PERIOPERATIVE ANTICOAGULATION CONTROVERSIES

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General Internal Medicine
OUTLINE

■ Cases
■ Neuraxial Anesthesia
  – *DOAC’s and Discontinuation Times*
■ Aspirin and Neurosurgery
  – *Continue vs Discontinue*
■ DVT/PE and Surgery
  – *IVC Filters*
■ Conclusion
CSIM Conference 2018

No Conflicts to Declare
HOT TOPICS SERIES
TOO HOT TO HANDLE

WHILE YOU SIT AND SWEAT IN YOUR SEAT
“The Dress”

- **Lafer-Sousa et al. 2015 – Current Biology**
  - $N = 1401$
    - 57% - #blueandblack
    - 30% - #whiteandgold
    - 11% - #blueandbrown
    - 2% - something else

- **Schlaffe et al. 2015 – Cortex**
  - #whiteandgold – higher activation in frontal/parietal area.
  - Regions associated with higher cognition.
How Color Blind People See Pie Charts

- First Category
- Second Category?
- There's a Third Category??
- Isn't That the Same As the Second????
Poll Everywhere

■ WEBSITE
  - PollEv.com/lukerannelli864

■ TEXT
  - LUKERANNELLI864 to 37607
  - Text A, B, C or D
Case 1 – Ms. Eli Quis

73 year old female with atrial fibrillation and a CHADS$_2$ score of 4 on Apixaban 5 mg PO BID, scheduled for elective hip replacement with spinal anesthesia.

Profile
- Diabetes
- COPD
- Hypertension
- Renal Dysfunction (CrCl 38 mL/min)

Patient seen in perioperative clinic, Internal Medicine recommends stopping Apixaban 2 days before surgery. However on the day of surgery Anesthesia cancels the procedure and says that it should have been stopped 5 days before surgery.

WHEN DO YOU DISCONTINUE THE DOAC?
A. Discontinue the Apixaban 2 days before the procedure
B. Discontinue the Apixaban 5 days before the procedure
C. Discontinue the Apixaban 3 days before the procedure
D. Discontinue the Apixaban 1 days before the procedure
E. Screw it....battle time!
Benefits of Neuraxial Anesthesia

- Rodgers et al. (2000) BMJ
  - Systematic Review
  - 141 trials, n = 9559 patients
  - Results
    - ↓ DVT (44%)
    - ↓ PE (55%)
    - ↓ Pneumonia (39%)
    - ↓ Respiratory Failure (59%)
GUIDELINES – STOP DATES
Perioperative Direct Oral Anticoagulants and Neuraxial Anesthesia

<table>
<thead>
<tr>
<th>GUIDELINE</th>
<th>Dabigatran</th>
<th>Rivaroxaban</th>
<th>Apixaban</th>
<th>Endoxaban</th>
</tr>
</thead>
<tbody>
<tr>
<td>CrCl &gt;50</td>
<td>CrCl 30-49</td>
<td>CrCl &gt;30</td>
<td>CrCl &gt;30</td>
<td>CrCl &gt;30</td>
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<tr>
<td><strong>Thrombosis</strong></td>
<td><strong>Canada</strong></td>
<td><strong>ASRA 2018</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2 DAYS</strong></td>
<td><strong>3-4 DAYS</strong></td>
<td><strong>2 DAYS</strong></td>
<td><strong>3-5 DAYS</strong></td>
<td></td>
</tr>
<tr>
<td>(skip 4 doses)</td>
<td>(skip 6 doses)</td>
<td>(skip 2 doses)</td>
<td>(skip 6-10 doses)</td>
<td></td>
</tr>
<tr>
<td><strong>4 DAYS</strong></td>
<td><strong>5 DAYS</strong></td>
<td><strong>2 DAYS</strong></td>
<td><strong>3 Days</strong></td>
<td></td>
</tr>
<tr>
<td>(skip 8 doses)</td>
<td>(skip 10 doses)</td>
<td>(skip 4 doses)</td>
<td>(skip 3 doses)</td>
<td></td>
</tr>
<tr>
<td><strong>2 DAYS</strong></td>
<td><strong>3 DAYS</strong></td>
<td><strong>2 DAYS</strong></td>
<td><strong>3 Days</strong></td>
<td></td>
</tr>
<tr>
<td>(skip 2 doses)</td>
<td>(skip 3 doses)</td>
<td>(skip 4 doses)</td>
<td>(skip 3 doses)</td>
<td></td>
</tr>
</tbody>
</table>
Is it worth the battle?
## Pharmacokinetics

