INTERNAL MEDICINE

□ CASE REPORT □

The Successful Removal of Two Retrievable Inferior Vena Cava (IVC) Filters after 67 Days in a Patient with a Double IVC

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Abstract

We herein present a case in which two retrievable inferior vena cava (IVC) filters, which were implanted to treat deep-vein thrombosis caused by the compression of a double IVC, were successfully removed on the 67th day after placement. The filters were individually placed in both the left and right IVCs. With a prevalence of only 0.2%, a double IVC is an extremely rare anatomical variation. The long-term effects of IVC filters are unknown, and the placement of a filter potentially introduces the risk of complications. Thus, if the patient's clinical condition allows, the endovascular retrieval of the filter should be considered within a few months after implantation.

Key words: retrievable inferior vena cava (IVC) filter, deep vein thrombosis (DVT), double inferior vena cava (IVC)

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Introduction

Inferior vena cava (IVC) filters are effective in preventing the onset and recurrence of pulmonary emboli (PE), as well as reducing the mortality of PE after recent deep venous thrombosis (DVT) (1). Many complications have been reported to be associated with the long-term use of retrievable IVC filters and concerns about the safety of the retrieval of IVC filters were expressed by the U.S. Food and Drug Administration (FDA) in 2010. Evidence supports the immediate removal of the filter once it is no longer indicated for the prevention of PE (2). Recently, the use of IVC filters has been declining. However, there are still cases in which they are effective. We herein present a case in which a retrievable IVC filter that was removed on the 67th day after placement in a patient with a double IVC, together with a review of the relevant literature.

Case Report

The patient was a 60-year-old woman with no history of thrombosis, embolism, or miscarriage. She complained of edema of both calves, which had occurred for several months prior to treatment; she had initially consulted a nearby physician in relation to the swelling. A physical examination revealed an unsuspected ovarian tumor and uterine myomata. In addition, DVTs of the bilateral lower extremities were diagnosed and the patient was hospitalized.

Lower extremity venous ultrasound and computed tomography (CT) revealed large bilateral DVTs extending from the distal iliac veins through the popliteal veins (Fig. 1). Pulmonary blood flow scintigraphy was bilaterally positive for multifocal perfusion defects. In addition, multiple uterine myomata and a right ovarian tumor (13×10×7 cm) that was suspicious for malignancy were detected on CT. The right and left iliac veins were found to ascend independently as a right and left IVC and joined into a single IVC after the left renal vein branched off from the left IVC.

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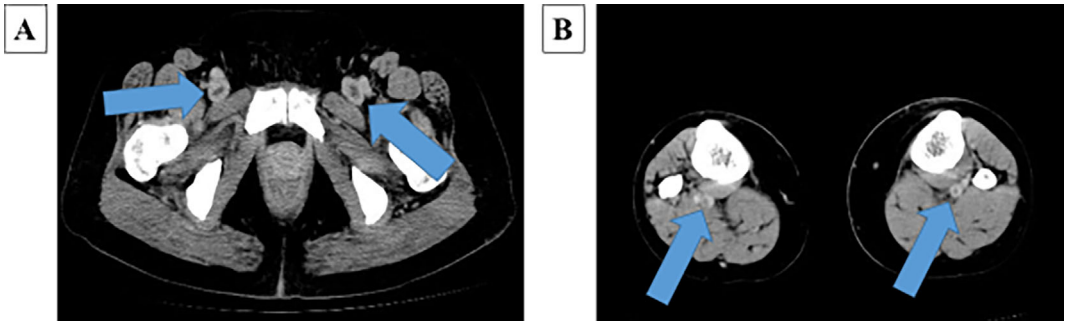

Figure 1. **A, B: Computed tomography on admission revealed large deep venous thromboses extending from the bilateral iliac veins to the popliteal veins.**

