



# Recanalization of an Occluded Vena Cava Filter and Iliac Veins with Kissing Stents to Treat Postthrombotic Syndrome with a Venous Stasis Ulcer

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Inferior vena cava filters (IVCFs) are effective in preventing pulmonary embolism and their usage has rapidly increased over the past decades. However, complications have also significantly increased, as IVCF occlusion causes serious chronic venous insufficiency. Herein, we report a case of infrarenal IVCF occlusion that was successfully treated with the introduction of kissing stents through the IVCF into both iliac veins. A 54-year-old male presented with non-healing ulcers on his left leg. He had undergone IVCF implantation and warfarin medication due to deep vein thrombosis 4 years earlier in another hospital. Computed tomography (CT) revealed the filter-bearing IVC occlusion. Endovascular IVCF removal was attempted but failed. Kissing stents were deployed across the IVCF and extended into both iliac veins. Cone beam CT showed well-deployed stents just behind the occluded IVCF. Venous flow was restored without complications, and the recurrent ulcer healed immediately.

**Key Words:** Inferior vena cava filter, Stents, Deep vein thrombosis, Postthrombotic syndrome, Venous stasis ulcer

Received February 28, 2020

Revised May 18, 2020

Accepted May 28, 2020

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Vasc Specialist Int 2020;36(2):116-121 • <https://doi.org/10.5758/vsi.200010>

## INTRODUCTION

Deep vein thrombosis (DVT) is a serious disease, sometimes causing life-threatening pulmonary embolism (PE) or limb-threatening post-thrombotic syndrome (PTS) [1]. Anticoagulation therapy is the standard treatment for acute venous thromboembolism (VTE) with good outcomes [2]. However, in cases of extensive iliofemoral DVT, anticoagulation is often unsuccessful. Recently, iliofemoral venous stenting has been actively attempted in patients with venous outflow obstruction, and its safety and effectiveness have been demonstrated [3]. Additionally, in recent decades, the use of inferior vena cava filters (IVCFs) has rapidly increased to prevent PE in patients with a contraindication to anticoagulation or a high risk of bleeding. However, IVC filters are often occluded due to thrombosis and

cause severe PTS [4].

Herein, we describe a successful case of recanalization of an occluded IVCF and both iliac veins using kissing stents. Informed consent was obtained from the patient for the publication of this article without releasing any personal information.

## CASE

A 54-year-old man visited our vascular clinic with edema, hyperpigmentation, and a non-healing ulcer on his left calf. The patient had undergone IVC filter implantation due to DVT 4 years earlier in another hospital and had been on anticoagulant therapy with warfarin. He had a previous history of left hemiparesis due to intracranial hemorrhage (ICH) 5 years earlier, with a poor performance. Because of

the patient's limited motility and risk of recurrent VTE, the filter was not removed. A venous stasis ulcer had developed on the left medial malleolus 2 years earlier. Compression therapy with a class II elastic stocking (20 mmHg, thigh type) had been performed with good compliance for 2 years; however, the ulcer did not heal. Physical examination revealed extensive hyperpigmentation and a recurrent 2×3 cm-sized ulcer was observed (Fig. 1). The Villalta score of the patient indicated severe PTS with a venous ulcer and 13 additional points; pain (1, mild), cramps (1), heaviness (2, moderate), paresthesia (0, none), pruritus (0), pretibial edema (2), skin induration (2), hyperpigmentation (2), venous ectasia (1), and pain on calf compression (2). The Clinical-Etiologic-Anatomic-Pathophysiologic (CEAP) classification was C<sub>6</sub>E<sub>5</sub>A<sub>D</sub>P<sub>0</sub>; C<sub>6</sub> (active venous ulcer), E<sub>5</sub> (secondary, post-thrombotic), A<sub>D</sub> (deep vein), P<sub>0</sub> (obstruction). The venous clinical severity score (VCSS) was 16; pain (1, occasional), varicose vein (0, none), venous edema (3, morning), skin pigmentation (2, diffuse), inflammation (1, mild cellulitis), induration (2, <1/3 gaiter), active ulcer (1, number), active ulcer size (2, 2 to 6 cm), ulcer duration (3, >1 year), and compression therapy (1, intermittent).

