Updates and Controversies in Perioperative Medicine

How long should we delay surgery:
- After ischemic stroke?
- After acute myocardial infarction
- After drug-eluting stent implantation?

Should we bridge patients on anticoagulants?

Postoperative anemia:
- How much evaluation is needed?
- When should patients be transfused?

Delaysing Surgery After Stroke

A 63-year-old man suffers an acute stroke that is managed without thrombolysis. Brain MRI incidentally detects a large meningioma. The neurosurgeon wants to resect the tumor in 2 weeks. Because of his stroke, you recommend delaying surgery for:

A. 1 month
B. 3 months
C. 6 months
D. 9 months
E. At least a year
**Delaying Surgery After Stroke**

**Question:** How does time between stroke and surgery affect the risk of cardiovascular complications?

- Danish cohort study of all adults undergoing elective noncardiac surgery from 2005-2011:
  - 7137 patients had prior stroke (1.5% of total cohort)
  - Outcome: 30-d postop Major Adverse Cardiac Events (MACE): nonfatal MI, ischemic stroke, cardiovascular death
  - Looked at effect of time since stroke on MACE rate

![MACE Incidence Graph](image)

**Jorgenson ME et al. JAMA 2014; 312:269-277**

**Conclusions:**
- Surgery after CVA associated with high CV risk
- Risk falls over 9 months, biggest drop after first 3 months

**Caveats:**
- Nonrandomized, observational study

**My take-away:**
- Delay elective surgery for at least 3 months (up to 9 months) if possible

**Delaying Surgery After MI**

A 63-year-old man suffers an acute myocardial infarction treated without PCI. He was already scheduled for prostate cancer surgery in one month. Because of his recent MI, you recommend delaying surgery for:

A. 1 month
B. 2 months
C. 3 months
D. 6 months
E. At least a year
Delaying Surgery After Acute MI

**Question:** How does time between acute MI and surgery affect the risk of postoperative MI?

563,842 patients (1999-2004) discharged after hip surgery, colectomy, cholecystectomy, AAA repair, or lower extremity amputation:
- 2.9% of cohort had experienced acute MI in prior year
- Outcome: 30-day postoperative MI


### How Long to Wait after MI?

**Conclusions:**
- Surgery within one year of acute MI associated with high risk of postoperative MI
- Risk falls over time; most of the reduction within 2 months
- Trend is similar when only elective surgery considered

**Caveats:**
- Nonrandomized, observational study

**ACC/AHA Guidelines:**
- Delay elective surgery for at least 2 months

### Surgery After Drug Eluting Stent

A 75-y.o. man sustains an unstable cervical spine fracture. He had a drug-eluting stent placed 8 months ago for stable angina. The spine surgeon wants to operate, but putting him in a halo vest is a less desirable alternative approach.

**What do you recommend?**

1. Operate now
2. Wait 12 months after DES
Perioperative Cardiac Complications in Patients with Coronary Stents

Question: How do stent type and time until surgery affect risk of cardiac complications?

Study Design: Retrospective cohort analysis
- Over 25,000 pts who had noncardiac surgery between 6 weeks & 2 years after BMS or DES placement
- Identify risk factors for cardiac complications (all-cause mortality, MI, revascularization)


Effect of Stent Type & Time After Implantation

Time of surgery after PCI didn’t matter after first 6 months

<table>
<thead>
<tr>
<th>Time between PCI &amp; Surgery</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>6%</td>
</tr>
<tr>
<td>120</td>
<td>5%</td>
</tr>
<tr>
<td>180</td>
<td>5%</td>
</tr>
<tr>
<td>240</td>
<td>5%</td>
</tr>
<tr>
<td>300</td>
<td>5%</td>
</tr>
<tr>
<td>360</td>
<td>5%</td>
</tr>
</tbody>
</table>

Guidelines for DES

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC / AHA</td>
<td>Wait 12 months before elective surgery...but may be 6 months is ok if delay is harmful</td>
</tr>
</tbody>
</table>

