

# Double inferior vena cava filter implantation in a patient with duplication of the inferior vena cava

Takahito Suzuki, MD, Susumu Fujino, MD, and Takahiko Aoyama, MD, *Fukui, Japan*

## ABSTRACT

An 84-year-old-woman was admitted because of syncope and dyspnea. She also required surgery for lumbar disc herniation. Computed tomography revealed bilateral massive pulmonary thromboembolism, deep vein thrombosis, and duplication of the inferior vena cava (IVC) in which the left IVC had merged with the left renal vein. Two retrievable IVC filters were deployed in both IVCs, and direct oral anticoagulant therapy was started. After orthopedic surgery for the lumbar disc herniation, the IVC filters were retrieved. No complications occurred. Different treatment strategies could be required for IVC filter implantation in a patient with duplication of the IVC. (*J Vasc Surg Cases and Innovative Techniques* 2021;7:520-3.)

**Keywords:** Congenital anomaly; Duplication of the IVC; IVC filter; Venous thromboembolism

Duplication of the inferior vena cava (IVC) is a congenital anomaly in which a normal IVC is along the right side of the spine and a left-sided IVC is present that ascends to the level of the renal veins to join the right-sided IVC. The reported prevalence of the duplication of the IVC is 0.2% to 0.3%.<sup>1</sup> This embryologic abnormality occurs because the left supracardinal vein fails to regress early in gestation, resulting in large veins on both sides of the aorta that join anterior to the level of the renal arteries to become the suprarenal IVC.<sup>2</sup>

When patients with duplication of the IVC develop venous thromboembolism (VTE), the position and size of the IVC filter must be carefully considered to prevent massive pulmonary thromboembolism (PE). However, to the best of our knowledge, this has not previously been discussed in detail. We have presented the case of VTE in a patient with duplication of the IVC. The patient provided written informed consent for the report of her case.

## CASE REPORT

An 84-year-old woman had been admitted to another hospital for lumbar disc herniation surgery. She experienced syncope and dyspnea when she went to the bathroom. Because she was in shock (systolic blood pressure, 80 mm Hg; heart rate >110 bpm), she was urgently transferred to our hospital. She

had a medical history of hypertension, diabetes mellitus, and dyslipidemia. Her current medications were candesartan/amlodipine, doxazosin, alogliptin/pioglitazone, and rosuvastatin. She had no known allergies.

On admission, her body temperature was 38.3°C, heart rate 109 bpm, systolic/diastolic blood pressure 163/85 mmHg, and oxygen saturation 95% with 5 L/min of oxygen. Her hemodynamic instability had improved during transfer to our hospital. The laboratory examinations on admission revealed a high D-dimer concentration (9.41 µg/mL), although the concentrations of activated protein C, activated protein S, and antithrombin III were within normal limits. Lupus anticoagulant, anticardiolipin antibody, and antinuclear antibody were negative. Contrast-enhanced computed tomography (CT) from the chest to the lower limbs was performed to evaluate for possible venous thrombosis from the IVCs to the lower limbs and to aid in planning for positioning of an IVC filter. CT revealed bilateral PE, right peroneal vein thrombosis, and duplication of the IVC, with the left IVC merging with the left renal vein (*Fig 1*). Transthoracic echocardiography revealed a flattened interventricular septum on the parasternal short-axis view, indicating right ventricular pressure overload. From these findings, we diagnosed PE of intermediate severity.<sup>3</sup>

We considered the following factors when selecting the treatment strategy. The patient had PE of intermediate severity, which has the potential to be fatal if the thrombus detaches from the lower leg veins and lodges in the pulmonary artery. Additionally, because lumbar disc herniation surgery was planned, it was necessary to discontinue the perioperative anticoagulation therapy.<sup>4</sup> Therefore, IVC filter implantation was considered desirable. CT showed that no thrombus remained in the proximal left leg veins, the two IVCs communicated through the transiliac vein (*Fig 1*), and the diameters of the right and left IVC were 16 and 19 mm, respectively. This type of duplicated IVC is classified as type I, which consists of two bilaterally symmetric trunks of approximately the same caliber.<sup>5</sup> The IVC diameters were sufficient for filter implantation; thus, we planned to implant IVC filters into both IVCs.

