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Inferior vena cava filter misplacement with SVC perforation

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1. Introduction

The use of inferior vena cava (IVC) filters had been increasingly growing in the last few years. The Food and Drug Administration (FDA) approved the use of retrieval filters, so they can be removed once the risk of venous thromboembolism has passed. This commits the interventional radiologist in knowing the retrieval techniques and how to manage a complex retrieval process, even though the retrieval rates remain significantly low.

Among the wide spectrum of IVC filter (IVCF) complications, the most frequent are filter tilt, embedded filter hook or apex, filter strut endothelialisation, filter component perforation, filter fracture and component embolization.

In this case report, we show the case of an unusual presentation of an IVCF complication that can be life threatening and discuss the diagnostic evaluation, techniques and treatment options that are available for these scenarios.

2. Case report

A 26-year-old female patient with class III obesity and a history of deep vein thrombosis (DVT) and pulmonary embolism (PE) underwent an IVCF placement two days prior at an outside facility. The operator noted an inferior vena cava diameter >3 cm and a Bird's Nest® IVC filter was placed (Figs. 1 and 2).

The filter was noted to be misplaced and the patient was sent for possible IVCF removal. She appears acutely ill, with a blood pressure of 90/60 mmHg and a pulse rate of 120 beats per minute.

A non-contrast CT scan of the chest and abdomen (Figs. 3 and 4) showed the anchoring legs misplaced in the SVC, the cables of the filter extending from the SVC into the IVC where the second pair of anchoring legs were placed. A hemopericardium was also noted (Fig. 5).

An echocardiogram was performed, but due to the morbid obesity, it was not conclusive.

The patient was taken by cardiothoracic surgery for an emergent pericardial window. After 80cc of blood were drained, she rapidly improved with normalization of the vital signs and liver and kidney function. Due to the patient class III obesity (more than 350 pounds) and the type of IVCF, it was decided not to retrieve the filter.

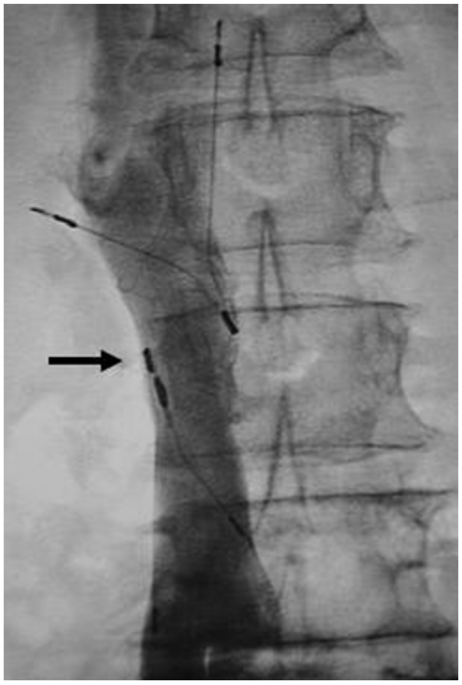

Fig. 1. IVC venogram in another patient shows a Bird's nest filter in an adequate position. The metallic anchoring struts are seen partially overlapping, and the "nest "wire is barely seen between the struts (black arrow).

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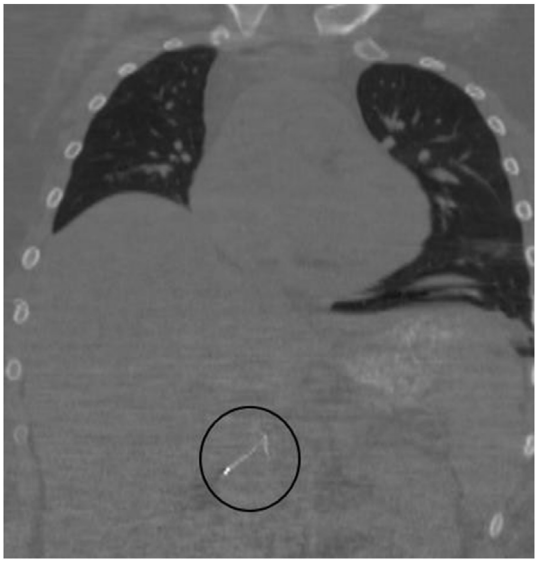

Fig. 2. Coronal CT view shows the lower struts in the inferior vena cava (black circle).

