

Thrombus Propagation across an Inferior Vena Cava Filter Resulting in Fatal Pulmonary Embolism: A Case Report

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Abstract

Inferior vena cava (IVC) filters have since been implanted in the 1970s. The aim of implantation is to prevent the occurrence of fatal pulmonary embolism (PE). However, fatal pulmonary embolisms have been occurring after filter insertion. The mechanism is that either a thrombus or an embolus was already located cranial to the site of deployment of the filter within the inferior vena cava. And so after the filter implantation significant embolism can still occur. We present the case of a 62-year-old woman who had an IVC filter but died two weeks later from pulmonary embolism, through an unusual mechanism. The patient had a fracture of the left tibia, had open reduction and internal fixation developed pulmonary embolism secondary to deep vein thrombosis of the left lower limb. Anticoagulation was started, an IVC filter was inserted and she was discharged home with a therapeutic INR. However, she passed away two weeks later from pulmonary embolism, through the unusual mechanism of thrombus propagation across the IVC filter. The clinical significance of this article is to draw clinicians' attention to the existence of another mechanism of fatal pulmonary embolism after an IVC filter insertion. The thrombus can propagate across the IVC filter leading to fatal pulmonary embolism.

Keywords

Inferior Vena cava Filter, Thrombus Propagation, Fatal Pulmonary Embolism

1. Introduction

Pulmonary embolism is the most fatal complication of deep vein thrombosis and

believed to be responsible for 300,000 deaths annually in the United States of America [1] [2]. Inferior vena cava (IVC) filters have been inserted to prevent fatal pulmonary embolism since the 1970s [1] [2]. Various types of IVC filters have been developed, including the notable Greenfield filter [3] [4]. Inferior vena cava filters are inserted percutaneously through the femoral veins or internal jugular veins and implanted in the IVC under fluoroscopic guidance.

Pulmonary embolism can still occur after IVC filter insertion, and the mechanism is attributable to either a breakthrough pulmonary embolism, or thrombus or embolus already located cranial to the site of deployment of the filter within the inferior vena cava. Breakthrough pulmonary embolisms are usually not fatal because the sizes of the emboli that pass through the filter are small.

Fatal pulmonary embolism occurring after IVC filter insertion in fully anti-coagulated patients is uncommon. We report the case of fatal pulmonary embolism after IVC filter placement due to thrombus propagation across the filter in a fully anti-coagulated patient on warfarin with a therapeutic INR of 2. The clinical significance of this case is firstly, the unusual mechanism of thrombus propagation across the filter, and secondly, the fatality of it.

2. Case Report

A 62-year old lady fell in her bathroom and fractured her left tibia. She had open reduction and internal fixation in a peripheral hospital and developed pulmonary embolism from left lower limb deep vein thrombosis in the immediate postoperative period. She was fully anticoagulated on warfarin and discharged from hospital. Three months later she developed a second massive pulmonary embolism, confirmed by CT pulmonary angiography scan and referred to our facility. She was admitted and started on enoxaparin 1 mg/kg 12 hourly. She improved significantly in 5 days. On the 7th day of admission she had a permanent IVC filter inserted (**Figure 1**). On table Venography showed a clear IVC. There



Figure 1. IVC filter in place after insertion.

were no thrombi or emboli. Post-operatively warfarin was started alongside enoxaparin. On the 10th day of admission, the international normalized ratio (INR) was 2.0, so the enoxaparin was stopped and she was discharged from hospital, to continue the warfarin at home. Two weeks later at home, on the morning that she was scheduled for review, she felt the need to pass stool. When she did not return, she was found dead on the toilet. The post mortem found a massive saddle embolism, and clots floating in the right atrium and right ventricle. There was also an extensive and continuous DVT from the left popliteal vein, superficial femoral vein, common femoral vein, iliac vein, IVC, extending across the IVC filter into the right atrium (**Figures 2-5**).

