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Case Report

Late endovascular removal of Günther-Tulip inferior vena cava filter and stent reconstruction of chronic post-thrombotic iliocaval obstruction after 4753 days of filter dwell time: a case report with review of literature

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ABSTRACT

Chronic post-thrombotic obstruction of the inferior vena cava (IVC) or iliocaval junction is an uncommon complication of long indwelling IVC filter. When such an obstruction is symptomatic, endovascular treatment options include stent placement with or without filter retrieval. Filter retrieval becomes increasingly difficult with longer dwell times. We present a case of symptomatic post-thrombotic obstruction of the iliocaval junction related to Günther-Tulip IVC filter (Cook Medical Inc, Bloomington, IN) with dwell time of 4753 days, treated successfully with endovascular filter removal and stent reconstruction. Filter retrieval and stent reconstruction may be a treatment option in symptomatic patients with filter-related chronic IVC or iliocaval junction obstruction, even after prolonged dwell time.

Introduction

Use of inferior vena cava (IVC) filters for pulmonary embolism (PE) prophylaxis has increased with relative increase in the use of retrievable filters [1]. Lack of long-term advantage and improved understanding of the IVC filter-related complications with longer dwell times have led to an increased emphasis on filter removal [2]. However, the filter retrieval rates still remain low largely due to lack of follow-up [1]. Filter removal becomes increasingly difficult with longer dwell times due to filter penetration, exaggerated filter tilt, embedded filter apex, and caval occlusion. Several advanced techniques have been described for removal of such filters [2–4].

One of the known complications of the retrievable IVC filters is vena cava thrombosis or stenosis occurring in 0.6%-8% of cases [1]. Chronic iliocaval obstruction from filter thrombosis may lead to post-thrombotic syndrome (PTS).

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Recanalization of the venous obstruction is the standard treatment for PTS [5]. When symptomatic venous obstruction is associated with long indwelling IVC filter, endovascular treatment options involve stent placement with [6] or without filter retrieval [7,8].

We present a case of PTS caused by iliocaval obstruction associated with Günther-Tulip IVC filter (Cook Medical Inc, Bloomington, IN) with dwell time of 4387 days, treated successfully with endovascular filter removal, and stent reconstruction of the iliocaval junction.

Case report

A 52-year-old Caucasian male with medical history of obesity, Protein S deficiency, hypertension, coronary artery disease, depression, recurrent PE, and deep vein thrombosis (DVT), presented with stigmata of PTS in both lower extremities, more severe on the right side. Severity of the chronic venous disease was classified based on Clinical-Etiology-Anatomy-Pathophysiology (CEAP) classification, originally developed in 1994 and subsequently revised in 2004 [9]. On the right side, CEAP classification at the time of presentation was $C_{4b,S}$,E_s,$A_{s,d}$,$P_{r,o}$ while the highest CEAP classification before treatment with wound care and compressive stockings was $C_{6,S}$,E_s,$A_{s,d}$,$P_{r,o}$. The CEAP classification on the left side was $C_{4a,S}$,E_s,$A_{s,d}$,$P_{r,o}$. The patient's quality of life, particularly mobility and exercise tolerance, were severely limited due to lower extremity swelling, pain, and heaviness that exacerbated with activity. The patient had a history of Günther-Tulip IVC filter placement at an outside institution in the infrarenal IVC in January 2002 after an episode of PE and DVT. The patient's last documented episode of DVT was in 2010. Most recent venous Doppler ultrasound in 2014 demonstrated bilateral deep venous incompetence without thrombosis. Digital subtraction venogram and CT scan of the abdomen were obtained to assess the IVC filter and the extent of venoocclusive disease. The images showed iliocaval junction obstruction with large iliolumbar and paravertebral collaterals. The IVC at the level of the filter apex was patent, but thick mural filling defects were noted around the filter struts indicating intimal and fibrous tissue growth (Fig. 1). The filter apex was abutting the IVC wall without evidence of filter fracture or wall penetration.

