Nuts & Bolts of IVC Filters
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Objectives
• What are Inferior Vena Cava (IVC) Filters?
• Types of IVC Filters
• Indications for placement and removal of IVC filters

IVC Filters
• A mechanical device that is deployed in the inferior vena cava at/below the level of the renal veins to capture large blood clots that may break off from deep vein thrombosis (DVTs) in the lower extremities and preventing them from traveling to the lungs and causing a pulmonary embolism
Venous Thromboembolism

- Venous thromboembolism (VTE) includes deep vein thrombosis (DVT) and pulmonary embolism (PE)
- PE is a major cause of morbidity and mortality in the United States
- 400,000–630,000 cases of non-fatal PE's annually
- 50,000–240,000 deaths due to PE's annually
- Up to 95% of PE's are caused by emboli from deep vein thrombosis in the lower extremities

Evolution of IVC Filters

- 1893: Surgical ligation of IVC
- 1967: Dr. Louis Durham: first retrievable IVC filter
- 1973: Dr. Lazar Greenfield: basic design for modern IVC filters
- 2003: 1st FDA-approved permanent IVC filter

Surgical Solutions

- Bilateral Femoral Vein ligation
- IVC ligation
- IVC plication
- IVC clipping: Deweese
  - 12% surgical mortality
- Complications
  - Decrease in cardiac output
  - Increase rate in post-thrombotic syndrome (PTS)
Types of IVC Filters

- Permanent
- Optional
  - Temporary
  - Convertible
  - Retrievable

Permanent IVC Filters

- Mobin-Uddin Filter - 1967
- Greenfield IVC Filter - 1987
- Bird’s Nest - 1989
- Vena Tech - 1989
- Simon Nitinol - 1990
- Trapease - 2000

Temporary IVC Filters

- Short term insertion & suspended by catheters/wires at target insertion
- Catheter buckling & atrial migration
- No current approval for use in US

Angel Catheter
**Convertible IVC Filter**

- Can be converted into stents when IVC filtration not needed
- Remove hub at filter tip allowing legs to unfold against IVC wall
- Sentry Bioconvertible IVC Clinical Trial at UTSW

**Filtering Configuration**

**Bioconverted Configuration**

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**Retrievable IVC Filters**

- Optease - 2002
- Gunther Tulip - 2003
- ALN - 2008
- Celect - 2008
- Option - 2009
- Denali – 2013

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**Improvement of IVC Filters**

- Electropolished laser cut alloys vs stainless steel and silicone
  - MRI compatible
  - Less thrombogenic
  - Decrease filter fracture
- Hooks and legs
  - Decrease tilting
  - Decrease migration
Treatment of Venous Thromboembolism

- Anticoagulation
  - Low molecular weight heparin
  - Vitamin K antagonist
    - Major bleeding: 1.6-24%
    - Recurrent PE: 8.3%
    - Lethal recurrent PE: 2.5%
    - Duration of treatment 3-6 months
- Thrombolytic agents or thrombectomy
  - Hemodynamically unstable PE or massive iliofemoral thrombosis with low risk bleeding
- Inferior vena cava

Indications for IVC Filters with Venous Thromboembolism (VTE)

- Contraindication to anticoagulation
  - Absolute Contraindications
    - Active Bleeding or Heparin Induced Thrombocytopenia (HIT)
  - Relative Contraindications
    - Recent Bleeding or Coagulopathy
    - Recent Surgery (CNS, Abdominal or Chest)
    - Recent Trauma
    - CNS Pathology
- Failure of anticoagulation or at high risk for proximal vein thrombosis or PE
- Recurrent thromboembolism despite therapeutic treatment with anticoagulation

Indications for IVC Filters

- Filters for confined proximal DVT
  - PREPIC Trial shows large decrease in PE in patients with IVC filter (permanent) vs anticoagulation alone
  - Increased risk of DVT (at 2yr) and PE (at 8yr), with no difference in the incidence of symptomatic DVT
  - FDA recommends that IVCF be removed when no indicated
  - PREPIC TRIAL 2 - Randomized trial using retrievable IVC filters
- Filters during pregnancy
  - Risk of PE and DVT 6x greater in pregnancy, greatest risk in the immediate post partum period
- Filters for high risk trauma patients
  - 60% of major trauma patients get VTE, with 50% of cases getting PE the 1st week post injury
  - PE is the leading cause of death in trauma patients surviving their initial injury
Indications for IVC Filters

- Filters in bariatric surgery patients
  - High risk of postoperative VTE postoperative period despite therapeutic prophylaxis
  - PE is 2nd common cause of death
  - Placed prophylactically in pts with history of VTE
- Filters during percutaneous venous intervention
  - Filters placed in patients getting percutaneous intervention (PEVI) – thrombolysis or mechanical thrombectomy for acute DVT
- Filters for patients with PE causing hemodynamic instability
  - 35% decrease in mortality of patients with IVC filter in addition to anticoagulation
- Filters in advanced-stage cancer patients

IVC Filters....