3. Discussion

IVC filters have been implanted since the 1970s [1] [2]. The Greenfield filter, the first to be implanted, was done in 1973 [1]. The purpose of the IVC filter is to prevent fatal pulmonary embolism [5] [6]. The incidence of nonfatal pulmonary embolism following IVC filter placement is 1.5% - 6.2% [7] [8] [9] [10]. Fatal pulmonary embolism after filter insertion, though uncommon, has also been reported with an incidence of 3.7% [8]. The study found the mortality occurring shortly after the filter insertion with a median of 4 days [8]. The mechanism is

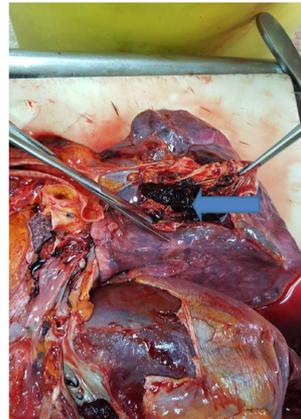


Figure 2. Embolus in the left lung.



Figure 3. Embolus in the right lung.



Figure 4. Filter in the IVC with thrombus below and above it.



Figure 5. Explanted IVC filter embedded in thrombus.

likely to be a significantly sized thrombus or embolus already located cranial to the site of deployment of the IVC which can still embolize after the deployment of the filter. Once a filter is deployed, any thrombi or emboli are trapped by the filter, and only small-sized thrombi or emboli can pass through the struts of the filter. This is called breakthrough pulmonary embolism. The size of the embolus in breakthrough pulmonary embolism is small and so not fatal.

In this patient who had the filter inserted on account of recurrent pulmonary embolism in spite of adequate anticoagulation, the mechanism of the pulmonary embolism was different. It occurred by thrombus propagation across the IVC filter. The fatal pulmonary embolism occurred on the 14th day post insertion. Caval thrombosis, with bilateral pedal oedema, post filter insertion, has been reported with an incidence of 5% - 30% [11]. The main therapy for post-filter insertion caval thrombosis is catheter-directed thrombolysis [12] [13] [14]. The caval thrombosis usually heralds the breakthrough pulmonary embolism. This patient did not have pedal oedema, implying that the caval occlusion from the thrombosis even if present was partial. Preoperative venous dopplerultrasound demonstrated a patent IVC with no thrombus and echocardiogram did not also reveal any clots in the right cardiac chambers. However, at post mortem, the

thrombus had propagated from the original site of the left popliteal vein (due to the left tibial fracture), continued across the filter (**Figure 4, Figure 5**) into the heart and pulmonary arteries (**Figure 2, Figure 3**) and she died in a manner suggestive of pulmonary embolism.

She improved on the low molecular weight heparin when she was on admission and during the time of insertion of the IVC filter, on-table cavalvenogram also showed a patent IVC with no thrombi or emboli. So when did the clot re-propagate from the left popliteal vein to the IVC and beyond? Was it when the low molecular weight heparin was stopped and she was discharged home on the warfarin? Would a fatal PE have occurred if we had extended the duration of the subcutaneous low molecular weight treatment in addition to warfarin being taken at home? It is known that some category of patients while on warfarin with a therapeutic INR, still develop deep venous thromboembolism (VTE) with an incidence of 1.6% - 9.0% [15] [16] [17]. So we believe that when she was discharged from hospital on only warfarin, the thrombotic process overcame the protective effect of the anticoagulant therapy. The thrombus therefore re-propagated from the original site of the left popliteal vein and continued across the IVC, and eventually embolized. Non-compliance was ruled out because the patient was adequately counseled, the relatives accounted for the leftover drugs and each administration of warfarin was witnessed and recorded by the daughter.

The first clinical challenge is the absence of criteria for predicting anticoagulant failure (on warfarin) post IVC filter insertion leading to fatal pulmonary embolism in this patient. The second clinical challenge is if a low molecular weight heparin was to be added to the warfarin when she was discharged from hospital, how long will she have to continue the low molecular weight heparin at home? We hope future studies will answer these questions.

4. Conclusion

Thrombus propagation across an inferior vena cava filter resulting in fatal pulmonary embolism is rare, but it is still possible.

Consent

Informed consent obtained from family members for publication of this article.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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