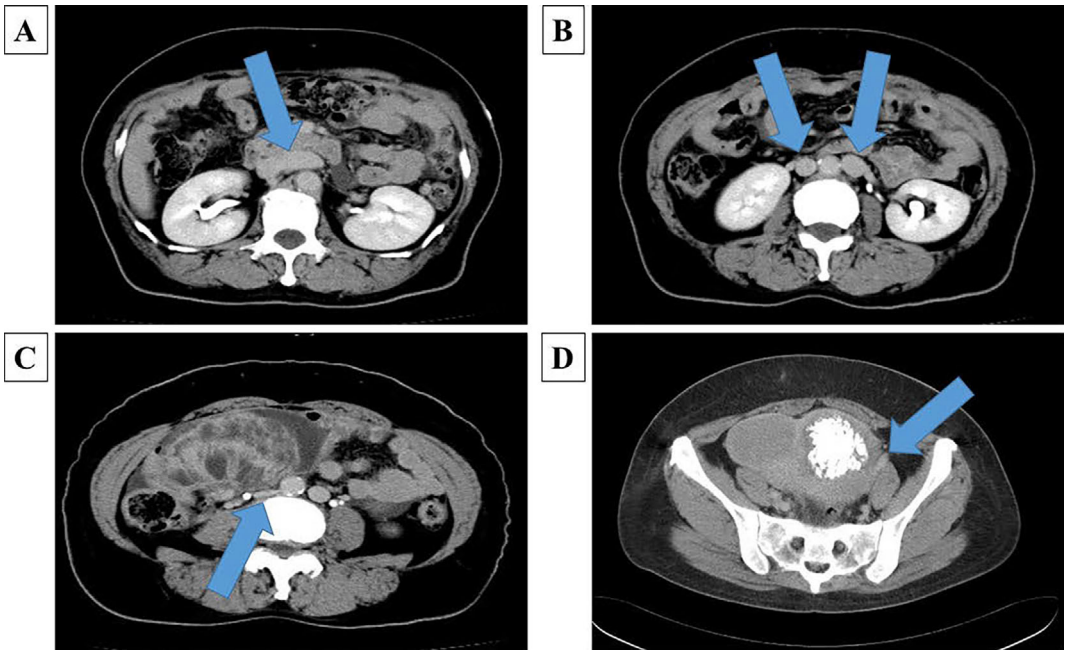

Figure 2. **Computed tomography before anticoagulant therapy. A: The bifurcation of the right and left inferior vena cava (IVC). B: The double IVC. C: The right IVC was compressed between an ovarian tumor and the lumbar vertebra. D: The left IVC was compressed between the uterine myomata and the left psoas major muscle.**

The right renal vein was found to branch off from the IVC stem immediately proximal to the location of the join. The diameter of the IVC stem was 25 mm (Fig. 2A, B). On contrast CT, the right IVC was found to be compressed between the ovarian tumor and the lumbar spine, and the left IVC was compressed between the uterine myomata and the left psoas muscle (Fig. 2C, D).

We initiated anticoagulant therapy using continuous heparin infusion and oral warfarin for two weeks, during which time the swelling of the lower extremities showed substantial improvement. Prior to discharge, we placed retrievable IVC filters (Günther Tulip®, Cook Medical, Bloomington, IN, USA) in order to prevent PE during planned ovarian tumor resection. After vena cavography, filters were individually placed below the renal vein via the right internal jugular vein in both the left and right IVCs (Fig. 3).

The patient underwent successful gynecological surgery, and anticoagulation therapy was continued for 8 weeks during chemotherapy. A postoperative evaluation revealed the complete disappearance of the DVT and the absence of any evidence of thrombosis in the IVC filters on CT (Fig. 4) prompted us to remove them at 67 days after implantation.

After confirming the absence of thrombi in the filters with a pigtail catheter (Fig. 5A), we proceeded to retrieve the Günther Tulip® filters through the right internal jugular vein, using the standard Günther Tulip® Retrieval Kit (Cook Medical). Although we felt strong resistance when pulling the filters, they were successfully removed. Inferior vena cavography with contrast revealed no apparent vascular injury (Fig. 5B). A small amount of thrombus was noted on the filters, with thin film formation, but strut fracture was not observed (Fig. 5C).