Description of the procedure

After thorough discussion of the risks and benefits, the patient was scheduled for the filter retrieval and stenting of the iliocaval junction with the objective of improvement in the venous symptoms and the quality of life. The procedure was

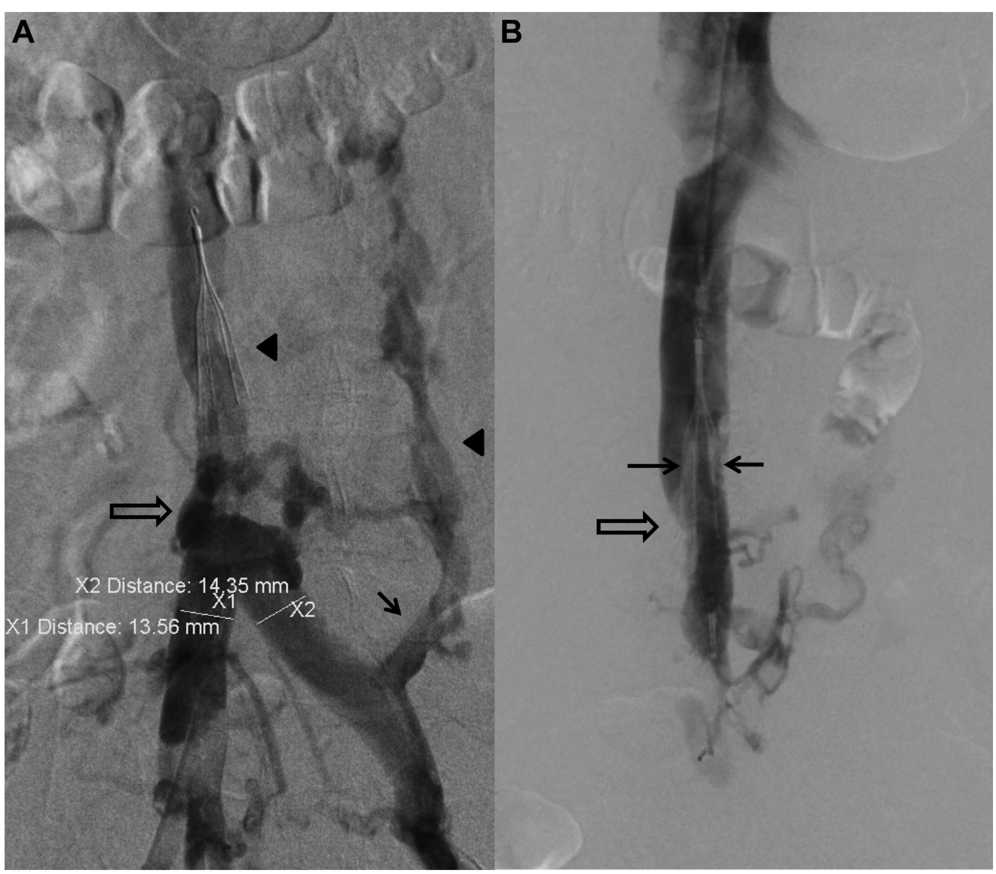

Fig. 1 – (A) This is an image of the planning venogram demonstrating chronic post-thrombotic obstruction of the lower IVC and bilateral iliocaval junction (hollow arrow) with enlarged iliolumbar (solid arrow) and paravertebral collaterals (solid arrowhead). (B) Inferior vena cavogram image before the retrieval is showing partial obstruction of the filter-bearing segment of the IVC (hollow arrow) with mural filling defects (solid arrows) along the filter struts.

