Coronary Heart Disease: Introductory Material Part II

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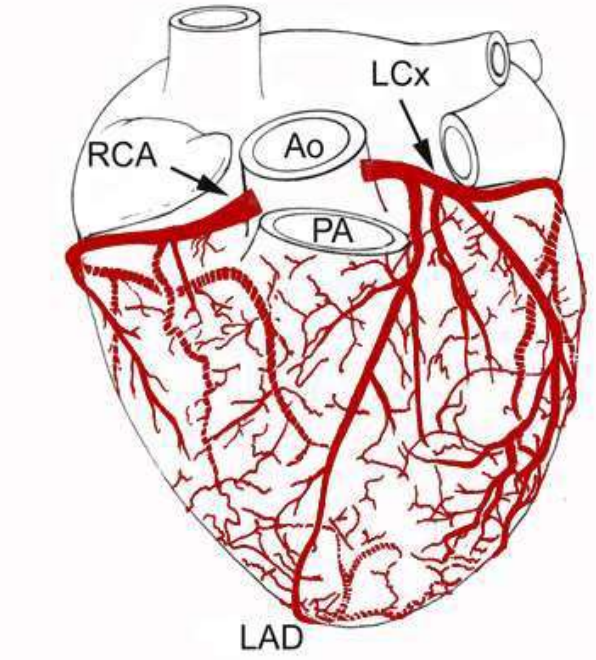
Coronary Heart Disease: Part 4 Pathophysiology of Angina

Coronary Heart Disease

- Chronic disorder that spans multiple decades
  - Defined phases:
    - asymptomatic
    - **stable angina = SIHD, CSA (CCS)**
    - progressive angina
    - unstable angina or acute MI (ACS)
  - May also present as:
    - May also present as ischemia without clinical symptoms or ischemia due to coronary vasospasm (Prinzmetal's angina) or microvascular disease
    - Patients transition from ACS to CCS

CCS Pathophysiology

- Common Mechanisms:
  - plaque-related obstruction of coronary arteries (macrovascular disease)
  - focal or diffuse spasm of normal or plaque-diseased arteries (vasospastic or Prinzmetal's Angina)
  - coronary microvascular dysfunction (microvascular disease)

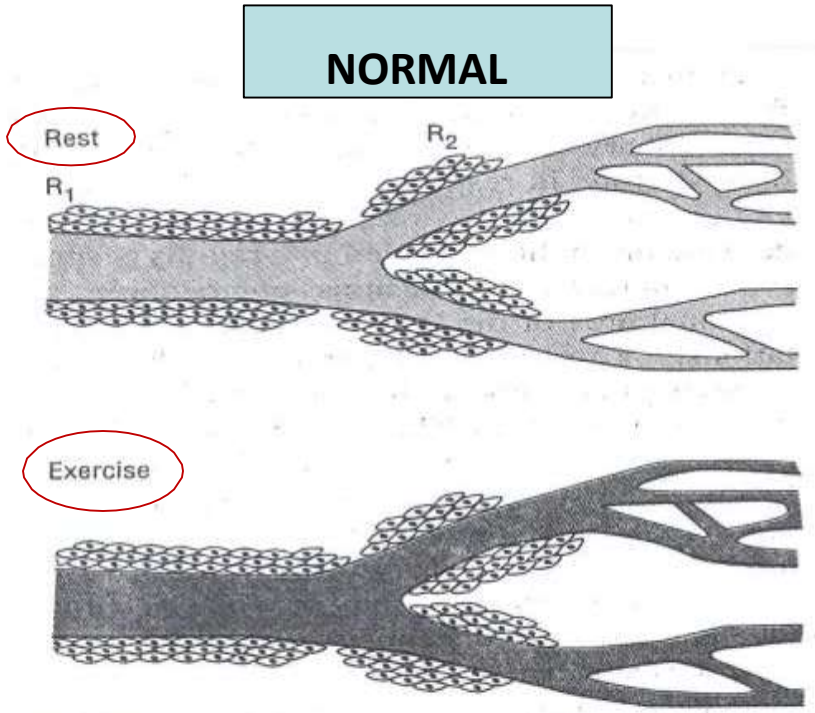


Important Terms to Know

- Ischemia – a lack of oxygen and decreased or no blood flow to tissues
- Angina – a spasmodic cramp-like choking pain in the chest, jaw, shoulder, back, or arm
- Angina pectoris – thoracic pain most commonly caused by myocardial ischemia
- Not all chest pain is due to the heart!

Coronary Blood Flow

Pharmacotherapy 5th ed. Figure 14-2

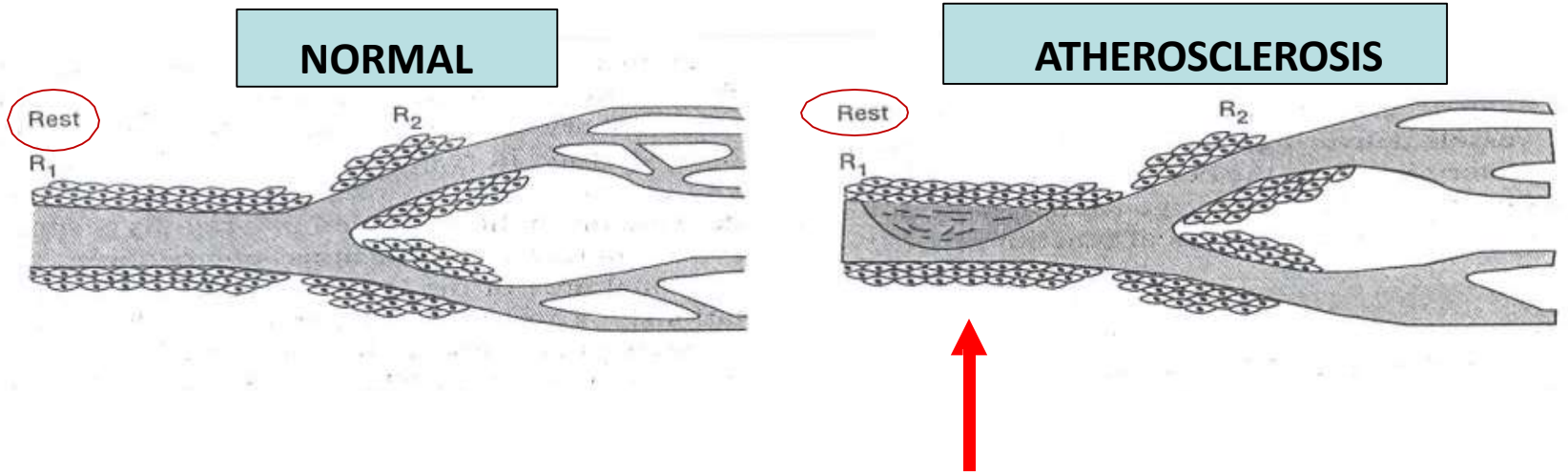


In response to exercise and increased oxygen require ments of the myocardium, both sets of arteries dilate. However, R2 arteries dilate more than R1.