<table>
<thead>
<tr>
<th></th>
<th>Dabigatran</th>
<th>Rivaroxaban</th>
<th>Apixaban</th>
<th>Edoxaban</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target</strong></td>
<td>Factor IIa</td>
<td>Factor Xa</td>
<td>Factor Xa</td>
<td>Factor Xa</td>
</tr>
<tr>
<td><strong>Tmax (hr)</strong></td>
<td>1-3 hr</td>
<td>2-4 hr</td>
<td>3-4 hr</td>
<td>1-2 hr</td>
</tr>
<tr>
<td><strong>Half-Life (hr)</strong></td>
<td>12-17 hr</td>
<td>5-9 hr</td>
<td>8-15 hr</td>
<td>10-14</td>
</tr>
<tr>
<td><strong>Bioavailability</strong></td>
<td>3-7%</td>
<td>66% (fasting)</td>
<td>50%</td>
<td>62%</td>
</tr>
<tr>
<td><strong>Renal Elimination</strong></td>
<td>80%</td>
<td>33%</td>
<td>27%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Dubois et al. Thrombosis Journal 2017
Risks of Spinal Anesthesia

- Spinal - 1/220,000 - 1/320,000
- Epidural - 1/150,000
  - Risks
    - Multiple attempts
    - Spinal abnormalities
    - Coagulopathy
    - Heparin administration
- "High Risk Procedures"
  - 2-day risk of major bleed >2%
  - i.e. - nephrectomy, major ortho, TURP/TURBT, Cancer surgery
Perioperative DOAC – Dabigatran

- **Schulman et al. (2015) Circulation**
  - *Prospective Cohort Study* - \( n = 541 \) patients
  - *Dabigatran (Afib + low/high risk procedure)*
    - Low Risk – last dose 24 hours
    - High Risk – last dose 48 hour
  - **OUTCOMES**
    - Clinical - major bleeding, thromboembolic events, minor bleeding
    - Lab – aPTT
  - **RESULTS**
    - 10 Major Bleeds (1.8%)
    - 28 Minor Bleeds (5.2%)
    - 1 TIA (0.2%)

- 13 patients had neuraxial anesthesia or epidural injection → NO COMPLICATIONS
- 80-86% patients → NO DETECTABLE ANTICOAGULANT EFFECT @ 48hrs
Table 2: Effect of dabigatran interruption on coagulation test results

<table>
<thead>
<tr>
<th>Coagulation test</th>
<th>All patients</th>
<th>Low bleeding risk surgery/procedure</th>
<th>High bleeding risk surgery/procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 181</td>
<td>n = 118</td>
<td>n = 63</td>
</tr>
<tr>
<td>PT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (IQR) (s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (11–15 s), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased (&gt; 15 s), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APTT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (IQR) (s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (22–35 s), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased (&gt; 35 s), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (IQR) (s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (20–30 s), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased (&gt; 30), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dTT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (IQR) (ng mL⁻¹)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (&lt; 20 ng mL⁻¹), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased (≥ 20 ng mL⁻¹), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dabigatran level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (IQR) (ng mL⁻¹)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (&lt; 20 ng mL⁻¹), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased (≥ 20 ng mL⁻¹), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SO WAITING LONGER MEANS LESS ANTICOAGULANT?

- Dilute TT – most reliable test to measure anticoagulant effect
- 60 hr Interval
  - 22/22 patients – normal aPTT
  - 21/22 patients normal dTT
    - dTT – 31 ng/ml

Douketis et al. (2016) Reg Anesth Pain Med
Godier et al. (2017) EHJ
- Prospective observational study
- DOAC concentration – DOAC concentration, PT, aPTT, TT, anti-Xa activity
- RESULTS – n = 422
  - Rivaroxaban (55%), Dabigatran (31%), Apixaban (14%)
  - 25 - 48 hr s
    - 38% >30 ng/ml
  - 49 – 72 hrs
    - 5% >30 ng/ml
“Been Hangin’ Around?”

