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### BACKGROUND

The inferior vena cava (IVC) returns venous blood from the lower extremities to the right atrium. Deep vein thrombosis (DVT) forms in the veins of the leg and can impair blood flow and damage venous valves. A detached clot may travel through the IVC and heart to the lungs as an embolus, causing pulmonary embolism (PE). PE is clinically important because it can block pulmonary circulation and lead to dyspnea, chest pain, tachypnea, and death.

### INTRODUCTION / OBJECTIVES

An inferior vena cava (IVC) filter is a small, wire-like metal device inserted into the IVC to trap thrombi and prevent them from reaching the lungs. IVC filters are used in selected patients with clotting disorders, especially when anticoagulant therapy is contraindicated or insufficient. We conducted a comprehensive literature review to summarize the types, indications, insertion procedure, complications, and future perspectives of IVC filters.

### METHODS

- Comprehensive literature review on IVC filters and venous thromboembolism management.
- Focus areas included indications for placement, types of filters, insertion technique, complications, anticoagulation, and follow-up considerations.
- IVC filter placement is considered in the following situations:
  - Acute VTE with a temporary contraindication to heparin or DOACs
  - High risk of DVT due to prolonged immobility or recent surgery
  - Prophylaxis in selected high-risk surgical or orthopedic patients
  - Massive PE treated with thrombectomy or thrombolysis