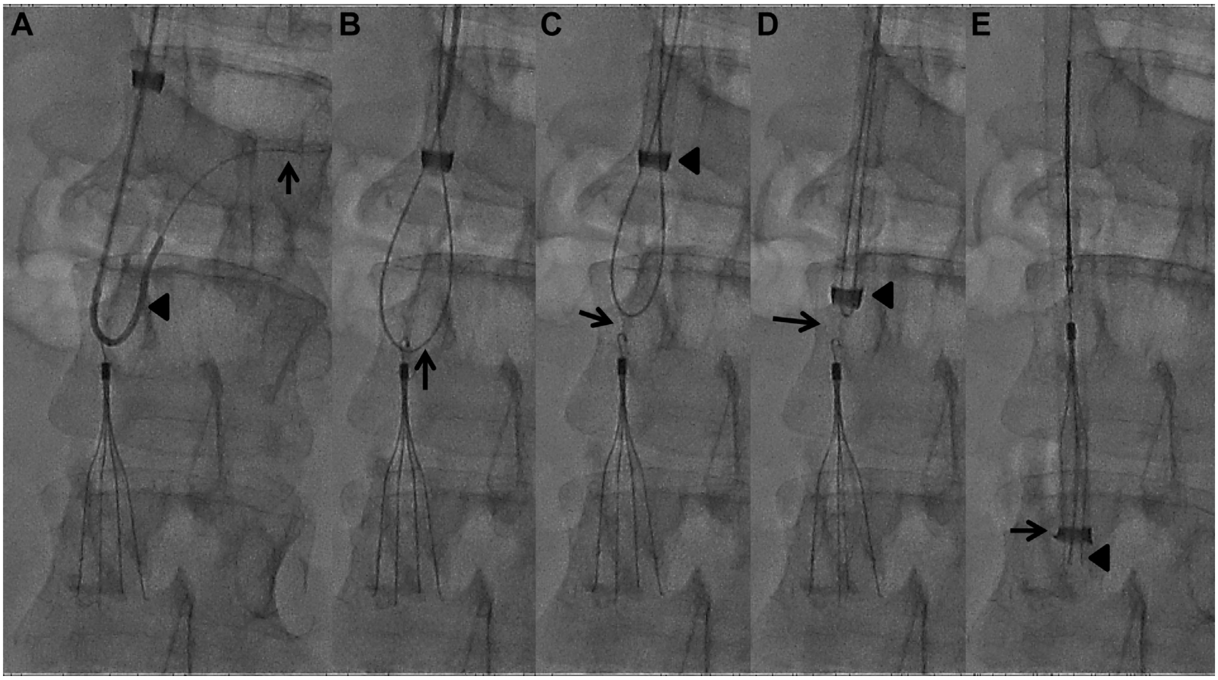

Fig. 2 – Steps of the "Hangman technique" (A) the leading end of the Glidewire (solid arrow) is passed through the subapical space using a reverse curve catheter (solid arrowhead). (B) Guidewire loop (solid arrow) is created through the subapical space after the leading end of the Glidewire is snared and externalized through the sheath. (C, D) The sheath (solid arrowhead) is then lowered while maintaining traction on both the ends of the Glidewire. The gap between the filter apex and the Glidewire loop (solid arrow) shows how the wire loop is dissecting the tissue cap without moving the filter. (E) The sheath is then lowered over the snared filter apex resulting in coaptation of most of the filter struts except for the distal few millimeters (solid arrowhead). Solid arrow shows splaying of the sheath edge because of the resistance from the adherent fibrotic tissue.

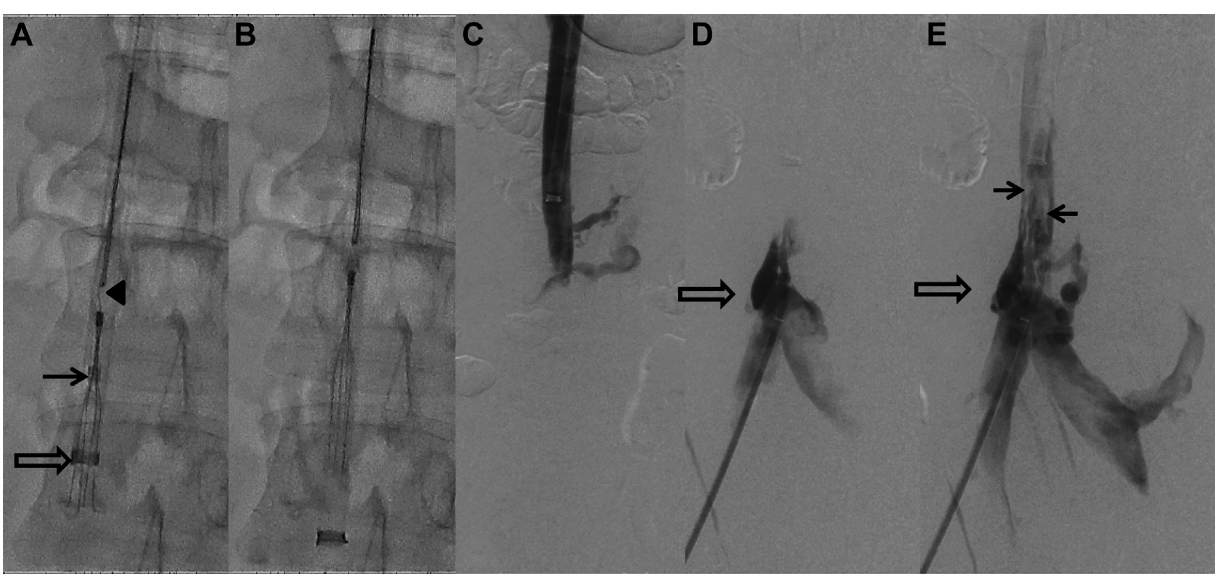

Fig. 3 – (A) A coaxial sheath (solid arrow) is used though the outer sheath (hollow arrow) over the snared apex (solid arrowhead). (B) IVC filter is now completely within the outer sheath after successful disengagement of the filter struts from the adherent fibrotic tissue. (C-E) Inferior vena cavogram and venogram images after filter retrieval do not show retrieval-related complications. There are persistent iliocaval obstruction (hollow arrows) and mural filling defects (solid arrows) in the lower IVC.

