62\textsuperscript{nd} Annual Greenville Postgraduate Seminar

Spotlight: Primary Care

Wifi: Greenville ONE Center
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Peri-procedural Anticoagulation Management

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62nd Annual Greenville Postgraduate Seminar
Spotlight: Primary Care
August 16th 2019
Disclosures

I have no financial disclosure or conflict of interest to report.
Case 1 --- Mary

- 80F with **Chronic Atrial Fibrillation** on **APIXABAN** on a background PMH of remote CVA + DM. CrCl 40. She is scheduled to have *single dental extraction* with local anesthesia.

- Do you interrupt APIXABAN?
- Do you bridge APIXABAN? If so, how?
- What if instead she was on VKA instead of APIXABAN?
- What if instead she was having full upper teeth extraction?
- What if instead a recent TEE (<2 weeks ago) showed left atrial appendage thrombus?
Case 2 --- Harry

• 70M with recent Pulmonary Embolism (~4 weeks ago) on **Rivaroxaban** on a background PMH of renal cell carcinoma + HTN + Tobacco abuse. CrCl 35. He is scheduled to have *right nephrectomy* with general anesthesia.

  • Do you interrupt Rivaroxaban?
  • Do you bridge Rivaroxaban? If so, how?
  • What if instead he was on Warfarin (VKA)?
  • What if instead he had remote DVT (>12 mo)
  • What if instead it was basal cell carcinoma and he was scheduled for outpatient dermatologic excision?
Case 3 --- Teri

• 50F with Congenital Aortic Stenosis s/p Bi-leaflet Mechanical Aortic Valve Replacement on **WARFARIN** on a background PMH of HTN + TIA. CrCl 70. She is scheduled to have *left knee arthroscopic surgery* with general anesthesia.

  • Do you interrupt WARFARIN?
  • Do you bridge WARFARIN? If so, how?
  • What if instead she had Mechanical MVR?
  • What if instead she was having total hip replacement?
Case 4 --- Larry

- 60M with **Coronary Artery Disease s/p recent DES proximal LAD (~8 weeks ago)** in setting of ACS/NSTEMI, on **PRASUGREL** and **low dose ASPIRIN**. He is scheduled to have outpatient *cataract surgery*.

  - Do you interrupt PRASUGREL and/or ASPIRIN?
  - Do you bridge? If so, how?
  - What if instead he had BMS proximal LAD (~8 weeks ago)?
  - What if instead he was having total colectomy for colon CA?
Case 5 --- Barry

• 90M with Rheumatic Heart Disease s/p Mechanical Mitral Valve Replacement on WARFARIN on a background of DM + CVA + chronic AF + dementia. He got his pill box mixed up and missed a week’s worth of his WARFARIN. His INR is 1.1

• Do you bridge WARFARIN. If so, how?
• Does he warrant hospitalization for bridging?
• What if instead his INR was 2.2?
• What if instead he had bioprosthetic AVR?
The Scope

- >35 million OAC Rx per year
- >3 million PCIs per year
- Peri-procedural anticoagulation/antiplatelet evaluation is quite common
  - 15-20% VKA patients have surgery annually
  - 10-15% DOAC patients have surgery annually
  - 5-15% DAPT patients have surgery annually
- General lack of clinical trials
- Left to rely on consensus documents/guidelines and expert opinion
- Bridging remains a highly variable practice
The landscape is diverse...

- Common indications for VKA or DOAC
  - Atrial fibrillation
  - Prosthetic heart valve
  - Venous (PE/DVT) or arterial thromboembolism
  - Severe Thrombophilia
  - Ventricular assist device (VAD)

- Common indications for DAPT
  - Coronary revascularization (PCI/POBA)
  - Peripheral artery revascularization (PPI)
  - Cerebrovascular accident (CVA)

- Common scenarios for “bridging”
  - Interruption for procedure
  - Sub-therapeutic INR
  - Medication non-compliance
  - Pregnancy
Varied Mechanism(s) of Action
Hot Potato...

Inconsistent decision maker in AC bridging during/after surgery

- Cardiologist
- Physician performing procedure
- Primary care physician
- Anticoagulation service
- Nurse practitioner
- Pharmacist
- Other

Inconsistent decisions made in AC bridging during/after surgery

- Variance in which CHA₂DS₂-VASc scores constitute a high thrombotic risk
- Variance in which procedures constitute a high bleeding risk
- No interruption of VKA or DOAC during surgery
  - Bridge with parenteral AC
  - Variance in parenteral AC dosing strategies
  - Variance in duration of parenteral AC
Who makes the decision(s)?

**FIGURE 1** Typical Managers of Periprocedural Anticoagulation

<table>
<thead>
<tr>
<th>During</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiologist</td>
<td>Cardiologist</td>
</tr>
<tr>
<td>Physician performing procedure</td>
<td>Primary care physician</td>
</tr>
<tr>
<td>Primary care physician</td>
<td>Anticoagulation service</td>
</tr>
<tr>
<td>Anticoagulation service</td>
<td>Physician performing procedure</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>Pharmacist</td>
</tr>
<tr>
<td>Nurse practitioner</td>
<td>Nurse practitioner</td>
</tr>
<tr>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td>Not sure</td>
<td>Not sure</td>
</tr>
</tbody>
</table>

N = 945 providers surveyed
What is the decision?
How to implement the decision?

<table>
<thead>
<tr>
<th>Duration</th>
<th>General Cardiology</th>
<th>Internist</th>
<th>Gastroenterologist</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 158)</td>
<td>(n = 146)</td>
<td>(n = 154)</td>
</tr>
<tr>
<td></td>
<td>Warfarin</td>
<td>Warfarin</td>
<td>Warfarin</td>
</tr>
<tr>
<td>5 days</td>
<td>37%</td>
<td>42%</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>3%</td>
<td>21%</td>
<td>13%</td>
</tr>
<tr>
<td>4 days</td>
<td>16%</td>
<td>5%</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>0%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>3 days</td>
<td>24%</td>
<td>27%</td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td>12%</td>
<td>18%</td>
<td>21%</td>
</tr>
<tr>
<td>2 days</td>
<td>3%</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>45%</td>
<td>25%</td>
<td>27%</td>
</tr>
<tr>
<td>1 day</td>
<td>0%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>22%</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>Not stopped</td>
<td>17%</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>12%</td>
<td>13%</td>
<td>12%</td>
</tr>
</tbody>
</table>

