

Extravascular Migration of a Fractured Inferior Vena Cava Filter Strut

Jung Hyeon Lim, M.D.¹, Weon Yong Lee, M.D., Ph.D.¹, Yong Joon Ra, M.D.¹,
Jae Han Jeong, M.D.², Bong Suk Park, M.D.¹, Ho Hyun Ko, M.D.¹

¹Department of Cardiothoracic Surgery, Hanllym University Sacred Heart Hospital, Hanllym University College of Medicine,

²Department of Cardiothoracic Surgery, Chosun University Hospital, Chosun University College of Medicine

A 20-year-old man presented with a femur fracture and epidural hemorrhage (EDH) following a fall. One month after fracture surgery, swelling developed in both legs, and he was diagnosed as having a deep-vein thrombosis and pulmonary embolism. A retrievable inferior vena cava filter (IVCF) was inserted, because EDH is a contraindication to anticoagulants. Four months later, he complained of abdominal pain, and a computed tomography scan showed a fractured IVCF strut. After percutaneous removal failed 3 times, the IVCF was surgically removed by orthopedists using a portable image intensifier without cardiopulmonary bypass.

Key words: 1. Vena cava filters
2. Migration
3. Fracture

Case report

A 20-year-old man presented to the emergency department after a fall. His initial vital signs were stable, but he was diagnosed as having an epidural hemorrhage (EDH) and left femur fracture. On admission, closed reduction with external fixation was performed to treat the fractured femur. One month post-operatively, swelling developed in both legs. A computed tomography (CT) scan showed deep-vein thrombosis (DVT) in the left popliteal vein and a pulmonary embolism (PE) in the left lower lobe. Therefore, a retrievable inferior vena cava (IVC) filter (IVCF, Celect; Cook Medical Inc., Bloomington, IN, USA) was inserted, because EDH is a contraindication for the use of anticoagulants. Removal was planned for 2 months after IVCF insertion (Fig. 1). A follow-up CT examination 2 months after the IVCF was in-

serted showed no PE, decreased but residual DVT, and an intact IVCF. We still planned IVCF removal, because the EDH was stable and the follow-up CT scan showed that the PE was resolved. However, the patient refused IVCF removal. Four months after IVCF insertion, he complained of abdominal pain. An abdominal CT scan showed that the strut of the IVCF was fractured, but it had not migrated. Anticoagulation therapy was started because of the fractured IVCF, and the patient agreed to IVCF removal. Three consecutive percutaneous trials of IVCF removal failed, as we were unable to capture the IVCF hook (Fig. 2). Therefore, surgical removal was considered.

The operation was performed through a right sub-costal incision, and the entire IVC below the liver was exposed. Six thousand units of heparin (100 U/kg) were infused. The IVC was clamped for 3 minutes to confirm that hemodynamic instability (i.e.,

Received: July 20, 2016, Revised: October 20, 2016, Accepted: October 24, 2016, Published online: June 5, 2017

Corresponding author: Weon Yong Lee, Department of Cardiothoracic Surgery, Hanllym University Sacred Heart Hospital, Hanllym University College of Medicine, 22 Gwanpyeong-ro 170beon-gil, Dongan-gu, Anyang 14068, Korea
(Tel) 82-31-380-3815 (Fax) 82-31-380-4118 (E-mail) lwyl206@hallym.or.kr

© The Korean Society for Thoracic and Cardiovascular Surgery. 2017. All right reserved.

© This is an open access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.



Fig. 1. Simple radiologic image after percutaneous inferior vena cava filter installation. Intact inferior vena cava filter is identified.



Fig. 2. Simple radiologic image for percutaneous inferior vena cava filter removal. Fractured strut is identified.

hypotension) had not developed, and then it was opened without circulatory supports such as cardiopulmonary bypass. The patient was hemodynamically stable during the 45 minutes of IVC clamping. The IVCF was found below the right renal vein, and the hook of the IVCF was embedded in the endothelial hyperplasia and fibrous tissue. The IVCF was easily removed from the IVC. However, the fractured strut was not found within the IVC. A portable image



Fig. 3. Removed inferior vena cava filter and fractured strut.

intensifier (C-arm) was used to localize the fractured strut, which had migrated extravascularly. An orthopedic surgical team performed exploration, and they found that the fractured IVCF strut had punctured the third lumbar vertebral body. They removed it with part of the third lumbar vertebral body (Fig. 3).

The patient was discharged on the seventh day post-operatively without adverse events. At the 6-month follow-up, he was doing well and had no symptoms.

Discussion

PE continues to be a main cause of morbidity and mortality in the United States. The incidence of fatal PE has been estimated to range from 50,000 to 200,000 cases per year. The causes of PE are thrombus, air, or fat, and a common source of embolism is DVT in the lower leg. The treatment of choice for DVT is anticoagulation therapy [1].

