IVC filters: an update

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Learning objectives

Recognize consensual and 'off-label' indications for IVC filtration.
Familiarize with placement and retrievable procedures.
Acknowledge the lack of strong evidence supporting IVC filtration, especially in prophylactic indications.
Background

Pulmonary thromboembolism (PE) is a serious, potentially fatal event, responsible for 5 to 10% of mortality in hospitalized patients. Recurrent PE events are likely immediately after the initial PE, with a significant decrease in its incidence shortly thereafter. Inferior Vena Cava (IVC) filters are medical devices that trap emboli and efficiently reduce the risk of recurrent PE in the short-term. However, long-term complications such as increased incidence of deep vein thrombosis (DVT) are the rule to all such devices, even though their incidence varies significantly between devices.

IVC filters can be designed for permanent use or to be retrieved at a later time. The interest of designing retrievable devices is to avoid the long-term complication associated with any IVC filter left in place. The FDA has recently issued a recommendation that every IVC filter deployed be a retrievable filter and that it should be retrieved as soon as the indication for IVC filtration has subsided.

Among the absolute indications for IVC filtration is the inability to adequately anticoagulate the patient, either because of a contraindication to, or a complication of pharmacological anticoagulation. Pharmacological optimization should be attempted prior to IVC filter placement. Relative indications refer to patients with a relative contraindication to pharmacological anticoagulation, like a recent major surgery, major trauma or frequent falling. Free-floating iliofemoral thrombi refer to a DVT with the proximal tip unattached to the vein's wall. In these cases an IVC filter is believed to be indicated due to an increased risk of PE, but this remains to be proven by current data.

Prophylactic indications of IVC filters are controversial and considered 'off-label' because of the associated risks and unproven benefits. These include IVC filtration on trauma, surgical and oncologic patients.

Absolute contraindications to IVC filtration include the complete occlusion of the vessel, the inability to access it or to choose the right device for the IVC's diameter. Active sepsis and uncorrectable severe coagulopathy are relative contraindication.

The PREPIC study (Prévention du Risque d'Embolie Pulmonar par Interruption Cave) study is the only published randomized clinical trial (RCT) studying IVC filters, and this trial was harshly criticized due to design flaws. Another ongoing RCT, the PREPIC2 seeks to address some of the criticism but other design problems have been pointed out.

Most other studies concerning IVC filters are largely retrospective and observational. The evidence supporting prophylactic uses of IVC filtration is both weak and contradictory.
**Absolute Indications**
PE and contraindication to anticoagulation
PE and important complication of anticoagulation
Recurrent PE despite adequate anticoagulation

**Relative Indications**
Free-floating thrombus
Prior to thrombolysis or mechanical thrombectomy in the setting of severe life-threatening PE
Poor cardiopulmonary reserve

**Prophylactic Indications**
Trauma, high-risk surgery, and prothrombotic states with no documented VTE

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**Table 1**

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Imaging findings OR Procedure details

Pre-procedure imaging is important to document the IVC's length, diameter and patency, so the device can be selected. Venous anatomy should be studied prior to the filter's placement as to exclude alternative venous pathways for thromboembolization.

IVC placement procedure
The placement procedure should follow the manufacturer's recommendations. Depending on the device chosen, the approach could be done from the internal or external jugular veins, the femoral veins, the brachial, antecubital or subclavian veins or directly through a translumbar puncture. The preferred final position for the filter is the infra-renal IVC, with the tip of the filter at the level of the lowest renal vein. Flow dynamics explains that this is the best position to prevent trapped clot progression on the tip of the filter. 'Off-label' placement positions have been reported with success, addressing special circumstances like exclusion of the infra-renal IVC by thrombus, pregnancy, gonadal vein thrombosis, anatomical venous variants and patients with abdominal and pelvic masses who will be submitted to surgery with expected infra-renal IVC mobilization.

