Annual Internal Medicine Review Series
Cardiology - Part 1

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Annual Internal Medicine Review Series
Cardiology
Part 1

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Saint Peter’s University Hospital, New Brunswick, NJ
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Learning Objectives

1. Describe the basic physiology and pathophysiology of cardiac disorders

2. Review the presenting symptoms, diagnostic imaging, and laboratory test findings associated with cardiac disorders

3. Develop a patient treatment plan based on the current evidence for treating and managing cardiac disorders
Disclosure

Dr. Singh has no conflicts of interest relevant to this activity.
Question 1

• A 52-year-old man is evaluated during a visit to establish care. He is asymptomatic, but he is seeking advice on how to modify his risk for cardiovascular disease. He drinks one glass of wine with dinner most nights, and he quit smoking 12 years ago. Family history is significant for a myocardial infarction in his father at age 61 years. He takes no medications. The patient is Hispanic.

• On physical examination, temperature is normal, blood pressure is 128/76 mm Hg, and pulse rate is 74/min. BMI is 28. The remainder of the physical examination is unremarkable.

• Which of the following risk factors most increases this patient's risk for cardiovascular disease?
  1. Alcohol Use
  2. Ethnicity
  3. Family Hx
  4. Hyperlipidemia
  5. Smoking hx
Question 1

A 52-year-old man is evaluated during a visit to establish care. He is asymptomatic, but he is seeking advice on how to modify his risk for cardiovascular disease. He drinks one glass of wine with dinner most nights, and he quit smoking 12 years ago. Family history is significant for a myocardial infarction in his father at age 61 years. He takes no medications. The patient is Hispanic.

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1. Alcohol Use
2. Ethnicity
3. Family Hx
4. Hyperlipidemia
5. Smoking hx
Potentially Modifiable Risk Factors Associated with MI (Interheart Study) In Descending Order

• Dyslipidemia (highest risk)
• Current Smoking
• Diabetes Mellitus
• Hypertension
• Abdominal Obesity
• No alcohol intake
• Inadequate Exercise
• Diet low in fruits and vegetables
Question 2: Lipids

42 M with 2 years DM2 on metformin, HTN on lisinopril. Chol 199, HDL 29, LDL 94, TG 380. In addition to lifestyle modifications, what is best next step to reduce CV events?

A. No additional medication
B. Ezetimibe
C. Simvastatin
D. Omega-3 acid ethyl esters
E. Niacin
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B. Ezetimibe
C. **Simvastatin**
D. Omega-3 acid ethyl esters
E. Niacin
CHD Risk Equivalents

- >20% 10-year risk of CHD (Framingham projections)
- Diabetes
- Other forms of clinical atherosclerotic disease:
  - Peripheral arterial disease
  - Abdominal aortic aneurysm
  - Carotid artery disease
<table>
<thead>
<tr>
<th>High-Intensity Statin Therapy</th>
<th>Moderate-Intensity Statin Therapy</th>
<th>Low-Intensity Statin Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily dose lowers LDL–C on average, by approximately ≥50%</td>
<td>Daily dose lowers LDL–C on average, by approximately 30% to &lt;50%</td>
<td>Daily dose lowers LDL–C on average, by &lt;30%</td>
</tr>
<tr>
<td>Atorvastatin (40†)–80 mg</td>
<td>Atorvastatin 10 (20) mg</td>
<td>Simvastatin 10 mg</td>
</tr>
<tr>
<td>Rosuvastatin 20 (40) mg</td>
<td>Rosuvastatin (5) 10 mg</td>
<td>Pravastatin 10–20 mg</td>
</tr>
<tr>
<td></td>
<td>Simvastatin 20–40 mg†</td>
<td>Lovastatin 20 mg</td>
</tr>
<tr>
<td></td>
<td>Pravastatin 40 (80) mg</td>
<td>Fluvastatin 20–40 mg</td>
</tr>
<tr>
<td></td>
<td>Lovastatin 40 mg</td>
<td>Pitavastatin 1 mg</td>
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<tr>
<td></td>
<td>Fluvastatin XL 80 mg</td>
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<td></td>
<td>Fluvastatin 40 mg bid</td>
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</tr>
<tr>
<td></td>
<td>Pitavastatin 2–4 mg</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 3.

Primary Prevention: Assess ASCVD Risk in Each Age Group

**Emphasize Adherence to Healthy Lifestyle**

**Age 0-19 y**
- Lifestyle to prevent or reduce ASCVD risk
- Diagnosis of Familial Hypercholesterolemia→ statin

**Age 20-39 y**
- Estimate lifetime risk to encourage lifestyle to reduce ASCVD risk
- Consider statin if family history of premature ASCVD and LDL-C ≥160 mg/dL (≥4.1 mmol/L)

**Age 40-75 y and LDL-C ≥70-<190 mg/dL (≥1.8-<4.9 mmol/L) without diabetes mellitus**
- 20-year ASCVD risk percent begins risk discussion

**Age >75 y**
- Clinical assessment, Risk discussion

**ASCVD Risk Enhancers:**
- Family history of premature ASCVD
- Persistently elevated LDL-C ≥160 mg/dL (≥4.1 mmol/L)
- Chronic kidney disease
- Metabolic syndrome
- Conditions specific to women (e.g., preeclampsia, premature menopause)
- Inflammatory diseases (especially rheumatoid arthritis, psoriasis, HIV)
- Ethnicity (e.g., South Asian ancestry)

**Lipid/Biomarkers:**
- Persistently elevated triglycerides (≥175 mg/dL, ≥2.0 mmol/L)
- In selected individuals if measured:
  - hs-CRP ≥2.0 mg/L
  - Lp(a) levels >50 mg/dL or >125 nmol/L
  - apoB ≥1.30 mg/dL
  - Ankle-brachial index (ABI) <0.9

**Risk Discussion:**

- **<5% “Low Risk”**
  - Risk discussion: Emphasize lifestyle to reduce risk factors (Class I)
  - If risk enhancers present then risk discussion regarding moderate-intensity statin therapy (Class IIb)

- **5% -<7.5% “Borderline Risk”**
  - Risk discussion: If risk estimate + risk enhancers favor statin, initiate moderate-intensity statin to reduce LDL-C by 30% - 49% (Class I)

- **≥7.5% -<20% “Intermediate Risk”**
  - Risk discussion: If risk estimate + risk enhancers favor statin, initiate moderate-intensity statin to reduce LDL-C by 30% - 49% (Class I)

