The use of retrievable inferior vena cava filters to prevent pulmonary embolism: A review of the literature

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INTRODUCTION

Inferior vena cava (IVC) filters were first used in the late 1960s in patients who were at high-risk for pulmonary embolism (PE) where first-line anticoagulation was contraindicated or not effective.[1] IVC filters function by preventing large venous emboli from reaching the lungs and causing symptomatic PE. Early IVC filter use involved permanent implantation. Despite being effective in preventing PE, long-term implantation has been associated with many complications, including increased risk of DVT, penetration of the IVC wall, IVC occlusion, filter migration, and filter fracture.[1,2]

Recently, retrievable IVC filters have been developed to give clinicians the option of using the filter in scenarios where PE risk is temporarily elevated and anticoagulation is not feasible (i.e., contraindicated or ineffective).[3] These filters may be left in permanently or may serve as a bridge until anticoagulation therapy can be restarted. Retrieving filters after the risk of PE declines may save patients from suffering the potential complications of long-term filter implantation.

OBJECTIVES

The purpose of this study was to conduct a literature review to assess evidence regarding the use of retrievable IVC filters. This work will serve as the basis for developing a protocol to characterize the use of retrievable IVC filters at The Ottawa Hospital and other future work.

METHODS

We searched PubMed for the terms *vena cava filters* [MeSH Terms] and *retrievable* [All fields], which yielded 210 articles. We limited the search to human studies, clinical trials, meta-analyses, randomized control trials, and studies published in English. This yielded 19 results. We excluded articles if they were not research articles (i.e., commentaries, letters to editors) (n=1), if they focused exclusively on pediatric populations (n=1), or if they assessed temporary vena cava filters (as opposed to retrievable IVC filters) (n=2). In the end, we identified 15 relevant studies for analysis.

RESULTS

Quality of the evidence

We assessed the quality of each study by assigning it a score based on the Oxford Centre for Evidence-Based Medicine – Levels of Evidence. We found no high-quality evidence to support the use of retrievable IVC filters. All the studies we identified were nonrandomized case-series (i.e., level 4 evidence). Some studies were carried out prospectively, though the majority were conducted retrospectively.

Indications for retrievable IVC filters

Several of the studies we encountered used a common classification system for indications for IVC filter use that was developed by the Society of Interventional Radiology. Indications have been divided into absolute, relative and prophylactic indications (Figure 1). We have added several prophylactic indications to the table, which were mentioned in studies we assessed.

Figure 1: Indications for IVC filter insertion[4,5,6]

Absolute	*Relative*	*Prophylactic*
• Recurrent DVT/PE despite adequate anticoagulation • PE/DVT with contraindication to anticoagulation • PE/DVT with complication of anticoagulation • Inability to achieve or maintain therapeutic anticoagulation	• Iliocaval DVT • Free-floating proximal DVT • Massive PE treated with thrombolysis/thrombectomy • Iliocaval DVT treated with thrombolysis/thrombectomy • DVT/PE and limited cardiopulmonary reserve • Poor compliance with anticoagulant therapy or other difficulty establishing therapeutic anticoagulation • High-risk of complication with anticoagulation	• High-risk of DVT/PE following trauma • High-risk of DVT/PE in peri-operative setting (e.g., bariatric, orthopedic, vascular procedures) • High-risk of DVT/PE in the perinatal period • Paralysis or prolonged immobilization (e.g., moribund in intensive care unit) • Medical condition with high-risk of DVT/PE (e.g., advanced malignancy, hypercoagulable state)

Filter implantation times prior to retrieval

Many studies assessing retrievable IVC filters documented the observed indwell filter times (i.e., how long filters were implanted for prior to retrieval). Earlier studies tended to have shorter indwell times than studies conducted more recently. The three earliest studies we identified had indwell times between 1 and 13 days.[3,7,8] Another study where filters were implanted for prophylaxis in the perinatal period had similarly short indwell times (between 9 and 12 days).[6] We found that studies conducted more recently have attempted to prolong filter implantation. Several studies documented successful filter retrievals at 175, 309, 345, 419, and 494 days.[1,9,10,11,12] With longer indwell times, we found that the rate of unsuccessful retrieval attempts increased.[1,12] One study presented a Kaplan-Meier product limit estimate for the success of filter retrieval, showing steady decreases as implantation time increased.[9]

Outcomes and complications

The rates of breakthrough PE and device-related mortality were consistently low with retrievable IVC filter use, with breakthrough PE being reported in 0% to 4.0% of cases[1,3,4,6] and device-related mortality in 0% to 1.2% of cases.[1,3,9]

A variety of complications were reported with retrievable IVC filter use. Access site thrombosis was documented in 0% to 3.8% of cases,[3,16] filter sepsis in 0.4% of cases,[4] filter thrombus in 0% to 2.0% of cases,[6,8] filter angulation in 37.5% to 37.7% of cases,[6,9] filter migration in 0% to 4.0% of cases,[8,15] filter occlusion in 0% to 6.0% of cases,[3,14] and caval stenosis in 0% to 8.3% of cases.[1,3,15]

FUTURE DIRECTIONS

We are in the process of developing a protocol to characterize the use of retrievable IVC filters at The Ottawa Hospital. In collaboration with Dr. Lisa Duffett (PGY-4, hematology) and Dr. Alan Forster (Scientist, Ottawa Hospital Research Institute), we will conduct a study to assess the appropriateness of retrievable IVC filter use, patient outcomes and complications. During this review, we also noted that there was no information with regards to the timing of filter placement (i.e., time it took for filter to be inserted after a decision was made to deploy a filter, filters being inserted after-hours), so, another future direction for this project will be to assess the timing of filter insertion and the impact on patient outcomes.

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