3. Discussion

The inferior vena cava is one of the main abdominal vessel that carries the lower limb and visceral organs blood to the right atrium.[1] The IVC filters had been used since the 1970s, and the Society of Interventional Radiology (SIR) has established the current indications[2] for inferior vena cava filters (IVCF) which include PE or proximal DVT and contraindication, failure or complication to anticoagulation; or as a prophylactic measure in severe trauma or patients at high risk of venous thromboembolism. Since 2003, the FDA has approved the use of retrievable IVCF. The retrieval process should take place once the anticoagulation therapy starts or when the risk of PE is low, and it's recommended to evaluate these filters every 1–3 months.[3]

The main anatomical variants that affect the filter placement are mega cava (>30mm diameter), tortuous IVC, multiple bilateral renal veins, IVC transposition or duplication.[4]

Among the wide spectrum of IVC filter complications, the most frequent are[5]: filter tilt, embedded filter hook or apex, filter strut endothelialisation, filter component perforation and filter fracture and component embolization.

Filter fracture is the loss of structural integrity that can lead to fragmentation and embolization of a component,[6] the main risk factors are implantation time of more than 1 year and penetration of struts. The clinical course depends on which place the strut is. Usually, chest pain is the most frequent symptom; however, cardiac complications such as arrhythmias, free wall rupture and tamponade[5] are feared scenarios.

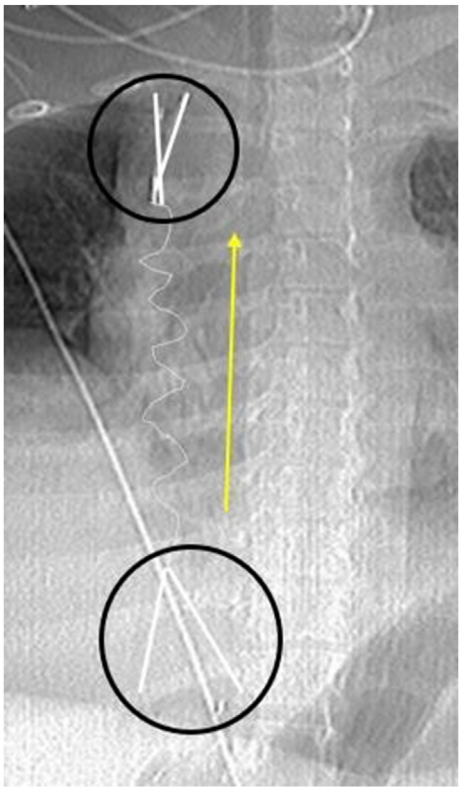

Fig. 4. Reformatted image shows the misplaced IVC filter with the anchoring struts in the IVC (inferior black circle) and SVC (superior black circle). The nest cable is seen extending between the struts (yellow arrow).

Filter migration is defined as a displacement more than 2 cm. from its original position.[7] When evaluating a fractured inferior vena cava filter, it is important to look at the most common areas of embolized struts, such as the inferior or superior vena cava, right atrium, right ventricle and pulmonary artery.

The number and location are important features that the interventional radiologist needs to know in order to plan a therapeutic response. An accumulation in the pericardial space is often seen and can be secondary to excess of pericardial fluid or blood products.

Transthoracic echocardiography is the modality of choice in an emergency setting, due to the wide availability, low cost, noninvasive, bedside method performed quickly. The disadvantages are the limited

