Cardiology Update for the Non-Cardiologist

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Topics for today

• Management of NSTEMI with a focus on current and future oral anti-platelet therapies
• Duration of anti-platelet therapy after coronary stenting
• Timing of elective non-cardiac surgery after coronary stenting
• Proton pump inhibitors and Clopidogrel
• Platelet function testing and genetic testing for Clopidogrel "responsiveness"

Case 1

A 76-year-old female with a history of hypertension, diabetes, chronic renal insufficiency, and arthritis of her knees presents to the ED 4 hours after the onset of substernal chest pain with radiation to the left arm and jaw. After two sublingual nitroglycerin tablets, the patient is free of chest pain.

Electrocardiography reveals 2-mm ST-segment depressions in the precordial leads.
Case 1 (cont’d)

- BP 136/80, HR 78, RR 16, Sats 94%
- Exam with no heart failure; + S4
- Aspirin (325 mg) is given.
- The initial troponin I level is elevated at 2 ng/mL.
- Lipids pending.

Case 1 (cont’d): How would you manage this patient next?

1. Load Clopidogrel, start unfractionated heparin and call cardiology for cath
2. Load Prasugrel, start unfractionated heparin and call cardiology for cath
3. Start unfractionated heparin; perform cath right away before deciding to start clopidogrel or prasugrel
4. None of the above

Teaching Points to Cover

- Review management strategies for non-ST elevation MI
- Review choices and indications for the approved oral anti-platelet therapies
- Update novel drugs on the horizon
Initial Steps in NSTEMI ACS Management

1. Assess Likelihood of CAD
2. Risk stratification
3. Target therapy: More aggressive Rx in higher risk Pts
4. Anti-ischemic, Anti-platelet, and Antithrombotic Rx
5. Invasive vs. Conservative Strategy

Likelihood of ACS Secondary to CAD

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Likelihood</th>
<th>Intermediate Likelihood</th>
<th>Low Likelihood</th>
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<tbody>
<tr>
<td>History</td>
<td>Typical angina</td>
<td>Probable angina</td>
<td>Atypical symptoms</td>
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<tr>
<td>Known hx of CAD,</td>
<td>Known hx of CAD,</td>
<td>Age&gt;70 years</td>
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<tr>
<td>including MI</td>
<td>including MI</td>
<td>Main DMtr</td>
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<tr>
<td>Examination</td>
<td>CHF</td>
<td>PVB, CVA</td>
<td>Pain on palpation</td>
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<td>ECG</td>
<td>New ECG Δs</td>
<td>Old ECG abnormalities</td>
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<tr>
<td>Cardiac Markers</td>
<td>Normal</td>
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</table>

TIMI Risk Score For UA/NSTEMI

7 Independent Predictors

1. Age ≥ 65 years
2. ≥ 3 CAD risk factors (high cholesterol, family history, hypertension, diabetes, smoking)
3. Prior coronary artery disease (stenosis > 50 %)
4. ST-segment deviation on the ECG
5. ≥ 2 anginal events ≤ 24 hours
6. ASA in last 7 days
7. Elevated cardiac biomarkers (troponin or CK-MB)

TIMI Risk Score For UA/NSTEMI

UFH Group TIMI 11B (N= 1957)

χ² trend P <0.001

<table>
<thead>
<tr>
<th>Number of Risk Factors</th>
<th>D/MI/Revasc (%)</th>
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<tr>
<td>% Pts:</td>
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<td>4.3</td>
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<td>13.0</td>
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<td>3.4</td>
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**EARLY INVASIVE STRATEGY**

### Class I Indications

- Any of the high-risk indicators
- Recurrent angina at rest/low level activity despite Rx
- Elevated Troponin
- New ST-segment depression
- Recurrent angina/ischemia with CHF symptoms
- Positive stress test
- EF <0.40
- ↓ BP
- Sustained VT
- PCI <6 months, prior CABG

**Milestones in ACS Management**

<table>
<thead>
<tr>
<th>Year</th>
<th>PRISM-PLUS</th>
<th>NAPLES II</th>
<th>PURSUIT</th>
<th>PURSUIT PLUS</th>
<th>PRISM-TIMI 15</th>
<th>TACTICS TIMI-18</th>
<th>SYNERGY</th>
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</tbody>
</table>