R_1 = epicardial arteries and collaterals are typically dilated and offer little resistance to blood flow

R_2 = intramyocardial arteries and arterioles can alter vascular tone to decrease resistance to blood flow based on oxygen demands of the myocardium

Coronary Blood Flow

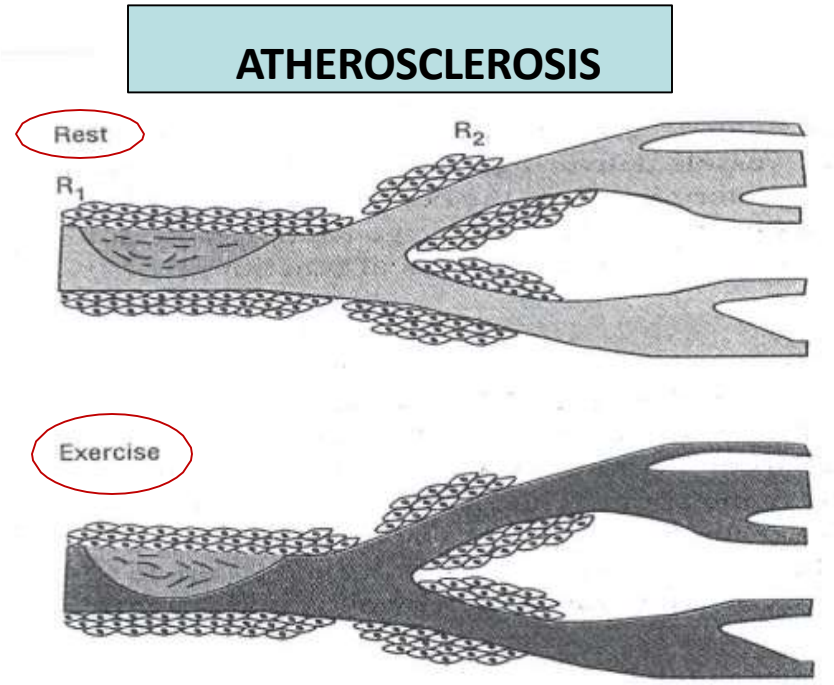


When blockage due to atherosclerosis occurs in R1 arteries, R2 arteries and arterioles dilate when the patient is at rest in order to maintain oxygenation to the myocardium.

Pharmacotherapy 5th ed. Figure 14-2

Coronary Blood Flow

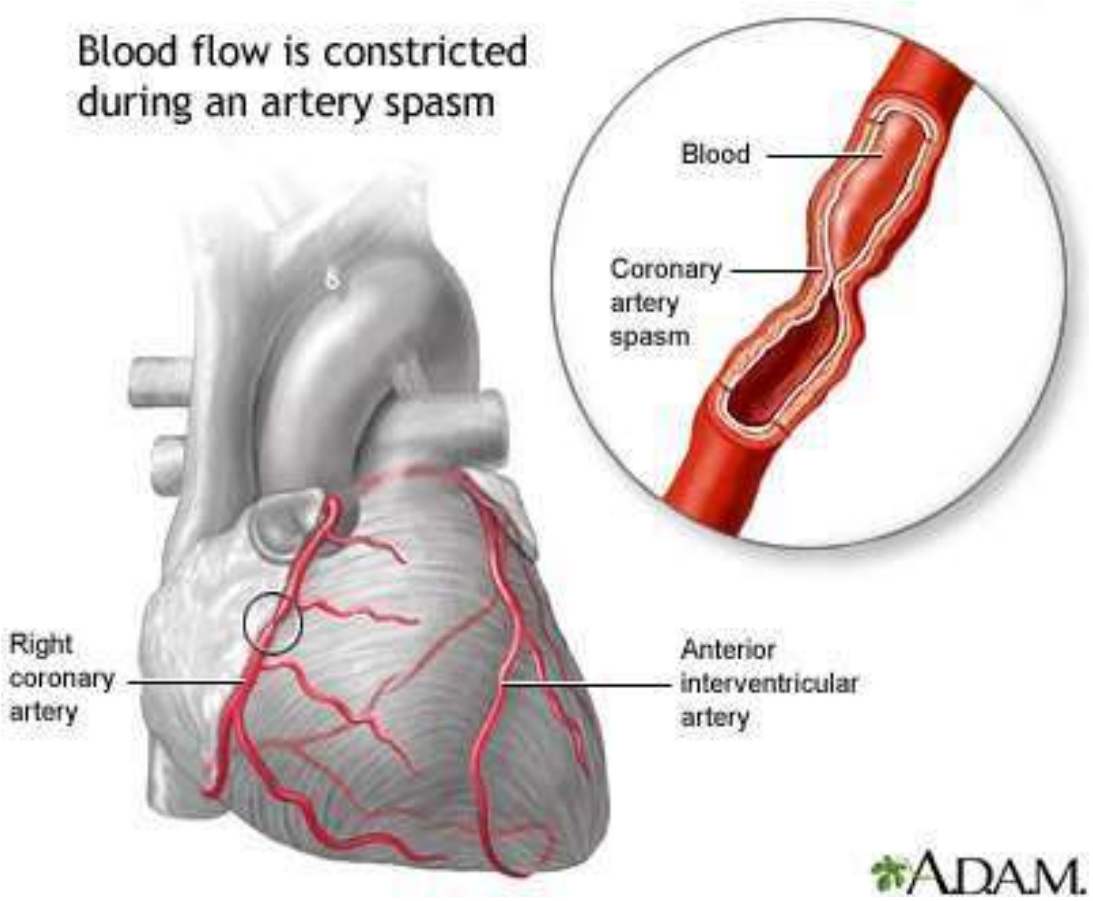
In the presence of severe stenosis (>70% obstruction) and increased oxygen demand with physical activity, the R2 arteries can not dilate further, leading to ischemia and angina.



This is the pathophysiology for disease in the large coronary arteries.

Pharmacotherapy 5th ed. Figure 14-2

Coronary Vasospasm



- ~ 2% of patients with stable angina
- Focal vaso-spasm of an epicardial artery
- Risk factors:
  - Heavy smokers
  - HTN
  - High cholesterol
  - Alcohol abuse

