• **Coronary Artery Disease**
  ○ Pre-operative work up using AHA guidelines (cont)
  ○ Management options
  ○ Stents
  ○ Plavix and its management
Case: 57 yr old male for left total mastectomy/ALND for breast cancer

- **HPI** – bloody discharge from nipple
- **PMH** –
  - **CAD**: MI age 44 treated with 1 stent
    - Current symptoms – chest pressure on exertion, monthly, relieved by rest.
  - Hypertension
  - DM for 15 years
  - Effort tolerance – 4 METs
- **PSH** –
  - Lap chole 15 years ago
  - Elbow surgery 18 years ago
Case (cont)

- Current smoker
- Meds:
  - Aspirin
  - Metformin
  - Sitagliptin (Januvia)
  - Glipizide
  - Nifedipine
  - Metoprolol
  - Isosorbide mononitrate
  - Rosuvastatin
Case (cont)

- Exam:
  - BMI 29
  - BP 120/70 HR 72

- ECG: SR 70, inf Q’s, poor R wave progression

- Followed by PMD only for 10 years.
Assessment

- No active cardiac conditions
- Low risk surgery – proceed to OR
- Continue care with cardiologist concurrently
- PCP felt differently and asked for a cardiac ‘clearance’
Cardiac evaluation and care algorithm for noncardiac surgery based on active clinical conditions, known cardiovascular disease, or cardiac risk factors for patients 50 years of age or greater

Step 1: Need for emergency noncardiac surgery?
- Yes (Class I, LOE C) → Operating room → Perioperative surveillance and postoperative risk stratification and risk factor management
- No → Step 2

Step 2: Active cardiac conditions*
- Yes (Class I, LOE B) → Evaluate and treat per ACC/AHA guidelines → Consider operating room
- No → Step 3

Step 3: Low risk surgery
- Yes (Class I, LOE B) → Proceed with planned surgery
- No → Step 4

Step 4: Good functional capacity (MET level greater than or equal to 4) without symptoms†
- Yes (Class I, LOE B) → Proceed with planned surgery
- No or unknown → Step 5

Step 5: 3 or more clinical risk factors‡
- Yes (Class Ia, LOE B) → Consider testing if it will change management§ → Vascular surgery
- No or unknown → 1 or 2 clinical risk factors‡
- Yes (Class Ib, LOE B) → Intermediate risk surgery
- No → Vascular surgery
- Intermediate risk surgery → Proceed with planned surgery with HR control§ (Class Ia, LOE B) or consider noninvasive testing (Class Ib, LOE B) if it will change management

Of the cardiology consultations, 40% contained no recommendations other than "proceed with case," "cleared for surgery," or "continue current medications."

But usually only after the obligatory echo and stress.
Stress test was positive for ischemia
Options

- Medical management
- CABG
- minimally invasive direct coronary artery bypass (MIDCAB)
Options (cont)

Percutaneous intervention (PCI)
- Balloon angioplasty
- Bare metal stent
- Drug eluting stent

(In stable angina PCI not superior to medical management. COURAGE and other trials.)
Coronary Angioplasty

Diagram shows the heart, main arteries (blood vessels) and catheterisation.

- Heart
- Aorta
- Catheter is commonly inserted into a blood vessel in the groin
- Catheter is manipulated by doctor

Tip of catheter pushed inside right coronary artery

Patch of atheroma which narrows the coronary artery to be widened by balloon (see detail below)

Catheter is pushed up the large blood vessels to the heart

Catheter passing up the aorta (large blood vessel) behind the heart
Proposed treatment for patients requiring percutaneous coronary intervention who need subsequent surgery

- Acute MI, high-risk ACS, or high-risk cardiac anatomy
- Bleeding risk of surgery
  - Low: Stent and continued dual-antiplatelet therapy
  - Not low:
    - Timing of Surgery
      - 14 to 29 days: Balloon angioplasty
      - 30 to 365 days: Bare-metal stent
      - Greater than 365 days: Drug-eluting stent

Balloon angioplasty

- Mid 1970s
- Artery wall weakened and collapsed after balloon angioplasty which led to 3% to emergent CABG
- 30% re-stenosis rate
- Needed stenting
Deflated balloon in artery

Inflated balloon compresses plaque against artery walls
Bare Metal stent

- 1986 in Europe (1994 in USA)
- Solved the weak wall/collapse
- Re-stenosis persisted in 25%
  usually by about 6 months
  - Not recurrence of atherosclerosis
  - But re-stenosis by smooth muscle proliferation – as past of healing/scar of the injury of angioplasty.
Drug eluting stents (DES)

- Approved by FDA 2003/4
- 2003 sirolimus (cypher®)
  - Antifungal rapamycin (Easter island bacteria)
  - Potent immunosuppressive (renal transplant often used later because of poor wound healing.)
  - Antiproliferative – stents
  - Anti cancer treatment
Neste local foram obtidas em janeiro de 1965 as amostras de solo que permitiram obter a rapamicina, substância que inaugurou uma nova era para os pacientes submetidos a transplantes de órgãos.