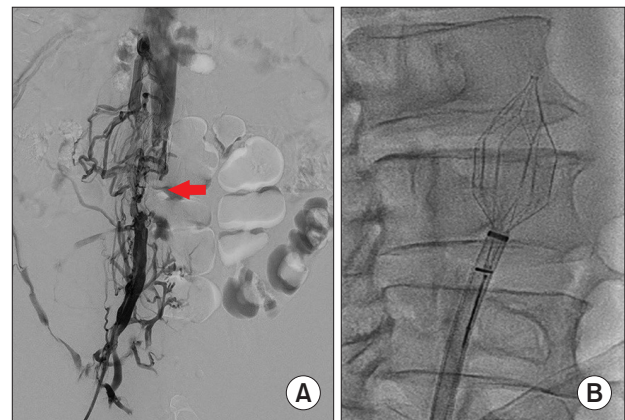
Venous duplex ultrasonography (DUS) showed chronic DVT with web-like thrombi from the common femoral vein (CFV) to the popliteal vein. Contrast-enhanced computed tomography (CT) venography revealed an occluded infra-



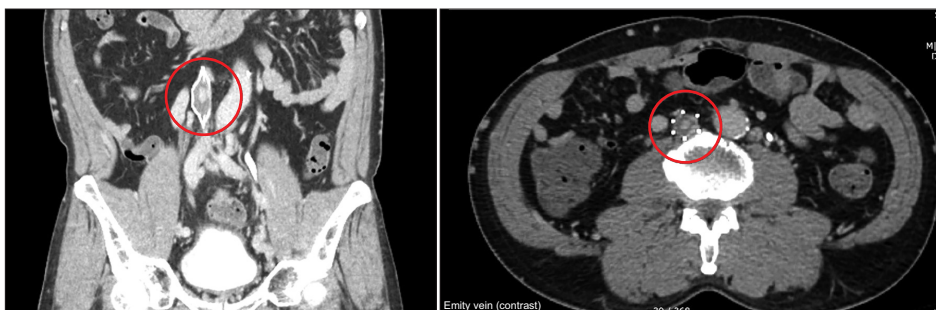
**Fig. 1.** The patient complained of left calf swelling and recurrent ulcers. An active ulcer above the healed ulcer was observed on the medial side of the distal calf.

renal IVCF and post-thrombotic changes in both common iliac veins (Fig. 2).