Managing Perioperative Anticoagulation

Two patients on warfarin therapy are scheduled for elective hip arthroplasty. You’re asked whether they should receive perioperative bridging anticoagulation (with enoxaparin):
- One patient has atrial fibrillation due to hypertension
- The other patient has a mechanical AVR
- Neither has any other relevant comorbidity

1. Heparin bridge for AVR only
2. Heparin bridge for AF only
3. Heparin bridge for both
4. Heparin bridge for neither
Benefits & Harm of Bridging Perioperative Anticoagulation

Death or disability from thromboembolism averted by bridging
Death or disability from perioperative bleeding caused by bridging

Meta-analysis of Cohort Studies

<table>
<thead>
<tr>
<th></th>
<th>Bridged</th>
<th>No Bridge</th>
<th>Hazard Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embolic Event</td>
<td>1.1%</td>
<td>0.9%</td>
<td>0.8 (0.4-1.5)</td>
</tr>
<tr>
<td>Bleeding</td>
<td>11%</td>
<td>2%</td>
<td>5.4 (3.0-9.7)</td>
</tr>
<tr>
<td>Serious Bleeding</td>
<td>3.7%</td>
<td>0.9%</td>
<td>3.6 (1.5-8.5)</td>
</tr>
</tbody>
</table>

BRIDGE Trial

Patients:
- 1884 patients on warfarin for atrial fibrillation
- CHADS2 score ≥ 1
- Excluded patients with mechanical valve or stroke within 12 weeks and cardiac and neurologic surgery

Intervention:
- Randomized to bridging with LMWH or placebo

Outcome:
- 30-day risk of arterial thromboembolism & bleeding

Doukels J et al. NEJM, 2015; 373:823-33

BRIDGE Trial

<table>
<thead>
<tr>
<th></th>
<th>Bridged</th>
<th>No Bridge</th>
<th>NNH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embolic Event</td>
<td>0.3%</td>
<td>0.4%</td>
<td>Non-inferior</td>
</tr>
<tr>
<td>Major Bleeding</td>
<td>3.2%</td>
<td>1.3%</td>
<td>NNH = 53</td>
</tr>
<tr>
<td>Minor Bleeding</td>
<td>21%</td>
<td>12%</td>
<td>NNH = 12</td>
</tr>
</tbody>
</table>
BRIDGE Trial for Atrial Fibrillation

Conclusions:
- Bridging did not reduce risk of embolism
- Bridging increases bleeding risk

Caveats:
- Few patients with high CHADS2 score (mean = 2.3)

My take-away:
- Don’t bridge majority of atrial fibrillation
- Carefully consider bridging if stroke risk is very high (CHADS2 score 5 or 6, rheumatic atrial fibrillation)

What About Mechanical Valves?

<table>
<thead>
<tr>
<th>Thromboembolic Risk (annual)</th>
<th>Without Anticoagulation</th>
<th>With Warfarin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial Fibrillation</td>
<td>7%</td>
<td>3%</td>
</tr>
<tr>
<td>Mechanical Valve</td>
<td>6%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Ansell J. Chest. 2004;126:204S-233S.

Effect of Mechanical Valve Location & Design on Thromboembolic Risk

Valve Location:
- Aortic: RR = 1.0
- Mitral: RR = 1.8

Valve Design:
- Caged Ball: RR = 1.0
- Tilting Disk: RR = 0.7
- Bi-leaflet: RR = 0.6


<table>
<thead>
<tr>
<th>Clot Risk</th>
<th>Atrial Fib.</th>
<th>Mechanical Valve</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHADS2 = 5-6; recent CVA; rheumatic AF</td>
<td>Any MVR; older (caged-ball or tilting disc) AVR; recent CVA</td>
<td>Bridge with heparin</td>
<td></td>
</tr>
<tr>
<td>CHADS2 = 3-4</td>
<td>Bileaflet AVR plus other stroke risk factor(s)</td>
<td></td>
<td>???</td>
</tr>
<tr>
<td>CHADS2 = 0-2</td>
<td>Bileaflet AVR without AF or other stroke risk factor</td>
<td>No heparin bridge</td>
<td></td>
</tr>
</tbody>
</table>
Perioperative Anticoagulation: My Approach after BRIDGE