48-72 hours = minimal residual anticoagulant effect

Godier et al. (2017) EHJ
### CASE STUDIES:...WE TALKIN’ ABOUT CASE STUDIES?

#### TABLE 10. Case Reports of Spinal Hematoma in Patients on New Oral Anticoagulants

<table>
<thead>
<tr>
<th>Drug</th>
<th>History</th>
<th>Outcome</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dalteparin</td>
<td>72 y, M, 20 mg BID dalteparin for AF; T1-T2 burst fracture after a fall, 2 h after last dose of dalteparin</td>
<td>Fresh flexion trauma, patient fell</td>
<td>Spontaneous hematoma</td>
</tr>
<tr>
<td>Dalteparin</td>
<td>72 y, M, 10 mg BID dalteparin for AF; intervertebral dislocation on MRI</td>
<td>Posterior dislocation, fall</td>
<td>Spontaneous hematoma</td>
</tr>
<tr>
<td>Rivaroxaban</td>
<td>60 y, M; TRH: 40 mg of aspirin started 21 h after stroke, then continued for 4 wk; 10 mg rivaroxaban started on POD1, 2 h after stroke, coffee pulse, and LE weakness 3 h after rivaroxaban started.</td>
<td>Symptoms improved 4 h later, complete recovery, 40 h after symptoms</td>
<td>Spontaneous hematoma</td>
</tr>
<tr>
<td>Rivaroxaban</td>
<td>60 y, M, 20 mg rivaroxaban daily for AF; intracranial bleed 36 h after transesophageal echocardiogram, bilateral LE weakness, C7-T2 intradural hematoma on MRI</td>
<td>Stiffness, hoarseness, and cervical stiffness, 8-4 days later (corticosteroids not recommended), no recovery, IV dexamethasone, sensory loss improvement after 1-2 CT scans done of fourth day, almost complete recovery</td>
<td>Spontaneous hematoma</td>
</tr>
<tr>
<td>Rivaroxaban</td>
<td>51 y, M; TRH (subcutaneously 1.2 mg/week)</td>
<td>Emergency transesophageal echocardiogram revealed a 1-cm defect in the atrial septum</td>
<td>Spontaneous hematoma</td>
</tr>
<tr>
<td>Rivaroxaban</td>
<td>51 y, M; TRH (subcutaneously 1.2 mg/week)</td>
<td>Patient had TBI (spinal 3 wk) before surgery, transesophageal examination revealed a 1-cm defect in the atrial septum</td>
<td>Spontaneous hematoma</td>
</tr>
<tr>
<td>Apixaban</td>
<td>78 y, M; 25 mg BID and clodipogrel after coronary stent placement, back pain, hypotension, renal failure (unrelated on hemorrhage on MRI)</td>
<td>Anticoagulants did not completely reverse at 3 wk</td>
<td>Spontaneous spinal subarachnoid hematoma</td>
</tr>
</tbody>
</table>

ASRA Guidelines 2018
Perioperative Anticoagulant Use for Surgery Evaluation Study (PAUSE) - ongoing

- **Standardized DOAC perioperative protocol**
- **Outcomes**
  - Major/minor bleeds, arterial/venous thromboembolism, DOAC lab test (dTT, Xa, PT/PTT)
  - N ~ 3000 patients
  - Low risk of bleeding (<1%) with low residual anticoagulant effect (<50 ng/ml)
Case 1 Follow-up

A. Discontinue the Apixaban 2 days before the procedure

B. Discontinue the Apixaban 5 days before the procedure

C. Discontinue the Apixaban 3 days before the procedure

D. Discontinue the Apixaban 1 days before the procedure

E. Screw it....battle time!
Case 2 – Mr. Lum Bar

65 year old male with a recent STEMI 12 months ago requiring 3 DES to the RCA. He is now seen for perioperative assessment as he is currently scheduled for lumbar decompression (2 segments) within the next 14 days.