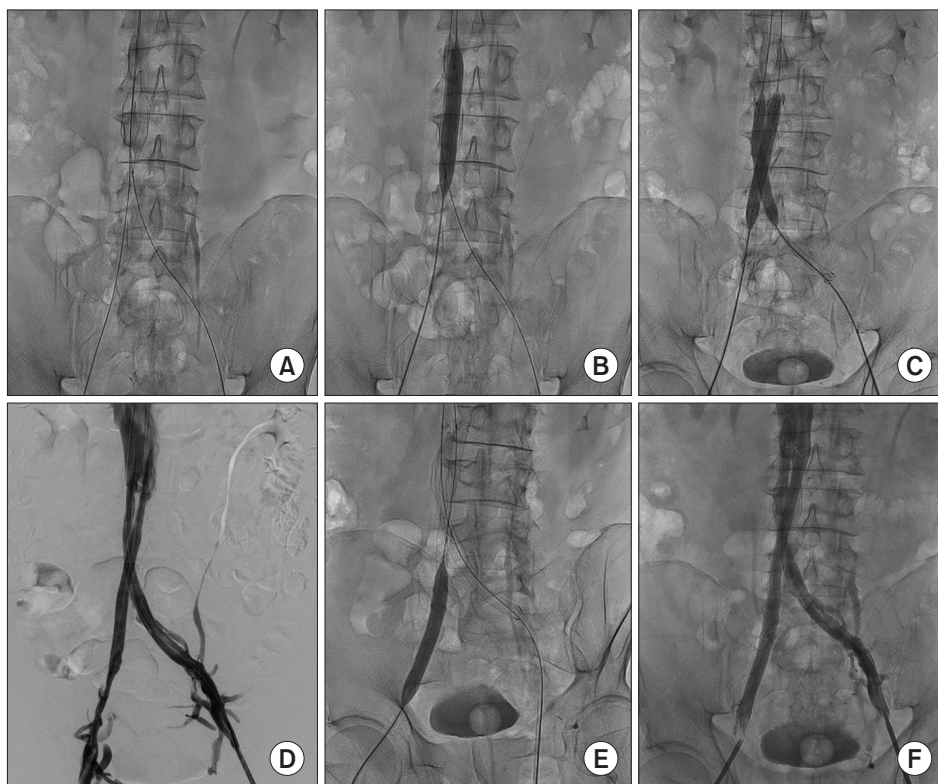
To treat the PTS, we first tried to remove the IVCF. After puncturing the right CFV, a 6-Fr-sized sheath was inserted. Vena cavography revealed an occluded infrarenal Optease filter (Cordis Corporation, Miami Lakes, FL, USA) and many collateral veins. The right iliac vein was also narrowed and collateral veins had formed (Fig. 3A). We changed to a 12-cm-long, 14-Fr-wide sheath, and filter removal was attempted using an 11-Fr-wide arrow sheath, a gooseneck snare, and alligator forceps. The filter was captured with forceps and partly retrieved into the sheath. However, IVCF removal was technically impossible due to severe tissue adhesion; thus, the filter could not be retrieved without tearing the IVC (Fig. 3B). Therefore, we planned to insert kissing stents across the occluded filter. In the next day, both femoral veins were punctured under DUS guidance and 5-Fr sheaths were inserted. Another venography confirmed that the suprarenal IVC was intact. Using a Davis diagnostic catheter (Cook Medical, Bloomington, IN, USA)



**Fig. 3.** (A) Vena cavography showed an occluded Optease inferior vena cava filter (arrow) and abundant collateral veins. (B) Using an 11-Fr-sized arrow sheath, a gooseneck snare, and alligator forceps, filter retrieval was attempted but failed due to severe adhesion.



**Fig. 2.** Computed tomography venography showed an occluded infrarenal vena cava filter (circle) and chronic deep vein thrombosis in both iliac veins.



**Fig. 4.** (A) Navigation to the supra-filter inferior vena cava (IVC) was performed between the IVC wall and the occluded filter. (B) Balloon angioplasty through the occluded IVC filter was performed. (C) Kissing stents were deployed in both external iliac veins (EIVs) and the IVC. (D) Venography revealed residual stenosis in the right distal EIV further from the stent coverage. (E) Another stent was deployed in the distal EIV. (F) Completion venography confirmed recanalization of the vena cava and both iliac veins without flow disturbance.



**Fig. 5.** Cone beam computed tomography confirmed the successful placement of both iliac stents behind the occluded inferior vena cava filter.

and a 0.035-inch hydrophilic stiff guidewire (Radifocus M; Terumo, Tokyo, Japan), navigation to the supra-filter IVC was performed between the caval wall and the filter. Segmental venous pressures were measured as follows: supra-filter IVC (12 mmHg), infra-filter IVC (20 mmHg), left external iliac vein (EIV) (20 mmHg), and right EIV (20 mmHg). The pressure gradient developed due to the filter occlusion (Fig. 4A). Balloon angioplasty from the supra-filter IVC to the bilateral EIVs was performed using a 12 mm×6 cm-



**Fig. 6.** Two weeks (A) and 3 months (B) after the procedure, the ulcer completely healed and the swelling markedly improved.

sized Mustang balloon (Boston Scientific Co., Natick, MA, USA) to secure a space (Fig. 4B). The sheaths were replaced with 9-Fr-wide ones, and self-expanding Niti-S stents (Taewoong Medical, Ilsan, Korea) were deployed into both EIVs up to the supra-filter infrarenal IVC using the kissing stent technique (12 mm×9 cm stent on the right side, 12 mm×10 cm on the left side) (Fig. 4C). On the subsequent venography, the flow inside the stents was intact, but a filling defect was found in the right distal EIV beyond the stent (Fig.