<table>
<thead>
<tr>
<th>Atrial Fib.</th>
<th>Mechanical Valve</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHADS2 = 5-6; recent CVA; rheumatic AF</td>
<td>Any MVR; older (caged-ball or tilting disc) AVR; recent CVA</td>
<td>Consider bridging</td>
</tr>
<tr>
<td>CHADS2 = 3-4</td>
<td>Bileaflet AVR plus other stroke risk factor(s)</td>
<td>No bridge</td>
</tr>
<tr>
<td>CHADS2 = 0-2</td>
<td>Bileaflet AVR without AF or other stroke risk factor</td>
<td></td>
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What About Venous Clots?

- Risk of Recurrent VTE
  - Bridged
    - Recurrent VTE: 0%
    - Bleeding: 2.7%
  - No Bridge
    - Recurrent VTE: 0.2%
    - Bleeding: 0.2%

- Hazard Ratio
  - Recurrent VTE: ns
  - Bleeding: 17 (4-75)

Retrospective cohort study
- 1178 patients on warfarin for DVT or PE
- Outcome: 30-day recurrent clotting & significant bleeding

Conclusions:
- Recurrent VTE is rare & bridging didn’t affect risk
- Bridging increases bleeding

Caveats:
- Nonrandomized study, so selection bias
- Few patients were considered high-risk for recurrence

My practice:
- Bridge or place temporary IVC filter only in high-risk group

Clark NP et al. JAMA Intern Med. 2015;175:1163
Venous Clots: 2012 ACCP Guideline

<table>
<thead>
<tr>
<th>Risk of Recurrent VTE</th>
<th>Recommendation</th>
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</thead>
<tbody>
<tr>
<td>High Risk:</td>
<td></td>
</tr>
<tr>
<td>VTE &lt; 3 months ago;</td>
<td>Bridge</td>
</tr>
<tr>
<td>Severe thrombophilia</td>
<td></td>
</tr>
<tr>
<td>Medium Risk:</td>
<td></td>
</tr>
<tr>
<td>VTE 3-12 months ago;</td>
<td>Case-by-case decision</td>
</tr>
<tr>
<td>recurrent VTE;</td>
<td></td>
</tr>
<tr>
<td>VTE with cancer other</td>
<td></td>
</tr>
<tr>
<td>thrombophilia</td>
<td></td>
</tr>
<tr>
<td>Low:</td>
<td>No bridge</td>
</tr>
<tr>
<td>Single VTE &gt; 12 months</td>
<td></td>
</tr>
<tr>
<td>ago</td>
<td></td>
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</tbody>
</table>

Venous Clots: My Approach

<table>
<thead>
<tr>
<th>Risk of Recurrent VTE</th>
<th>Recommendation</th>
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<tr>
<td>High Risk:</td>
<td>Consider bridging or IVC filter</td>
</tr>
<tr>
<td>VTE &lt; 3 months ago;</td>
<td></td>
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<tr>
<td>Severe thrombophilia</td>
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</tr>
<tr>
<td>ago</td>
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Postoperative Anemia

You visit a 79-year-old woman on postoperative day #1 after hip fracture repair. You notice her hemoglobin dropped from 11.6 g/dL on admission to 8.5 g/dL today. The operative note reports an EBL (estimated blood loss) of 300 mL.

Which of the following actions is most likely to be useful?