Nonetheless, insertion of an IVCF is considered in cases with a contraindication for the use of anticoagulants. The most common indication for an IVCF is a DVT followed by a PE, which is a contraindication for anticoagulation therapy. Other indications for an IVCF are recurrent DVT despite adequate anticoagulation therapy, complications of anticoagulation therapy, massive PE with residual DVT in a patient at risk for further PE, free-floating iliofemoral or IVC thrombus, and severe cardiopulmonary disease [2]. In patients whose IVCF is transiently inserted (e.g., vic-

tims of trauma), a retrievable filter is recommended, because late complications can be avoided. Removal of the IVCF is considered in patients who are no longer at a significant risk of thromboembolic disease, those who are able to tolerate the therapeutic level of anticoagulation, and patients who are at risk of infection and other morbidities [3].

Compared to a permanent IVCF, a retrievable IVCF has a similar incidence of complications. Early complications of an IVCF include misplacement, hematoma, insertion site bleeding or thrombosis, and infection; late complications include recurrent DVT, IVC thrombosis, IVC penetration, filter migration, filter tilting, and strut fracture [4].

Ray et al. [2] reported a failure rate of 14.9% for percutaneous IVCF removal. Half of the failures were due to a thrombus in the filter, and the other half occurred because the filter attached to the IVC wall. The migration of a filter, defined as moving more than 1 cm, occurs in 5% of cases, and this can obstruct major circulatory systems such as the renal veins, pulmonary veins, and even the heart [5,6]. The causes of migration are the failure of firm engagement, a large vena cava, trauma, physiologic changes in the IVC diameter, and the Valsalva maneuver. Fractures of the IVCF strut occur in 3.4% of patients who have had an IVCF over the long term. The mechanism of fracture may be associated with tilting of the filter, continuous strain on the engaged strut, and metal fatigue [5,7]. If the fractured fragment migrates, it is usually found in the pulmonary arteries, iliac or femoral veins, right heart, or IVC near the filter. Few cases of extra-caval migration have been reported in the literature. Migration sites have included the adjacent pancreas, the area around the in situ IVCF, the retroperitoneum, and unknown sites. A case of extravascular migration of a fractured strut that punctured the vertebral body has not been previously reported. Migration of the fragment can cause embolism, fatal arrhythmia, and cardiac wall injury. Even cardiac tamponade and sudden cardiac death due to migration of the fractured fragments of the IVCF have been reported [6,7]. If fracture of the IVCF strut is detected, close surveillance for the possibility of migration is required.

It is controversial whether the use of circulatory supports during IVC clamping is beneficial. Our patient tolerated IVC clamping for 45 minutes without

cardiopulmonary bypass. Clamping the IVC around the right renal vein results in the loss of venous return from the lower legs, which is approximately 30% of systemic venous return. The natural collateral veins such as the azygous, epidural, and superficial abdominal veins have the ability to increase flow. The mean arterial pressure is generally well maintained because of the compensatory increase in systemic vascular resistance and a moderate increase in the heart rate. Although these responses vary widely, most patients can tolerate IVC clamping for approximately 1 hour. Beyond this period, decompensation becomes increasingly apparent [8].

If surgical removal is needed in cases of a fractured and migrated IVCF strut, localization of the IVCF and its fragment is important. In the present case, it was difficult to localize the fractured strut using previous imaging studies with a long interval because of the possibility of extravascular migration. Therefore, repeating 3-dimensional CT immediately before an operation and use of an intraoperative C-arm are recommended to localize the position of the IVCF and fractured strut.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

References

1. Tapson VF. *Acute pulmonary embolism*. N Engl J Med 2008;358:1037-52.
2. Ray CE Jr, Mitchell E, Zipser S, Kao EY, Brown CF, Moneta GL. *Outcomes with retrievable inferior vena cava filters: a multicenter study*. J Vasc Interv Radiol 2006;17:1595-604.
3. Grande WJ, Trerotola SO, Reilly PM, et al. *Experience with the recovery filter as a retrievable inferior vena cava filter*. J Vasc Interv Radiol 2005;16:1189-93.
4. British Committee for Standards in Haematology Writing Group, Baglin TP, Brush J, Streiff M. *Guidelines on use of vena cava filters*. Br J Haematol 2006;134:590-5.
5. Kumar SP, Mahtabifard A, Young JN. *Fractured inferior vena cava filter strut presenting as a penetrating foreign body in the right ventricle: report of a case*. J Card Surg 2008;23:378-81.
6. Tam MD, Spain J, Lieber M, Geisinger M, Sands MJ, Wang W. *Fracture and distant migration of the Bard Recovery filter: a retrospective review of 363 implantations for po-*

Extravascular Migration of a Fractured Inferior Vena Cava Filter Strut

- tentially life-threatening complications. J Vasc Interv Radiol 2012;23:199-205.e1.*
7. Khurana D, Raza J, Abrol S, Coplan NL. *Fractured inferior vena cava filter strut presenting with ST-segment elevation and cardiac tamponade. Tex Heart Inst J 2015;42:181-3.*
 8. Reddy K, Mallett S, Peachey T. *Venovenous bypass in orthotopic liver transplantation: time for a rethink? Liver Transpl 2005;11:741-9.*