Profile
- Hypertension
- Dyslipidemia
- Coronary Artery Disease
- Diabetes

Medications
- Ticagrelor 90 mg BID
- Aspirin 81 mg daily
- Rosuvastatin 20 mg daily
- Metformin 1000 mg BID
- Perindopril 4 mg daily

WHAT WOULD YOU DO WITH HIS ANTIPLATELETS?
Case 2 – Mr Lum Bar

A. Discontinue the Ticagrelor and stop the Aspirin 3 days before the procedure.

B. Discontinue the Ticagrelor and stop the Aspirin 7 days before the procedure.

C. Discontinue the Ticagrelor and continue the Aspirin for the procedure.

D. Discontinue the Ticagrelor and stop the Aspirin now.
POISE 2 – PCI Subgroup

- *ASA in patients with previous PCI and non-cardiac surgery*
- *N = 470 patients with prior PCI*
- **Results**
  - ↓ Primary Outcome (death + nonfatal MI)
    - *HR 0.50, CI 0.26-0.95*
  - **Secondary Outcome**
    - ↓ MI *(HR 0.44, CI 0.22-0.87)*
    - ↑ Major/life threatening bleeds *(HR 1.22, CI 1.03-1.44)*

![Graph showing cumulative percentage of patients with event over days from randomization. The graph compares Placebo and Aspirin groups. The Placebo group shows a higher cumulative percentage of patients with events, especially in the later days.](attachment:image.png)
So who does it?
Aspirin and Spinal Surgery

- Survey of Germany Neurosurgeons
  - N = 142
  - 80.3% Discontinued
  - Discontinuation Time
    - Mean = 6.9 days (range 0-21 days)
    - 66.2% - Considered increased risk for hemorrhage
    - 51.4% - personal experience of problems

Korinth et al. (2007) Eur Spine
<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Intervention</th>
<th>3-7 Days</th>
<th>≥7 days</th>
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<tbody>
<tr>
<td>Aspirin Discontinuation Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Kang et al. 2011</td>
<td>38</td>
<td>Lumbar Fusion</td>
<td></td>
<td>ASA D/C’d @ 7 days</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EBL- 855.3 ±623 ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Epidural Hematoma – 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Blood Transfusions – 2.4 ±2.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NO ASA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EBL- 840 ±209 ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Epidural Hematoma – 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Blood Transfusions – 1.6 ±1.2</td>
</tr>
<tr>
<td>Park et al. 2013</td>
<td>182</td>
<td>Lumbar Fusion</td>
<td>EBL- 150 ml</td>
<td>EBL- 225.8 ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No epidural hematomas</td>
<td>No epidural hematomas</td>
</tr>
<tr>
<td>Cueller et al. 2015</td>
<td>200</td>
<td>Cardiac stents + spinal surgery</td>
<td>EBL – 697 ml</td>
<td>EBL – 642 ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blood Transfusion – 1.2 ± 2.4</td>
<td>Blood Transfusion - 1.6 ± 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No epidural hematomas</td>
<td>No epidural hematomas</td>
</tr>
<tr>
<td>Soleman et al. 2016</td>
<td>105</td>
<td>Lumbar/spinal surgery</td>
<td>EBL- 221 ml</td>
<td>EBL- 140.16 ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blood Transfusion – 0.16</td>
<td>Blood Transfusion – 0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Epidural Hematoma - 1</td>
<td>Epidural Hematoma - 0</td>
</tr>
<tr>
<td>Shin et al. 2018</td>
<td>284</td>
<td>Thoracolumbar decompression</td>
<td>EBL – 820.6 ml</td>
<td>EBL – 921.7 ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thecal Sac Area - 120.2 mm²</td>
<td>Thecal Sac Area - 123.6 mm²</td>
</tr>
</tbody>
</table>
Need More.....Analysis

- **Goes et al. (2017) Spine Journal**
  - Meta-Analysis – ASA continuation + Spine Sx
  - 3 trials (N - 370 patients)
  - RESULTS
    - Mean discontinue time = 5-7 days (secondary prevention)
    - NO difference
      - Blood loss (pre, peri, post)
      - Epidural hematoma
      - Cardiac events