AC = anticoagulation.
How to implement the decision?
PARADOX OF CHOICE
LESS IS MORE - TOO MUCH CHOICE IS STRESSFUL
Checklist for Peri-operative Management of Anticoagulation/Antiplatelets

- Re-evaluate urgency/timing of planned elective surgery
- Re-evaluate patient specific indication(s) for their current anticoagulation/antiplatelet
- Estimate surgery-specific bleeding risk(s)
- Estimate patient-specific bleeding risk(s)
- Estimate baseline thromboembolic (TE) / thrombosis risk and risk with interruption of anticoagulation/antiplatelet
- Weigh bleeding vs thromboembolic (TE) / thrombosis risk
- Determine timing of anticoagulation/ antiplatelet interruption and resumption if interruption indicated
- Determine whether or not bridging is indicated
- Communicate plan with multi-disciplinary team
<table>
<thead>
<tr>
<th>PROCEDURAL BLEEDING RISK ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH</strong></td>
</tr>
<tr>
<td>• Aortic aneurysm repair</td>
</tr>
<tr>
<td>• Bladder surgery</td>
</tr>
<tr>
<td>• Bowel polypectomy</td>
</tr>
<tr>
<td>• Coronary artery bypass grafting (CABG)</td>
</tr>
<tr>
<td>• Heart valve replacement</td>
</tr>
<tr>
<td>• Intracranial surgery</td>
</tr>
<tr>
<td>• Major cancer surgery</td>
</tr>
<tr>
<td>• Major orthopedic surgery (hip or knee replacement)</td>
</tr>
<tr>
<td>• Peripheral artery bypass and other major vascular surgery</td>
</tr>
<tr>
<td>• Reconstructive plastic surgery</td>
</tr>
<tr>
<td>• Spinal surgery/ Epidural procedure</td>
</tr>
</tbody>
</table>
**HAS-BLED score**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>H - Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>A - Abnormal renal or liver function (1 point each)</td>
<td>1 or 2</td>
</tr>
<tr>
<td>S - Stroke</td>
<td>1</td>
</tr>
<tr>
<td>B - Bleeding</td>
<td>1</td>
</tr>
<tr>
<td>L - Labile INRs</td>
<td>1</td>
</tr>
<tr>
<td>E - Elderly (&gt; 65 years)</td>
<td>1</td>
</tr>
<tr>
<td>D - Drugs or alcohol (1 point each)</td>
<td>1 or 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HAS-BLED score</th>
<th>Bleeds per 100 patient-years</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.13</td>
</tr>
<tr>
<td>1</td>
<td>1.02</td>
</tr>
<tr>
<td>2</td>
<td>1.88</td>
</tr>
<tr>
<td>3</td>
<td>3.74</td>
</tr>
<tr>
<td>4</td>
<td>8.70</td>
</tr>
<tr>
<td>5</td>
<td>12.5</td>
</tr>
</tbody>
</table>

**Additional patient specific bleeding considerations:**
- Prior bleed event within 3 months
- Quantitative or qualitative platelet abnormality
- Concomitant use of antiplatelet therapy
- INR above therapeutic range at time of procedure
- Prior bleed with similar procedure
- Prior bleed with peri-procedural bridging
# THROMBOEMBLIC (TE) RISK ASSESSMENT

<table>
<thead>
<tr>
<th>HIGH</th>
<th>MODERATE</th>
<th>LOW</th>
</tr>
</thead>
</table>
| **Mechanical valve**  
• Any mitral valve  
• Recently placed mechanical valve (<3 months)  
• Recent stroke or TIA (<6 mo)  

| **Atrial fibrillation**  
• With mechanical heart valve  
• With rheumatic heart disease  
• With recent CVA/TIA (<3 mo)  
• CHADS2-VASc ≥ 7  

| **Venous thromboembolism (VTE)**  
• Recent VTE (< 3 mo)  
• With severe thrombophilia  
(ex. Protein C, S, or Antithrombin III deficiency, Antiphospholipid syndrome, Homozygous factor V Leiden mutation)  

| **Mechanical valve**  
• Bi-leaflet aortic valve and 1 of the following: atrial fibrillation, prior stroke or TIA, HTN, diabetes, heart failure, age > 75 y  
• Prior TE during VKA interruption  

| **Atrial fibrillation**  
• CHADS2-VASC 5 or 6  
• Prior TE during VKA interruption  

| **Venous thromboembolism (VTE)**  
• Recent VTE (within 3-12 months)  
• Recurrent VTE  
• With non-severe thrombophilia  
(ex. heterozygous factor V Leiden mutation, heterozygous factor II mutation)  
• With active cancer (treated within 6 months or palliative)  

| **Mechanical valve**  
• Bi-leaflet aortic valve without atrial fibrillation and no other risk factors for stroke  

| **Atrial fibrillation**  
• CHADS2-VASc score ≤ 4 AND no prior CVA/TIA  

| **Venous thromboembolism (VTE)**  
• Single VTE > 12 months ago and not due to thrombophilia disorder  

---

### References

1. [Prisma Health](https://www.prismahealth.org)
<table>
<thead>
<tr>
<th>CHA2DS2-VASc Risk</th>
<th>Score</th>
<th>CHA2DS2-VASc Score</th>
<th>Adjusted stroke rate (% / year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHF or LVEF &lt;40%</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Age &gt; 75</td>
<td>2</td>
<td>2</td>
<td>2.2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1</td>
<td>3</td>
<td>3.2</td>
</tr>
<tr>
<td>Stroke / TIA /</td>
<td></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Thromboembolism</td>
<td></td>
<td>5</td>
<td>6.7</td>
</tr>
<tr>
<td>Vascular Disease</td>
<td>1</td>
<td>6</td>
<td>9.8</td>
</tr>
<tr>
<td>Age 65-74</td>
<td>1</td>
<td>7</td>
<td>9.6</td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>15.2</td>
</tr>
</tbody>
</table>

CHF = congestive heart failure; TIA - transient ischemic attack; LVEF = left ventricular ejection fraction.
Warfarin (VKA)