Coronary Microvascular Disease

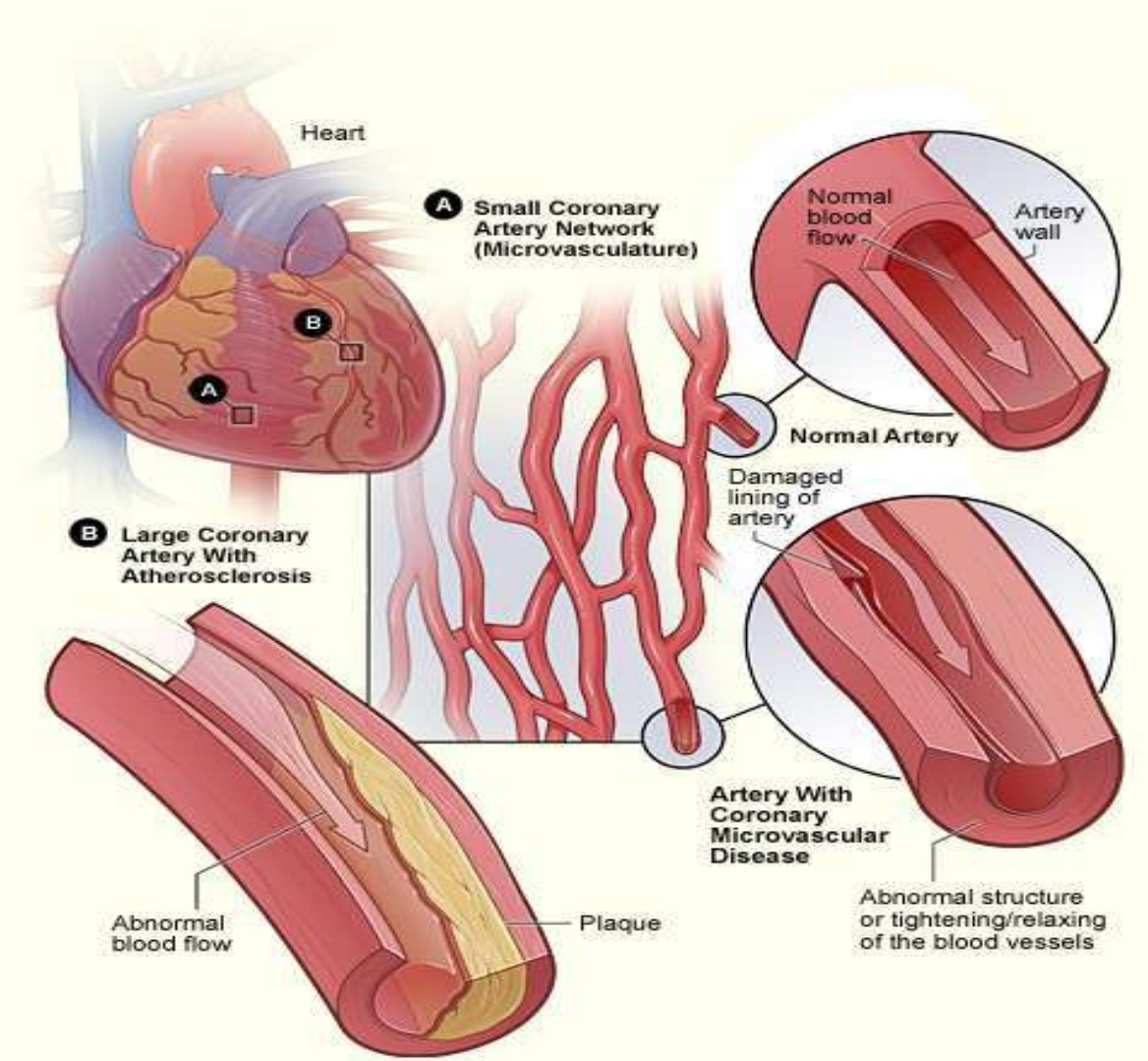


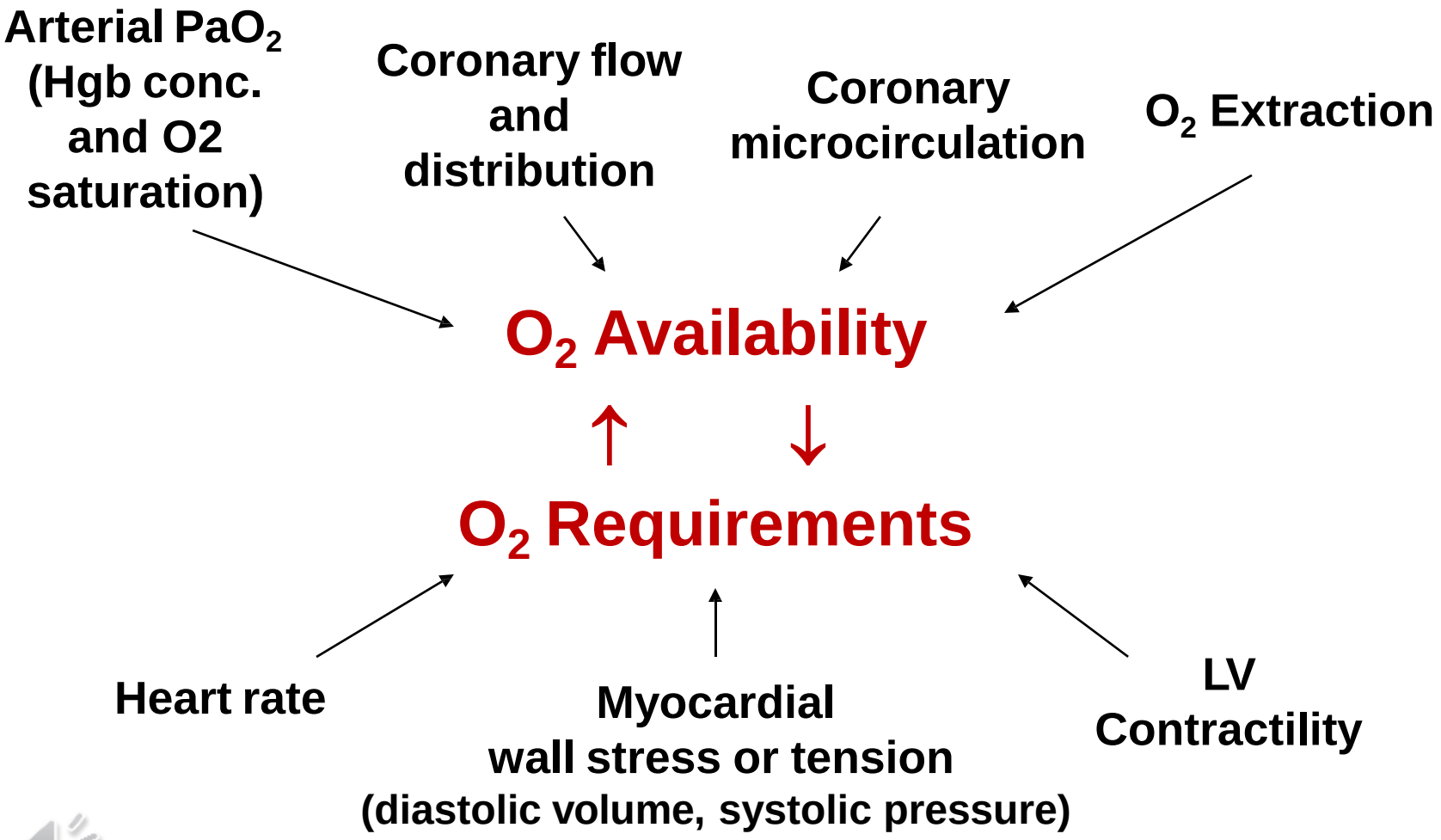
Figure A: small coronary arteries are affected with MVD.

Pathogenesis underlined by endothelial dysfxn that leads to inappropriate vaso-constriction with impaired vasodilation.

Patients at risk for MVD include:

nhlbi.nih.gov

O_2 Economics: Regulation of Oxygen Supply and Demand



Regulation of Oxygen Supply

Arterial PaO_2 (Hgb conc. and O2 saturation)