1. Order labs to rule out coagulopathy
2. Order labs to rule out hemolysis
3. Recheck CBC, the results are wrong
4. No work-up; the EBL is wrong

Estimated & Actual Blood Loss

Estimated Blood Loss (EBL):
- Based on suctioned blood and weight of sponges
- Poor repeatability and inter-observer variability

Actual Blood Loss (ABL):
- Calculated value based on patient’s estimated blood volume and change in hemoglobin level
  \[ ABL = \frac{Estimated\ Blood\ Volume \times \Delta \text{Hct}}{(initial\ Hct + final\ Hct) / 2} \]
**EBL versus ABL**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Estimated Blood Loss</th>
<th>Actual Blood Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Hip Arthroplasty</td>
<td>362 mL</td>
<td>1383 mL</td>
</tr>
<tr>
<td>Total Knee Arthroplasty</td>
<td>159</td>
<td>1067</td>
</tr>
<tr>
<td>Posterior Spinal Fusion</td>
<td>975</td>
<td>1606</td>
</tr>
<tr>
<td>Retropubic Prostatectomy</td>
<td>1300</td>
<td>1794</td>
</tr>
</tbody>
</table>

Table courtesy Barbara Slawski, MD (Medical College of Wisconsin)

**Postoperative Anemia**

You visit a 79-year-old woman on postoperative day #1 after hip fracture repair. You notice her hemoglobin dropped from 11.6 g/dL on admission to 8.5 g/dL today. She has no complaints other than moderate hip pain.

**When should she receive red blood cell transfusion?**

1. Now
2. Now, if she has CV disease
3. Wait until hemoglobin < 8 g/dL
4. Wait until hemoglobin < 7 g/dL

**FOCUS* Trial**

(*Functional Outcomes in Cardiovascular Patients Undergoing Surgical Hip Fracture Repair*)

**Patients:** 2016 patients undergoing hip fracture repair.
- Mean age = 82
- 63% with CV disease (CAD (40%); CVA (24%); CHF(17%))

**Treatment:** Randomized to 2 transfusion triggers:
1. Hemoglobin < 10 g/dL
2. Symptoms of anemia (chest pain, CHF, hypotension or tachycardia unresponsive to fluids) or at physician discretion for Hgb < 8 g/dL

**FOCUS Trial Results**

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Median PRBC Units Transfused (IQR)</th>
<th>Total Units Transfused</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 g/dL Trigger</td>
<td>2 (1,2)</td>
<td>1866</td>
</tr>
<tr>
<td>Symptomatic Trigger (or 8 g/dL)</td>
<td>0 (0,1)</td>
<td>652</td>
</tr>
</tbody>
</table>

Carson JL et al. NEJM, 2011; 365
## FOCUS Trial Results

<table>
<thead>
<tr>
<th></th>
<th>In-hospital mortality</th>
<th>60-day mortality</th>
<th>60-day mortality or disability</th>
<th>3-year mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 g/dL Trigger Symptom Triggered</td>
<td>2.0%</td>
<td>7.6%</td>
<td>35%</td>
<td>46%</td>
</tr>
<tr>
<td>1.4%</td>
<td>6.5%</td>
<td>35%</td>
<td>45%</td>
<td></td>
</tr>
</tbody>
</table>

Carson JL et al. NEJM, 2011; 365  
Carson JL et al. Lancet, 2015; 386

## Caveats to FOCUS Trial

- Small difference in hemoglobin levels may not be clinically significant
- Inadequate power to determine if presence of CV disease affects outcome
- Restrictive transfusion strategy leads to more symptomatic anemia (mostly ↑HR or ↓BP)

## AABB Transfusion Guidelines

The society formerly known as the American Association of Blood Banks:

- "In postoperative surgical patients, transfusion should be considered at a hemoglobin concentration of 8 g/dL or less or for symptoms (chest pain, orthostatic hypotension or tachycardia unresponsive to fluid resuscitation, or congestive heart failure)."  
  *Strong recommendation*

- Same recommendation if patient has pre-existing CV disease  
  *Weak recommendation*


## Conclusions

- Recent MI & stroke predicts postoperative cardiac events, especially within first 2 (for MI) or 3 (for stroke) months
- While waiting 12 months to go to OR after DES is standard, 6 months may be adequate
- Bridging anticoagulation not indicated for most patients with atrial fibrillation, mechanical valves, or VTE
- Possible exceptions CHADS2 = 5-6, MVR, acute VTE
- They call it an "estimated" blood loss for a reason
- Transfuse after surgery for symptoms (or maybe if hgb > 8)
Thank You

quinny.cheng@ucsf.edu