- **Wisconsin Alumni Research Foundation + (-arin)**
- Spoiled sweet clover hay → livestock hemorrhage/death
- Then developed as rat poison 1948
- FDA approved 1954 as anticoagulant for humans
- Inhibits Vitamin K epoxide reductase enzyme
- Inhibits synthesis of Vitamin K dependent clotting factors II, VII, IX and X as well as Protein C and S
- Indications: NVAF, VTE treatment and prophylaxis, prosthetic heart valves, arterial/venous thrombus, hypercoagulable states, LVAD, CVA
- Dosing individualized according to INR
Mechanism of Action

Edoxaban

Warfarin

Heparin

LMWH

Dabigatran

Insoluble Fibrin

Soluble Fibrin

Fibrinogen
Peri-procedural VKA options

<table>
<thead>
<tr>
<th>Low Bleeding Risk</th>
<th>Low TE Risk</th>
<th>Moderate TE Risk</th>
<th>High TE Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>VKA hold: NO</td>
<td>VKA hold: NO</td>
<td>VKA hold: NO</td>
<td>VKA hold: NO</td>
</tr>
<tr>
<td>Bridging: NO</td>
<td>Bridging: NO</td>
<td>Bridging: NO</td>
<td>Bridging: NO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moderate Bleeding Risk</th>
<th>Low TE Risk</th>
<th>Moderate TE Risk</th>
<th>High TE Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>VKA hold: YES</td>
<td>VKA hold: MAYBE</td>
<td>VKA hold: MAYBE</td>
<td>VKA hold: MAYBE</td>
</tr>
<tr>
<td>Bridging: NO</td>
<td>Bridging: MAYBE</td>
<td>Bridging: MAYBE</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High Bleeding Risk</th>
<th>Low TE Risk</th>
<th>Moderate TE Risk</th>
<th>High TE Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>VKA hold: YES</td>
<td>VKA hold: YES</td>
<td>VKA hold: YES</td>
<td>VKA hold: YES</td>
</tr>
<tr>
<td>Bridging: NO</td>
<td>Bridging: MAYBE</td>
<td>Bridging: YES</td>
<td>Bridging: YES</td>
</tr>
</tbody>
</table>
Overestimation of TE risk & Underestimation of bleeding risk

• To justify interruption of OAC with “bridging,” the risk of TE while off OAC should be greater than the risk of bleeding from “bridging”

• Rate of peri-procedural TE off OAC is only ~0.5-1%

• Peri-procedural bleeding-to-TE risk 13:1 with bridging and 5:1 without.

• Another meta-analysis showed OR 3.6 for bleeding with bridging, with no difference in TE or mortality

• We tolerate higher risk of bleeding because generally systemic TE event is more devastating than bleeding
A  Major Bleeding

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Bridging Events</th>
<th>Bridging Total</th>
<th>No Bridging Events</th>
<th>No Bridging Total</th>
<th>Weight</th>
<th>Odds Ratio M-H, Random, 95% CI</th>
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</thead>
<tbody>
<tr>
<td>Daniels et al., 2009</td>
<td>15</td>
<td>342</td>
<td>5</td>
<td>213</td>
<td>24.9%</td>
<td>1.91 [0.68, 5.33]</td>
</tr>
<tr>
<td>Garcia et al., 2008</td>
<td>4</td>
<td>108</td>
<td>2</td>
<td>1185</td>
<td>15.3%</td>
<td>22.75 [4.12, 125.68]</td>
</tr>
<tr>
<td>Jaffer et al., 2010</td>
<td>13</td>
<td>229</td>
<td>3</td>
<td>263</td>
<td>21.0%</td>
<td>5.22 [1.47, 18.54]</td>
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<tr>
<td>McBane et al., 2010</td>
<td>14</td>
<td>514</td>
<td>2</td>
<td>261</td>
<td>17.9%</td>
<td>3.63 [0.82, 16.08]</td>
</tr>
<tr>
<td>Wysokinski et al., 2008</td>
<td>6</td>
<td>204</td>
<td>4</td>
<td>182</td>
<td>20.8%</td>
<td>1.35 [0.37, 4.86]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>1397</strong></td>
<td><strong>2104</strong></td>
<td><strong>100.0%</strong></td>
<td></td>
<td></td>
<td><strong>3.60 [1.52, 8.50]</strong></td>
</tr>
<tr>
<td><strong>Total events</strong></td>
<td><strong>52</strong></td>
<td><strong>16</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.50; \text{Chi}^2 = 8.41, \text{df} = 4 (P = 0.08); I^2 = 52%$
Test for overall effect: $Z = 2.92 (P = 0.004)$

B  Thromboembolic Events

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Bridging Events</th>
<th>Bridging Total</th>
<th>No Bridging Events</th>
<th>No Bridging Total</th>
<th>Weight</th>
<th>Odds Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daniels et al., 2009</td>
<td>4</td>
<td>342</td>
<td>1</td>
<td>213</td>
<td>8.8%</td>
<td>2.51 [0.28, 22.60]</td>
</tr>
<tr>
<td>Garcia et al., 2008</td>
<td>0</td>
<td>108</td>
<td>7</td>
<td>1185</td>
<td>5.2%</td>
<td>0.72 [0.04, 12.76]</td>
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<td>Jaffer et al., 2010</td>
<td>1</td>
<td>229</td>
<td>3</td>
<td>263</td>
<td>8.2%</td>
<td>0.38 [0.04, 3.68]</td>
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<tr>
<td>Marquie et al., 2006</td>
<td>0</td>
<td>114</td>
<td>2</td>
<td>114</td>
<td>4.6%</td>
<td>0.20 [0.01, 4.14]</td>
</tr>
<tr>
<td>McBane et al., 2010</td>
<td>10</td>
<td>514</td>
<td>6</td>
<td>513</td>
<td>40.5%</td>
<td>0.84 [0.30, 2.35]</td>
</tr>
<tr>
<td>Tompkins et al., 2010</td>
<td>1</td>
<td>155</td>
<td>6</td>
<td>513</td>
<td>9.4%</td>
<td>0.55 [0.07, 4.59]</td>
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<tr>
<td>Varkarakis et al., 2005</td>
<td>0</td>
<td>25</td>
<td>3</td>
<td>762</td>
<td>4.7%</td>
<td>4.25 [0.21, 84.56]</td>
</tr>
<tr>
<td>Wysokinski et al., 2008</td>
<td>3</td>
<td>204</td>
<td>4</td>
<td>182</td>
<td>18.6%</td>
<td>0.66 [0.15, 3.01]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>1691</strong></td>
<td><strong>3493</strong></td>
<td><strong>100.0%</strong></td>
<td></td>
<td></td>
<td><strong>0.80 [0.42, 1.54]</strong></td>
</tr>
<tr>
<td><strong>Total events</strong></td>
<td><strong>19</strong></td>
<td><strong>32</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.00; \text{Chi}^2 = 3.68, \text{df} = 7 (P = 0.82); I^2 = 0%$
Test for overall effect: $Z = 0.67 (P = 0.50)$
BRIDGE trial