- **≥20% “High Risk”**
  - Risk discussion: Initiate statin to reduce LDL-C ≥50% (Class I)

**LDL-C ≥190 mg/dL (≥4.9 mmol/L)**
- No risk assessment; High-intensity statin (Class I)

**Diabetes mellitus and age 40-75 y**
- Moderate-intensity statin (Class I)

**Diabetes mellitus and age 40-75 y**
- Risk assessment to consider high-intensity statin (Class IIa)

**If risk decision is uncertain:**
- Consider measuring CAC in selected adults:
  - CAC = zero (lowers risk; consider no statin, unless diabetes, family history of premature CHD, or cigarette smoking are present)
  - CAC = 1-99 favors statin (especially after age 55)
  - CAC = 100+ and/or ≥75th percentile, initiate statin therapy
Secondary Prevention

Clinical ASCVD

Healthy Lifestyle

ASCVD not at very high-risk*

Age ≤75 y
- High-intensity statin (Goal: ↓ LDL-C ≥50%) (Class I)
  - If high-intensity statin not tolerated, use moderate-intensity statin (Class I)

Age >75 y
- If on maximal statin therapy and LDL-C ≥70 mg/dL (≥1.8 mmol/L), adding ezetimibe may be reasonable (Class IIb)
- Initiation of moderate- or high-intensity statin is reasonable (Class IIa)
- Continuation of high-intensity statin is reasonable (Class IIa)

Very high-risk* ASCVD

High-intensity or maximal statin (Class I)

If on maximal statin and LDL-C ≥70 mg/dL (≥1.8 mmol/L), adding ezetimibe to maximal statin before adding PCSK9-I (Class I)

If PCSK9-I is considered, adding ezetimibe to maximal statin before adding PCSK9-I (Class I)

Dashed arrow indicates RCT-supported efficacy, but is less cost effective

If on clinically judged maximal LDL-C lowering therapy and LDL-C ≥70 mg/dL (≥1.8 mmol/L), or non-HDL-C ≥100 mg/dL (≥2.6 mmol/L), adding PCSK9-I is reasonable (Class IIa)
Question 3: Lipids

38 F with two children, planning a third, parents both with CAD in their early 50's, on pravastatin, Chol 265 HDL 36 TG 149, LDL 199. Safest effective medication during pregnancy?:

A. Continue Pravastatin
B. Fenofibrate
C. Colesevelam
D. Omega-3-acid ethyl esters
E. Evolocumab
• **Statins**: mortality data
  ➢ Choice for elev LDL (raise HDL, lower TG)
  ➢ Contraindicated in pregnancy
  ➢ Anti-inflammatory/pleiotrophic effects

• **Bile acid sequestrants**: colesevelam, cholestyramine, colestipol (lower LDL)
  ➢ Choice in children, child-bearing patient
  ➢ Do not use in TG > 300
  ➢ Interact absorption other meds, bloating

• **Omega – 3 Fatty acids**
  ➢ Lower TG (*raise LDL, but not small dense)
  ➢ No benefit Rx or Prevention outcomes
Question 4: Lipids

42 M with 2 years DM2, on metformin, HTN on lisinopril. Chol 181, HDL 29, LD 90, TG 310, despite simvastatin. In addition to lifestyle modifications, what is best next step in reducing his risk of CV events?

A. No additional medication
B. Colestipol
C. Fenofibrate
D. Omega-3 acid ethyl esters
E. Niacin
Question 4: Lipids

42 M with 2 years DM2, on metformin, HTN on lisinopril. Chol 181, HDL 29, LD 90, TG 310, despite simvastatin. In addition to lifestyle modifications, what is best next step in reducing his risk of CV events?

A. **No additional medication**
B. Colestipol
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E. Niacin
ACCORD

5518 pts DM2 on simvast
Fenofibrate vs placebo

*No diff*
Nonfatal MI, CVA, or CV death at 4.7 yrs
~10 % (p=0.32)
Reduced TG: 120 vs. 150

NEJM 2010; 362: 1563-74
• **Fibrates**: gemfibrozil, fenofibrate
  ➢ Most effective TG lowering (can raise HDL)
  ➢ Caution renal insufficiency
  ➢ Can cause liver damage, gallstones, myositis (particularly with statin, fenofibrate less so)

• **Niacin**: Most effective raise HDL (lower LDL/TG)
  ➢ Flushing, nausea, gout, glucose intolerance

• **Ezetimibe**: combined with statins, lower LDL
  ➢ Not with bile acid sequestrants or fibrates
  ➢ Contraindicated in liver abnormalities
AIM-HIGH Trial

3414 pts Cardio/Cerebro/Periph Vasc Dz on Simvast +/- ezetimibe
Niacin vs placebo

No diff ~20% both groups (p=0.79)
- Death from coronary dz, nonfatal
- MI, ischemic CVA, hosp for ACS,
- coronary or cerebral revasc
Increased HDL 35 to 44

NEJM 2011;365:2255-67
IMPROVE-IT

18,144 ACS pts (STEMI 29%, NSTEMI 47%, UA 24%)
Simvastatin vs simvastatin

↓ CV death, MI, rehosp, revasc, CVA
33% vs. 35% (p=0.016)  NNT = 50
(particularly in DM2 and age > 65)

↓ LDL 54 vs. 70

AHA Meeting Nov. 2014
FOURIER Trial: Evolocumab (PCSK9-inh)

27,564 pts: prior MI, CVA or sympt PAD

• On statin with LDL ≥ 70 (median LDL 92)
• Mean age 63, female 25%, DM 37%
• 69% were on high-intensity statin (30% mod)

Reduced CV death, MI, CVA, hosp UA or cor revasc
12.6% vs 14.6% (p<0.0001)
(Median LDL 30 on Rx)

NEJM 2017:
# Recommendations for Adults With CKD

<table>
<thead>
<tr>
<th>COR</th>
<th>LOE</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIA</td>
<td>B-R</td>
<td>In adults 40 to 75 years of age with LDL-C 70 to 189 mg/dL (1.7 to 4.8 mmol/L) who are at 10-year ASCVD risk of 7.5% or higher, CKD not treated with dialysis or kidney transplantation is a risk-enhancing factor and initiation of a moderate-intensity statin or moderate-intensity statins combined with ezetimibe can be useful.</td>
</tr>
<tr>
<td>IIB</td>
<td>C-LD</td>
<td>In adults with advanced kidney disease that requires dialysis treatment who are currently on LDL-lowering therapy with a statin, it may be reasonable to continue the statin.</td>
</tr>
<tr>
<td>III: No Benefit</td>
<td>B-R</td>
<td>In adults with advanced kidney disease who require dialysis treatment, initiation of a statin is not recommended.</td>
</tr>
</tbody>
</table>
68-year-old woman is evaluated during a routine exam. She went through menopause 16 years ago. She is obese. Family hx is significant for a paternal aunt with ovarian cancer at age 64. Takes no meds