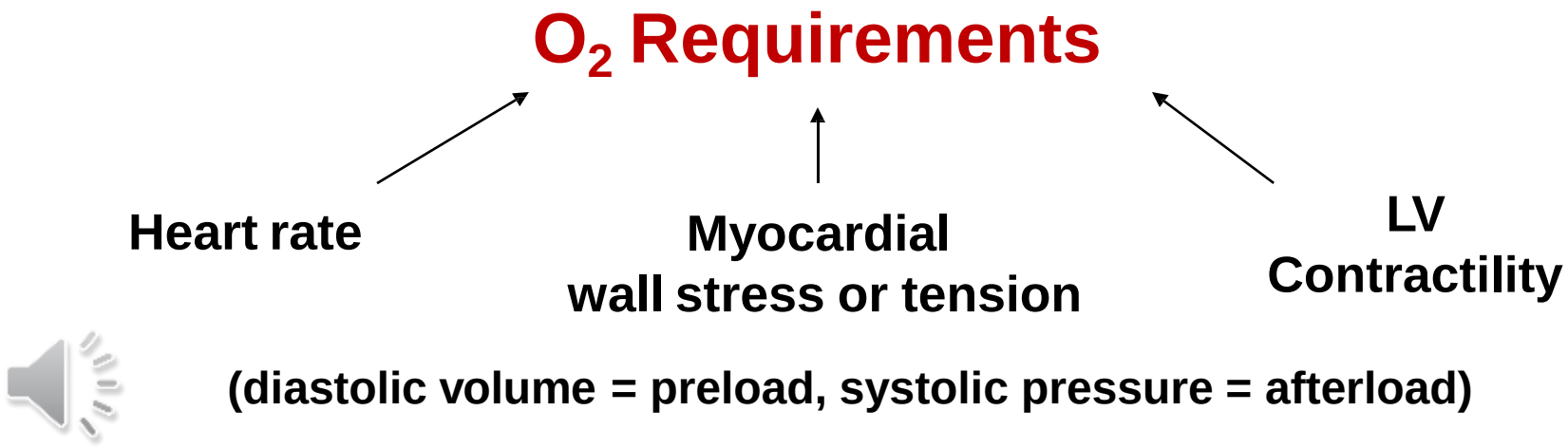
Coronary flow and distribution

Coronary microcirculation

O_2 Extraction

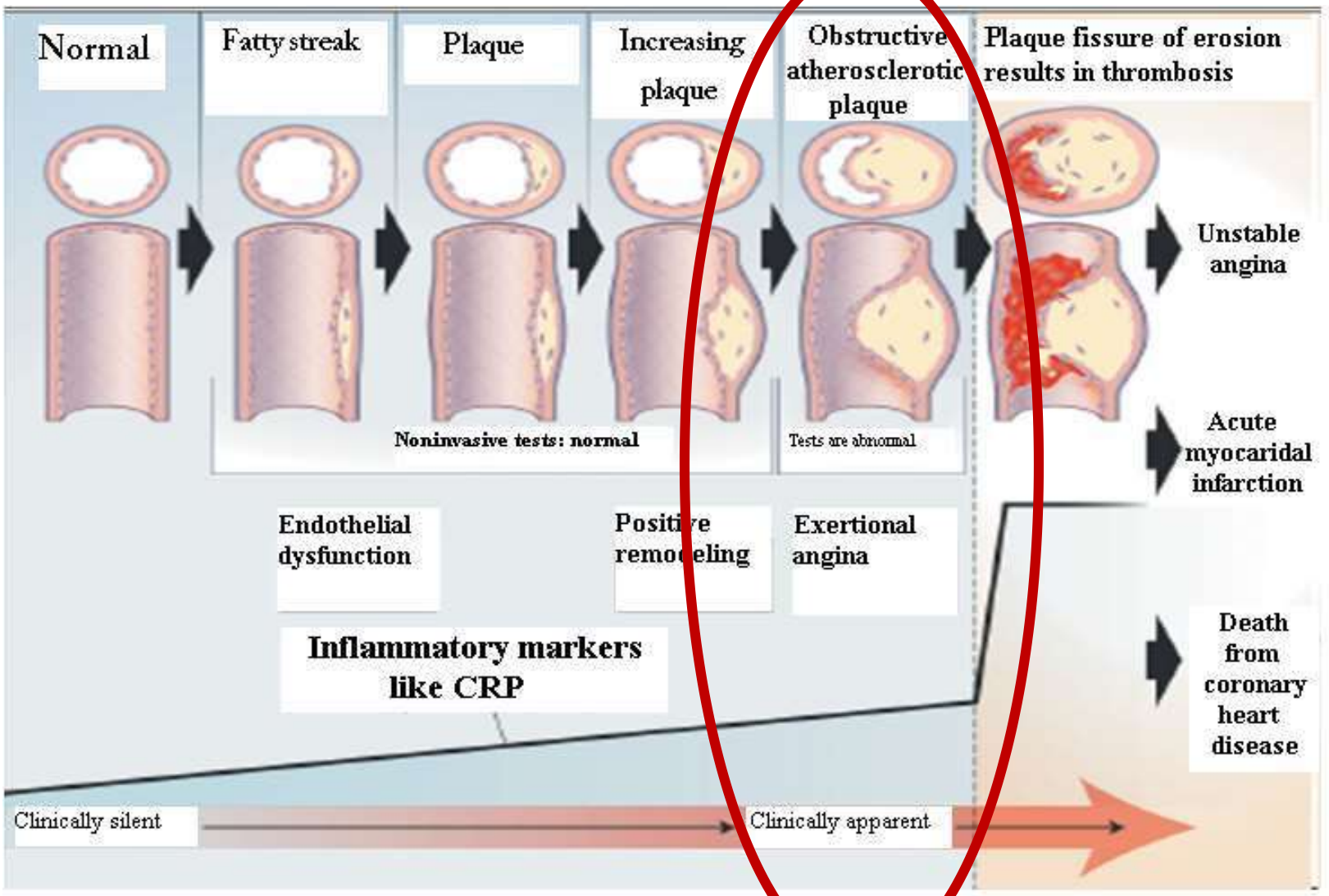
O_2 Availability

Regulation of Oxygen Demand



(diastolic volume = preload, systolic pressure = afterload)

Coronary Heart Disease: Part 5 Physical Presentation of CCS



Adapted from NEJM 2005;352:2524-2533

Evaluation of Chest Pain Associated with Stable Angina

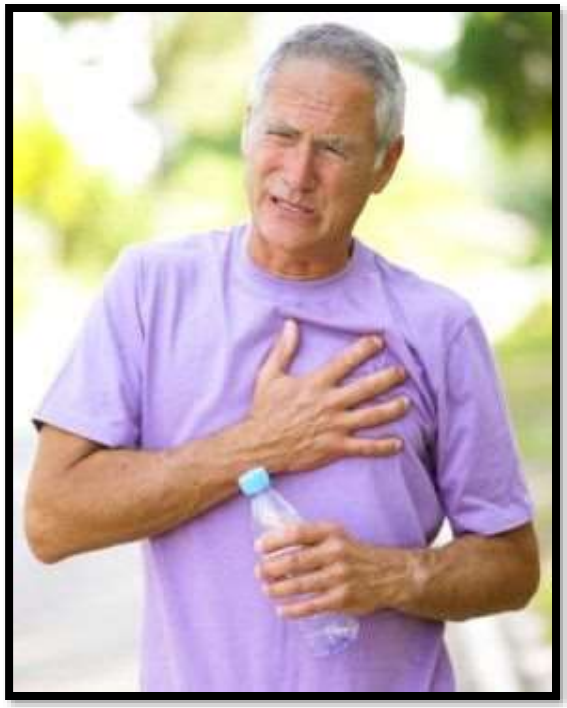
American Heart Association. Learn and Live.

- ACC/AHA recommends:
  1. History and Physical
     - In patients presenting with chest pain, a detailed symptom history, focused physical examination, and risk-factor assessment should be performed.
  2. Noninvasive Testing
  3. Invasive Testing

ACC/AHA 2002 CSA Guidelines, 2007 Update; 2013 SIHD Guidelines

Clinical Evaluation: History

- ✓ Risk Factors for CHD (CCS, ACS)
- Characterization of chest pain associated with stable angina
  - Quality
  - Location
  - Duration of pain
  - Factors that provoke pain
  - Factors that relieve pain
- Classification of Chest Pain
  - stable, unstable, Prinzmetal, silent



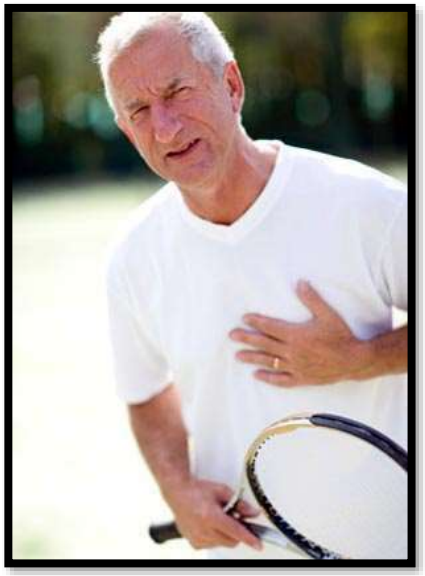
Character of Chest Pain: Quality

- Patients have described anginal pain as “squeezing”, “grip-like”, “pressure-like”, “suffocating”, and “heavy”
- Patients may describe SOB or a choking feeling
- Pain gradually increases in intensity then gradually fades away
- Not like a Hollywood movie!