performed under general anesthesia. A 16 Fr × 45 cm Check-Flo Performer introducer sheath (Cook Medical Inc) was introduced via right internal jugular vein. A right common femoral vein access was also obtained in case a modification in the technique was warranted. Initial attempts to capture the apex of the filter with a 20-mm loop diameter Amplatz GooseNeck Snare Kit (eV3 Endovascular, Inc, Plymouth, MN) were unsuccessful as the filter apex was embedded. The Hangman technique [4] was then used using 20-mm loop diameter Amplatz GooseNeck Snare Kit, a 4-French SOS Omni Selective catheter (AngioDynamics, Latham, NY) and a 0.035-inch angled Glidewire (Terumo Medical Corp, Somerset, NJ) to release the filter apex from the IVC wall (Fig. 2). The Hangman technique uses a subapical guidewire loop to dissect the tissue cap and release the embedded filter apex. The released apex was then snared using the standard technique, and the 16-French sheath was lowered to coapt the filter struts. However, as the lower ends of the struts were deeply embedded in the tissue overgrowth, they could not be released despite significant traction on the snare (Fig. 2E). To improve the vector of force, a 10-French outer and 8-French inner introducer sheath combination of the CloverSnare (Cook Medical Inc) kit was coaxially inserted through the 16-French sheath, and the filter apex was snared using the 4-loop vascular retriever (Fig. 3A). Gradual telescopic advancement of the sheaths enabled release of the struts from the fibrous tissue and retrieval of the filter (Fig. 3B). Post-retrieval cavogram did not show any complication (Fig. 3C). The retrieved filter was structurally intact and covered with fibrotic tissue (Fig. 4). A left femoral vein access was then obtained, and a 6 Fr × 25 cm introducer sheath was placed. The iliocaval obstruction was crossed from the right femoral approach using a 0.035-inch Glidewire (Terumo Medical Corp). A 24 × 45-mm^2 Wallstent (Boston Scientific, Natick, MA) was placed in the distal IVC. Glidewire from the left femoral access was threaded through the iliocaval obstruction and the Wallstent. Two 14 × 40-mm^2 Protégé GPS stents (eV3 Endovascular, Inc) were then placed across bilateral iliocaval junction overlapping the caval stent. Postdilatation was performed with a 14-mm diameter balloon. Final venogram showed restored patency and brisk flow through the reconstructed iliocaval junction (Fig. 5A). Fluoroscopy time was 37.7 minutes, and radiation exposure dose was 3041.78 mGy.

The patient was discharged home next day after an uneventful recovery. Anticoagulation and antiplatelet therapies were initiated with rivaroxaban and low-dose aspirin. Over the next 2 weeks, patient's exercise tolerance improved dramatically, being able to walk up to 2 miles without venous claudication. At 1 year, the patient remains free from thromboembolic episode and the symptoms of venous hypertension except for the skin pigmentation from hemosiderin deposits. Venogram at 9 months showed complete patency of the stents (Fig. 5B).