**TACTICS: Troponin T: at 6 months**

- **Death, MI, Rehosp ACS at 6 Months**
  - CONS
  - INV
  - OR=0.52, p=0.001
  -Interaction P=0.001

  TnT cut point = 0.01 ng/ml  (54% of Pts TnT+)

<table>
<thead>
<tr>
<th></th>
<th>CONS</th>
<th>INV</th>
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<tbody>
<tr>
<td>(%)</td>
<td>N=414</td>
<td>N=396</td>
</tr>
<tr>
<td>p=NS</td>
<td>N=463</td>
<td>N=495</td>
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</table>

**TACTICS: TIMI UA Risk Score at 6 months**

- **Death/MI/ACS Rehosp (%)**

- **% of Pts:**
  - Low: 25%
  - Intermed.: 60%
  - High: 15%

- **TIMI Risk Score**
  - Low: 0-2
  - Intermed.: 3-4
  - High: 5-7

- **OR=0.76, CI (0.57, 1.00)**

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Adapted from and with the courtesy of Steven Manoukian, MD.

UCSF, Department of Medicine, CME
ICTUS: Major results at one year

<table>
<thead>
<tr>
<th>End point</th>
<th>Early invasive strategy (%)</th>
<th>Selective invasive strategy (%)</th>
<th>p</th>
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<tbody>
<tr>
<td>Death/MI/</td>
<td>22.7</td>
<td>21.2</td>
<td>NS</td>
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<tr>
<td>rehospitalization for angina</td>
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<td></td>
<td></td>
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<tr>
<td>Death</td>
<td>2.5</td>
<td>2.5</td>
<td>NS</td>
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<tr>
<td>MI</td>
<td>15.0</td>
<td>10.0</td>
<td>0.005</td>
</tr>
<tr>
<td>Rehospitalization for angina</td>
<td>7.4</td>
<td>10.9</td>
<td>0.04</td>
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</table>


Teaching Points to Cover

- Review management strategies for non-ST elevation MI
- Review choices and indications for the approved oral anti-platelet therapies
- Update novel drugs on the horizon
Platelet-mediated Thrombosis Targets

GP = glycoprotein; vWF = von Willebrand factor; ADP = adenosine diphosphate; TXA = thromboxane.

No currently approved antiplatelet agents specifically target Adhesion.

Most approved antiplatelet agents affect different aspects of platelet Activation.

GP I b/IIIa inhibitors inhibit the "final common pathway" Aggregation.

LANCELOT-ACS


Platelet Activation

Platelet

ADP

Thrombin

PAR-1

P2Y12

TXA2

Aspirin

Collagen

P2Y12

Inhibition:

Clopidogrel

Ticlodipine

Prasugrel

Ticagrelor

Eliquis

Aspirin

cAMP

Oral Anti-Platelet Therapies

Timing of Antiplatelet Therapy in UA/NSTEMI

New Recommendation

Patients with definite or likely UA/NSTEMI selected for an invasive approach should receive dual antiplatelet therapy.
Aspirin should be initiated on presentation.
Clopidogrel (before or at the time of PCI) or prasugrel (at the time of PCI) is recommended as a second antiplatelet agent.

Please see Important Safety Information, including Boxed Warning, and Full Prescribing Information provided.
Efficacy Endpoints: Composite Endpoint and Components at End of Trial

Rates of Stent Thrombosis Over Time: Prasugrel Compared With Clopidogrel

Non-CABG TIMI Major or Minor Bleeding Risk by Age and Weight

Appropriate Patient Selection

* Based on TRITON-TIMI 38 data, prasugrel appears to be most appropriate for use in patients with ACS managed with PCI who:
  - Have no history of TIA/stroke
  - Are <75 years of age
  - Weigh ≥60 kg (132 lb)
Teaching Points to Cover

- Review management strategies for non-ST elevation MI
- Review choices and indications for the approved oral anti-platelet therapies
- Update novel drugs on the horizon

Ticagrelor

- Oral direct inhibitor of P2Y12 ADP receptor
- Not a pro-drug
- Faster onset and offset than clopidogrel
- PLATO study randomized 18,624 patients with ACS to clopidogrel vs. ticagrelor
  - NEJM 2009 Sep 10;361(11):1045-57
- Recently FDA approved
Adverse effects