Character of Chest Pain:
Location and Duration

- Located over the sternum
- Occasionally limited to left shoulder and arm
- Lower cervical or upper thoracic spine
- Left interscapular or suprascapular area
- Radiate?
- Typical episode is minutes in duration

Character of Chest Pain:
Precipitating Factors



- Five E's of angina:
  - **E**xercise
  - **E**xposure to cold
  - **E**motional stress
  - **E**ating large meals
  - Severe an**E**mia
- Effort that requires use of arms above the head
- Walking against the wind
- Sexual activity
- Often symptoms are reproducible after specific amount of exertion

Character of Chest Pain:
Relieving Factors

- Rest
- Nitroglycerin:

  Questions to ask

  1.

  2.

Clinical Evaluation: History

- ✓ Risk Factors for CHD
- ✓ Characterization of Chest Pain

- Classification of Chest Pain
  - Stable
    - typical, atypical, non-cardiac chest pain
  - Unstable
  - Prinzmetal
  - Silent

Clinical Evaluation:
Stable Angina Classification

1. *Typical angina*
   - substernal chest pain with characteristic quality and duration
   - provoked by exertion or emotional stress
   - relieved by rest or nitroglycerin
2. *Atypical angina*
   - Meets 2 of the above characteristics
3. *Non-cardiac chest pain*
   - Meets 1 or none of the above characteristics

Other Sources of Chest Pain

- Nonischemic cardiovascular
  - Aortic dissection, pericarditis
- Pulmonary
  - PE, pneumothorax, pneumonia
- Gastrointestinal
  - Esophageal, biliary, peptic, pancreatic
- Chest wall
  - Costochondritis, rib fracture, herpes zoster
- Psychiatric
  - Anxiety disorders, depression

Coronary Heart Disease: Part 6 Diagnosis and Treatment of CHD

Evaluation of Chest Pain Associated with CCS

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ACC/AHA 2002 CSA Guidelines, 2007 Update

Clinical Evaluation: PE

- Possible cardiac findings:
  - S_4 or S_3 gallop, mitral regurgitation murmur, bibasilar crackles, or chest wall heave
  - Typical clinical exam:

- Labs: Hemoglobin, fasting glucose, fasting lipid panel, SCr, troponin
- VS: HR, BP, RR, pulse ox

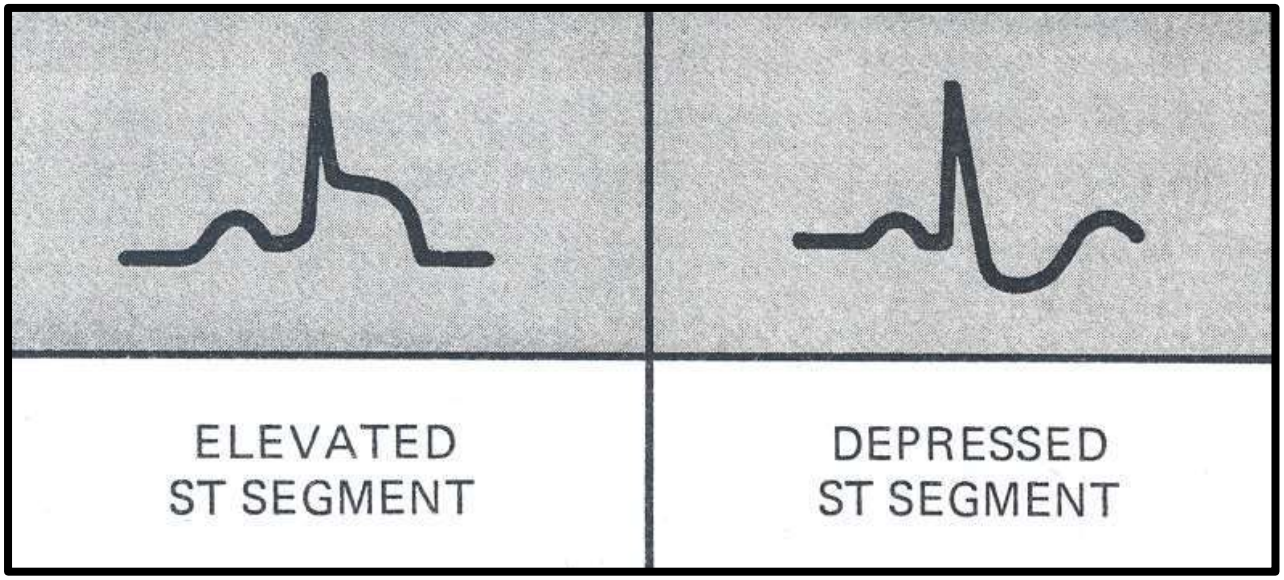
Evaluation of Chest Pain

American Heart Association. Learn and Live.

- ACC/AHA recommends:
  1. History and Physical
  2. Noninvasive Testing
     - Electrocardiography (12 lead ECG)
     - Chest X-ray
     - Exercise ECG Testing
     - Echocardiography
     - Stress Imaging
     - Computed tomography angiography (CTA)
  3. Invasive Testing
     - Coronary Angiography

ACC/AHA 2002 CSA Guidelines; 2013 SIHD

Testing: ECG

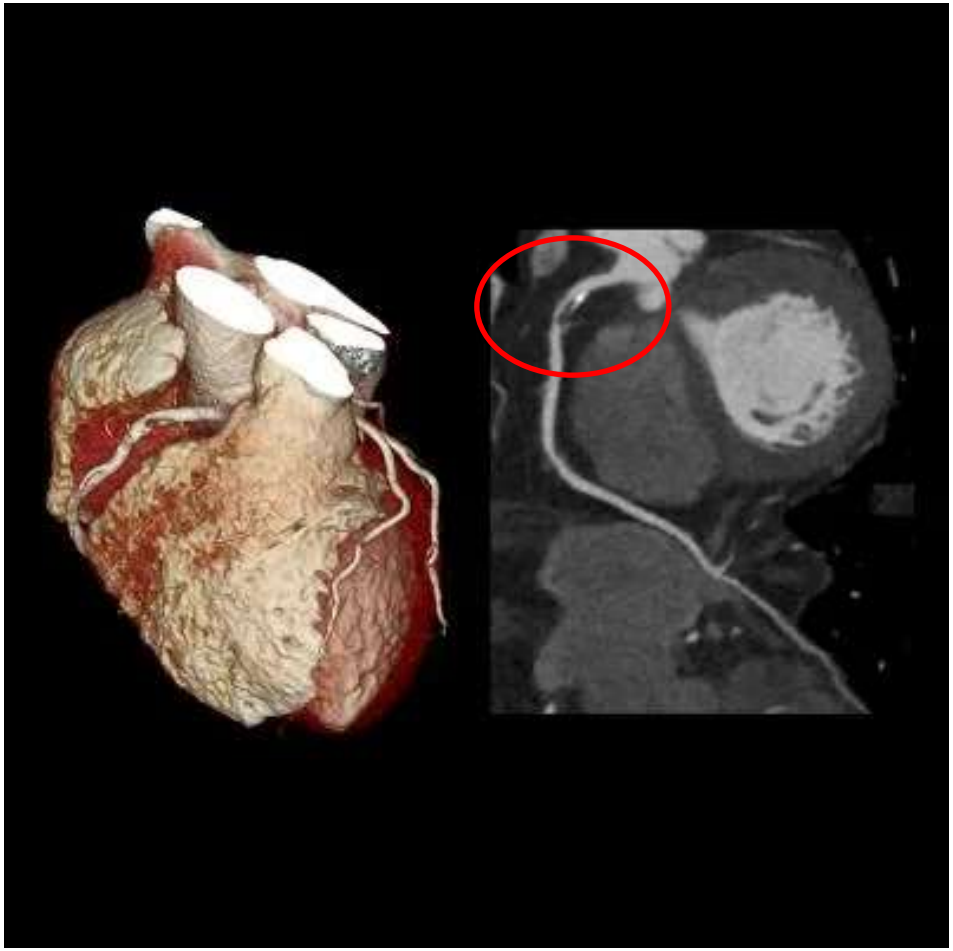


- ST-segment elevation indicates acute infarction (STEMI)
- ST-segment depression may indicate ischemia (stable or unstable angina) or infarction (NSTEMI)