The gynecologist reported that the ovarian tumor was completely excised; however, anticoagulant therapy with

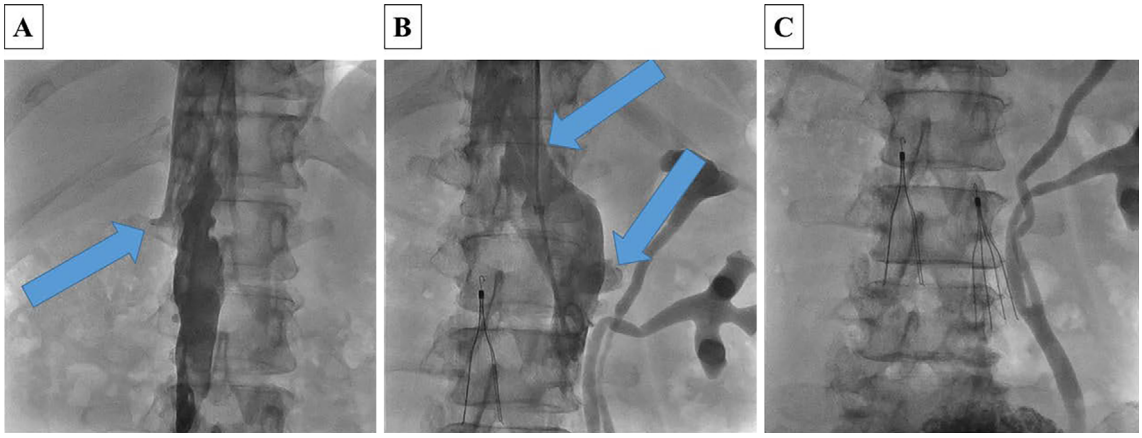

Figure 3. **The placement of the inferior vena cava (IVC) filters. A: A right vena cavogram of the right renal vein ostium. B: The bifurcation of the right and left IVC (upper arrow) and a left vena cavogram of the left renal vein ostium (lower arrow). C: IVC filters were individually implanted in each IVC, caudally to the renal veins.**

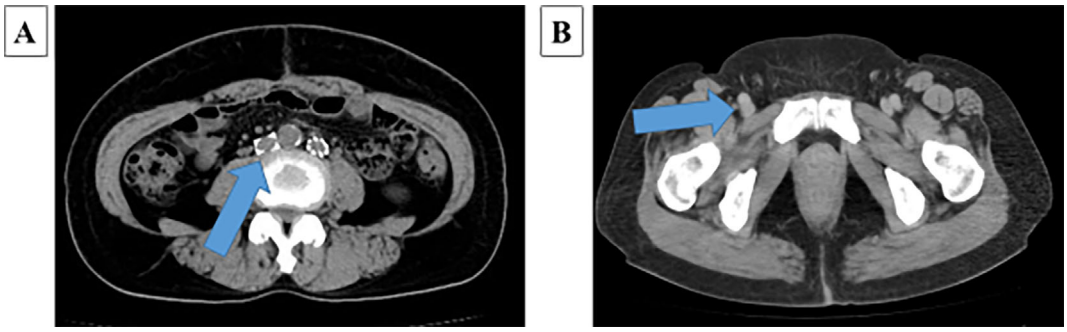

Figure 4. **Computed tomography after anticoagulant therapy. A: The inferior vena cava (IVC) filters were visualized in the right and left IVCs. No thrombus was recognized within any filter. B: The previously identified deep venous thromboses had completely disappeared.**

warfarin was continued for 6 months after the surgery. Anticoagulant therapy was terminated after confirming that there was no obvious ovarian tumor recurrence. There has been no recurrence of DVT.

Discussion

Malignant tumors are a recognized risk factor for arteriovenous thrombosis, which is generally known as Trousseau syndrome and which may be caused by a hypercoagulable state (3). In addition, the presence of ovarian tumors and uterine myomata can physically compress the IVC, as occurred in the present case. Our management included the placement of two retrievable IVC filters. These were placed preoperatively in order to prevent recurrent acute pulmonary thromboembolism.