<table>
<thead>
<tr>
<th></th>
<th>Ticagrelor N=9,235</th>
<th>Clopidogrel N=9,186</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventricular pauses &gt; 3 sec in first week, %</td>
<td>5.8</td>
<td>3.6</td>
<td>0.01</td>
</tr>
<tr>
<td>Ventricular pauses &gt; 5 sec in first week, %</td>
<td>2.0</td>
<td>1.2</td>
<td>0.10</td>
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<td>Ventricular pauses &gt; 3 sec at 30d, %</td>
<td>2.1</td>
<td>1.7</td>
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<tr>
<td>Ventricular pauses &gt; 5 sec at 30d, %</td>
<td>0.8</td>
<td>0.6</td>
<td>0.60</td>
</tr>
<tr>
<td>Syncope</td>
<td>1.1</td>
<td>0.8</td>
<td>0.08</td>
</tr>
<tr>
<td>Vasomotor instability</td>
<td>0.9</td>
<td>0.9</td>
<td>0.87</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>4.4</td>
<td>4.0</td>
<td>0.21</td>
</tr>
<tr>
<td>Heart failure</td>
<td>0.7</td>
<td>0.7</td>
<td>1.00</td>
</tr>
<tr>
<td>Dyspnea – any</td>
<td>13.8</td>
<td>7.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Dyspnea with discontinuation</td>
<td>0.9</td>
<td>0.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Malignant neoplasms</td>
<td>1.2</td>
<td>1.3</td>
<td>0.60</td>
</tr>
<tr>
<td>Benign neoplasms</td>
<td>0.2</td>
<td>0.4</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Brilinta (Ticagrelor)

“aspirin doses above 100 milligrams per day decrease the effectiveness of the medication.”
**Vorapaxar**

- Protease-activated-receptor 1 (PAR-1) thrombin-receptor antagonist
- Projected to have $5 billion in sales
- TRA-2P (ACS, PAD and Stroke) and TRACER (ACS patients) – two large clinical studies of Vorapaxar (2.5 mg daily dose)
- Clinical trial halted 1/2011 and changes made:
  - “The DSMB has recommended that subjects with a history of stroke not receive Vorapaxar. They have observed an increase in intracranial hemorrhage in patients with a history of stroke that is not outweighed by their considerations of potential benefit.
  - Trial is to continue in the other patients with MI and PAD who have not had a stroke

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**Cardiac Catheterization**

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**Case (cont’ d): How would you manage this patient next?**

1. Load Clopidogrel, start unfractionated heparin and cath
2. Load Prasugrel, start unfractionated heparin and cath
3. Start unfractionated heparin; perform cath right away before deciding to start clopidogrel or prasugrel
4. None of the above

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**Topics for today**

- Management of NSTEMI with a focus on current and future anti-platelet therapies
- Duration of anti-platelet therapy after coronary stenting
- Timing of elective non-cardiac surgery after coronary stenting
- Proton pump inhibitors and Clopidogrel
- Platelet function testing and genetic testing for Clopidogrel “responsiveness”
Case 2: 76 y.o. female s/p NSTEMI

- The same patient is now seen in your clinic ~4 weeks after discharge. She is feeling well, denies chest pain or shortness of breath, but she wants to undergo right knee surgery so she can exercise more regularly. She wants to get in better shape.
- She has been very compliant with her medications, which include aspirin, clopidogrel, toprol xl, statin, low dose ace-inhibitor
- Her BP and HR are well controlled. Exam is benign.
- She has been doing some reading on the internet and has some questions for you …..

**Question A**

What is the recommended duration of dual anti-platelet therapy post coronary drug-eluting stent placement?

- A) 6 weeks
- B) 6 months
- C) 12 months

**Question B**

What is the risk of stent thrombosis after coronary stent implantation while the patient is on dual anti-platelet therapy?

- A) 1-1.5%
- B) 5-10%
- C) 10-15%

**Question C**

The risk of death/MI if surgery is performed “early” after stent implantation even while the patients is still taking their dual anti-platelet therapy with Aspirin+Clopidogrel is?