- **Zhang et al. (2017) Medicine**
  - Meta-Analysis – ASA continuation + Spine Sx
  - 7 trials (n - 547 patients)
  - RESULTS
    - NO Difference
      - Blood loss (pre, peri, post)
      - Epidural hematoma
      - Cardiac events
Case 2 – Follow-up

A. Discontinue the Ticagrelor and stop the Aspirin 3 days before the procedure.

B. Discontinue the Ticagrelor and stop the Aspirin 7 days before the procedure.

C. Discontinue the Ticagrelor and continue the Aspirin for the procedure.

D. Discontinue the Ticagrelor and stop the Aspirin now.
Case 3 – Mr Dan VanTom

59 year old male admitted for a prostatectomy in 5 days for a new diagnosis of prostate cancer, however was recently diagnosed with a provoked proximal distal DVT 20 days ago.

Profile
- Hypothyroidism
- Hypertension

Medications
- Synthroid 75 mcg daily
- Amlodipine 5 mg daily
- Tinzaparin 175mg/kg daily

HOW WOULD MANAGE THIS PATIENT?
Case 3 - Dan VanTom

A. Half the dose of Tinzaparin 24 hours before the procedure, resume Tinzaparin as soon as possible post operation as surgeons discretion.

B. Delay of surgery.

C. Half the dose of Tinzaparin 24 hours before the procedure, insert a IVC filter now, and resume Tinzaparin as soon as possible post operation as surgeons discretion.

D. Stop the Tinzaparin now and start therapeutic heparin infusion, stop 4 hours before the procedure and restart the heparin as possible post operation as surgeons discretion.
# Pre-operative Guidelines and IVC Filters

<table>
<thead>
<tr>
<th>IVC Indication</th>
<th>American College of Chest Physicians</th>
<th>American Heart Association</th>
<th>European Society of Cardiology</th>
<th>British Committee for Standards in Hematology</th>
<th>European Society of Anesthesiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative Acute VTE &amp; Anticoagulation Interrupted for Surgery</td>
<td>No Comment</td>
<td>No Comment</td>
<td>No Comment</td>
<td>Yes (Grade C, level IV)</td>
<td>Yes (Grade 2C)</td>
</tr>
</tbody>
</table>
Pre-operative Guidelines and IVC Filters

- **ACCP - Antithrombotic Therapy for VTE Disease**
  - “In patients with acute PE and contraindication to anticoagulation, we recommend the use of an IVC filter (Grade 1B).”

- **ESA – Perioperative Venous Thromboembolism Prophylaxis**
  - “We suggest considering temporary IVCF placement in patients with documented recent DVT, and with an absolute contra-indication for full anticoagulation and planned non-deferrable major surgery (Grade 2C).”

- **BJH – Guidelines on Use of Vena Cava Filters**
  - “VC filters should be considered in any pre-operative patient with recent VTE (within 1 month) in whom anticoagulation must be interrupted. Retrievable VC filters should be considered in this situation where a temporary contraindication to anticoagulation exists (Grade C, level IV)”
WHY 30 DAYS?

Table 1. Estimated Rates of Thromboembolism Associated with Various Indications for Oral Anticoagulation, and the Reduction in Risk Due to Anticoagulant Therapy.

<table>
<thead>
<tr>
<th>Indication</th>
<th>Rate without Therapy</th>
<th>Risk Reduction with Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute venous thromboembolism</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>Month 1</td>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>Months 2 and 3</td>
<td>15‡</td>
<td>80</td>
</tr>
<tr>
<td>Recurrent venous thromboembolism‡</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonvalvular atrial fibrillation and previous embolism</td>
<td>12‡</td>
<td>80</td>
</tr>
<tr>
<td>Mechanical heart valve</td>
<td>8‡</td>
<td>75</td>
</tr>
<tr>
<td>Acute arterial embolism</td>
<td>1.5</td>
<td>66</td>
</tr>
</tbody>
</table>

*Risk shown is per year.

**Values shown are estimated numbers of major events caused (+) or prevented (−) if therapy is administered to 10,000 patients undergoing major surgery.

†A 100-fold increase in the postoperative rate of venous thromboembolism has been assumed, to reflect the added risk associated with major surgery.