It has been shown that placement of an IVC filter in the acute phase of DVT is effective for preventing the development of PE and reducing the resultant mortality (1, 4). However, in the PREPIC study, the only published randomized controlled trial of the permanent placement of a type of IVC filter, revealed that it had no significant preventive effect of against symptomatic PE in the chronic phase after 2 years in comparison to patients who did not undergo filter placement (3.4% vs. 6.3%, p=0.16). Indeed, the rate of DVT recurrence was higher in the filter placement group (20.1% vs. 11.8%, p=0.02) (4, 5). Recently, the PREPIC2 study, showed that the use of a retrievable IVC filter plus anticoagulation did not reduce the risk of symptomatic recurrent PE at 3 months in comparison to anticoagulation therapy alone (3.0% vs. 1.5%, p=0.50) (6). Furthermore, long-term complications have been reported, including migration (2-13%) or fracture (1.5-14%) of the filter and occlusion (6-30%) or perforation (9-24%) of the IVC (7, 8).

Based on the above reasons, many physicians have raised concerns regarding the prolonged placement (≥3 months) of IVC filters. However, there are cases in which the short-term placement of an IVC filter is necessary during the perioperative period.

There are several reports describing the placement of IVC filters in a double IVC, but the anatomy of the IVC and the patient backgrounds were different in each case. As a result, there are no established guidelines regarding the optimal location or the number of IVC filters that should be im-

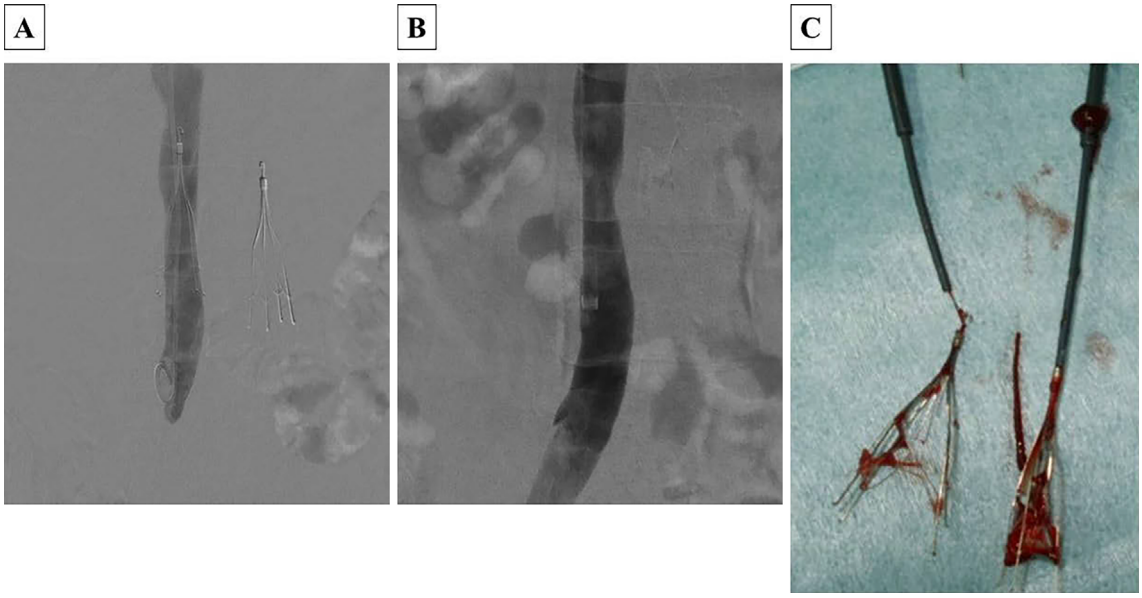

Figure 5. **A: The left and right inferior vena cava filters were removed after performing angiography to confirm the absence of large thrombi on each filter. B: Angiography of the right inferior vena cava (IVC) after filter removal showed no vascular injury. C: The retrievable filters showed a small amount of thrombus deposition and thin film formation. Strut fracture was not observed.**