- A) 1-2%
- B) 3-5%
- C) 5-10%
- D) 10-15%
- E) >15%
**Long-Term Antithrombotic Therapy at Hospital Discharge after UA/NSTEMI**

**UA/NSTEMI**

**Patient Groups at Discharge**

- **Bare Metal Stent**
- **Drug Eluting Stent**

**Question A**

What is the recommended duration of dual anti-platelet therapy post coronary drug-eluting stent placement?

- A) 6 weeks
- B) 6 months
- C) 12 months

**What to do with Patients Awaiting Surgery after PCI?**

- Stenting prior to non-cardiac surgery?
- Analysis of the Mayo Clinic PCI and Surgical databases (1990-2000)
- 207 patients identified who underwent surgery after a successful PCI with Bare Metal Stent
- How did they do?


**Complications of Non-cardiac Surgery after Coronary PCI**

- Death (%)
- Death/MI (%)
- Thrombosis (%)
- Death/Mi/thrombosis/TVR (%)

It is suggested that post PCI with a BMS, surgery be delayed by 6 weeks, and preferably be delayed till 3 months

What is the Risk of “Early Surgery” (or within the timeframe when Clopidogrel is required) Post-stenting?

- Single center study, 192 patients
- Successful PCI (either BMS or DES)
  - BMS treated with asa/plavix for at least 1 month
  - Cypher treated at least 3 months
  - Taxus treated at least 6 months
- “Early surgery” vs. “late surgery” outcomes (within 30 days post-op):
  - 13.6% death or MI vs. 0.6% (if on asa/plavix)
  - 30.7% death or MI in the “early surgery” group (if NOT TAKING plavix)!!

Schouten O et al JACC 2007;49:122-4

How to Avoid Peri-op Stent Thrombosis?

- Avoid pre-op revascularization – pending coronary anatomy
- Revascularize without stent (balloon only)
- Delay surgery
  - PTCA only → delay surgery at least 1 week (ideally, days 14-29)
  - BMS → delay surgery at least 6 weeks (preferably 3 months)
  - DES (any type) → delay surgery 12 months
- Consider resuming dual anti-platelet therapy post-op even after surgery is performed >12 months after initial PCI, especially in selected high-risk patients
- Consider operating on dual anti-platelet therapy for select patients, even after appropriate waiting period
- Education and team-approach

Brilakis ES et al. JACC 2007;49:2145-50

Question B
What is the risk of stent thrombosis after coronary stent implantation while the patient is on dual anti-platelet therapy?

- A) 1-1.5%
- B) 5-10%
- C) 10-15%

Question C
The risk of death/MI if surgery is performed “early” after stent implantation even while the patients are still taking their dual anti-platelet therapy with Aspirin+Clopidogrel is?

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Case 3: 76 y.o. female s/p NSTEMI

- You have successfully convinced the patient to delay her knee surgery. One month later, she calls you complaining of "stomach upset." She states that she has been taking over the counter antacids which help her condition. She denies bleeding or weight loss.
- She is continuing her dual anti-platelet therapy as per your recommendation. Her CBC is stable.
- Should you give her a PPI?
  - Yes
  - No

Dual Anti-Platelet Therapy (DAPT) and GI bleeding

- Single anti-platelet therapy increases GI ulceration and bleeding
- Famotidine 20mg bid protects against ASA-induced GI ulceration
- DAPT increases GI bleeding 2-3 X over ASA alone
- PPI more effective than H2 blockers at preventing DAPT-induced GI bleeding

Should patients on DAPT be prescribed PPIs to prevent GI bleeding?
PPIs and Clopidogrel

- Pharmacokinetic and pharmacodynamic data suggest PPIs may reduce effectiveness of clopidogrel.
- Clinical observational studies are conflicting, but do not overall support this.
- However, the interaction is biologically plausible and therefore should be considered possible.
- Risk vs. benefit should be considered in individual patients when considering PPI and clopidogrel.