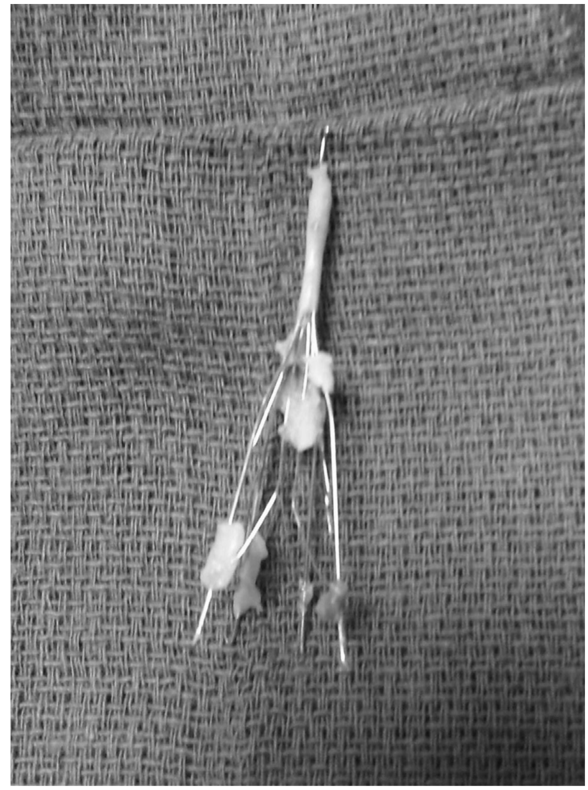

Fig. 4 – The picture of the retrieved filter is showing fibrotic tissue overgrowth covering the apex and the struts of the retrieved filter.

Discussion

Failure rate of the standard technique for IVC filter removal has been reported as high as 40% with prolonged dwell time considered as the most important cause [4,6]. Use of adjunctive or advanced techniques improve retrieval rate. Al-Hakim et al and Kuo et al [3,6] reported success rates of 94.7 and 100% with the use of advanced technique for complex filter retrieval. Improved success with advanced technique is also associated with significantly higher complication rate. Al-Hakim et al [3] reported a complication rate of 5.3% when advanced retrieval techniques were needed compared to 0.4% ($P < .05$) for standard technique. Lind et al [10] recently reported a successful case of Günther-Tulip filter retrieval after dwell time of 3334 days. The dwell time in our case was 4753 days. To our knowledge, this is the longest reported dwell time before successful removal of any IVC filter by endovascular approach without complication.

The most commonly used advanced techniques for filters with embedded apices are the use of endobronchial forceps or laser sheath [3,6]. In our case, we used the Hangman technique. Al-Hakim et al, in their series on Hangman technique, reported a technical success rate of 81.8% (9/11) without any complications. Mean dwell time in this series was 194.5 days with the technique being unsuccessful in the case with the longest dwell time (613 days) [4].

Releasing the embedded apex using the Hangman technique was relatively easier in our case. Most challenging part of the procedure was disengaging the filter struts from chronic fibrosis which necessitated use of 3 coaxial sheaths to improve vector of force. In the event of failure with coaxial sheaths, other options were simultaneous balloon disruption from femoral access, use of laser sheath, or stenting across