Testing: CTA

- A CT scan is an x-ray technique that uses radiation and a computer to create cross-sectional pictures of the heart. The computer puts all the images together to make one 3D picture.
- CTA combines a CT scan with an injection of radioactive dye to picture the coronary arteries and look for plaque or calcium deposits in the arterial walls.

Example of CT Scan Results



CT coronary angiogram of the Right Coronary Artery revealing a severe lesion.

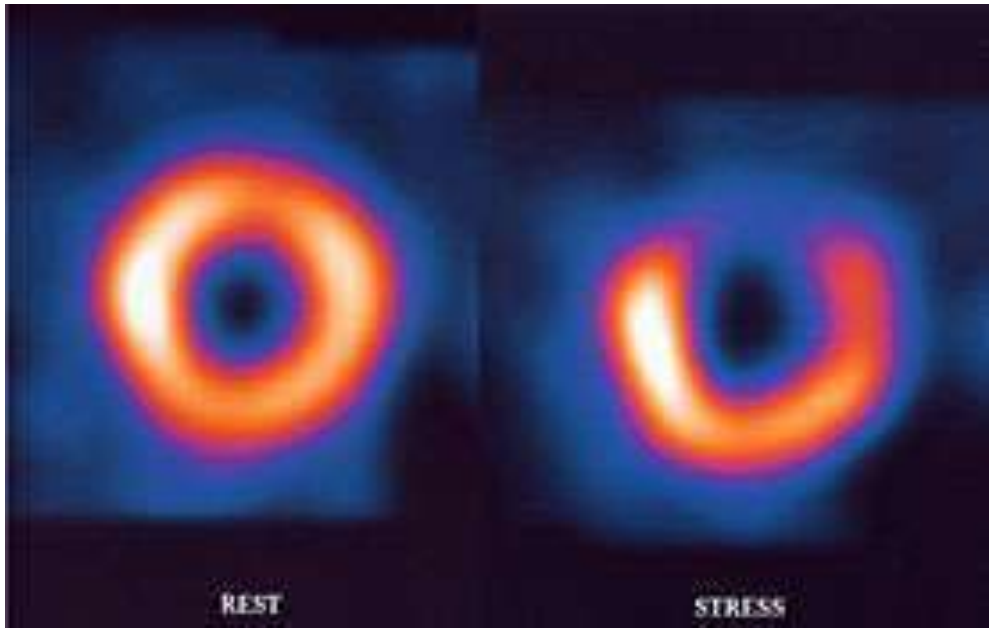
Testing: Exercise ECG

- Most commonly used diagnostic test
- Patient exercises on a bicycle or treadmill with continuous ECG performed
- Important ECG findings:
- Drug considerations:

Testing: Stress Imaging

- Involves echocardiography or myocardial perfusion imaging to identify the extent, severity, and location of ischemia
- Images obtained during rest and under stress
- Stress can be induced by exercise or pharmacologic agents
  - chemical "stressors" (adenosine, dipyridamole, dobutamine)
  - radioactive tracers (thallium, technetium, technetium-labeled sestamibi)

Testing: Stress Imaging



Images taken at rest (left) and during exercise (right) during a nuclear stress test. The dark area in the right image shows a location of the myocardium where blood flow is abnormal.

Evaluation of Chest Pain

American Heart Association. Learn and Live.

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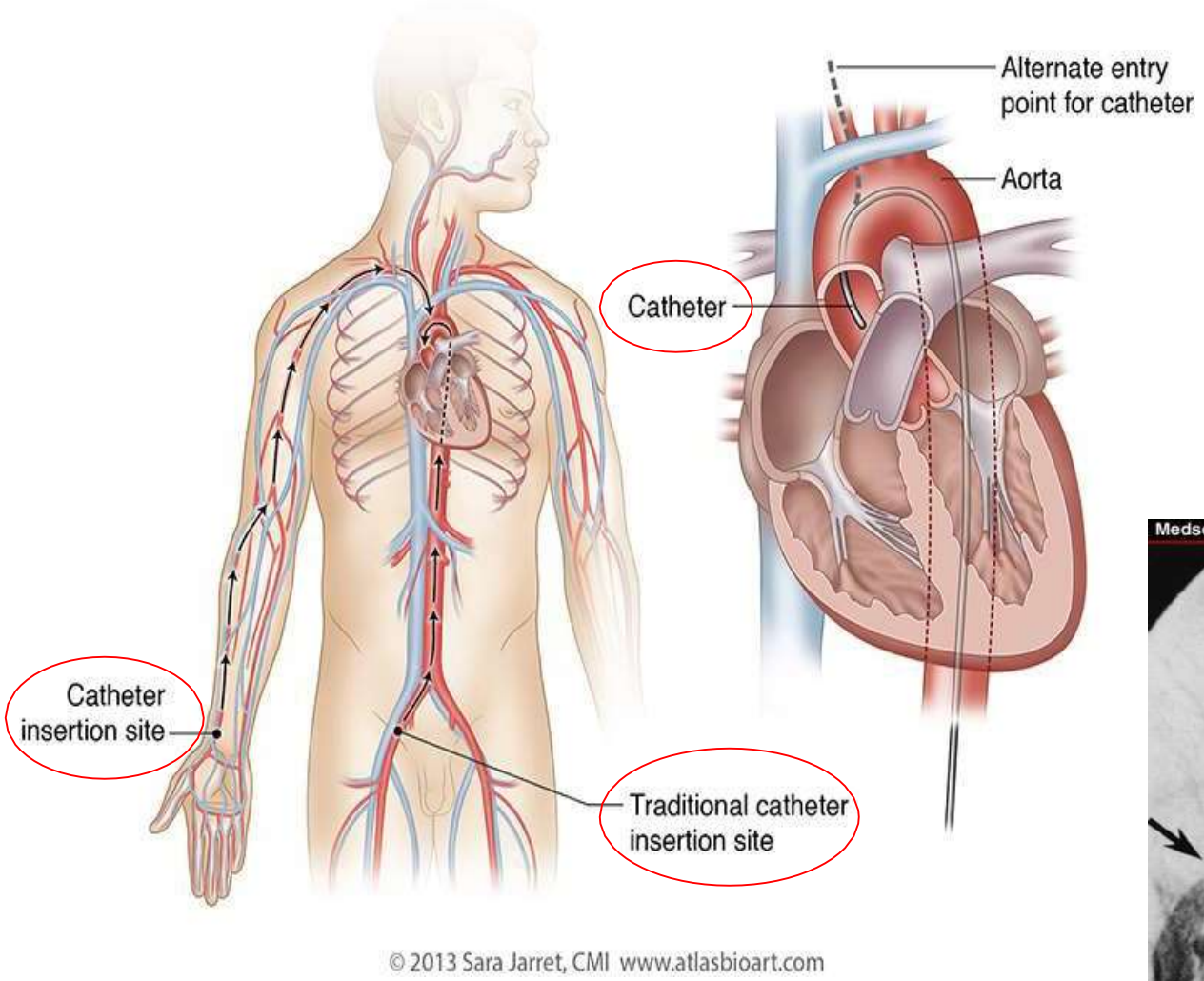
     - Chest X-ray
     - Exercise ECG Testing
     - Echocardiography
     - Stress Imaging
     - Computed tomography (CT) angiography (CTA)
  3. Invasive Testing
     - Coronary Angiography

