Removal of the Difficult IVC Filter: Advanced Techniques

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I do not have any potential conflict of interest
### Absolute and Relative Indications for IVC Filter Placement

| Absolute indications | • Venous thromboembolism (VTE) and contraindications to anticoagulation
|                      | • Failure of anticoagulation (recurrent VTE despite anticoagulation)
|                      | • Complication of anticoagulation
| Relative contraindications | • Unstable patients with VTE or patients with poor cardiopulmonary reserves and VTE
|                          | • Massive PE treated with thrombolysis
|                          | • Iliocaval deep vein thrombosis (DVT)
|                          | • Floating proximal DVT
|                          | • Prophylaxis in patients undergoing high-risk surgeries |
Dramatically increasing rate of IVC filter insertions

• Nationwide Inpatient Sample (NIS) study conducted from 1998 to 2005 assessing IVC filter placement rates*
  – 157% increased rate for prophylactic purposes
  – 42% increased rate for venous thromboembolism (VTE) treatment

• 1979-84♦
  – 17,000 IVC filters inserted
    • 8000 in patients with PE
    • 4000 in patients with DVT only
    • 5000 in patients at risk of VTE who had neither (prophylaxis)

• 1985-2006♦
  – 803,000 IVC filters inserted
    • 285,000 in patients with PE
    • 360,000 in patients with DVT
    • 158,000 in patients who had neither (prophylaxis)

IVC filter insertions and litigation
Initial evaluation before retrieval

• Anticoagulation?
  – Not a contraindication to removal
  – Heparin does not need to be held
  – Lovenox bridge in patients on Warfarin?

• Exclusion of DVT if not on anticoagulants
  – Exclude IVC thrombosis or filter-associated thrombus

• Filter dwell time since insertion
  – Often increased difficulty if longer dwell time; more filter endothelialization

• IVC filter position
  – Contact with IVC wall
  – Tilted filter
  – IVC penetration
Imaging evaluation before retrieval

• Lower extremity ultrasound
  – Exclusion of DVT, if patient not anticoagulated

• Contrast-enhanced CT
  – Position of filter relative to renal veins
  – Any IVC penetration by struts
  – Strut penetration/contact with adjacent structures
  – Orientation of filter
  – Degree of filter tilt
  – Filter contact with IVC, particularly tip/hook
  – Any filter associated thrombus

• Non-Contrast CT scan also very helpful
Imaging evaluation before IVC filter retrieval:
Filter penetration of duodenum

Endoscopy demonstrating filter strut perforation of duodenum
Grading strut penetration

Grade 0:
All struts within the IVC

Grade 1:
Struts tenting the IVC

Grade 2:
Strut penetration of retroperitoneum

Grade 3:
Strut penetration of adjacent organ

Oh et al. J Vasc Interv Radiol 2011
Grade 3 Filter penetration: strut penetrating abdominal aorta
Retrieval access

• Internal jugular vein access
  – Over 95% of cases
  – Challenging cases rarely may require femoral & jugular access

• Common femoral vein access
  – Optease® IVC filter retrieval requires common femoral access
    • Very short window for retrieval; extensive filter contact with IVC wall
Retrieval techniques

• First order techniques
  – Standard retrieval techniques using sheath and snare

• Second order techniques
  – Guidewire loop-and-snare technique
  – Balloon displacement technique
  – Buddy guidewire technique

• Third order techniques
  – Dual access techniques

• Fourth order techniques
  – Dissection techniques
    • Endobronchial forceps
    • Endovascular laser
Second order techniques

• Guidewire loop-and-snare (sling) technique
  – Utilizes reverse curve catheter, guidewire, snare and sheath
Retrieval of embedded filter via jugular access
*using a reverse-curve catheter, guidewire, snare & sheath
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Retrieval of embedded filter via jugular access *using a reverse-curve catheter, guidewire, snare & sheath

Snare encircling both guidewire segments used to pull filter close to sheath, which is then advanced to collapse IVC filter.
Second order techniques

• Guidewire loop-and-snare (sling) technique
  – Utilizes reverse curve catheter, guidewire, snare and sheath

• Balloon displacement technique
  – Utilizes angioplasty balloon to disrupt tissue embedding filter hook
Retrieval of embedded filter via jugular access
*using angioplasty balloon to reposition filter & hook

Internal jugular-to-femoral guidewire access (yellow arrows) used to try to center filter within IVC; balloon inflated to attempt to disrupt endothelial tissue covering hook & displace hook for snaring
Second order techniques

- **Guidewire loop-and-snare (sling) technique**
  - Utilizes reverse curve catheter, guidewire, snare and sheath

- **Balloon displacement technique**
  - Utilizes angioplasty balloon to disrupt tissue embedding filter hook

- **“Buddy” guidewire technique**
  - Stiff guidewire introduced via sheath through filter; snare passed alongside stiff guidewire
Optease® Retrieval

Normally a “first order” retrieval technique via femoral venous access
“Buddy” guidewire technique

Pass Catheter introduced through sheath and used guidewire; to direct stiff guidewire through filter
Third order techniques

• Dual access technique
  – Simultaneous introduction of guidewires, sheaths and/or snares from jugular and femoral venous access sites
“Sandwich” technique: parallel guidewires, snares and dual sheaths

- Guidewires passed cephalad & caudally adjacent to filter hook, and are snared
- Each guidewire is externalized via opposite femoral and jugular access
- Sheaths are then advanced over each guidewire adjacent to the filter
- Force applied in cranial and caudal directions to “rock” the filter free
Trapease® IVC filter retrieval

*Can also be used for embedded Optease® IVC filters

Guidewires passed through cephalad & caudal ends of filter using reverse-curve catheters