- Randomized double blinded placebo controlled non-inferiority trial of NVAF patients undergoing VKA interruption
- 1884 patients, avg CHADS2=2.3 (intermediate TE risk)
- Randomized to LMWH (Dalteparin) or placebo
- Primary endpoints were arterial TE and major bleeding
- Rate of arterial TE in placebo was non-inferior to bridging (0.4% vs 0.3%, p=0.1 for non-inferiority)
- Rate of major bleeding in placebo was less than bridging (0.3% vs 3.2%, p=.005)
- Rate of minor bleeding in placebo was less than bridging (12% vs 20.9%, p=0.001)
- No difference in MI, DVT, PE, or death

PERIOP2

- Randomized double-blinded placebo controlled, multicenter Canadian trial of postop patients at high risk for arterial TE (10/2006-5/2016)
- 1471 patients with mechanical heart valves (304) and AF (1167) with higher CHADS2
- Randomized to LMWH (Dalteparin) or placebo
- Primary end-point is major TE event, including CVA, MI, systemic embolism, VTE, or vascular death.
- Presented American Society Hematology 12/2/2018
- No TE benefit to postop LMWH bridging in these higher TE risk patients either
- NOT YET PUBLISHED
Direct Acting Oral Anticoagulants (DOACs)

- Dabigatran (2010)
  - RE-LY
  - RE-COVER
  - RE-MEDY

- Rivaroxaban (2011)
  - ROCKET-AF
  - EINSTEIN
  - COMPASS

- Apixaban (2012)
  - ARISTOLE
  - AMPLIFY
  - AVERROES

- Edoxaban (2015)
  - ENGAGE – AF TIMI 48
  - HOKUSAI – VTE
Mechanism(s) of Action
DOACs

• Three considerations to factor into decisions:
  • No readily available/reliable lab tests to confirm absence of residual anticoagulant effect
  • DOAC half lives and elimination differ by drug
  • DOACs have rapid onset of action with peak effect in 1-2 hours

• Therefore DOAC perioperative management is more highly influenced by:
  • Drug specific half life/elimination
  • Renal function and effect on half life/elimination
  • Bleeding risk for procedure
  • Spinal/epidural anesthesia or NOT
DOACs

- There were interruption rates of 25% (RE-LY), 33% (ROCKET-AF), 34% (ARISTOLE)
- No increased TE or bleeding events, whether patients were bridged or not
- Less clear about continuing DOACs uninterruptedly in low bleeding risk procedures than with VKA
- Bridging with UFH/LMWH generally not indicated
- Less clear about when to restart DOACs postoperatively than with VKA due to rapid onset of action (peak concentration 1-2 hours)
- Interruption and Resumption are all about CrCl
- No randomized prospective trials published yet, but PAUSE trial presented 12/2018 with proposed algorithm
Peri-procedural DOAC options

<table>
<thead>
<tr>
<th></th>
<th>LOW TE RISK</th>
<th>MODERATE TE RISK</th>
<th>HIGH TE RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOW BLEEDING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RISK</td>
<td>DOAC hold:</td>
<td>DOAC hold:</td>
<td>DOAC hold:</td>
</tr>
<tr>
<td></td>
<td><em>MAYBE</em></td>
<td><em>MAYBE</em></td>
<td><em>MAYBE</em></td>
</tr>
<tr>
<td>Bridging:</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td><strong>MODERATE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLEEDING RISK</td>
<td>DOAC hold:</td>
<td>DOAC hold:</td>
<td>DOAC hold:</td>
</tr>
<tr>
<td></td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Bridging:</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td><strong>HIGH</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLEEDING RISK</td>
<td>DOAC hold:</td>
<td>DOAC hold:</td>
<td>DOAC hold:</td>
</tr>
<tr>
<td></td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Bridging:</td>
<td>NO</td>
<td>NO</td>
<td><em>MAYBE</em>*</td>
</tr>
</tbody>
</table>
Table 4 Summary of recent propositions for perioperative management of DOACs

<table>
<thead>
<tr>
<th>DOAC</th>
<th>Bleeding risk of invasive procedure</th>
<th>Dabigatran</th>
<th>Rivaroxaban - Apixaban</th>
<th>Edoxaban</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LOW</td>
<td>HIGH</td>
<td>LOW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bleeding risk</td>
<td>Bleeding risk</td>
<td>Bleeding risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low dose</td>
<td>Last dose</td>
<td>Last dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 24 h before surgery</td>
<td>4 days before surgery</td>
<td>3 days before surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CrCl &gt; 50 mL/min</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last dose</td>
<td>5 days before surgery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For very high risk procedure (neuraxial anaesthesia)</td>
<td></td>
<td>Last dose</td>
<td>5 days before surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resumption after invasive procedure or surgery</td>
<td>Low Bleeding Risk</td>
<td>Resume minimum 6 h after invasive procedure or surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Prophylactic dose of LMWH, UFH or fondaparinux minimum 6 h after invasive procedure or surgery if venous thromboprophylaxis is indicated</td>
<td>Therapeutic dose of DOACs when hemostasis is controlled (24-72 h)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No official indication for use</td>
<td>No official indication for use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CrCl 2.80 mL/min</td>
<td>≥ 24 h</td>
<td>≥ 48 h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CrCl 5.0-80 mL/min</td>
<td>≥ 36 h</td>
<td>≥ 72 h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CrCl 5.0-50 mL/min</td>
<td>≥ 48 h</td>
<td>≥ 96 h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CrCl 15-30 mL/min</td>
<td>Not indicated</td>
<td>Not indicated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CrCl &lt;15 mL/min</td>
<td>No official indication for use</td>
<td>No official indication for use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spyropoulos et al.</td>
<td>Preoperative interruption</td>
<td>No bridging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CrCl &gt; 50 mL/min</td>
<td>Last dose 2 days before surgery</td>
<td>Last dose 3 days before surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CrCl 5.0-50 mL/min</td>
<td>Last dose 4-5 days before surgery</td>
<td>Last dose 3 days before surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CrCl 5.0-29 mL/min</td>
<td>Depends on patient and procedural factors</td>
<td>Depends on patient and procedural factors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resumption after invasive procedure or surgery</td>
<td>Low Bleeding Risk</td>
<td>Resume DOACs 48-72 h after procedure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low TE risk → resume DOACs 48-72 h after procedure</td>
<td>High TE risk → prophylactic or intermediate dose of LMWH 6-8 h after procedure, resume DOACs when hemostasis is controlled (48-72 h)</td>
</tr>
</tbody>
</table>