BP 148/90. HR 83. BMI 35

Which of the following diseases poses the greatest risk of death in this patient?
1. Breast cancer
2. CAD
3. DM
4. Ovarian cancer
Question 5

- 68-year-old woman is evaluated during a routine exam. She went through menopause 16 years ago. She is obese. Family hx is significant for a paternal aunt with ovarian cancer at age 64. Takes no meds

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- Which of the following diseases poses the greatest risk of death in this patient?
  1. Breast cancer
  2. CAD
  3. DM
  4. Ovarian cancer
Women and Heart Disease

• More women die because of heart disease than men
• Mortality is greater for women with NSTEMI/STEMI
• Death due to CAD is more common than due to breast cancer, diabetes and kidney disease combined
• Black and Mexican-American women have more CV risk than White women
• More atypical presentation
• Endothelial dysfunction more common
• Routine aspirin-controversial. Ischemic strokes are reduced if used in over 65 years of age. No mortality benefit
A 54-year-old man has substernal chest pain that may follow large meals and usually resolves after several minutes. The episodes are not clearly related to activity or relieved by rest. The most recent episode occurred while walking and lasted 20 minutes. Physical examination, ECG, and cardiac biomarkers are negative.

Which of the following is the best diagnostic option?
A. Coronary angiography
B. Empiric treatment with a proton pump inhibitor
C. Exercise stress test
D. Upper endoscopy
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C. Exercise stress test
D. Upper endoscopy
Key Point

• Exercise stress testing is indicated for patients with this range of pretest probability of coronary artery disease

• Approximately 10%-90%
Serious Causes of Chest Pain

“Serious six” causes of chest pain

- Acute coronary syndrome
- Pulmonary embolism
- Pericarditis
- Pneumothorax
- Aortic dissection
- Esophageal rupture

Up to 12% of all cases are caused by myocardial ischemia
Anginal Chest Pain

- Increased probability ischemic chest pain
  - Chest pain radiating to one or both arms
  - Discomfort that occurs with exertion
  - Presence of an $S_3$ during pain
Anginal Chest Pain

- Categorized by the nature of the pain
  1. Substernal chest discomfort
  2. Symptoms precipitated by exertion or stress
  3. Relief within 10 minutes of rest or NTG
- Typical (or classic) angina → all 3 features
- Atypical angina → any 2 features
- Nonanginal chest pain → ≤1 feature
<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Nonanginal</th>
<th>Atypical</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men %</td>
<td>Women %</td>
<td>Men %</td>
</tr>
<tr>
<td>30-39</td>
<td>4</td>
<td>2</td>
<td>34</td>
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<tr>
<td>40-49</td>
<td>13</td>
<td>3</td>
<td>51</td>
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<tr>
<td>50-59</td>
<td>20</td>
<td>7</td>
<td>65</td>
</tr>
<tr>
<td>60-69</td>
<td>27</td>
<td>14</td>
<td>73</td>
</tr>
</tbody>
</table>
A 68-year-old woman is evaluated for atypical chest pain of 3 months’ duration. She has asthma treated with inhaled glucocorticoids. She can walk at a brisk pace without asthma symptoms if pretreated with albuterol. The results of the physical examination and ECG are normal.

Which of the following is the most appropriate diagnostic test?

A. Adenosine perfusion stress test
B. Coronary angiography
C. Dobutamine stress echocardiography
D. Exercise stress test
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B. Coronary angiography
C. Dobutamine stress echocardiography
D. Exercise stress test
Key Point

• The most appropriate diagnostic stress test for women (and men) who can exercise and have normal or minor baseline ECG abnormalities

• Exercise stress test
## Selecting the Proper Stress Test

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Stress Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Able to exercise</td>
<td>Exercise ECG test</td>
</tr>
<tr>
<td>• Normal or nonspecific baseline ECG (including complete RBBB)</td>
<td>(preferred in most patients)</td>
</tr>
<tr>
<td>• Able to exercise</td>
<td>Exercise ECG test with perfusion imaging or Exercise echocardiography</td>
</tr>
<tr>
<td>• Previous myocardial revascularization</td>
<td></td>
</tr>
<tr>
<td>• Preexcitation (e.g., WPW pattern)</td>
<td></td>
</tr>
<tr>
<td>• Baseline ST-depression &gt;1 mm</td>
<td></td>
</tr>
<tr>
<td>• Taking digoxin</td>
<td></td>
</tr>
<tr>
<td>• Left ventricular hypertrophy</td>
<td></td>
</tr>
<tr>
<td>• Able to exercise</td>
<td>Vasodilator perfusion imaging or Dobutamine echocardiography</td>
</tr>
<tr>
<td>• LBBB</td>
<td></td>
</tr>
<tr>
<td>• Paced ventricular rhythm</td>
<td></td>
</tr>
<tr>
<td>• Unable to exercise</td>
<td>Vasodilator perfusion imaging or Dobutamine echocardiography</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Dipyridamole and adenosine are contraindicated in patients with bronchospastic disease
High Risk Nuclear Scans

• Multiple perfusion defects

• Increased uptake of thallium or technetium (reflects exercise-induced LV dysfunction)

• Post-exercise LV cavity dilatation
Which of the following patients should have ‘Regadenoson (Lexiscan) Stress Test’?