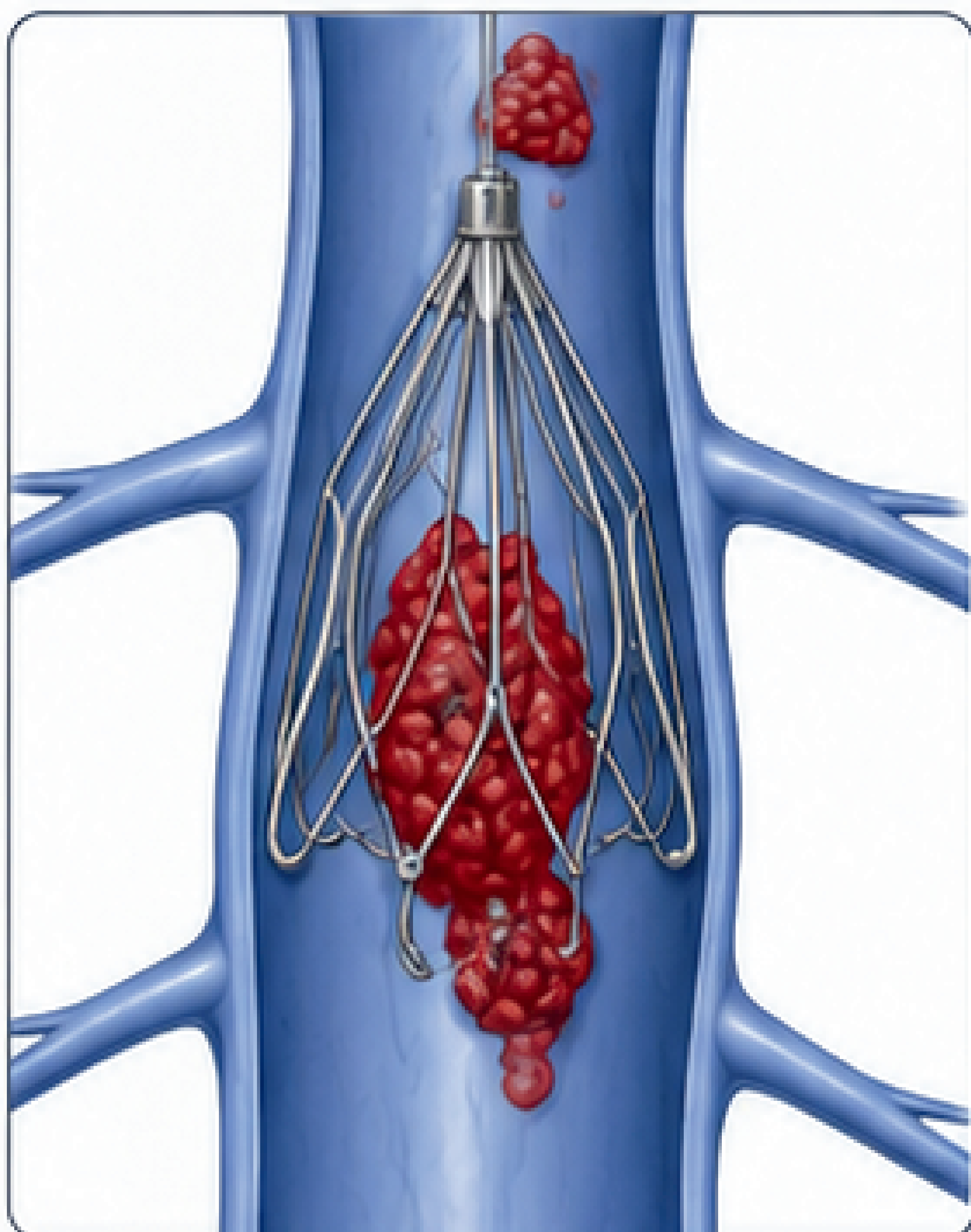


Figure 1: Diagram of an inferior vena cava (IVC) filter capturing a blood clot within the IVC.

### RESULTS

Our review highlights the major filter categories, clinical indications, insertion steps, and peri-procedural considerations.

#### Types of IVC Filters

- **Permanent (non-retrievable) filters:** designed for long-term use in patients who cannot take anticoagulants. Examples include Greenfield and Vena Tech.
- **Optional (retrievable) filters:** can be removed once the risk of thromboembolism decreases, often within about six months. Examples include Denali and Celect.
- The first filters used in clinical practice were permanent. Retrievable filters were developed in the 1990s to reduce long-term complications and allow short-term protection.

#### Indications for Use

- History of DVT or PE with contraindication to anticoagulation
- Patients at high risk of developing blood clots
- IVC filters do not prevent DVT; they reduce the risk of emboli reaching the lungs