CrCl: creatinine clearance, LMWH: low molecular weight heparin, UFH: unfractionated heparin, TE: thrombo-embolic
# How to interrupt/restart DOACs

## Preprocedure Interruption

<table>
<thead>
<tr>
<th>CrCL (mL/min)</th>
<th>High bleeding-risk procedure</th>
<th>Low bleeding-risk procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apixaban</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;50</td>
<td>2-3 days (4-5 doses)</td>
<td>1 day (2 doses)</td>
</tr>
<tr>
<td>15-49</td>
<td>3-4 days (6-7 doses)</td>
<td>2 days (3-4 doses)</td>
</tr>
<tr>
<td>Edoxaban</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;50</td>
<td>2 days (2 doses)</td>
<td>1 day (1 dose)</td>
</tr>
<tr>
<td>30-49</td>
<td>2-3 days (2-3 doses)</td>
<td>1-2 days (1-2 doses)</td>
</tr>
<tr>
<td>15-29</td>
<td>3-4 days (5-6 doses)</td>
<td>2 days (3-4 doses)</td>
</tr>
<tr>
<td><strong>Rivaroxaban</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;80</td>
<td>2 days (2 doses)</td>
<td>1 day (1 dose)</td>
</tr>
<tr>
<td>30-80</td>
<td>2-3 days (2-3 doses)</td>
<td>1-2 days (1-2 doses)</td>
</tr>
<tr>
<td>15-29</td>
<td>2-3 days (2-3 doses)</td>
<td>1-2 days (1-2 doses)</td>
</tr>
<tr>
<td><strong>Dabigatran</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;80</td>
<td>3 days (5-6 doses)</td>
<td>1 day (2 doses)</td>
</tr>
<tr>
<td>50-79</td>
<td>3-4 days (6-7 doses)</td>
<td>1-2 days (3-4 doses)</td>
</tr>
<tr>
<td>30-49</td>
<td>3-4 days (7-8 doses)</td>
<td>2-3 days (3-4 doses)</td>
</tr>
<tr>
<td>15-29</td>
<td>5-6 days (9-12 doses)</td>
<td>3-4 days (5-7 doses)</td>
</tr>
</tbody>
</table>

## Postprocedure Resumption

<table>
<thead>
<tr>
<th></th>
<th>Any</th>
<th>48-72 hours</th>
<th>24 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All drugs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Timing assumes good control of postoperative hemostasis and should be adjusted based for postprocedure bleeding. Information is provided at creatinine clearance (CrCl) levels Administration's approval for use, as CrCl in individual patients may have decreased from value at medication initiation (due to new illnesses, etc.).*
Still confused? There’s an app for that...

- **Plan Periprocedural Interruption and Bridging**
  - View Details

- **Address an Acute Bleed**
  - View Details

- **Determine Anticoag Restart**
  - View Details

**Determine Anticoag Restart**

- **Restarting Anticoagulation Suggested**
  - Choose OAC agent
    Consider switching agent if a reversible cause related to the OAC agent contributed to the bleed. For instance, a patient on warfarin with a history of labile INR values who had a hemorrhagic complication with an elevated INR may benefit from a DOAC, or a patient with a decrement in renal function who had a bleeding complication on a DOAC may benefit from a change to warfarin. However, it is beyond the scope of this app to recommend specific agents for individual patients.
  - Note: In most cases of GI bleeding, the writing committee favors reinitiation of anticoagulation in patients with an indication for OAC once bleeding has been controlled (including patients in whom no discrete source of bleeding was identified) and adequate time has elapsed to allow for healing. This will depend on the nature and type of the bleeding lesion. See full source document for more details.

- Determining the appropriateness of the drug (source)
Or if you like ACC guidelines and flow charts instead of tables...
WHETHER TO INTERRUPT VKA THERAPY

**Increased patient bleed risk?**

**Yes**

**Procedural bleed risk?**

- **Intermediate or high**
  - Insufficient data on best practices; likely interrupt but consult with proceduralists.
  - Use clinical judgment: Persistent concern for bleeding?
    - **No**
      - Perform the procedure uninterrupted. Exit the pathway.
    - **Yes**
      - Interrupt

- **Not clinically important or low**
  - Perform the procedure uninterrupted. Exit the pathway.

**No**

**Procedural bleed risk?**

- **Intermediate or high**
  - Interrupt
- **Uncertain**
  - Perform the procedure uninterrupted. Exit the pathway.
- **Uncertain**
  - Perform the procedure uninterrupted. Exit the pathway.

Assess patient bleed risk checklist

Bleed risk considered increased if any 1 of the following: major bleed or ICH <3 months; quantitative or qualitative platelet abnormality, including aspirin use, INR above therapeutic range; prior bleed during previous bridging or similar procedure.
WHETHER TO INTERRUPT DOAC THERAPY

Assess patient bleed risk checklist
Bleed risk considered increased if any 1 of the following: major bleed or ICH <3 months; quantitative or qualitative platelet abnormality, including aspirin use; prior bleed during previous bridging.

CONSIDERATIONS

Increased patient bleed risk?

No

Yes

Procedural bleed risk?

No clinically important risk

Low

Uncertain, intermediate, or high

GUIDANCE

Perform the procedure uninterrupted, but time it at DOAC interval trough.