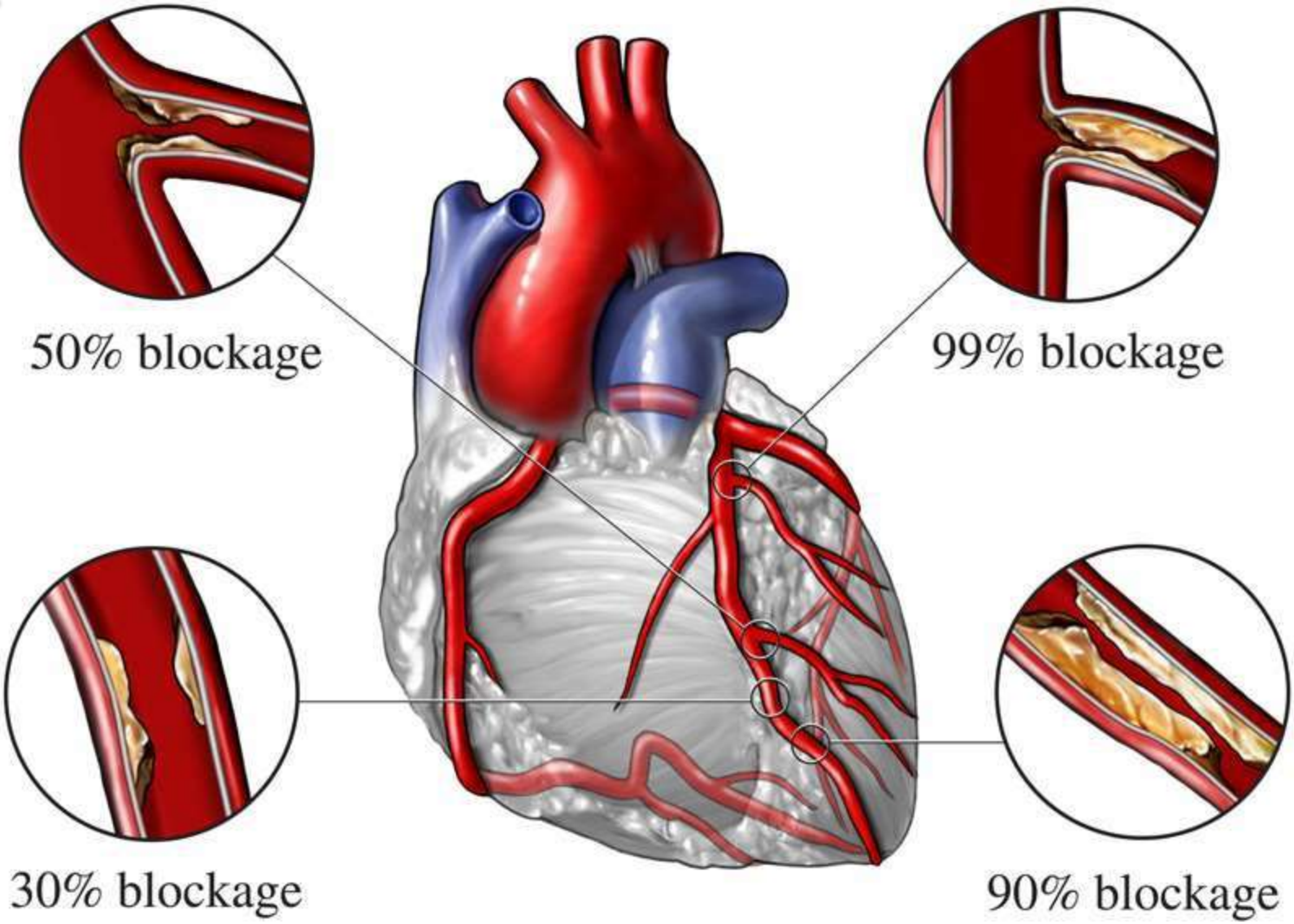
ACC/AHA 2002 CSA Guidelines; 2013 SIHD

Testing: Coronary Angiography

- Most accurate procedure for the diagnosis of obstructive coronary atherosclerosis and uncommon causes of angina (like vasospastic angina)
- Used in patients who are candidates for revascularization or high risk for stress testing

Coronary Angiography




50% blockage
99% blockage
30% blockage
90% blockage

CHD Extent and Severity

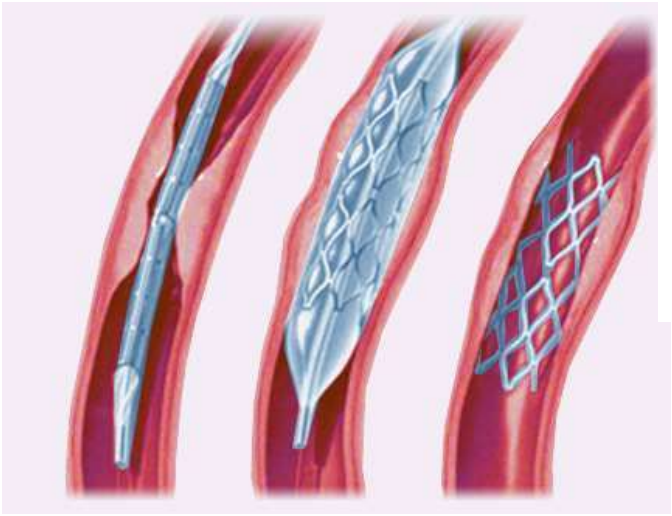
- CHD is described by number of vessels involved and which epicardial arteries diseased
- Significant disease
  - Obstruction of at least 1 major epicardial artery that occupies at least 70% of the artery's cross-sectional diameter
  - Obstruction of the left main artery that occupies at least 50% of its diameter

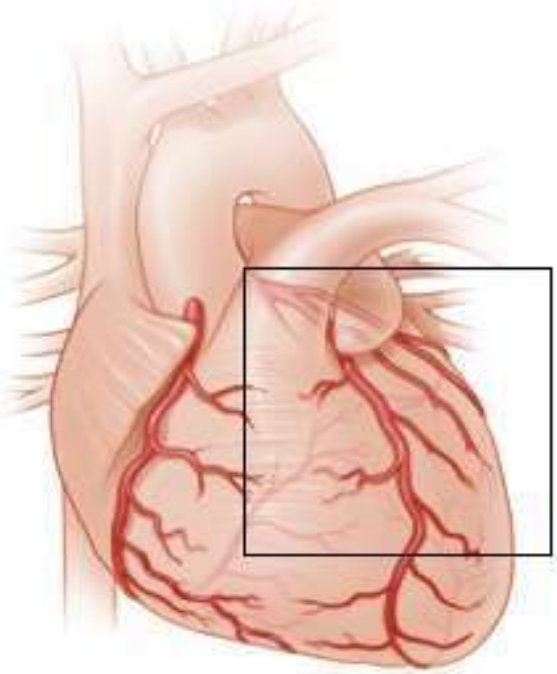
Revascularization for CHD

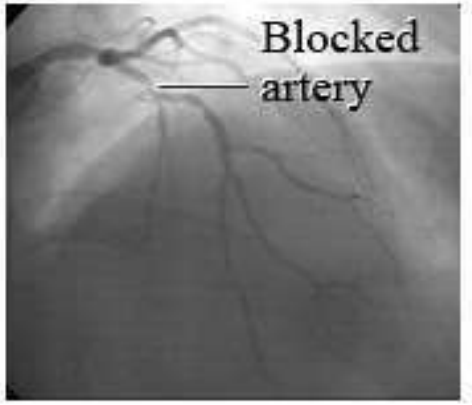
- ACC/AHA recommends revascularization for patients who fail medical therapy
  - Percutaneous coronary intervention (PCI)
  - Coronary artery bypass grafting