Factors increasing Risk of GI Bleeding

- Prior GI bleed
- Age
- H. Pylori
- Warfarin
- Steroids or NSAID use

Factors increasing Risk of Stent Thrombosis

- Renal failure
- Long stents
- Multi-vessel disease
- Cessation of DAPT
- Diabetes
- Calcified lesions
- Low LVEF%
- Thrombus
- Bifurcation lesions

Approach to the Individual on DAPT

- Should not adopt an “all-comers” approach to prescribing PPIs in patients taking DAPT.
- Assess need for PPI based on symptoms and risk for GI bleeding.
- Assess risk for stent thrombosis (i.e. what if DAPT effect is actually lessened by PPI).
- If high risk for GI bleed, and low risk of stent thrombosis, PPI is reasonable. (I avoid omeprazole)
- If low risk for GI bleed and require GI symptom relief, but high risk for stent thrombosis, consider H2 blocker or PPI but change clopidogrel to another agent.
- If use an H2 blocker, AVOID CIMETIDINE (which competitively inhibits Cyp2C19)
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Case 4: 75 y.o. female s/p NSTEMI

- Your favorite patient calls you again as her friend, who also had a stent placed in her coronary artery, has told her that her doctor tested her blood to see if she is “responding” to the clopidogrel. Your patient asks you if you should do platelet function or genetic testing?
  - YES – do the platelet function or genetic testing as it will change management
  - NO – no need to do the platelet function or genetic testing as it will not change management
  - I do not know. Please stop asking me questions!

How about platelet function testing or genetic testing to assess responsiveness?

Platelet function testing and Clopidogrel

- Many studies show that impaired platelet inhibition is associated with increased rates of CV events
- Many tests of platelet function exist, should we use them clinically?? (none of them have a very good sensitivity or predictive value)
- If so, which ones??
- How should they guide clinical therapy?
**GRAVITAS**

- Patients undergoing PCI with drug-eluting stents screened with VerifyNow
- Those with high residual platelet reactivity (n=2214) randomized to standard dose clopidogrel vs double-dose clopidogrel.
- Primary endpoint CV death, MI or stent thrombosis

**AHA Scientific Sessions 2010**

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**GRAVITAS protocol**

- Elective or Urgent PCI with DES*
- VerifyNow P2Y12 Test 12-24 hours post-PCI
- PRU ≥ 230

- High-Dose Clopidogrel:
  - clopidogrel 600-mg, then clopidogrel 150-mg daily x 6 months
- Standard-Dose Clopidogrel:
  - clopidogrel 75-mg daily x 6 months

Primary Efficacy Endpoint: CV Death, Non-Fatal MI, Stent Thrombosis at 6 mo
Key Safety Endpoint: GUSTO Moderate or Severe Bleeding at 6 mo
Pharmacodynamics: Repeat VerifyNow P2Y12 at 1 and 6 months

*placebo-controlled  All patients received aspirin (81-162mg daily)

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**Primary Endpoint: CV Death, MI, Stent Thrombosis**

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<th>Days</th>
<th>Cumulative incidence of CV death, non-fatal MI, or ST (%)</th>
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<tbody>
<tr>
<td>0</td>
<td>High-Dose Clopidogrel: 1.4%  Standard-Dose Clopidogrel: 2.3%</td>
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<tr>
<td>100</td>
<td>High-Dose Clopidogrel: 2.9%  Standard-Dose Clopidogrel: 3.6%</td>
</tr>
<tr>
<td>210</td>
<td>High-Dose Clopidogrel: 3.2%  Standard-Dose Clopidogrel: 3.9%</td>
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HR 1.01 (95% CI: 0.88 - 1.16) p=0.88

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**Bleeding Events: Safety Population**

- Patients with Endpoint (%)
  - HD Clopidogrel: 12.1%  SD Clopidogrel: 10.3%
  - GUSTO Severe/Moderate: 2.3%
  - Any GUSTO: 1.4%

p=0.18

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Lessons from GRAVITAS

- Double dose clopidogrel not effective in all-comers
- Repeated testing with increasing dose until platelet inhibition adequately achieved
- Change to another anti-platelet agent like prasugrel if high on-treatment PRU with clopidogrel
- Currently no study demonstrates platelet function testing can guide therapy to reduce CV events

RECLOSE-2 ACS

The results also show that increasing the clopidogrel dose was **not** associated with clinical benefit in these patients.
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- Management of NSTEMI with a focus on current and future anti-platelet therapies
- Duration of anti-platelet therapy after coronary stenting
- Timing of elective non-cardiac surgery after coronary stenting
- Proton pump inhibitors and Clopidogrel
- Platelet function testing and genetic testing for Clopidogrel "responsiveness"

THANK YOU