INTERRUPT

INTERRUPT

INTERRUPT
WHETHER TO BRIDGE

1. Assess patient bleed risk checklist
   - Bleed risk considered increased if any 1 of the following: major bleed or ICH <3 months; quantitative or qualitative platelet abnormality including aspirin use, INR above therapeutic range; prior bleed from previous bridging

2. Assess patient thrombotic risk definitions:
   - Low: CHA₂DS₂-VASc 1-4 (annualized stroke risk <5%), no prior TE
   - Moderate: CHA₂DS₂-VASc 5-6 (annualized stroke risk 5-10%) or prior TE more than 3 months previously
   - High: CHA₂DS₂-VASc 7+ (annualized stroke risk >10%) or prior TE within 3 months

CONSIDERATIONS

Type of anticoagulant?
- DOAC
- VKA

Thrombotic risk?
- Low
- Moderate
- High

Recent TE <3 months?
- Yes
- No

Increased patient bleed risk?
- Yes
- No

Prior stroke or TIA?
- No
- Yes

Major bleed or ICH <3 months?
- Yes
- No

Address other factors: ASA, high INR. Also consider bleed history.

GUIDANCE

Use of parenteral agent not indicated.
- Likely do not bridge
- Likely bridge

Indication for bridging: strongly consider parenteral agent.

DO NOT BRIDGE

USE CLINICAL JUDGMENT

BRIDGE
**HOW TO RESTART ANTICOAGULATION**

**CONSIDERATIONS**

1. Original anticoagulant?
   - No: Cardiac valve surgery?
     - No: Complete hemostasis achieved, with no bleeding complications, no high-bleed-risk features of the patient, and absence of a potentially catastrophic bleed location (intracranial, intraspinal)
     - Yes: DoAC
       - No: Can the patient tolerate oral medications?
         - No: Postprocedural bleed risk?
           - High: Use clinical judgment.*
           - Low: Consider parenteral anticoagulation until oral medications are possible. Start parenteral agent 48-72hrs following the procedure.† When tolerating oral medications, convert from parenteral agent to DOAC.
         - Yes: Postprocedural bleed risk?
           - High: Consider delaying reinitiation of anticoagulation; use clinical judgment.*
           - Low: Reasonable to reinitiate DOAC within 48-72hrs after the procedure.**
   - Yes: VKA
     - No: Complete hemostasis achieved, with no bleeding complications, no high-risk features of the patient, and no potentially catastrophic bleed location (intracranial, intraspinal)
     - Yes: Plan or indication to administer parenteral agent after procedure?
       - No: Start VKA within 24hrs.*
       - Yes: Start VKA within 24hrs. Restart parenteral agent if applicable 48-72hrs following the procedure. Discontinue parenteral agent when INR reaches 2.

**GUIDANCE**

* In cooperation with the managing team and the proceduralist
† At a dose based on postprocedural renal function
Antiplatelet Mechanism(s) of Action
CENTRAL ILLUSTRATION: Recommendations for Dual Antiplatelet Therapy in Patients Undergoing Percutaneous Coronary Intervention


Key:
- BMS: Bare metal stent
- DES: Drug-eluting stent
- DCB: Drug-coated balloon
- BRS: Bioresorbable scaffold
# Thrombotic Risk

## Table 1: Determination of Thrombotic Risk

<table>
<thead>
<tr>
<th>Low Risk (&lt;1%)*</th>
<th>Intermediate Risk (1%–5%)*</th>
<th>High Risk (&gt;5%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;4 weeks after PCI with POBA</td>
<td>&gt;2 weeks and ≤4 weeks after PCI with POBA</td>
<td>≤1 month after PCI with BMS</td>
</tr>
<tr>
<td>&gt;6 months after PCI with BMS</td>
<td>&gt;1 month and ≤6 months after PCI with BMS</td>
<td>≤6 months after PCI with DES</td>
</tr>
<tr>
<td>&gt;12 months after PCI with DES</td>
<td>&gt;6 months and ≤12 months after PCI with DES</td>
<td>≤12 months after complex PCI with DES</td>
</tr>
<tr>
<td></td>
<td>&gt;12 months after complex PCI with DES (long stents, multiple stents, overlapping small vessels, bifurcations, left main, last remaining vessel)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤6 months after PCI for MI Previous ST</td>
<td></td>
</tr>
</tbody>
</table>

*30-day ischemic event rates of cardiovascular death and MI (20).

**BMS** – bare-metal stent(s); **DES** – drug-eluting stent(s); **MI** – myocardial infarction; **PCI** – percutaneous coronary intervention; **POBA** – plain old balloon angioplasty; **ST** – stent thrombosis.

**Acute stent thrombosis (AST) is the ENEMY!!!**
### TABLE 4
Clinical and Procedural Factors Associated With Increased Ischemic Risk (Including Stent Thrombosis) or Increased Bleeding Risk (62-70)

<table>
<thead>
<tr>
<th>Increased Ischemic Risk/Risk of Stent Thrombosis (may favor longer-duration DAPT)</th>
<th>Increased Bleeding Risk (may favor shorter-duration DAPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased ischemic risk</td>
<td>History of prior bleeding</td>
</tr>
<tr>
<td>Advanced age</td>
<td>Oral anticoagulant therapy</td>
</tr>
<tr>
<td>ACS presentation</td>
<td>Female sex</td>
</tr>
<tr>
<td>Multiple prior MIs</td>
<td>Advanced age</td>
</tr>
<tr>
<td>Extensive CAD</td>
<td>Low body weight</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>CKD</td>
</tr>
<tr>
<td>CKD</td>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>Increased risk of stent thrombosis</td>
<td>Anemia</td>
</tr>
<tr>
<td>ACS presentation</td>
<td>Chronic steroid or NSAID therapy</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td></td>
</tr>
<tr>
<td>Left ventricular ejection fraction &lt;40%</td>
<td></td>
</tr>
<tr>
<td>First-generation drug-eluting stent</td>
<td></td>
</tr>
<tr>
<td>Stent undersizing</td>
<td></td>
</tr>
<tr>
<td>Stent underdeployment</td>
<td></td>
</tr>
<tr>
<td>Small stent diameter</td>
<td></td>
</tr>
<tr>
<td>Greater stent length</td>
<td></td>
</tr>
<tr>
<td>Bifurcation stents</td>
<td></td>
</tr>
<tr>
<td>In-stent restenosis</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 5
Factors Used to Calculate a “DAPT Score”