From the Department of Cardiology, Fukui Prefectural Hospital.

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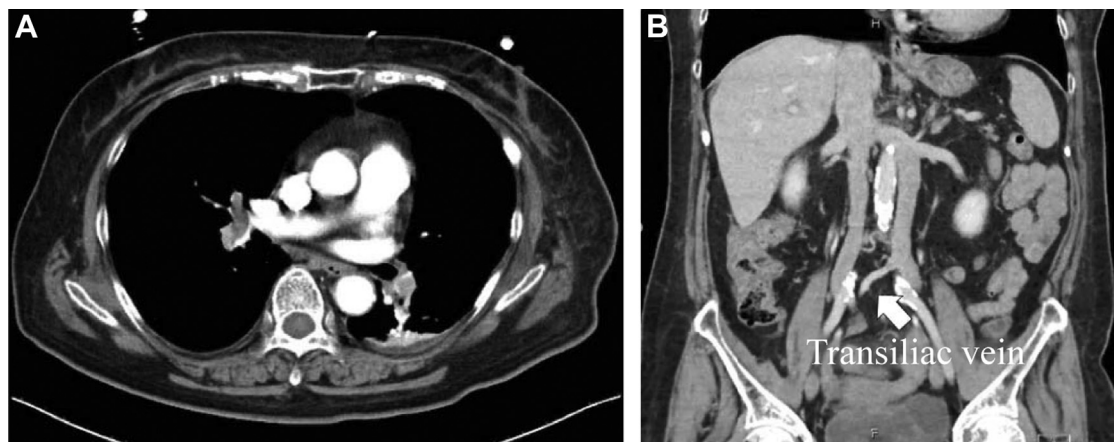
Correspondence: Takahito Suzuki, MD, Department of Cardiology, Fukui Prefectural Hospital, 2-8-1 Yotsui, Fukui City, Fukui Prefecture 910-0846, Japan (e-mail: [m09054ts@jichi.ac.jp](mailto:m09054ts@jichi.ac.jp)).

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**Fig 1.** **A**, Computed tomography (CT) scan of the chest revealing thrombus in the bilateral main pulmonary arteries. **B**, CT scan revealing duplication of the inferior vena cava (IVC) in which the left IVC merged with the left renal vein. Both IVCs had similar diameters.

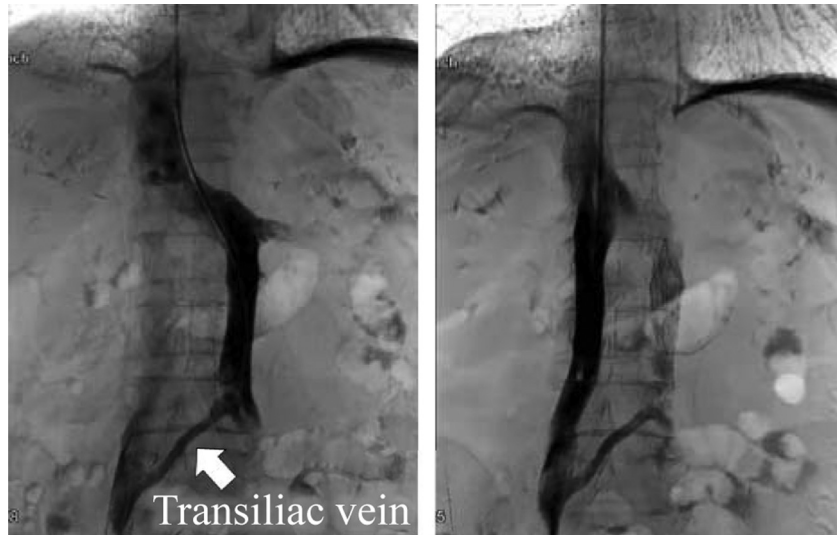
A retrievable IVC filter (OptEase retrievable vena cava filter; Cordis, Santa Clara, Calif) was deployed into each IVC from the right internal jugular vein (Fig 2), and direct oral anticoagulant therapy (edoxaban 60 mg once daily) was started on day 0. Follow-up echocardiography showed a reduction in the right ventricular pressure overload, and her respiratory condition had improved. The pain from her lumbar disc herniation was severe. Accordingly, orthopedic surgery for the lumbar disc herniation was performed on day 16. The postoperative course was good, and contrast-enhanced CT performed on day 24 confirmed resolution of the thrombi in the pulmonary artery and lower limb veins. The IVC filters were removed on day 28 (Fig 3). In such cases, the risk of VTE will decrease in parallel with improvement in the postoperative activities of daily living. Therefore, anticoagulant therapy was stopped 3 months postoperatively.<sup>6</sup> D-dimer evaluation, which is useful for excluding thrombosis, was measured at 3-month intervals after discharge. No increase in the D-dimer concentrations or symptomatic VTE recurrence was identified within the first postoperative year.