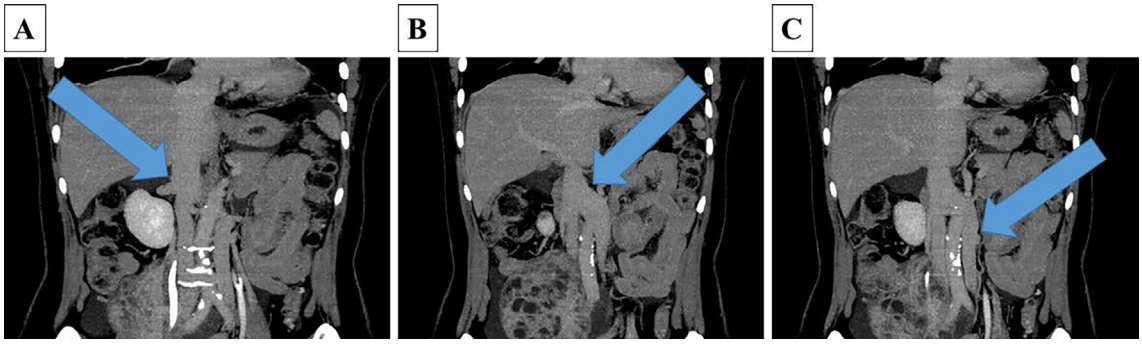

Figure 6. **Computed tomography (coronal view). A: The right renal vein first branches out from the IVC (arrow). B: The IVC proved to be a double IVC, bifurcating into the right and left immediately after the branching of the right renal vein (arrow). C: The left renal vein branched off from the left IVC (arrow).**

planted (9).

In a recent study of iliac vein variations, anatomical abnormalities were observed in 20.9% of cases; however, a double IVC was only observed in 0.92% of cases. Furthermore, a double IVC without connection veins (as was observed in the present case) was only found in 0.2% of cases (10). There are no reported cases in which the implantation and retrieval of Günther Tulip® filters was used to treat DVT in a patient with a double IVC of this type (10).

In the current case, the right renal vein was found to branch off from the IVC stem immediately proximal to the location of the join, and the diameter of the IVC stem, before it branched out to the left and right, was 25 mm (Fig. 6). It was judged that it would be impossible to prevent filter migration or pulmonary embolism if the filter was placed in the IVC stem. Thus, we chose to place the filters individually in the left and right IVCs.

Smouse et al. conducted a prospective study of Günther Tulip® implantation cases, evaluating the results of 275 cases in which the filter was retrieved after long-term implantation - the average period between the implantation and the retrieval of the IVC filter was 58.9 days (the longest period was 494 days). They reported a high success rate of 90.2%. A Kaplan-Meier analysis showed that the success rate of retrieval decreased as the age of the implant increased, falling from 94% at 12 weeks to 67% at 26 weeks (11).

A filter leg was reported to protrude through the IVC at the time of filter retrieval in as many as 85.9% of cases, but such events did not influence the filter retrieval rate and would not be a reason to avoid filter retrieval. No significant complications have been reported in association with retrieval, and many reports have confirmed that retrieval can be conducted safely (12, 13). There have also been many re-

ports that special techniques (such as adjusting the tilt of the filter using a U-shaped 0.035" wire or using a balloon to make it easier to snare the filter with a hook) may be effective in cases in which filter removal using the usual retrieval system proves difficult (14). The success rate of retrieval can be increased by mastering such techniques for these rare cases.

Thus far, no reports have indicated that the incidence of PE recurrence increases after filter retrieval (15). However, according to an 8-year follow-up of the PREPIC study, the long-term placement of an IVC filter may have a preventive effect against PE (6.2% vs. 15.1%, p=0.08). The decision to retrieve the filter should be made after the careful consideration of various factors, such as the reversibility of the clinical cause of DVT and the patient's activity level, underlying diseases, and risk factors for DVT. In the current case, we concluded that it was clinically advantageous to postpone the decision to remove the filter for a few months. The filter was removed at more than 2 months after implantation because the main causes of the DVT - physical obstruction due to the ovarian tumor and uterine myomata - had been surgically removed. Anticoagulant therapy was discontinued after filter retrieval and the patient has been followed up. There has been no recurrence of DVT.

