
14. Sharafuddin MJ, Sun S, Hoballah JJ, Youness FM, Sharp WJ, Roh BS. Endovascular management of venous thrombotic and occlusive disease of the lower extremities. *J Vasc Interv Radiol* 2003;14:405-423
15. Decousus H, Leizorovicz A, Parent F, Page Y, Tardy B, Girard P, et al. A clinical trial of vena caval filters in the prevention of pulmonary embolism in patients with proximal deep-vein thrombosis. *N Engl J Med* 1998;338:409-415
16. Yamagami T, Kato T, Iida S, Hirota T, Nishimura T. Gunther tulip inferior vena cava filter placement for deep venous thrombosis of the lower extremity. *Cardiovasc Intervent Radiol* 2005;28:442-453
17. Rosenthal D, Wellons ED, Lai KM, Bikk A, Henderson VJ. Retrievable inferior vena cava filters: initial clinical results. *Ann Vasc Surg* 2006;20:157-165
18. Kalva SP, Wicky S, Waltman AC, Athanasoulis CA. TrapEase vena cava filter: experience in 751 patients. *J Endovasc Ther* 2006;13:365-372
19. Kim JY, Choi D, Guk Ko Y, Park S, Jang Y, Lee do Y. Percutaneous treatment of deep vein thrombosis in May-Thurner syndrome. *Cardiovasc Intervent Radiol* 2006;4:571-575
20. Kwak HS, Han YM, Lee YS, Jin GY, Chung GH. Stents in

common iliac vein obstruction with acute ipsilateral deep venous thrombosis: early and late results. *J Vasc Interv Radiol* 2005;16:815-822
21. Blum A, Roche E. Endovascular management of acute deep vein thrombosis. *Am J Med* 2005;118:S31-S36
22. Liang HL, Pan HB, Lin YH, Chen CY, Chung HM, Wu TH, et al. Metallic stent placement in hemodialysis graft patients after insufficient balloon dilation. *Korean J Radiol* 2006;7:118-124
23. Cho SK, Do YS, Shin SW, Park KB, Kim DI, Kim YW, et al. Subintimal angioplasty in the treatment of chronic lower limb ischemia. *Korean J Radiol* 2006;7:131-138
24. Delis KT, Bountouroglou D, Mansfield AO. Venous claudication in iliofemoral thrombosis: long-term effects on venous hemodynamics, clinical status, and quality of life. *Ann Surg* 2004;239:118-126
25. Neglen P, Thrasher TL, Raju S. Venous outflow obstruction: an underestimated contributor to chronic venous disease. *J Vasc Surg* 2003;38:879-885