Homenagem aos investigadores brasileiros.

DES (cont)

- 2004 paclitaxel (Taxus®)
- Bark of Pacific Yew tree
- Mitotic inhibitor
- Stabilization of microtubules
- Cancer chemotherapy
DES (cont)

- Prevents neo-intimal growth / scar tissue and endothelium
- Initially 3 (sirolimus) or 6 (paclitaxel) months of clopidigrel
- 650 000/year
- Restenosis - < 10%

Newer: Xience® - everolimus 2008 – Medtronic
Biodegradable coating/stent
DES (cont)

- AHA advisory January 2007 – risk of late in-stent thrombosis. (>30% mortality)
- What happened?
- On label vs. off label use of stents
  - Length
  - Diameter
  - Fitting snugly in arterial wall
On label:

- sirolimus-eluting stents were de novo lesions no longer than 30 mm in native coronary arteries with reference vessel diameters of at least 2.5 mm to at most 3.5 mm
- paclitaxel-eluting stents de novo lesions no longer than 28 mm in native coronary arteries at least 2.5 to at most 3.75 mm in diameter.
• Non-diabetics
• Preserved renal function
• Not bifurcations
• Single vessel
• Native coronaries only

Today 70% at SBUMC are off label usage.
### Table 1. Frequency of Off-Label Criteria*

<table>
<thead>
<tr>
<th>Criteria for Off-Label Use</th>
<th>No. (%) of Patients (n = 1817)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1 Lesion treated</td>
<td>1073 (59.1)</td>
</tr>
<tr>
<td>Total stent length $\geq 36$ mm</td>
<td>975 (53.7)</td>
</tr>
<tr>
<td>Bifurcation lesion</td>
<td>473 (26.0)</td>
</tr>
<tr>
<td>Lesion in coronary artery</td>
<td>173 (9.5)</td>
</tr>
<tr>
<td>bypass graft surgery</td>
<td></td>
</tr>
<tr>
<td>Baseline creatine kinase-MB $&gt;3$ ULN</td>
<td>118 (6.5)</td>
</tr>
<tr>
<td>Stenosis preprocedure, 100%</td>
<td>112 (6.2)</td>
</tr>
<tr>
<td>Maximum balloon diameter $&gt;4$ mm</td>
<td>76 (4.2)</td>
</tr>
<tr>
<td>Ejection fraction $&lt;25$%</td>
<td>77 (4.2)</td>
</tr>
<tr>
<td>Unprotected LM intervention</td>
<td>20 (1.1)</td>
</tr>
</tbody>
</table>

Abbreviations: LM, left main coronary artery; ULN, upper limit of normal.

*Criteria are not mutually exclusive.

Eluting the drug

Drug needs to be washed out before endothelium can cover stent
Normal endothelium is needed for coagulation hemostasis.

Wash out is related to:

- Cardiac output vol/min
  \[ \text{HR} \times \text{SV} \]
- Concentration gradient
- Flow through the stent
  - Length
  - Diameter
  - Turbulent flow vs laminar
- **Unpredictable**
What did the cardiologist do with the positive stress test?

- Cardiac Cath
- PCI
- Stent
- Drug eluting stent
- Clopidogrel and aspirin for life
Proposed treatment for patients requiring percutaneous coronary intervention who need subsequent surgery

- Acute MI, high-risk ACS, or high-risk cardiac anatomy
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Clopidogrel (plavix)

Clopidogrel

- thienopyridine class antiplatelet
- prodrug
- ADP (adenosine diphosphate) receptor on platelet cell membranes
- Irreversible inhibition
- Prevents aggregation of platelets / fibrin cross linking
- Slow onset (2 hours) loading dose preferred
- Effect 7-10 days

- Aspirin
  - COX2 inhibitor – also irreversible – platelet inhibition
Clopidogrel and Anesthesia implications

- No antidote
- No quick/cheap or easy lab test
- Platelet transfusion

Common recommendations:
- Delay elective surgery for one year
- If have to proceed: hold for 4 days, stay on aspirin

ASRA guidelines neuroaxial blockade can only be done after holding clopidogrel for 7 days
Our patient

- DES
- Surgery on aspirin and plavix
- Increased bleeding
- Hematoma
- Returned at 2 months for ALND
- Same problem
Summary

**Drug Eluting Stents**
- Avoid surgery in first year
- Lifetime aspirin and long term plavix
- Significant risk of in-stent thrombosis

**Plavix instructions**
- Ideally from the interventionalist
- If have to stop:
  - As short as possible (3-4 days)
  - Stay on aspirin
  - Stay on Statin
  - Loading dose of 300mg of clopidogrel in PACU or as soon as possible after surgery.