<table>
<thead>
<tr>
<th>Variable</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥75 y</td>
<td>-2</td>
</tr>
<tr>
<td>Age 65 to &lt;75 y</td>
<td>-1</td>
</tr>
<tr>
<td>Age &lt;65 y</td>
<td>0</td>
</tr>
<tr>
<td>Current cigarette smoker</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>MI at presentation</td>
<td>1</td>
</tr>
<tr>
<td>Prior PCI or prior MI</td>
<td>1</td>
</tr>
<tr>
<td>Stent diameter &lt;3 mm</td>
<td>1</td>
</tr>
<tr>
<td>Paclitaxel-eluting stent</td>
<td>1</td>
</tr>
<tr>
<td>CHF or LVEF &lt;30%</td>
<td>2</td>
</tr>
<tr>
<td>Saphenous vein graft PCI</td>
<td>2</td>
</tr>
</tbody>
</table>

A score of ≥2 is associated with a favorable benefit/risk ratio for prolonged DAPT while a score of <2 is associated with an unfavorable benefit/risk ratio. Adapted with permission from Yeh et al. (61).

ACS indicates acute coronary syndrome; CAD, coronary artery disease; CKD, chronic kidney disease; DAPT, dual antiplatelet therapy; MI, myocardial infarction; and NSAID, nonsteroidal anti-inflammatory drug.
<table>
<thead>
<tr>
<th></th>
<th>LOW THROMBOSIS RISK</th>
<th>MODERATE THROMBOSIS RISK</th>
<th>HIGH THROMBOSIS RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW BLEEDING</td>
<td>P2Y12 hold: MAYBE</td>
<td>Delay surgery?</td>
<td>P2Y12 hold: NO</td>
</tr>
<tr>
<td>RISK</td>
<td>Bridging: NO</td>
<td></td>
<td>Bridging: NO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODERATE</td>
<td>P2Y12 hold: YES</td>
<td>Delay surgery?</td>
<td>P2Y12 hold: YES</td>
</tr>
<tr>
<td>BLEEDING</td>
<td>Bridging: NO</td>
<td></td>
<td>Bridging: MAYBE</td>
</tr>
<tr>
<td>RISK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH BLEEDING</td>
<td>P2Y12 hold: YES</td>
<td>Delay surgery?</td>
<td>P2Y12 hold: YES</td>
</tr>
<tr>
<td>RISK</td>
<td>Bridging: NO</td>
<td></td>
<td>Bridging: MAYBE</td>
</tr>
</tbody>
</table>
FIGURE 6  Treatment Algorithm for the Timing of Elective Noncardiac Surgery in Patients With Coronary Stents

Patients Treated With PCI Undergoing Elective Noncardiac Surgery

BMS treated with DAPT

0 d

30 d since BMS implantation

<30 d

Class III: Harm
Delay surgery

≥30 d

Class I:
Proceed with surgery

DES treated with DAPT

3 mo since DES implantation

<3 mo since DES implantation

Class III: Harm
Delay surgery

≥6 mo since DES implantation, discontinue DAPT

3-6 mo since DES implantation, discontinue DAPT; delayed surgery risk is greater than stent thrombosis risk

Class IIIb: Proceeding with surgery may be considered

≥6 mo since DES implantation, discontinue DAPT

Class I:
Proceed with surgery
How to interrupt/restart DAPT

• Continue low dose ASPIRIN 81 mg daily peri-procedure without interruption
• Stop CLOPIDOGREL 5-7 days before surgery
• Stop PRASUGREL 7-10 days before surgery
• Stop TICAGRELOR 3-5 days before surgery
• Re-LOAD after hemostasis achieved 4-6h for low bleeding risk procedures or high thrombosis risk and >24h for high bleeding risk and acceptable thrombosis risk
• Consider bridging in high thrombosis risk patient
Bridging for DAPT

• **UFH/LMWH**
  - Primary mechanism of AST is platelet aggregation not activation of clotting cascade
  - No benefit, and actually may be pro-thrombotic
  - Increased bleeding
  - Could consider if also plan to interrupt OAC/DOAC

• **GP IIb/IIIa inhibitors**
  - NO DATA, especially in non-cardiac surgeries
  - Theoretically works by inhibiting platelet aggregation and reducing AST
  - Tirofiban (Aggrastat), (T1/2 = 2h)
  - Eptifibatide (Integrillin) (T1/2 = 2.5h)
  - Cangrelor (T1/2 = 3-5 minutes)
-MUST CONTINUE LOW DOSE ASPIRIN
-RE-LOAD P2Y12 POST PROCEDURE
Special Bridging Consideration: Sub-therapeutic Prosthetic Valves

1. **If INR is < 1 INR value from the lower limit of goal INR range:**
   - Protocol not required, adjust warfarin and recheck INR in 3-5 days.
   - If INR remains subtherapeutic for the second consecutive visit start the bridging protocol

2. **If INR is ≥ 1 INR value from the lower limit of goal INR range:**
   - **Bioprosthetic valve:**
     - Protocol not required, adjust warfarin and recheck INR in 3-5 days.
   - **Mechanical Valve:**
     - **Aortic**
       - High risk
         - Caged ball or single tilting disk
         - Bi-leaflet tilting disk plus any of the following risk factors: AF, previous thromboembolism, LV systolic dysfunction, or hypercoagulable conditions
         - Initiate LMWH bridge and adjust warfarin; Recheck INR in 3-5 days
       - Low risk
         - Bi-leaflet tilting disk with no additional risk factors above
         - Protocol not required, adjust warfarin and recheck INR in 3-5 days.
     - **Mitral (any)**
       - Initiate LMWH bridge and adjust warfarin; Recheck INR in 3-5 days
Summary/Observations

- Peri-procedural management of anticoagulation/antiplatelet is very common, but clinical practice remains widely variable
- Definition of truly low and truly high risk bleeding risk procedures still up for debate
- Thromboembolic (TE) events are rare
- In general bridging = more bleeding
- VKA is interrupted too often
- VKA is bridged too often
- DOACs are generally interrupted given short half life pre-op and rapid onset of action post-op
- DOACs interruption timing variable. Check pharmakinetics/CrCl
- DOACs rarely require bridging
- DAPT should never be interrupted <6 wk after DES
- DAPT can be interrupted >6 mo DES, can be considered >3 mo
- DAPT bridging is not validated. Use GP IIb/IIIa if high bleeding and thrombosis risks
- Spinal/epidural anesthesia is its own category of risk
Case 1 --- Mary

• 80F with **Chronic Atrial Fibrillation** on **APIXABAN** on a background PMH of remote CVA + DM. CrCl 40. She is scheduled to have *single dental extraction* with local anesthesia.