The placement procedure can be complicated by incomplete opening of the IVC filter or guide-wire entanglement with the filter's struts. When an IVC filter is incompletely opened, it shows a narrow base and crossed or entangled struts. In the case of a retrievable filter it should then be removed and replaced by a new filter. If a permanent or convertible was used, an angled tip catheter can be used to gently manipulate the filter so that it can be opened as desired. If the final result is considered to result in a non-functional filter, a second filter should be placed above the first one. If a guide-wire gets entangled with the filters struts, a catheter should be advanced over the guide-wire and then both the catheter and the guide-wire should be pushed as a single unit. Care should be used to avoid pulling the guide-wire without advancing a catheter first as this can make the guide-wire more difficult to disengage and the filter can migrate.

IVC filter retrieval procedure
An absolute indication to retrieve an IVC filter is unmanageable comorbidity such as IVC penetration or perforation. Relative indications include adequate anticoagulation or loss of filter's function as a result in changes in filter's position or structural integrity. Significant retained thrombus in the filter is associated with a high risk of future PE events. The filter should also not be retrieved if the patient has a life expectancy of less than six months.

The retrieval procedure should follow the manufactures' recommendations. General purpose retrieval devices like the gooseneck Snare can be useful and easy to use. Tilted filters can be hard to engage and an angle tip catheter can be used to reposition the filter into place. Careful inflation of a balloon can also help to separate the filter's tip from the IVC's sidewall.

Neointimal proliferation can cover part of the filter making it difficult to engage or extract the filter. Bronchoscopic forceps and photothermal ablation have been used to dissect the tissue cap covering the filter.
Images for this section:

Fig. 3

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Fig. 2: Tilted IVC filter

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Fig. 1: Thrombus trapped in the filter's tip

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Fig. 4

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**Fig. 7:** Filter migration

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Fig. 5

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**Special circumstances**

*Partial Thrombosis of the IVC*
A cone-shaped filter should be placed as low as possible above the thrombus, preferably in the infrarenal IVC.
If it is not possible to deploy the filter in the infrarenal IVC, it should be placed as low as possible in the suprarenal IVC.

*Duplicated IVC*
IVC filters can be placed in each IVC or a single filter can be placed in the supra-renal IVC.

*Circumaortic left renal vein*
The IVC filter should be placed below the retroaortic component of the venous ring.
When infrarenal placement is not possible, a suprarenal filter may be considered.

*Retroaortic left renal vein*
The filter should be placed below the level of the left renal vein, at each common iliac vein or in the suprarenal IVC.

*Megacava*
The Bird's Nest® filter has been reported to be safe in an IVC with a diameter of 42mm.
In Europe, the Vena Tech™ LP is approved for IVC diameters of up to 35mm.

*Pregnancy*
Suprarenal IVC filter placement can reduce fetal radiation exposure. IVUS-guided placement of the filter could be useful in this condition.
Concerns about maternal or fetal side-effects of filter compression have not been supported by evidence. Some practitioners favor a suprarenal position of the filter in any woman of child-bearing age.

*SVC filter*
An SVC filter should be deployed with its apex caudally, above the right atrium. The filter's feet should be placed above the level of the azygos vein. Placement that is too low is associated with penetration of the pericardium with possible hemopericardium or cardiac tamponade.

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**Table 2:** Problem-solving techniques

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**Fig. 6:** IVC filter retrieval with a bronchoscopic forceps

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Conclusion

All IVC filter devices have been shown to prevent recurrent PE events efficiently. No single device has been shown to have a clear advantage in efficiency over the others, but complication rates vary significantly between them. Placement and retrieval procedures are safe and new problem-solving techniques are still being developed. Besides the consensual absolute indications, relative and prophylactic indications are suggested and are being actively investigated, but benefit is still to be proven. Much of the accepted knowledge about IVC filters lacks level 1 evidence. More prospective studies and randomized controlled trials are needed.
References


2. NIH Consensus Development. Jama 1986;256:744-749


6. ACR-SIR practice guideline for the performance of IVC filter placement for the prevention of pulmonary embolism (resolution 46 - revised in 2010)