1. 50 yr old man recovered from inf MI 6 weeks ago-asymptomatic now. ETT post-MI was normal
2. 45 yr old female with asthma and recurrent SOB and chest pain
3. 50 yr old man with amputation below knee in one leg who is scheduled for a CABG surgery
4. 50 yr old man with h/o remote MI scheduled for aortofemoral bypass surgery
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Coronary Angiography Indications

- High probability of coronary artery disease (classic angina)
- Angina and left ventricular dysfunction
- Severe angina despite therapy
- High risk features on noninvasive testing
- Surviving sudden cardiac death
- Suspected coronary vasospasm
- Uncertain diagnosis after noninvasive testing
• For treatment or prevention of chronic stable angina do not select
  • Hormone replacement therapy (chronic estrogen therapy)
  • Antioxidant vitamins (vitamin E)
  • Treatment of abnormal serum homocysteine with folic acid or vitamin $B_{12}$
  • Treatment of lipoprotein(a) levels
A 65-year-old man with a previous history of MI is treated with ASA, metoprolol, atorvastatin, lisinopril, a long-acting nitrate and sublingual NTG. He now has stable exertional angina and must use sublingual NTG on a daily basis. BP is 130/60 mm Hg and HR is 85/min; PE is otherwise normal and the ECG is unchanged.

Which of the following is the most appropriate management?

A. Add clopidogrel  
B. Add nifedipine  
C. Add ranolazine  
D. Increase metoprolol
Question 9 CV

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Key Point

- Target resting heart rate for β-blocker treatment of chronic stable angina
- 55-60/min
Chronic Stable Angina Medical Therapy for All Patients

- Aspirin (not clopidogrel unless ASA intolerant)
- High-intensity statin
- β-Blocker (resting HR → 55-60/min)
- Calcium channel blocker
  - If β-blockers are inadequate, not tolerated, or contraindicated (airway disease)
    - Nifedipine and other short-acting agents are contraindicated
  - Short acting nitrates (if no contraindications)
Nitrates

• Long-acting preparations useful for decreasing anginal episodes in select patients
  • 8- to 12-Hour nitrate-free period (overnight) to avoid tolerance

• Nitrate contraindications
  • Taking PDE-5 inhibitors (tadalafil, vardenafil, sildenafil)
  • Severe aortic stenosis
  • Hypertrophic cardiomyopathy
Other Medical Therapies

• ACE inhibitor
  • Ejection fraction <40%
  • Diabetes
  • Proteinuric chronic kidney disease
  • Hypertension

• Ranolazine
  • Reduces anginal symptoms and improves exercise capacity when added to conventional medical therapy
Secondary Prevention for Chronic Stable Angina

- Complete tobacco cessation
- High-intensity statin therapy
  - Moderate-intensity statin therapy if age >75 years or intolerant of high-intensity therapy
- Blood pressure <130/80 mm Hg
- Glycemic control
- Weight loss if overweight
- Daily moderate-intensity aerobic exercise
A 52-year-old man had a MI 5 years ago treated with PCI and stenting. One month ago, he developed progressive exertional angina. Coronary angiography showed 50% stenosis of the left main coronary artery and 75% stenosis of the left circumflex artery and the proximal left anterior descending artery. Ejection fraction is 42%. Physical examination is normal. Symptoms are completely abated by an increase in his medical therapy.

Which of the following is the most appropriate treatment?
A. Coronary artery bypass surgery
B. Percutaneous intervention
C. Start ranolazine
D. Observation
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Which of the following is the most appropriate treatment?

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C. Start ranolazine
D. Observation
Four indications for CABG in the treatment of chronic stable angina

1. Angina refractory to medical therapy
2. High-risk criteria on stress testing
3. Left main disease or left main equivalent disease
4. Significant CAD with reduced LV function
Coronary Revascularization for Chronic Stable Angina

• Percutaneous coronary intervention (PCI) or CABG benefits limited to patients with:
  • Angina refractory to medical therapy
  • A large area of reversible ischemic myocardium
  • High-risk criteria on stress testing
  • Significant CAD with reduced LV function
  • Left main stenosis or equivalent

• CABG primarily indicated for left main stenosis or left main equivalent disease
Survival in Diabetics in BARI Trial

Key Point

Diabetics should go for CABG over PCI when revascularization is indicated for multi-vessel disease.
Restenosis vs Thrombosis

Bare Metal Stent

Drug-eluting Stent
Restenosis in PTCA / Stent

- Incidence
  - 30% to 40% with PTCA
  - 15-20% with bare metal stents
  - 0-5% with drug eluting stents
- Timing
  - Peak incidence 2-3mths after procedure.
  - Hardly ever after 6 months
- Cause
  - Elastic recoil
  - Medial hyperplasia
  - Arterial remodeling
- Treatment
  - PTCA or another DES or CABG
Key Point

- Antiplatelet meds **DO NOT** prevent restenosis
- Anti-mitotic drugs on the drug-eluting stents prevent restenosis
Acute Coronary Syndrome

ECG

No ST Elevation

ST Elevation

Trop

neg

Unstable Angina

NSTEMI

2014 ACC/AHA Guidelines JACC 2014; 64: 2645-87
Acute Coronary Syndrome Definitions

- Unstable angina
  - Symptoms of ischemia
  - Normal cardiac biomarkers
  - No ST-segment elevation

- NSTEMI
  - Symptoms of ischemia
  - Positive biomarkers
  - No ST-segment elevation
3rd Universal Definition of MI

- **Type 1**: classic plaque rupture
- **Type 2**: Demand/Supply mismatch
  - Spasm, embolism, tachy-brady, anemia, respiratory failure, hypotension, etc...
- **Type 3**: sudden death presumed MI
- **Type 4a**: PCI related; **4b**: Stent thrombosis
- **Type 5**: CABG related

*CIRC 2012; 126: 2020-35*
Acute Coronary Syndrome Definitions

• STEMI
  • Symptoms of ischemia
  • Positive biomarkers
  • Persistent ST-segment elevations
    • ST elevation at the J point in 2 contiguous leads
    • ST elevation $\geq 2$ mm in men or $\geq 1.5$ mm in women in leads V2-V3
    • ST elevation $\geq 1$ mm in all other leads
    • ST depression in $\geq 2$ leads V1-V4 (posterior injury)
Presentation of ACS

- 25% → Severe retrosternal chest pressure
- 25% → Mimics heartburn pain
- 25% → Other pain
  - Stabbing chest pain
  - Pain reproducible by palpation
  - Jaw, neck, back, and left arm discomfort
- 25% → Clinically silent
- Atypical symptoms
  - More common in women, patients with diabetes, and the elderly
Don’t Be Tricked

• STEMI is not the only cause of ST elevations

• Other causes:
  • Acute pericarditis
  • Left ventricular aneurysm
  • Stress-induced (Takotsubo) cardiomyopathy
  • Coronary vasospasm
  • Normal variant
A 69-year-old woman is treated for acute coronary syndrome. BP is 160/60 mm Hg, HR is 88/min. ECG shows T-wave inversions in the inferior leads and no Q waves. Serum troponin is elevated. No evidence of heart failure. Aspirin and LMWH are initiated.