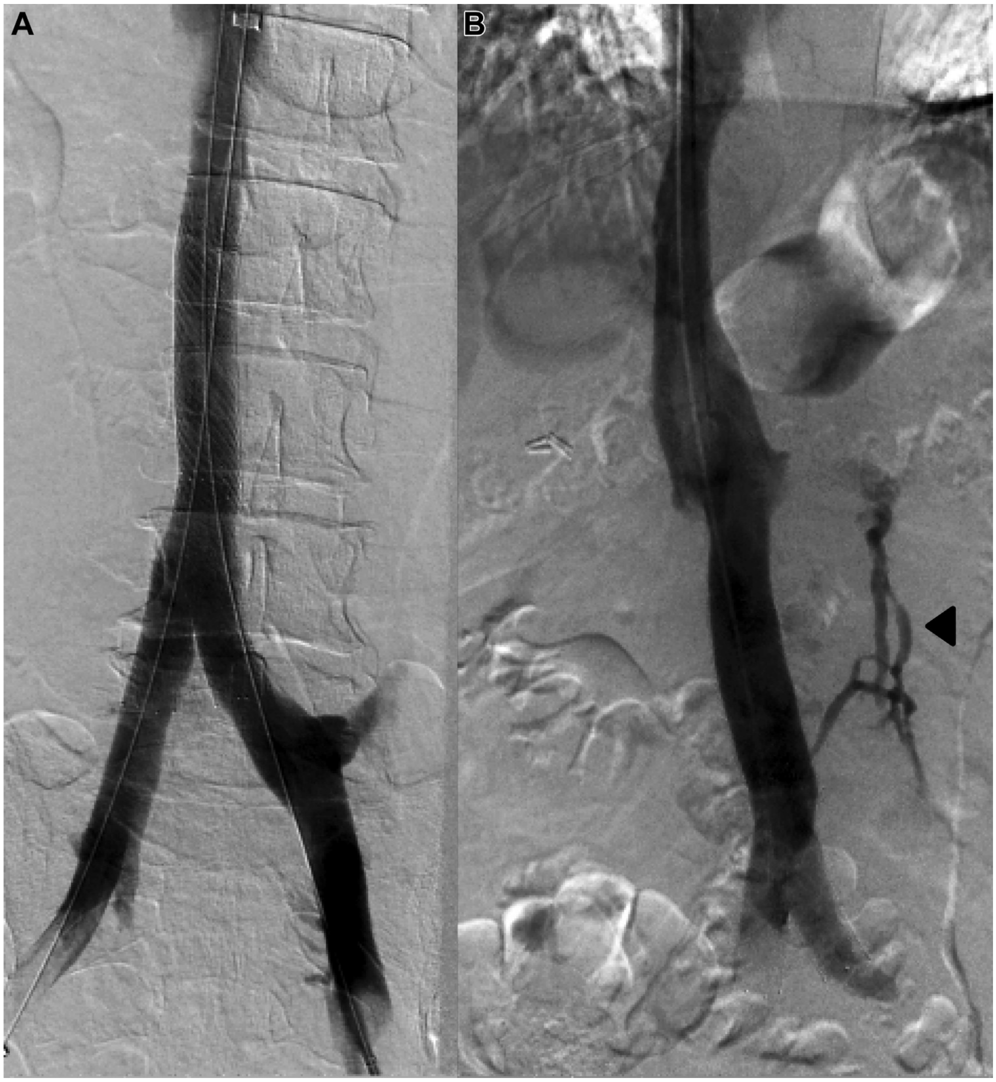

Fig. 5 – (A) Final venogram is showing restored patency after stent reconstruction of the iliocaval junction with preferential flow away from the collaterals. (B) Image of the follow-up venogram obtained 9 months after the procedure shows patent stents and reduced size of the previously enlarged paravertebral collaterals (solid arrowhead).

the filter. It could be argued that endovascular removal of a chronically embedded filter such as ours would invariably involve use of excessive force that could predispose the filter to fracture and cause fragment embolization. In their series of 50 complex filters with emphasis on filter fracture, Kuo et al [6] did not report any intraprocedure fracture while electron microscopy revealed that the most existing factures were caused by chronic high-cycle fatigue. Also, Günther-Tulip filter is made from Conichrome which is a much stronger alloy compared to nitinol [11]. The difference in the alloys also reflects in the fact that most of the filter fractures are reported in nitinol filters. Our literature search yielded only 2 cases of Günther-Tulip filter fracture, one reported by Dowell et al, and other by Kuo et al in one of their case examples; although, they did not report fracture rates by individual filter types [6,11].

An alternative endovascular approach in this case could have been angioplasty and stent placement across the filter-bearing segment of the IVC and iliocaval junction. Neglén et al reported long-term patency outcomes in 25 cases of stent placement across the filter and compared those with the cases where stent terminated below the level of filter or cases without filter. Although the cumulative secondary patency rates were lower with stenting across the filter than the cases without the filter, this was attributed to the higher degree of obstruction seen in patients with indwelling filters; and the patency rates were found to be comparable to similar degree of obstruction without filters [7]. Vedantham et al described their experience of endovascular recanalization in thrombosed filter-bearing IVC in 10 patients. Stent placement across the filter-bearing segment of the IVC was performed in three of those cases. They reported the maneuver of deforming the IVC filter with balloon to cause balloon rupture ($n = 2$), entanglement ($n = 1$), and filter fracture ($n = 1$) during the procedure [8]. Neither of the studies reported any clinical sequel associated with balloon deformation of the filter and subsequent stenting, however, concerns of balloon rupture, entanglement, and filter fracture with this approach remain; whereas, long-term effects of "entombing" the filter remain unknown. While contrasting our technique based on one case that involved a retrievable filter (Günther-Tulip), readers should note that all the filters in the study by Vedantham et al and a majority (18/25) in the study by Neglén et al were permanent [7,8]. For stenting the iliocaval confluence, there are 4 different techniques previously described. We preferred the "confluence" technique for our case as we felt that any future reintervention will be easier without having to cross fenestrations of an existing stent [12].

Removal of an IVC filter after prolonged dwell time needs careful planning, proficiency, and carries considerable risks. This report illustrates the successful retrieval of a GT filter after 4753 days of dwell time with reconstruction of iliocaval junction obstruction by stent placement in a confluence configuration; and how an aggressive approach with careful planning in a patient with IVC filter-related chronic venous obstruction and severely limiting PTS can lead to desirable clinical outcome.

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