‡The term refers to patients whose last episode of venous thromboembolism occurred more than three months before surgery but who require long-term anticoagulation because of a high risk of recurrence.

Kearon & Hirsh NEJM 1997
What are they being placed for?

- Wassef et al. (2016) Thrombosis Research

<table>
<thead>
<tr>
<th>Indication</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute DVT (0-28 days) + Contraindication to AC</td>
<td>44.4% (n = 206)</td>
</tr>
<tr>
<td>Subacute DVT (28 days-3 months) + Contraindication to AC</td>
<td>3.4% (n = 16)</td>
</tr>
<tr>
<td>Acute PE (0-28 days) + Contraindication to AC</td>
<td>20% (n = 93)</td>
</tr>
<tr>
<td>Subacute PE (28 days-3 months) + Contraindication to AC</td>
<td>1.9% (n = 9)</td>
</tr>
<tr>
<td>Prevention of PE with limited CV reserve</td>
<td>1.7% (n = 8)</td>
</tr>
<tr>
<td>No Indication</td>
<td>0.6% (n = 3)</td>
</tr>
</tbody>
</table>
What are they being placed for?

- **Filter Complications:**
  - Thrombosis ~ 12.5%
  - Filter tilt ~ 9.5%
  - Erosion ~ 3.4%
- Time to occurrence 0-28 days ~ 75.7%

Wassef et al. (2016) Thrombosis Research
How effective are IVC filters?

- No RCT of patients with contraindication to anticoagulation and acute VTE

**Health Services and Outcomes Research**

**Outcomes After Vena Cava Filter Use in Noncancer Patients With Acute Venous Thromboembolism**

A Population-Based Study

Richard H. White, MD; Ann Brunson, MS; Patrick S. Romano, MD, MPH; Zhongmin Li, PhD; Ted Wun, MD

*Background*—Evidence that vena cava filters (VCFs) are beneficial is limited. *Methods and Results*—We retrospectively analyzed all noncancer patients admitted to nonfederal California hospitals for acute venous thromboembolism from 2005 to 2010. Analysis was stratified by the presence/absence of a contraindication to anticoagulation (active bleeding, major surgery). Outcomes were death within 30 or 90 days of admission and the 1-year incidence of recurrent venous thromboembolism manifested as pulmonary embolism or deep vein thrombosis. Propensity score methods were used to account for observed systematic differences in baseline characteristics between patients treated and those not treated with a VCF. Among 80,697 patients with no contraindication to anticoagulation,
How effective are IVC filters?

- **Retrospective Observational Study**
  - \( N = 1,445 \) admitted to California hospital from 2005-2010
  - Subgroup → anticoagulation held for all/part of hospitalization for OR with or without IVC
How effective are IVC filters?

- Group 2 – Surgery + IVC
  - $N = 1445$

<table>
<thead>
<tr>
<th>VTE Event</th>
<th>No IVC</th>
<th>IVC Placement</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE (with/without DVT)</td>
<td>45.6%</td>
<td>52.4%</td>
<td>0.015</td>
</tr>
<tr>
<td>Proximal DVT</td>
<td>41.4%</td>
<td>30.3%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Distal DVT</td>
<td>13%</td>
<td>17.4%</td>
<td>0.024</td>
</tr>
<tr>
<td><strong>Major Surgery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>85%</td>
<td>96%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>No</td>
<td>15%</td>
<td>3.7%</td>
<td></td>
</tr>
<tr>
<td><strong>Bleeding</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bleeding on Admission</td>
<td>6%</td>
<td>12.3%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>No Bleed</td>
<td>90.5%</td>
<td>76.7%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
How effective are IVC filters?

- **RESULTS**
  - No reduction in death at 30 days
  - No reduction in PE/DVT at 1 year.
A. Half the dose of Tinzaparin 24 hours before the procedure, resume Tinzaparin as soon as possible post operation as surgeons discretion.

B. Delay of surgery.

C. Half the dose of Tinzaparin 24 hours before the procedure, insert a IVC filter now, and resume Tinzaparin as soon as possible post operation as surgeons discretion.

D. Stop the Tinzaparin now and start therapeutic heparin infusion, stop 4 hours before the procedure and restart the heparin as possible post operation as surgeons discretion.