Which of the following is the most appropriate additional treatment for this patient?

A. Diltiazem
B. Labetalol
C. Metoprolol
D. Ranolazine
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Which of the following is the most appropriate additional treatment for this patient?

A. Diltiazem  
B. Labetalol  
C. Metoprolol  
D. Ranolazine
Key Point

Initial medical therapy for most patients with ACS associated with mortality benefit

1. Anticoagulant therapy (e.g., UFH, LMWH)
2. Dual antiplatelet therapy (ASA, clopidogrel, prasugrel or ticagrelor)
3. β-blockade without intrinsic sympathomimetic activity
NSTE-ACS Treatment

Aspirin at least 162mg, 81 mg daily after

• Preferred (Class IIa):
  
  • Prasugrel 60mg, 10 mg  (only if PCI & no CVA/TIA and <75 yrs)
    (Stop 7 days pre-CABG)
  
  • Ticagrelor 180 mg, 90 mg bid, *w/ ASA < 100 mg
    (Stop 5 days pre-CABG)

• If above two are contraindicated:
  
  • Clopidogrel 300 mg load, 75 mg daily
    (Stop 5 days before CABG)

ACC/AHA Focused Update DAPT. CIRC 2016; on line
Question 12

• 56 yr old man is admitted to the hospital with new onset substernal chest pressure. Has HLPD and cigarette smoker. Meds are ASA, atorvastatin; upon admission to the hosp, he began getting metoprolol, clopidogrel and IV heparin

• Troponin was 1.2. Cardiac cath showed preserved EF with diffuse severe disease of the distal portion of all 3 major vessels. No intervention was performed

• Which of the following is the most appropriate management of this patient’s clopidogrel therapy?

1. Stop clopidogrel
2. Continue clopidogrel for 2 weeks
3. Continue clopidogrel for 1 year
4. Continue clopidogrel lifelong
Question 12

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1. Stop clopidogrel
2. Continue clopidogrel for 2 weeks
3. **Continue clopidogrel for 1 year**
4. Continue clopidogrel lifelong
Key Point

• If patient presents with a NSTEMI or STEMI, DAPT should be continued for 1 year irrespective whether the patient gets a stent or not or gets a bare metal stent.
Exceptions to β-Blockade for ACS

- Cocaine-induced vasospasm
- Decompensated heart failure
- High grade AV-block
  - Defined by several P waves in a row without QRS complexes
- Severe bronchospasm
Additional ACS Medical Therapy

• Nitroglycerin, except:
  • Inferior/posterior infarction (danger of hypotension)
  • Aortic stenosis
  • Obstructive hypertrophic cardiomyopathy
  • PDE-5 inhibitor use
Additional ACS Medical Therapy

• High-intensity statin
  • All patients
  • Atorvastatin 40 to 80 mg or rosvastatin 20 to 40 mg

• Calcium channel blocker (CCB)
  • Contraindication to β-blocker
  • Continued pain despite β-blocker and NTG
  • Nifedipine and other short-acting CCBs are contraindicated
TIMI Score for Patients with Unstable Angina or NSTEMI

• Estimates risk and guides therapy

• Score 1 point for each variable
  • Age ≥65 years
  • ≥3 Traditional CAD risk factors
  • Coronary obstruction ≥50% diameter stenosis
  • ST-segment deviation
  • ≥2 Episodes of angina in the past 24 hours
  • Aspirin use in the past week
  • Elevated cardiac biomarkers [creatine kinase MB or troponin]
# Using the TIMI Score to Guide Therapy

<table>
<thead>
<tr>
<th>TIMI Risk Score</th>
<th>Strategy</th>
</tr>
</thead>
</table>
| 0-2             | Stress test  
Angiography if significant ischemia |
| 3-7             | Early angiography and possible PCI |
Question 13 Ischemic Heart Dz
Question 13 Ischemic Heart Dz

53 yo Korean female on outpatient aspirin admitted to Obs Unit with angina, now recurrent despite SL nitroglycerin, IV then po metoprolol, morphine IV. HR 100, BP 110/78, RR 20, pOx 90% 2L NC, rales, S3, 2/6 HSM. Trop neg X1. Next best step?

A. Cardiac cath next morning in 12 hours
B. Cardiac cath if positive stress test next day
C. Cardiac cath within next 2 hours
D. Increase beta-blocker first
E. Cardiac gated CTA now
Question 13 Ischemic Heart Dz

53 yo Korean female on outpatient aspirin admitted to Obs Unit with angina, now recurrent despite SL nitroglycerin, IV then po metoprolol, morphine IV. HR 100, BP 110/78, RR 20, pOx 90% 2L NC, rales, S3, 2/6 HSM. Trop neg X1. Next best step?

A. Cardiac cath next morning in 12 hours
B. Cardiac cath if positive stress test next day
C. **Cardiac cath within next 2 hours**
D. Increase beta-blocker first
E. Cardiac gated CTA now
## Timing of Cardiac Catheterization

| “Ischemia Guided” | Maybe, depends on tests |
| “Immediate Invasive” | Tonight |
| “Early Invasive” | Tomorrow morning |
| “Delayed Invasive” | On Monday |
Immediate Invasive (within 2 h)

- Refractory angina
- Signs/symptoms HF, new/worse MR
- Hemodynamic instability
- Recurrent angina/ ischemia
- Sustained VT/ VF

2014 ACC/AHA Guidelines JACC 2014; 64: 2645-87
Early Invasive (within 24 h)

- Rising troponin
- New ST depression

Delayed Invasive (25-72 h)

- DM2 or CKD (CrCl < 60)
- Reduced EF (< 40%)
- PCI within 6 mos, or any CABG hx
- TIMI risk ≥ 2
A 62-year-old woman is evaluated in the ED for 5 hours of chest pain. She has type 2 diabetes mellitus, hypertension, and a stroke 1 year ago. BP is 190/90 mm Hg; the remainder of the PE is normal. The ECG shows 2-mm ST-elevation in leads II, III, and aVF. The nearest hospital with PCI is 55 minutes away.

Which of the following is the best management option?