## DISCUSSION

Anatomic abnormalities of the IVC are rare and, accordingly, few studies have reported on the treatment strategies at the onset of VTE in patients with duplication of the IVC. In patients with VTE, it is always important to assess the anatomic and clinical features. When the IVC is unusually small, or the first CT scan before deployment of an IVC filter reveals a prominent cross pelvic vein, a duplicated IVC might be present. If an abdominal CT scan has not been performed, IVC retrograde venography can reveal the other IVC and transiliac vein (Fig 2). Additionally, when recurrent PE occurs despite implantation of an IVC filter, an anatomic abnormality of the IVC should be suspected. Several reports of clinically significant PE occurring after placement of an IVC filter in patients with undiagnosed duplication of the IVC.<sup>7</sup> In the present case, the

two IVCs communicated through the transiliac vein. The transiliac vein is derived embryologically from the posterior cardinal vein and becomes the left common iliac vein. A transiliac vein has been reported in 68.3% of cases of duplicated IVCs.<sup>8</sup>

In our institution, we have usually used a right internal jugular vein approach when deploying and removing an IVC filter to not provoke release of thrombus from the central lower limbs by catheter movement and to shorten the postoperative bed rest time. In the present case, we had to consider the unusual vessels and the risk of vascular injury. Especially when removing IVC filters, an approach from each femoral vein might be safer because the catheter must be pushed to retrieve the filters. The appropriate diameters of the vessels in which retrievable IVC filters covered by insurance are to be placed are stipulated in Japan for safety reasons. In the present patient, the diameters of the vessels evaluated by CT were sufficient for an OptEase filter, which is suitable for vessels with a diameter of 10 to 30 mm. If an abdominal CT scan is not performed, intravascular ultrasound can be used to assess the target vessel diameters. We placed an infrarenal filter in each IVC and performed lumbar disc herniation surgery safely and effectively without complications before removing the filters. A filter can also reportedly be safely placed in the suprarenal portion of the IVC.<sup>9</sup> Therefore, if the diameter of the IVC is too small, placement of the filter in the suprarenal IVC should be considered. However, the risk of complications, such as acute kidney injury because of thrombotic occlusion or caudal migration of the filter into the renal vein must be carefully considered. Additionally, in the present patient, the suprarenal IVC was dilated (29 mm) to the upper limit of the compatible vessel diameter for the filter because of the right ventricular pressure overload. Therefore, infrarenal vein placement was considered more desirable.



**Fig 2.** Inferior vena cava (IVC) filters were appropriately deployed into the bilateral IVCs from the right internal jugular vein.



**Fig 3. A,** Bilateral inferior vena cava (IVC) filters shown appropriately placed below the level of the renal veins. **B,** Completion venogram showing bilateral IVCs after IVC filters were removed from each femoral vein without complications.

Although some reports have described a possible relationship between the venous stasis caused by IVC anomalies and deep vein thrombosis in young patients,<sup>10,11</sup> some cases of coincidental detection of duplicate IVCs have also been identified by CT in adults. Severe PE is fatal and can necessitate urgent implantation of an IVC filter. Thus, it is important to accumulate cases and establish a protocol for filter implantation for VTE in patients with duplication of the IVC.

### CONCLUSIONS

We have reported the case of double IVC filter implantation in a patient with duplication of the IVC. Anatomic

abnormalities of the IVC are rare; however, when patients with duplication of the IVC develop severe VTE, the position and size of the IVC filter must be carefully considered to avoid complications from filter implantation.

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