Trapease IVC filter removed through either jugular or femoral sheath

Sheaths advanced from above & below collapsing cephalad & caudal ends of IVC filter
Dissection techniques

• Endobronchial forceps dissection technique
  – forceps used to microdissect filter hook from the fibrosed tissue
  – requires large caliber jugular sheath (e.g., 16, 18, 20 Fr)

• Laser thermal dissection technique
  – intravascular laser used to ablate fibrotic tissue and to dissect embedded filter hook
  – large caliber jugular sheath
Retrieval of embedded filter using endobronchial forceps
Endobronchial forceps retrieval of embedded G-2 IVC filter
Endobronchial forceps retrieval of embedded G-2 IVC filter
Retrieval of embedded permanent filter using endobronchial forceps

Simon Nitinol® (Bard) permanent IVC filter
Retrieval of Option Elite® IVC filter in piecemeal fashion
Fractured filter specimens after endobronchial forceps retrieval
Unusual retrieval routes
Unusual retrieval routes

Guidewire passed caudally in azygos vein through IVC filter

Guidewire snared via femoral access and externalized
Unusual retrieval routes: dual access with retrieval via azygos vein

1. Large caliber sheath passed over guidewire
2. Filter hook grasped with endobronchial forceps
3. Filter pulled into sheath, snared and removed
Unusual retrieval routes: dual access with retrieval via azygos vein

Retrieved Option® (Argon) IVC filter specimen
Retrieval of embedded filter using endobronchial forceps from femoral approach

Filter retrieved via femoral vein access using endobronchial forceps
Filter retrieved intact using endobronchial forceps
Excimer Laser–Assisted Removal of Embedded Inferior Vena Cava Filters
A Single-Center Prospective Study

William T. Kuo, MD; Justin I. Odegaard, MD; Jarrett K. Rosenberg, PhD; Lawrence V. Hofmann, MD
Excimer laser-assisted removal of embedded inferior vena cava filters: a single-center prospective study

- 100 patients
- Failed routine attempts at retrieval
- 98% success rate
- Mean filter dwell time: 855 days
- Procedure performed AFTER filter realigned (un-tilted) and after moderate force applied to pull filter out
- 10% complication rate
  - 3% caval rupture requiring stent-graft
  - 3% minor extravasations
IVC filter retrieval algorithm

- Embedded or tilted filter?
  - Yes: Advanced retrieval techniques
  - No: Standard retrieval technique
    - If fail: Tilted, minimally-embedded filter?
      - Yes: Densely-embedded filter?
        - Yes: Extensively-embedded filter with fibrous tissue?
        - No: Dissection techniques
      - No: Wire loop-and-snare technique
        - If fail: Balloon-assisted or dual-access guidewire and snare technique
          - If fail: Dissection techniques

Retrieval of Tip-embedded Inferior Vena Cava Filters by Using the Endobronchial Forceps Technique: Experience at a Single Institution

- 114 patients (77 women, 37 men; mean age 43 yrs; range 18-79 years)
- Mean filter dwell time: 465 days (range 31-2876 days)
- 79 pts had failed routine retrieval attempt at outside hospital
- Rotational venography before retrieval so as to identify embedded hook
- 12 Fr 45 cm long sheath placed coaxially through 14 Fr 30 cm long sheath
  - Endobronchial forceps used to dissect hook free and grasp filter hook/tip
  - Larger 14 Fr sheath used to oversheathe grasped IVC filter
- 109/114 successfully retrieved (96% success rate)
- 3 minor ♦ and 1 major * complication
  - Embolized filter fragments in 2 pts, successfully snared and retrieved ♦
  - Small IVC pseudoaneurysm where hook tip dissected free; no Rx needed ♦
  - Larger IVC pseudoaneurysm requiring balloon tamponade *
MGH endobronchial forceps experience

IVC filter retrieval attempts using endobronchial forceps after failed standard techniques

- 60 consecutive pts (23 men, 37 women; mean age 49.3 yrs; range 19–77 yrs) over 6 yrs
- Mean dwell time: 565 days (range, 15–7366 days)
- Filter types
  - Argon Option n=33
  - Cook Gunther Tulip n=9
  - Cook Celect n=8
  - Bard G2 n=4
  - Bard Eclipse n=3
  - Cordis Optease n=2
  - Simon nitinol n=1

Fracture 3/60 filters; caval penetration by filter legs (56/60) and/or apex/hook (28/60)

58/60 filters retrieved successfully (96.7%)

- 2 required second attempt
- Mean fluoroscopic retrieval time: 33.2 minutes (range 10–76.9 minutes)
- Inconsequential intra-procedural filter fracture in 10 patients

Complications:

- Retroperitoneal hemorrhage n=1
- IVC dissection flap n=1
- Migration of limb* (right ventricle) n=1
- Migration of limb* (right pulmonary artery) n=1

* Successful endovascular retrieval
Conclusions

• Rate of placement of retrievable IVC filters has been increasing for both VTE treatment and prophylaxis
• Low filter retrieval rates have prompted FDA statement emphasizing need for timely removal
  • Retrieval recommended within 2 months of filter placement or as soon as risk for VTE is negligible
• Retrieval can be technically challenging in up to 40-60% of cases
  • Advanced techniques may be required for successful retrieval
• Factors predisposing to complicated retrievals include prolonged filter dwell times, degree of filter tilt, endothelial ingrowth into filter
  • Advanced retrieval techniques carry significant risks that should be carefully considered against those of leaving the filter permanently in place
• Complicated filter removal should be individualized to each patient, with careful consideration of age and existing comorbidities
Thank you
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