A. Medical therapy without reperfusion therapy
B. Thrombolytic therapy
C. Transfer for CABG
D. Transfer for PCI
A 62-year-old woman is evaluated in the ED for 5 hours of chest pain. She has type 2 diabetes mellitus, hypertension, and a stroke 1 year ago. BP is 190/90 mm Hg; the remainder of the PE is normal. The ECG shows 2-mm ST-elevation in leads II, III, and aVF. The nearest hospital with PCI is 55 minutes away.

Which of the following is the best management option?

A. Medical therapy without reperfusion therapy
B. Thrombolytic therapy
C. Transfer for CABG
D. Transfer for PCI
Key Point

• In patients with STEMI presenting to a facility without percutaneous coronary intervention (PCI), time window for transfer to a PCI-capable facility

• Interhospital transfer to a PCI-capable hospital is the recommended triage strategy if primary PCI can be performed within 120 minutes of first medical contact
Reperfusion Therapy

• **Indications**
  • Presentation within 12 hours of symptom onset
  • STEMI
  • Selected NSTEMI patients with high-risk TIMI score

• **Methods**
  • PCI
  • Thrombolytic therapy
Percutaneous Coronary Intervention

• Survival advantage for most patients

• If PCI not available, transfer for PCI if:
  • Time from first medical contact to PCI ≤120 min
  • Risk features present (HF, shock)
  • Need for rescue PCI (thrombolytic therapy unsuccessful)
  • Thrombolytic therapy contraindicated

• Transfer to PCI capable facility 3 to 24 hours after successful thrombolysis
Thrombolytic Therapy

• If PCI not available within time window
• Common absolute contraindications
  • Previous intracranial hemorrhage
  • Ischemic stroke, head or facial trauma within 3 mo
  • Major surgery (within 3 weeks) or recent internal bleeding
  • Blood pressure >180/110 mm Hg on presentation
Don’t Be Tricked

- Do not choose thrombolytic therapy for patients with NSTEMI
- Do not treat reperfusion arrhythmias (accelerated idioventricular rhythm) following thrombolytic therapy
CABG Considerations

- Failure of PCI or thrombolytic therapy
- Cardiogenic shock
- Left main or left main equivalent disease
- Two- or three-vessel disease involving the LAD artery and ↓ LVEF
SHOCK Trial

301 Pts: Acute MI (20% NSTEMI) + Shock

• Emerg PCI or CABG with pressors, +/- IABP
  vs. Medical Rx with pressors, +/- IABP

  - No Diff: 30 d mortality
    - 47% vs. 56% (p=0.11)
    - Decreased mort age < 75 (41% vs. 57%) (p=0.01)

  - Decreased 6 mo mortality
    - 50% vs. 63% (p=0.003) (No diff age >75: 79%v56%)

Am Heart J 1999; 137: 313-21
NEJM 1999; 341: 625-34
Question 15: Ischemic Heart Dz

56 yo F, NSTEMI, cardiogenic shock, LAD with prox 95%, s/p bare metal stent. HR 110 bpm, BP 84/60 mm Hg, CI = 1.8 L/min/m$^2$, wedge = 35 mm Hg. For shock, next best step?

A. Dopamine
B. Milrinone
C. Norepinephrine
D. Intravenous fluids
Question 15: Ischemic Heart Dz

56 yo F, NSTEMI, cardiogenic shock, LAD with prox 95%, s/p bare metal stent. HR 110 bpm, BP 84/60 mm Hg, CI = 1.8 L/min/m\(^2\), wedge = 35 mm Hg. For shock, next best step?

A. Dopamine
B. Milrinone
C. Norepinephrine
D. Intravenous fluids
Shock: Norepi vs. Dopamine
SOAP II Trial

1679 pts w/ shock
Norepi vs. Dopamine
(~10 % MI/cardio shock)

No diff
(p=0.1)
28 d death: 49% vs 53%

Dopa more arrhythmia:
12% vs. 24% (p<0.001)

In Cardiogenic Shock Subset
↑ death Dopa (p=0.03)

NEJM 2010; 362: 779-89
Guidelines: IABP

**STEMI** ACC/AHA 2013 STEMI
- Class IIa: “can be useful with cardiogenic shock after STEMI (after) pharmacologic tx”

**NSTE-ACS** ACC/AHA 2013 STEMI
- Not classified: “may be used to treat severe persistent or recurrent ischemia... despite intensive medical therapy”

**Cardiogenic Shock** ESC 2016 HF
- Class III: Not recommended

ACC/AHA 2013 STEMI, JACC 2013; 61 (4): e78-140
SHOCK II Trial

600 pts acute MI, cardiogenic shock
70% STEMI, 30 % NSTEMI
Intraaortic Balloon Pump (IABP) vs. none
***All after PCI

No diff \( (p=0.92) \)
30 day all-cause mortality: 40% vs 41%
ICU LOS, lact, Cr, pressor, bleeding or vasc compl

NEJM 2012; 367: 1287-96
A 52-year-old woman is diagnosed with ACS. BP is 84/62 mm Hg and HR is 98/min. The lungs are clear bilaterally; JVD is present to the angle of the jaw. Electrocardiogram shows ST-elevation on right-sided V₄R.

Which of the following should be given first?

A. Dobutamine
B. Metoprolol
C. Nitroglycerin
D. Normal (0.9 %) saline
A 52-year-old woman is diagnosed with ACS. BP is 84/62 mm Hg and HR is 98/min. The lungs are clear bilaterally; JVD is present to the angle of the jaw. Electrocardiogram shows ST-elevation on right-sided V$_4$R.

Which of the following should be given first?

A. Dobutamine  
B. Metoprolol  
C. Nitroglycerin  
D. Normal (0.9 %) saline
Key Point

- Treatment of hypotension in patient with inferior/posterior myocardial infarction
- Intravenous fluids for volume expansion
Right Ventricular/Posterior MI

- Initial hypotension or develops following NTG
- Clear lungs, JVD (right heart dysfunction)
- ST-elevation in $V_4R$ and sometimes in $V_1$
- Echocardiography $\rightarrow$ RV hypokinesis
- Echocardiography also excludes other causes of shock (e.g., acute MR or VSD)
- Treat with Intravenous fluids, reperfusion therapy
Pacing Indications

- Asystole
- Symptomatic bradycardia
- Complete heart block
- Alternating LBBB and RBBB
- New or indeterminate-age bifascicular block with first-degree AV block
- Bifascicular block with syncope
Complications 2 to 7 Days after MI