4D). A 12 mm×6 cm-sized stent was deployed, followed by balloon angioplasty using a 10-mm-sized balloon (Fig. 4E). Completion venography showed excellent recanalization without flow disturbance (Fig. 4F), and the pressure gradient decreased as follows: supra-filter IVC (16 mmHg), left EIV (18 mmHg), and right EIV (18 mmHg). Finally, cone beam CT was performed to confirm the positional relationship between the stents and the remnant IVCF. The stents were located behind the IVCF and both stents were fully deployed without any compression or kink (Fig. 5). Oral antithrombotics were administered with Cilostazol 50 mg twice a day (bid) (Otsuka Pharmaceutical, Tokushima, Japan) and Apixaban 5 mg bid (Bristol-Myers Squibb and Pfizer, NY, USA). In the outpatient visit 2 weeks later, the venous stasis ulcer appeared completely healed, while the swelling and hyperpigmentation also markedly improved (Fig. 6). Follow-up DUS 3 months later revealed the patent stents.

## DISCUSSION

PTS presents with variable symptoms of swelling, hyperpigmentation, venous claudication, skin eczema, lipodermatosclerosis, induration, and venous ulcerations. Recently, endovenous stenting has been actively attempted to resolve these symptoms by recanalization. In a systematic review and meta-analysis of 37 studies focused on venous stenting for iliofemoral venous outflow obstruction [3], technical success rates were 94% to 96%. Complications included periprocedural mortality (0.1% to 0.7%), major bleeding (0.3% to 1.1%), PE (0.2% to 0.9%), and early thrombosis (1.0% to 6.8%). Primary and secondary patency rates, respectively, at 1 year were 96% and 99% for nonthrombotic, 87% and 89% for acute thrombotic, and 79% and 94% for chronic post-thrombotic occlusion. The authors concluded that stent placement for iliofemoral venous outflow obstruction resulted in high technical success rates and acceptable complication rates regardless of the cause of obstruction [3].

However, several critical problems are associated with vein stenting. First, vein rupture occurs uncommonly during the procedure. Frank rupture of the intervened vein occurs due to relatively low pressure and significant periaortic fibrosis around the vein. Second, in-stent restenosis (ISR) develops more commonly, arising from intimal hyperplasia within the stent. The incidence of ISR has been reported up to 25% (median 15 months, range 2 to 84 months) [5]. Third, poor outflow or mechanical effects may cause thrombosis in the stent, with an overall incidence of approximately 3.5% (median 5.8 months, range 1 day to 14.4 years). In addition, stent compression, migration, and

contralateral iliac vein thrombosis may occur [5]. In order to overcome these problems, a novel alternative hybrid surgery has been attempted [6]. Femoral endovenectomy with iliac stenting for iliofemoral venous occlusion has been performed with demonstrated effectiveness [7].

The benefits of the IVCF should be carefully considered. Hann and Streiff [8] reported that IVCFs were recommended for contraindication to anticoagulation and the use of retrievable IVCFs has reduced complications. Moreover, the investigators of a randomized trial for the Prevention du Risque d'Embolie Pulmonaire par Interruption Cave (PREPIC) study [9] reported that the use of IVCFs reduced the risk of PE but had no effect on survival rate, and IVCF implantation should not be recommended for general VTE because the risk of DVT was significantly increased. Similarly, the American College of Chest Physicians (ACCP) guideline in 2012 also recommended the limited use of IVCFs only in contraindication to anticoagulation [10].

We previously reported real world experience of the retrieval rate of retrievable IVCFs from a tertiary referral center in Korea [11]. The most common indication for IVCF was thrombolysis/thrombectomy for ilio caval DVT (47.8%). The filter retrieval rate was 59%, and the most common cause of non-retrieval was chronic high risk of VTE (51%), followed by residual proximal DVT (15%) and negligence by unknown reasons (13%). Similarly to this case, the remaining IVCF may cause IVC occlusion and resultant severe PTS. IVCF was inserted due to DVT development after ICH and was not retrieved in an outside hospital. In that situation, we usually wait 4 weeks after the event to start anticoagulation and retrieve the filter. History of ICH does not constitute a contraindication to filter retrieval.