  - Do you interrupt APIXABAN?
    - Yes/No. Hold AM dose day of procedure. Resume in PM. Moderate TE risk for low bleeding risk procedure
  - Do you bridge APIXABAN? If so, how?
    - No
  - What if instead she was on VKA instead of APIXABAN?
    - Stay on VKA without interruption
  - What if instead she was having full upper teeth extraction?
    - Hold APIXABAN 2 days prior to procedure. Resume in PM vs next AM. Moderate TE risk for moderate bleeding risk procedure.
  - What if instead a recent TEE (<2 weeks ago) showed left atrial appendage thrombus?
    - Postpone procedure and remain on uninterrupted APIXABAN.
Case 2 --- Harry

• 70M with recent Pulmonary Embolism (~4 weeks ago) on **RIVAROXABAN** on a background PMH of renal cell carcinoma + HTN + Tobacco abuse. CrCl 35. He is scheduled to have *right nephrectomy* with general anesthesia.

• Do you interrupt **RIVAROXABAN**?
  • No. High TE risk for high bleeding risk procedure. Delay procedure if possible until PE treated >3 mo. If procedure absolutely necessary now then stop **RIVAROXABAN** 3 days prior to procedure

• Do you bridge **RIVAROXABAN**? If so, how?
  • Yes, if procedure cannot be delayed bridging may be indicated with LMWH

• What if instead he was on **WARFARIN (VKA)**?
  • Same plan to delay procedure if possible. If necessary now would need bridging with LMWH

• What if instead he had remote DVT (>12 mo)
  • Yes interrupt **RIVAROXABAN** 3 days prior to procedure. Moderate TE risk for high bleeding risk procedure. No bridging necessary

• What if instead it was basal cell carcinoma and he was scheduled for outpatient dermatologic excision?
  • Hold **RIVAROXABAN** the day of the procedure and resume in PM. Low TE risk and low bleeding risk procedure
Case 3 --- Teri

- 50F with Congenital Aortic Stenosis s/p Bi-leaflet Mechanical Aortic Valve Replacement on **WARFARIN** on a background PMH of HTN + TIA. CrCl 70. She is scheduled to have *left knee arthroscopic surgery* with general anesthesia.

- **Do you interrupt WARFARIN?**
  - No interruption. Moderate TE risk with low bleeding risk surgery. Consider reduced INR protocol peri-op.

- **Do you bridge WARFARIN? If so, how?**
  - No bridging indicated.

- **What if instead she had Mechanical MVR?**
  - No interruption. High TE risk for low bleeding risk surgery

- **What if instead she was having total hip replacement?**
  - If mech AVR, yes interruption. Mod TE risk for high bleeding risk surgery. Consider bridging with LMWH
  - If mech MVR, yes interruption. High TE risk for high bleeding risk surgery. Yes to bridging with LMWH vs UFH
Case 4 --- Larry

• 60M with Coronary Artery Disease s/p recent DES proximal LAD (~6 weeks ago) in setting of ACS/NSTEMI, on PRASUGREL and low dose ASPIRIN. He is scheduled to have outpatient cataract surgery.

• Do you interrupt PRASUGREL and/or ASPIRIN?
  • No. High Ischemic/AST risk for low bleeding risk. Either do procedure on DAPT or postpone procedure

• Do you bridge? If so, how?
  • No bridging indicated unless it was mandatory high risk bleed procedure instead of low bleed risk cataract surgery

• What if instead he had BMS proximal LAD (~8 weeks ago)?
  • Remain on DAPT. It moderate ischemic/AST risk for low bleeding risk procedure. If it was moderate bleeding risk advanced eye surgery could consider holding PRASUGREL and continuing ASPIRIN

• What if instead he was having total colectomy for colon CA?
  • Postpone procedure if possible. High Ischemic/AST risk for high bleeding risk procedure. If cannot postpone stop PRASUGREL 7 days prior to procedure, continue ASPIRIN, and consider bridging with GP IIb/IIIa
Case 5 --- Barry

• 90M with Rheumatic Heart Disease s/p Mechanical Mitral Valve Replacement on **WARFARIN** on a background of DM + CVA + chronic AF + dementia. He got his pill box mixed up and missed a week’s worth of his WARFARIN. His INR is 1.1

• Do you bridge WARFARIN. If so, how?
  • Yes. His goal INR is 2.5-3.5. Bridge with LMWH

• Does he warrant hospitalization for bridging?
  • Yes if using UFH instead of LMWH or if he has any signs of valve thrombosis or heart failure. This is a source of debate.

• What if instead his INR was 2.2?
  • Bridging not indicated. Increase VKA dose and recheck INR 3-5 days

• What if instead he had bioprosthetic AVR?
  • Bridging not indicated though it would not be unreasonable if thought to be high TE risk or if prior CVA was during sub-therapeutic INR
Tom is a 68 year old male on WARFARIN with plans to undergo elective total hip replacement. Which of the following additional clinical findings would NOT mandate peri-operative “bridging” with LMWH/UFH if WARFARIN interrupted?

- Mechanical mitral valve prosthesis
- Venous thromboembolism within last 3 months
- Atrial fibrillation with TIA within last 3 months
- Atrial fibrillation with longstanding Diabetes II
Checklist for Peri-operative Management of Anticoagulation/Anti-platelets

✓ Re-evaluate urgency/timing of planned elective surgery
✓ Re-evaluate patient specific indication(s) for their current anticoagulation/antiplatelet
✓ Estimate surgery-specific bleeding risk(s)
✓ Estimate patient-specific bleeding risk(s)
✓ Estimate baseline thromboembolic (TE)/thrombosis risk and risk with interruption of anticoagulation/antiplatelet
✓ Weigh bleeding vs thromboembolic (TE)/thrombosis risk
✓ Determine timing of anticoagulation/antiplatelet interruption and resumption if interruption indicated
✓ Determine whether or not bridging is indicated
✓ Communicate plan with multi-disciplinary team
Questions???
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Spotlight: Primary Care