- Ventricular septal defect and papillary muscle rupture
  - Abrupt pulmonary edema or hypotension
  - Loud holosystolic murmur and thrill
  - Echocardiogram diagnostic

- Left ventricular free wall rupture
  - Sudden hypotension or cardiac death
  - Pulseless electrical activity
  - Ventricular arrhythmias
Medications to Begin During Hospitalization

• Statins (indefinitely)
  • High-intensity statin therapy to reduce LDL-cholesterol by 50%
  • Moderate-intensity statin therapy if age >75 years

• ASA (indefinitely)
Medications to Begin During Hospitalization

- Platelet P2Y12 receptor inhibitor (ticagrelor/prasugrel/clopidogrel)
  - Recommended for 1 year if tolerated following ACS presentation
  - Prasugrel indicated only in patients treated with PCI
Medications to Begin at or Before Discharge

- β-Blocker (indefinitely)
- ACE-inhibitors (indefinitely)
  - ARB if ACE-inhibitor intolerant
A 68-year-old man had a MI 4 months ago treated with PCI and placement of a drug-eluting stent. Today his ejection fraction is 25%. He is asymptomatic. Physical examination is normal. ECG shows signs of an old anterior MI, sinus rhythm and a normal QRS complex. He is on optimal medical therapy for heart failure.

Which of the following is the most appropriate management option?
A. Biventricular pacemaker
B. Coronary angiography
C. Exercise stress test
D. Implantable cardioverter-defibrillator
A 68-year-old man had a MI 4 months ago treated with PCI and placement of a drug-eluting stent. Today his ejection fraction is 25%. He is asymptomatic. Physical examination is normal. ECG shows signs of an old anterior MI, sinus rhythm and a normal QRS complex. He is on optimal medical therapy for heart failure.

Which of the following is the most appropriate management option?

A. Biventricular pacemaker
B. Coronary angiography
C. Exercise stress test
D. Implantable cardioverter-defibrillator
Key Point

- Indication for ICD placement following acute MI
- Ejection fraction less than ≤35% 40 days post-MI or 3 months post-revascularization (PCI or CABG) on optimal medical therapy for heart failure
Implanted Cardioverter-Defibrillator Indications

• Must meet all criteria
  • 40 Days since MI or >3 months since PCI or CABG
  • Ejection fraction ≤35%
  • On optimal medical therapy for heart failure
Therapeutic Hypothermia

**CLASS I**

1. Therapeutic hypothermia should be started as soon as possible in comatose patients with STEMI and out-of-hospital cardiac arrest caused by ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT), including patients who undergo primary PCI (156–158). *(Level of Evidence: B)*

2. Immediate angiography and PCI when indicated should be performed in resuscitated out-of-hospital cardiac arrest patients whose initial ECG shows STEMI (159–174). *(Level of Evidence: B)*
Atheroembolic Disease

• Aortic plaque
  • Risk of thromboembolism or cholesterol emboli from unstable or ruptured plaque

• High risk factors
  • Thick plaques (≥ 4 mm)
  • Cardiac/aortic surgery
  • Arterial catheterization

• Clinical manifestations depend on type of embolization
Atheroembolic Disease

- Clinical manifestations depend on type of embolization
  - Thromboembolism → larger arteries
  - Cholesterol emboli → smaller capillary beds (less common than thromboembolism)
Atheroembolic Disease

• Clinical manifestations
  • Stroke, TIA, acute kidney injury
  • Hollenhorst plaque - pathognomonic
  • Livedo reticularis, blue toe syndrome, digital ulcers and gangrene

• Vascular assessment
  • TEE, CT or MRI to evaluate aortic source
  • Clinical diagnosis or biopsy of muscle, skin, kidney for cholesterol emboli

• Therapy → statins to reduce future embolization
Golden yellow retinal intra-arterial refractile body characteristic of a cholesterol embolus (Hollenhorst plaque)
A 63-year-old man is found to have an asymptomatic 42 mm ascending aortic aneurysm (stable for 1 year). Physical examination is normal.

**Which of the following is the most appropriate management?**

A. Delay repair until symptomatic  
B. Elective repair  
C. Repeat echocardiogram in 1 year  
D. Repeat echocardiogram in 3 months
A 63-year-old man is found to have an asymptomatic 42 mm ascending aortic aneurysm (stable for 1 year). Physical examination is normal.

Which of the following is the most appropriate management?

A. Delay repair until symptomatic
B. Elective repair
C. Repeat echocardiogram in 1 year
D. Repeat echocardiogram in 3 months
Question 18 CV Key Point

• Threshold for elective repair of asymptomatic ascending thoracic aneurysm

• Elective repair is recommended for ascending aortic aneurysms 50-60 mm

• Echocardiographic surveillance if <50 mm
Thoracic Aortic Aneurysm

- Most thoracic aneurysms are incidental findings
- Echocardiographic monitoring
  - Yearly if <45 mm
  - Every 6 months if ≥45 mm
  - Repair if ≥ 50-60 mm (ascending) or 60-70 mm (descending)
Thoracic Aortic Dissection Findings

- Chest, flank, abdominal, and back pain
- New aortic regurgitation, heart failure, and BP differential between arms
- Other possible findings
  - Thromboembolism
  - Dissection of branch arteries (stroke, MI)
  - Cardiac tamponade
- Chest x-ray $\rightarrow$ widened mediastinum
Thoracic Aortic Dissection Diagnosis

- TEE
- CT scan with contrast
- MRA
  - Type A dissections $\rightarrow$ ascending aorta
  - Type B dissections $\rightarrow$ all others
A 63-year-old man is diagnosed with acute dissection of the aortic arch.

Which of the following should be done next?
A. Begin hydralazine
B. Begin metoprolol and nitroprusside
C. Immediate surgery
D. Monitor with echocardiography
A 63-year-old man is diagnosed with acute dissection of the aortic arch.

Which of the following should be done next?