Recanalization of the occluded IVCF can relieve the symptoms, and many novel such techniques have been reported. Patel et al. [12] successfully inserted a Palmaz stent across the IVCF. Vedantham et al. [13] recanalized a thrombosed filter-bearing IVC and iliac veins by deploying overlapping kissing Wallstents (Boston Scientific Co.) [13], while several similar reports were subsequently published [14–17]. Ye et al. [18] published the excellent outcomes of stent placement for a chronic occlusion of a filter-bearing IVC. At 1 year, primary and secondary patency rates were 67% and 91%, and at 2 years, 45% and 77%, respectively. At 2 years, the ulcer-healing rate was 73%, and the cumulative rates of complete relief of pain (visual analog scale >5) and swelling (grade 3) were 77% and 75%, respectively. There were no complications of critical bleeding, symptomatic PE, or mortality [18]. Although the short-term results of venous stenting are promising, there are still insufficient data for the long-term outcomes. Therefore, venous stenting should be considered carefully in terms of indication, techniques,

selection of the proper stents, post-stenting medication, and follow-up.

This was the first case performed in our center and in Korea; thus, several issues should be discussed for a successful long-term outcome. The first issue is the stent type; despite the variety of developed venous stents, they are not all available in Korea. Although Niti-S stents were used in this case, the Wallstent (Boston Scientific Co.) could be an alternative. The Niti-S stent is a closed cell-type stent that is flexible and resistant to fracture. In addition, it has a large-diameter product family with a suitable radial force, making it a useful stent for venous system intervention. Furthermore, the large-diameter Wallstent is not available in Korea. Therefore, we preferred to use the Niti-S stent in the treatment of the large venous system.

The second issue is how to prevent a new stent thrombosis. If the inserted stents became occluded again, they could induce occlusion of collaterals and severe exacerbation of the symptoms. Post-stenting medication is very important, and basically includes indefinite anticoagulant therapy, which sometime fails. Authors prescribed a combined therapy with an anticoagulant and an antiplatelet agent adopting the strategy of Comerota et al. [6]. Dual inhibition of coagulation cascade and platelet activation might reduce stent thrombosis with acceptable bleeding complications.

Another important issue is the technique applied and extent of stenting. To maintain a good flow from both iliac veins, it is recommended for each iliac stent to have a diameter of at least 10 to 14 mm. Moreover, both iliac stents should be included in the patient's IVC. Considering these two recommendations, 12-mm-sized stents were selected in this case. Inserting a stent across an occluded IVCF requires specialized techniques, which can be attempted only in experienced centers. Authors immediately checked the stent configuration by on-table cone beam CT, which showed good alignment of the well-expanded stents beneath the occluded IVCF. Careful evaluation with completion venography and cone beam CT is very important to define technical success without flow disturbance. Another way to immediately assess the outcome is to measure the pressure gradient. In this case, preprocedural pressure gradient between supra-filter IVC and EIV was 8 mmHg and decreased to 2 mmHg after stenting, confirming the improved hemo-

dynamics after stenting. The important factor in determining the outcome of this patient's treatment was not the absolute pressure value, but the pressure gradient across the IVC filter segment. Absolute pressure values may vary according to changes in sensor position or time and patient movement. In general, there is a slight pressure gradient between the IVC and the iliac veins to maintain intravascular blood flow, so we considered the final 2-mmHg pressure gradient as a sufficiently successful result compared to the initial 8-mmHg pressure gradient.

In conclusion, an occluded IVCF was successfully recanalized with the introduction of kissing stents, while technical success was confirmed objectively by completion venography and cone beam CT. The venous ulcer healed immediately after the procedure and the swelling markedly improved.

## CONFLICTS OF INTEREST

The authors have nothing to disclose.

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Concept and design: SH, SKM. Analysis and interpretation: HK, SH, SKM. Data collection: HK. Writing the article: HK, SKM. Critical revision of the article: SA, SM, SH, HJJ, SKM. Final approval of the article: all. Obtained funding: none. Overall responsibility: SKM.

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