Prevent all emboli
Prevent DVT
Treat DVT/PE
Enhance anticoagulation

IVC Filter Placement

- Percutaneous Access
- Caval Venography
- Filter Deployment
- Post Deployment
  - Caval Venography
IVC Filter Placement

- Access
  - Right internal jugular vein
  - Right femoral vein
  - Brachial vein
  - Subclavian vein

Caval Venography

- Caval diameter
  - 15-30mm
- Variant caval anatomy
  - Mega Cava >30mm
  - Tortuous IVC
  - Multiple bilateral renal veins
  - IVC transposition
  - IVC duplication
  - IVC agenesis
- Determine location of renal veins joining the IVC
  - Decrease risk of filter-related vein thrombosis causing post-renal failure

Deployment

Post Cavagram
Thrombus in the IVC
- Extrinsic IVC compression
- Circumaortic renal vein
- Pregnancy or other pelvic mass
- Planned pelvic surgery (due to risk of dislodging filter)
- Renal or gonadal vein thrombosis
- Chronic occlusion/intrinsic narrowing
- Duplicated IVC

Upper extremity DVT
- 75% due to central venous catheters and malignancy
- Less likely to cause PE than LE DVT’s (5.4% vs 25.1%)
- Higher risk of complications
  - 5.6% vs 0.7%
- SVC filters are not recommended

IVC filters are used off-label
Bedside Placement of IVC Filters
• Rationale
  • ICU/immobilized patients
  • Lower cost (?)
  • Lower risk (no contrast with US/IVUS)
  • Limited experience
  • Regressive practice

Complications of IVC Filters
• Acute procedure related complications
  • Misplacement 1.3%
  • Pneumothorax 0.02%
  • Local hematoma 0.6%
  • Air embolism 0.2%
  • Carotid artery puncture 0.04%
  • Arteriovenous fistula 0.02%

• 93% of complications associated with retrievable IVC filters with long-term use (>30d)
• DVT
• IVC thrombosis
• Filter Migration – 0.3%
• IVC penetration – 1.6%
• Filter tilt >15 degree
• Filter fracture
• Guidewire entanglement and filter damage
• Post-thrombotic syndrome (PTS)
**Indication for IVC Filter Removal**

- Since retrievable filters were approved in 2003, there is a lower threshold for filter placement.
- Estimated that >224,700 IVC filters placed in 2012.
- The trend is increasing in placement in younger patients and for prophylaxis.
- PREPIC Trial shows large decrease in PE in patients with IVC filter (permanent) vs anticoagulation alone.
  - Increased risk of DVT (at 2yr) and PE (at 8yr), with no difference in the incidence of symptomatic DVT.

In 2010, updated 2014 - The FDA recommends that retrievable IVC filters be removed when protection from pulmonary embolism is no longer needed. The risk/benefit profile begins to favor removal of the IVC filter between 29 and 54 days after implantation.

**Quality Improvement Project at UTSW**

- Baseline IVC filter retrieval was 8% (Jan-Aug 2012).
- IVC filter retrieval rate from Aug 2012: April 2013 was 40% where sent letters to get patients back to clinic.
- Prospective group May 2013-December 2014 (128 filters) – 38%.
- 17 patients still need follow-up in the Interventional Radiology Clinic to date.
**Case Study #1**

65yo male with right common femoral vein DVT with active GI bleeding

Candidate for IVC filter?

**YES!**

**Case Study #2**

55yo male with acute PE and was started on systemic IV heparin. Patient subsequently developed retroperitoneal bleeding

Candidate for IVC filter?

**YES!**

**Case Study #3**

32yo male with spinal cord injury with no DVT

Candidate for IVC filter?

**X**
Case Study #4

47yo female with hemorrhagic brain metastases developed a right common femoral vein DVT

Candidate for IVC filter?

YES!

Case Study #5

55yo male with pancreatic cancer with a free floating caval thrombus. Patient can be anticoagulated

Candidate for IVC filter?

X

References