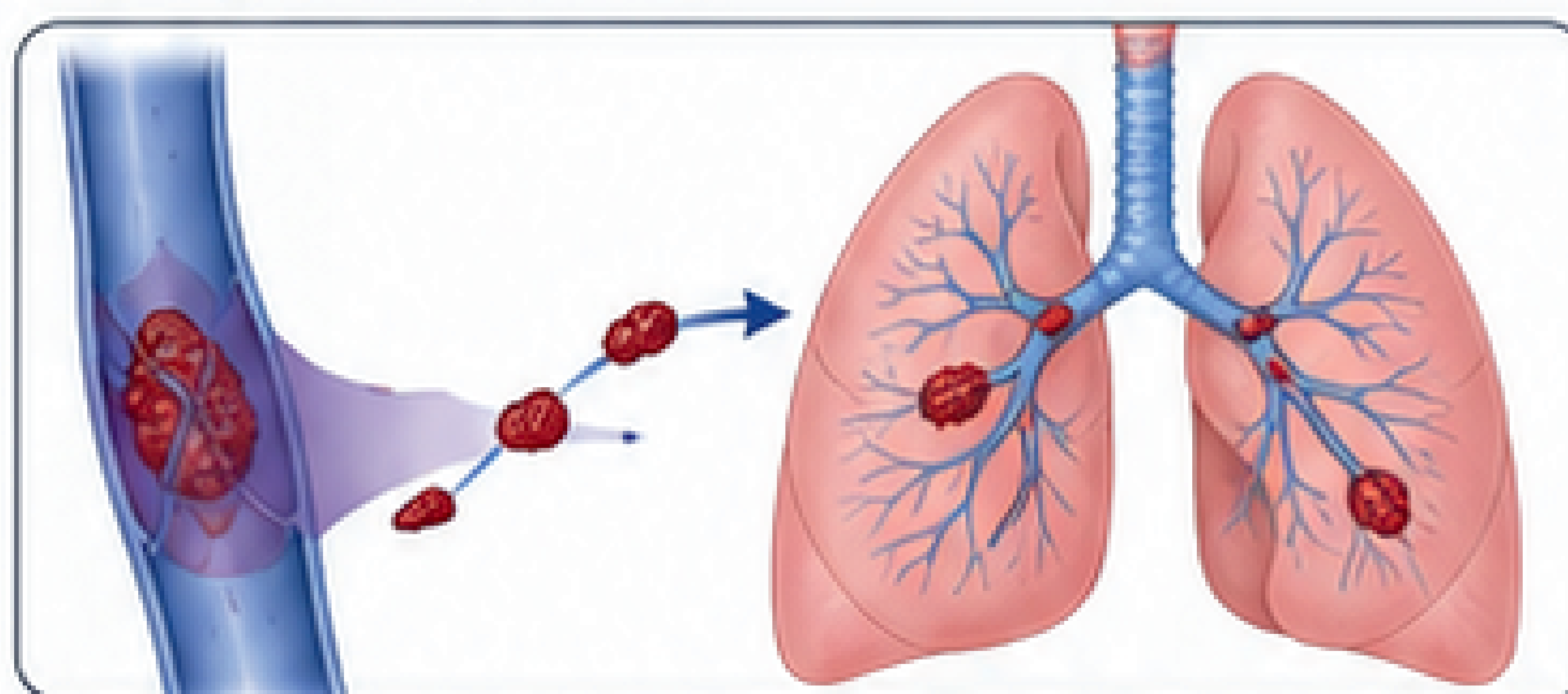


Figure 2: Illustration of deep vein thrombosis embolizing to the pulmonary arteries and causing pulmonary embolism.

#### Procedure for Insertion

1. A small incision is made in a vein, usually in the groin.
2. A catheter is threaded through the vein to the IVC.
3. The filter is delivered through the catheter and attached to the IVC wall, where it traps clots.