A. Begin hydralazine
B. Begin metoprolol and nitroprusside
C. Immediate surgery
D. Monitor with echocardiography
Key Point

• Treatment of an uncomplicated type B aortic dissection
• β-Blocker and vasodilator
Thoracic Aorta Dissection Therapy

• Acute therapy
  • IV β-blocker plus vasodilator (nitroprusside or enalaprilat)

• Emergent surgery for type A dissection

• Uncomplicated type B dissection → medical therapy alone
Thoracic Aorta Aneurysm Therapy

• Treat hypertension with β-blocker
  • ACE-inhibitor or ARB acceptable alternatives

• Avoid pregnancy if >40 mm

• Consider prophylactic surgery
  • Symptoms of hoarseness, dysphagia, back pain
  • Ascending aorta diameter >50-60 mm
  • Descending aorta diameter >60-70 mm
  • Rapid growth >10 mm/year or > 5 mm/year for Marfan and other congenital syndromes
• Do not use hydralazine for acute aortic dissection because it results in increased shear stress

• Surgery for type B dissection is indicated if aneurysm involves major aortic vessels e.g., renal arteries.
A 67-year-old man, a life-long smoker, has recently been screened with abdominal ultrasonography for an abdominal aortic aneurysm. Screening revealed no evidence of aneurysmal dilatation. He is receiving treatment for hypertension and hyperlipidemia.

When should abdominal aortic aneurysm screening be repeated in this individual?
A. 1 year
B. 5 years
C. 10 years
D. Never
A 67-year-old man, a life-long smoker, has recently been screened with abdominal ultrasonography for an abdominal aortic aneurysm. Screening revealed no evidence of aneurysmal dilatation. He is receiving treatment for hypertension and hyperlipidemia.

When should abdominal aortic aneurysm screening be repeated in this individual?

A. 1 year
B. 5 years
C. 10 years
D. Never
Question 21 CV

- Indications and frequency of abdominal aortic aneurysm screening
- One-time screening for men ≥65 years who have ever smoked
Abdominal Aortic Aneurysm

• Screening
  • 1-time ultrasound for men, ages 65-75 years, who have ever smoked
  • Selective screening men ages 65 to 75 years who have never smoked but at higher risk (e.g., family history of AAA)

• Surveillance
  • Optimal frequency unknown
  • For aneurysms 4.0 to 5.4 cm follow-up ultrasound in 6 to 12 mo
Don’t be tricked

• Do not screen women for abdominal aortic aneurysm.
Abdominal Aortic Aneurysm

- AAA rupture
  - New abdominal, flank, back pain; hypotension; syncope; sudden onset and shock
  - Diagnosis → MRA or CT scan
  - Emergent surgery
AAA

Class I

• AAA ≥ 5.5 cm: repair
  • Open or endovascular
  • Periodic long-term surveillance leak

• AAA 4- 5.4 cm: US or CTA
  q 6-12 mos

ACC/AHA 2013 PAD Guideline JACC 2013; 61 (14)
Which of the following is the correct method to calculate the ankle-brachial index?

A. Highest ankle diastolic blood pressure divided by the highest brachial diastolic pressure (either arm)
B. Highest ankle systolic blood pressure divided by the highest brachial systolic pressure (either arm)
C. Lowest ankle diastolic blood pressure divided by the lowest brachial diastolic pressure (either arm)
D. Lowest ankle systolic blood pressure divided by the lowest brachial systolic pressure (either arm)
Which of the following is the correct method to calculate the ankle-brachial index?

A. Highest ankle diastolic blood pressure divided by the highest brachial diastolic pressure (either arm)
B. **Highest ankle systolic blood pressure divided by the highest brachial systolic pressure (either arm)**
C. Lowest ankle diastolic blood pressure divided by the lowest brachial diastolic pressure (either arm)
D. Lowest ankle systolic blood pressure divided by the lowest brachial systolic pressure (either arm)
Key Point

- Correct method to measure ABI
- Highest ankle SBP (dorsalis pedis or posterior tibial) divided by the highest brachial artery SBP in either arm to obtain the ABI for each lower extremity
Peripheral Artery Disease (PAD) and the Ankle-Brachial Index (ABI)

- PAD $\rightarrow$ coronary artery disease equivalent
- Only 20% present with intermittent claudication
- ABI = Highest ankle SBP divided by the highest brachial artery SBP in either arm
  - ABI $\leq 0.90$ = PAD
  - ABI $\leq 0.40$ = ischemic rest pain
  - ABI $>1.40$ = diabetes-related noncompressible calcified arteries
    - Select toe-brachial index for these patients
• Be able to differentiate claudication due to PAD from claudication due to spinal stenosis
• Spinal stenosis is associated with pain that variably occurs with walking, persists with standing (resting) and resolves when sitting or flexing the spine (bending forward)
PAD Therapy

- Cardiovascular risk factor reduction
- Supervised exercise training program best therapy to improve function
- Aspirin (first choice) or clopidogrel
- Cilostazol for symptomatic PAD
- High-intensity statin therapy
- Angioplasty or surgery for patients who
  - Do not improve on medical therapy
  - Have pain at rest or poorly healing ulcers
• Do not use cilostazol in patients with decreased left ventricular ejection fraction or history of heart failure
Interventional PAD Treatment: LE

Class I for stent or surgery

• Vocational/life-style limiting sx$s$, inadequate response to exercise/ meds

• Critical limb ischemia
  • Ulcers, gangrene, necrosis

2016 AHA/ACC LE PAD Guideline; avail on line
Acute Arterial Ischemia

• **Diagnosis**
  - Pain, paresthesias, pallor, paralysis, pulselessness
  - Echocardiography to locate potential embolic source

• **Therapy**
  - Antiplatelet agents
  - Heparin anticoagulation
  - Urgent surgical consultation
Question 17: Renal Arteriogram
31 F from Philippines, history of gestational diabetes, BP controlled on four, near maximal, anti-hypertension medications, occasional headaches, abdominal bruit, borderline chronic kidney disease.

Based on prior image, next best step?
A. Renal artery balloon angioplasty
B. Captopril renal scintigraphy
C. Selective renal vein renin measurement
D. MRA of the brain
Fibromuscular Dysplasia

FMD is 10% of RAS cases (>90% is atheroscler)

“String of beads” median to distal

Bilateral in 60%

Young females age 30 – 50 yo

CLASS I

2. Balloon angioplasty with bailout stent placement if necessary is recommended for fibromuscular dysplasia lesions. (Level of Evidence: B)
Renal Artery Stenosis: Atherosclerotic

Medical Management
Renal Artery Revascularization - When?

**Fibromuscular Dysplasia** (Class I)
- Balloon angioplasty/ bail out stent

**Flash Pulmonary Edema** (Class I)
- Hemodynam sig/ recurrent, unexplained CHF/ sudden pulm edema
Cardiology Continues

• Wednesday, June 30
• Wednesday, July 7
• Wednesday, July 14

Next up in the series – Gastroenterology
Stay tuned for dates