We described a case in which retrievable IVC filters, which were used to treat extensive DVT, which had been caused by the compression of a double IVC by an ovarian tumor and uterine myomata, were successfully removed on the 67th day after placement. We believe that this was an extremely rare case, as there have been no similar reports in the literature. The long-term effects of an IVC filter after the acute phase of a PE are unclear and the filter may increase the risk of DVT recurrence and hemorrhagic complications, which may occur in association with continued anticoagulant therapy. In addition, there are sporadic reports of filter migration and vessel perforation due to filter fracture. Thus, if a patient's clinical condition allows, the endovascular retrieval of the filter should be considered within a few months after implantation.

The authors state that they have no Conflict of Interest (COI).

This study complied with the Declaration of Helsinki and was approved by the local ethics committee.

Written informed consent was obtained for the publication of this case report and the accompanying images.

References

1. Sakuma M, Nakamura M, Nakanishi N, et al. Inferior vena cava filter is a new additional therapeutic option to reduce mortality from acute pulmonary embolism. Circ J **68**: 816-821, 2004.

2. Angel LF, Tapson V, Galgon RE, Restrepo MI, Kaufman J. Systematic review of the use of retrievable inferior vena cava filters. J Vasc Interv Radiol **22**: 1522-1530, 2011.

3. Sutherland DE, Weitz IC, Liebman HA. Thromboembolic complications of cancer: epidemiology, pathogenesis, diagnosis, and treatment. Am J Hematol **72**: 43-52, 2003.

4. Decousus H, Leizorovicz A, Parent F, et al. A clinical trial of vena caval filters in the prevention of pulmonary embolism in patients with proximal deep-vein thrombosis. Prévention du Risque d'Embolie Pulmonaire par Interruption Cave Study Group. N Engl J Med **338**: 409-415, 1998.

5. PREPIC Study Group. Eight-year follow-up of patients with permanent vena cava filters in the prevention of pulmonary embolism: the PREPIC (Prevention du Risque d'Embolie Pulmonaire par Interruption Cave) randomized study. Circulation **112**: 416-422, 2005.

6. Mismetti P, Laporte S, Pellerin O, et al. Effect of a retrievable inferior vena cava filter plus anticoagulation vs anticoagulation alone on risk of recurrent pulmonary embolism: a randomized clinical trial. JAMA **313**: 1627-1635, 2015.

7. Ingber S, Geerts WH. Vena caval filters: current knowledge, uncertainties and practical approaches. Curr Opin Hematol **16**: 402-406, 2009.

8. Imberti D, Ageno W, Manfredini R, et al. Interventional treatment of venous thromboembolism: a review. Thromb Res **129**: 418-425, 2012.

9. Malgor RD, Oropallo A, Wood E, Natan K, Labropoulos N. Filter placement for duplicated cava. Vasc Endovascular Surg **45**: 269-273, 2011.

10. Shin M, Lee JB, Park SB, Park HJ, Kim YS. Multidetector computed tomography of iliac vein variation: prevalence and classification. Surg Radiol Anat **37**: 303-309, 2015.

11. Smouse HB, Rosenthal D, Thuong VH, et al. Long-term retrieval success rate profile for the Günther Tulip vena cava filter. J Vasc Interv Radiol **20**: 871-877, 2009.

12. Oh JC, Trerotola SO, Dagli M, et al. Removal of retrievable inferior vena cava filters with computed tomography finding indicating tenting or penetration of the inferior vena cava wall. J Vasc Interv Radiol **22**: 70-74, 2011.

13. Pellerin O, Barral FG, Lions C, Novelli L, Beregi JP, Sapoval M. Early and late retrieval of the ALN removable vena cava filter: results from a multicenter study. Cardiovasc Intervent Radiol **31**: 889-896, 2008.

14. Al-Hakim R, McWilliams JP, Derry W, Kee ST. The hangman technique: a modified loop snare technique for the retrieval of inferior vena cava filters with embedded hooks. J Vasc Interv Radiol **26**: 107-110, 2015.

15. Yavuz K, Geyik S, Hoppe H, Kolbeck KJ, Kaufman JA. Venous thromboembolism after retrieval of inferior vena cava filters. J Vasc Interv Radiol **19**: 504-508, 2008.