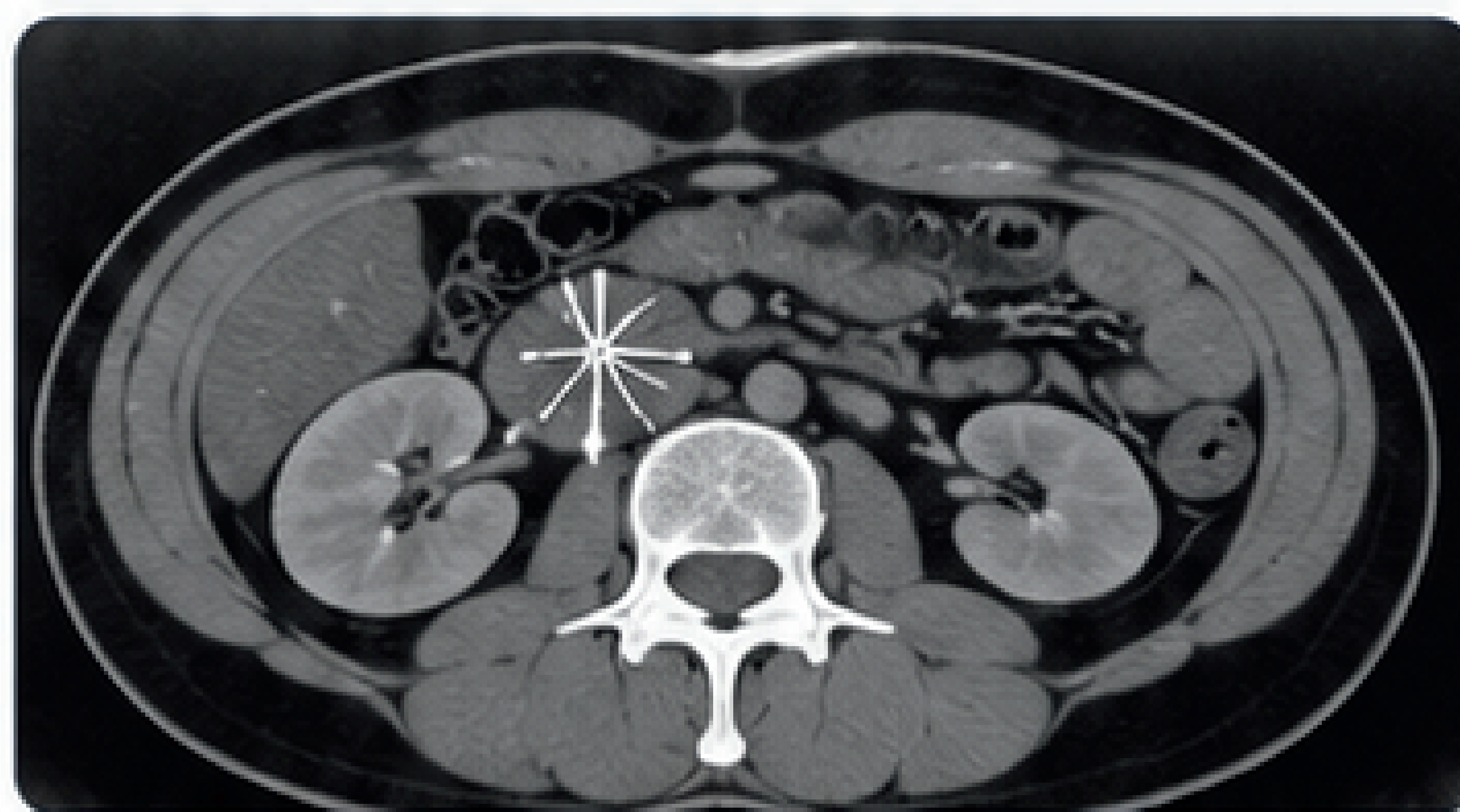


Figure 3: CT scan-style image showing an inferior vena cava (IVC) filter positioned within the IVC.

#### Precautions Before Insertion

- Pre-procedure imaging is performed to evaluate anatomy and overall patient status.
- Coagulation profile, platelet count, kidney function, and allergies are reviewed.
- Sterile technique is maintained and informed consent is obtained.

#### Anticoagulation

- Patients should generally be anticoagulated unless active bleeding or high bleeding risk is present.
- Oral agents: warfarin, apixaban, dabigatran, rivaroxaban
- Intravenous agents: heparin, enoxaparin
- Intravenous anticoagulants are useful in the hospital because they act quickly and can be closely monitored, while oral agents are commonly used long-term.

### RISKS AND COMPLICATIONS

- Allergic reaction to contrast material
- Bleeding or infection at the catheter insertion site
- Damage to blood vessels
- Filter fracture or migration
- Perforation of the IVC
- IVC thrombosis or recurrent DVT
- Kidney failure
- Pulmonary embolism

#### Early Complications

- Bleeding, infection, arteriovenous fistula, accidental arterial puncture, post-procedural hematoma, or thrombosis
- Filter-related issues such as malposition, incomplete expansion, caval penetration, or guidewire entrapment

#### Delayed Complications

- Often arise after the first month of insertion
- Include DVT, filter occlusion, migration, fracture, caval rupture, and thrombosis

### IMPORTANT CONSIDERATIONS

- The American College of Chest Physicians recommends IVC filter placement in patients with acute DVT only when anticoagulant therapy is contraindicated.
- In 2020, the Society of Interventional Radiology recommended against routine IVC filter placement in patients already treated with anticoagulation.
- Retrievable filters are often preferred when possible because long-term risks include fracture, migration, and recurrent DVT.
- Removal is considered when anticoagulation can be safely resumed or when the risk of PE has passed.
- After placement, patients are typically monitored for a few hours and many can go home the same day.

### FUTURE PERSPECTIVES

- Bioconvertible filters that transition to an open, non-filtering configuration
- Filters that avoid the need for retrieval procedures
- Continued refinement of percutaneous and removable filter systems for high-risk patients

### CONCLUSIONS

IVC filters are an important option for preventing life-threatening pulmonary embolism in carefully selected patients. They are available in permanent and retrievable forms and are placed by interventional radiology under imaging guidance. Appropriate patient selection, peri-procedural precautions, anticoagulation management, and follow-up are essential to minimize complications and improve outcomes. Future innovations may further refine the role of caval filters in thromboembolism care.