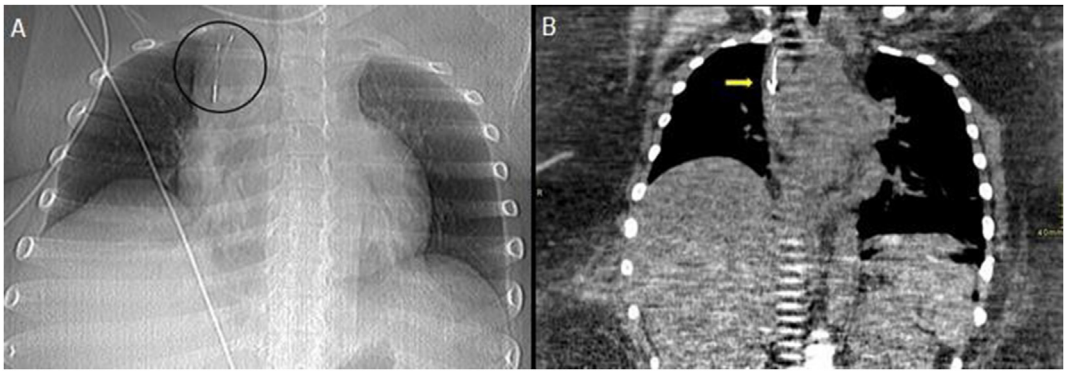

Fig. 3. A.- Chest CT Scout image shows the upper struts in the superior vena cava (black circle). B.- Coronal view of chest CT without contrast shows upper struts in the superior vena cava (yellow arrow).

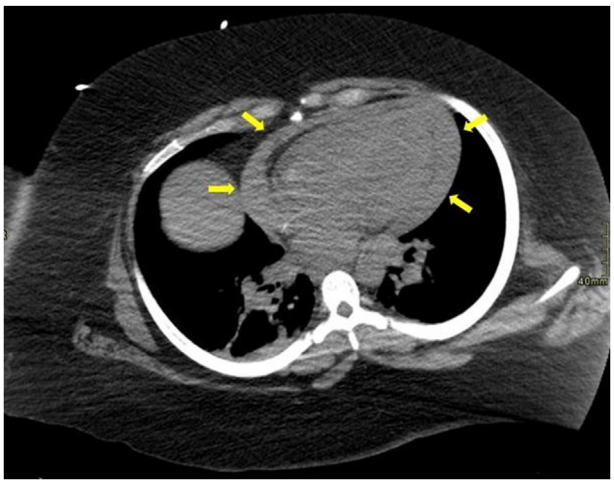

Fig. 5. Chest CT of the thorax in axial view without contrast shows a hyperdense pericardial effusion consistent with recent hemorrhage (yellow arrows).

windows, low image quality and the operator's expertise.[8]

The main factors that affect the filter retrieval can be related to the patient, such as advanced age, discharge from ICU, morbid obesity, acute bleeding, current malignancy, and more than 90 days between the placement and retrieval attempts.[9] Mechanical stability is defined as filter migration cephalad or caudal <20 mm, perforation <5 mm from the caval wall, and no filter fracture or component embolization. All of the above are associated with technical difficulties leading to complex retrieval.[10]

According to the PRESERVE trial[10]; venography showing a clot in the IVCF with or without associated extra ICVF thrombus was the main reason for not performing a filter retrieval attempt.

Complications such as cardiac tamponade, dysrhythmias or free wall rupture require immediate treatment in the emergency department.[6] The superior vena cava perforation is another uncommon scenario that requires prompt management. There may be embolized struts to the heart, which is one of the most serious consequences and a gated CT of the heart is needed to plan the treatment. If the clinical scenarios described above are not present, the prognosis is usually good.

The retrieval process for the embolized struts can be made more often through endovascular snares, balloon techniques, endobronchial forceps or excimer laser sheath; the last one has rates of successful filter retrieval rates up to 99%.[11]

Concomitant complications, such as filter tilt or filter embedded in the vessel wall, may have better results when treated with endobronchial forceps or balloon technique; however multiple IVCF are available, such as convertible, bioconvertible and central venous catheter/IVC filter combination device.[12]

4. Conclusion

Even though the inferior vena cava filter is a common and safe procedure, it is not exempt of complications, which need to be recognized promptly by the clinician and the radiologist in order to provide a quick treatment. The interventional radiologist needs to have high yield training in the diagnosis and management of such scenarios, which in some cases may be life threatening.

Ethical approval

The study was approved by the ethics committee of the University of Texas Health Science Center at San Antonio. All clinical practices and observations were conducted in accordance with the Declaration of Helsinki.

Patient consent

Written informed consent was obtained from the patient for publication of the case report and any accompanying images.

Declaration of competing interest

The authors declare that there is no conflict of interest.

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