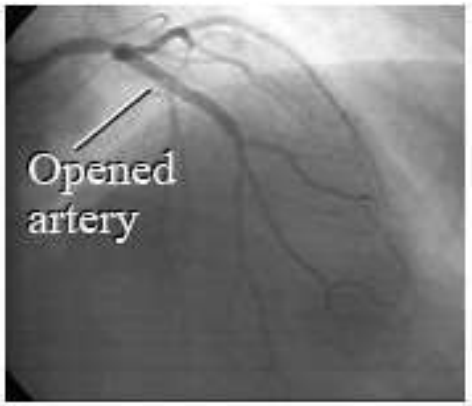
ACC/AHA 2002 CSA Guidelines; 2012 SIHD Guidelines

PCI = Angioplasty with Stent

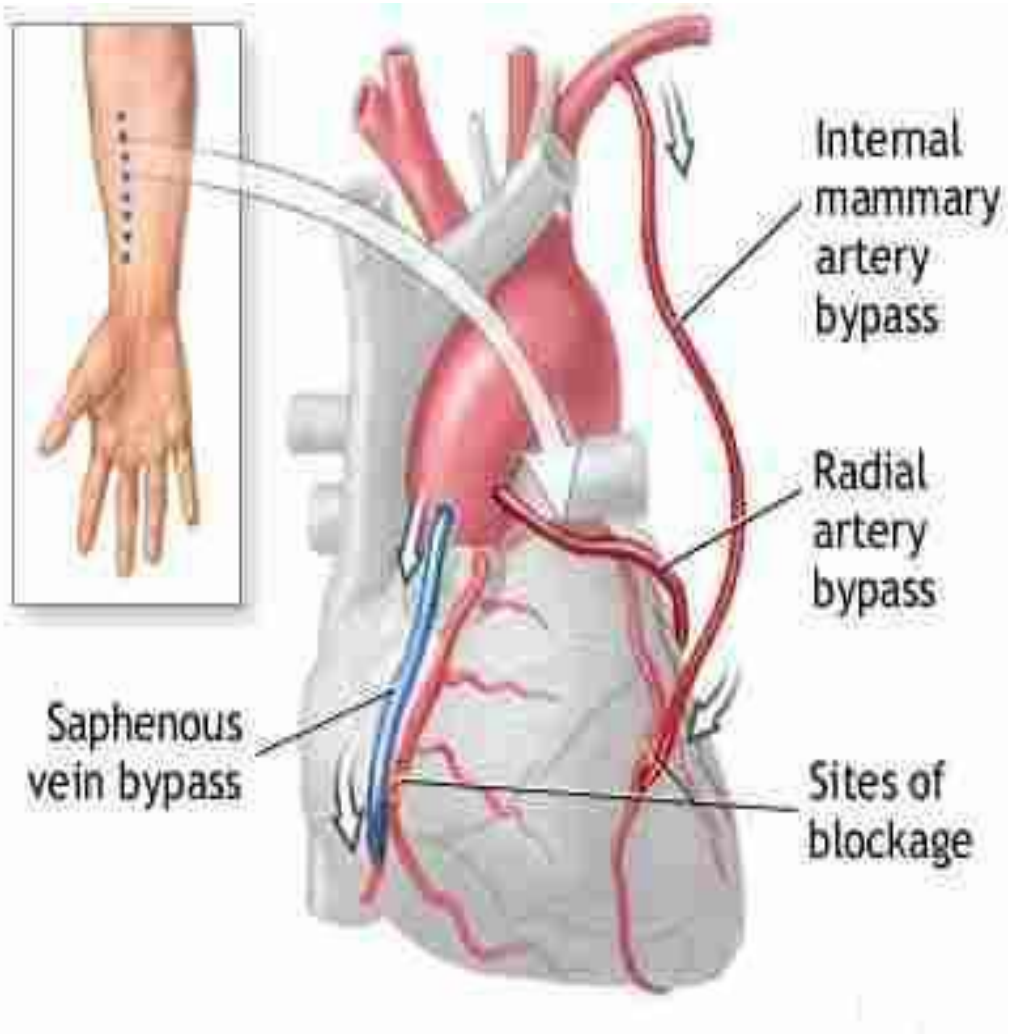


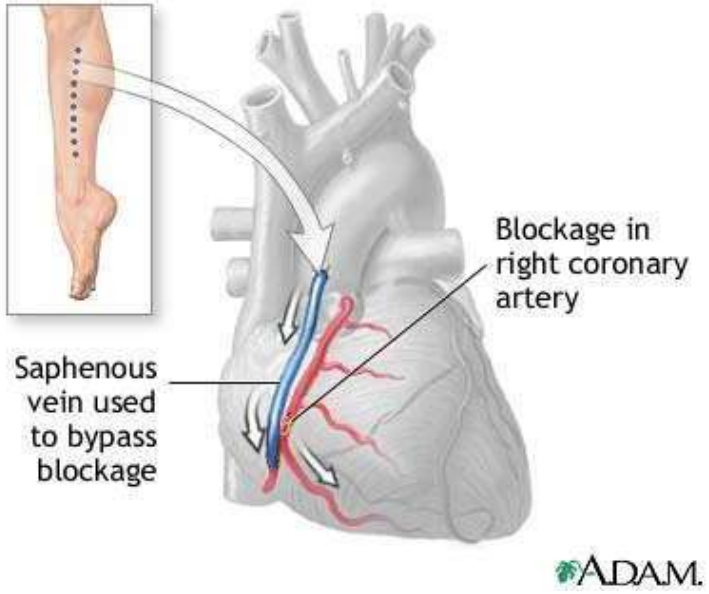






Revascularization Surgery





CHD Prognosis

- Risk of death or nonfatal MI is based on several characteristics:
  - Cardiovascular abnormalities: HF (EF), PAD, cerebrovascular diseases
  - Extent/severity of atherosclerosis
  - Recent plaque rupture (ACS)
  - General health and co-morbidities:
    - Age, socio-economic status, risk factors, comorbid conditions (DM, CKD, COPD, CA), depression

ACC/AHA 2002 CSA Guidelines, 2012 SIHD Guidelines

Secondary Prevention Drug Therapies

A: Antiplatelets, antianginals, ACE Inhibitors (RAAS blockers)

B: Beta blockers, blood pressure

C: Cholesterol, cigarettes

D: Diet (weight management), diabetes, depression

E: Exercise, Education (Cardiac Rehab)

F: InFLUenza vaccination, ? Fish oil

ACC/AHA 2002 CSA Guidelines; 2007 CSA Focused Update; 2011 Secondary Prevention Update; 2012 SIHD guidelines; 2013 Secondary Prevention in Older Adults

Thank-you!