



# All You Need to Know About CAD in 60 min

or less, but probably longer

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INTERVENTIONAL CARDIOLOGY

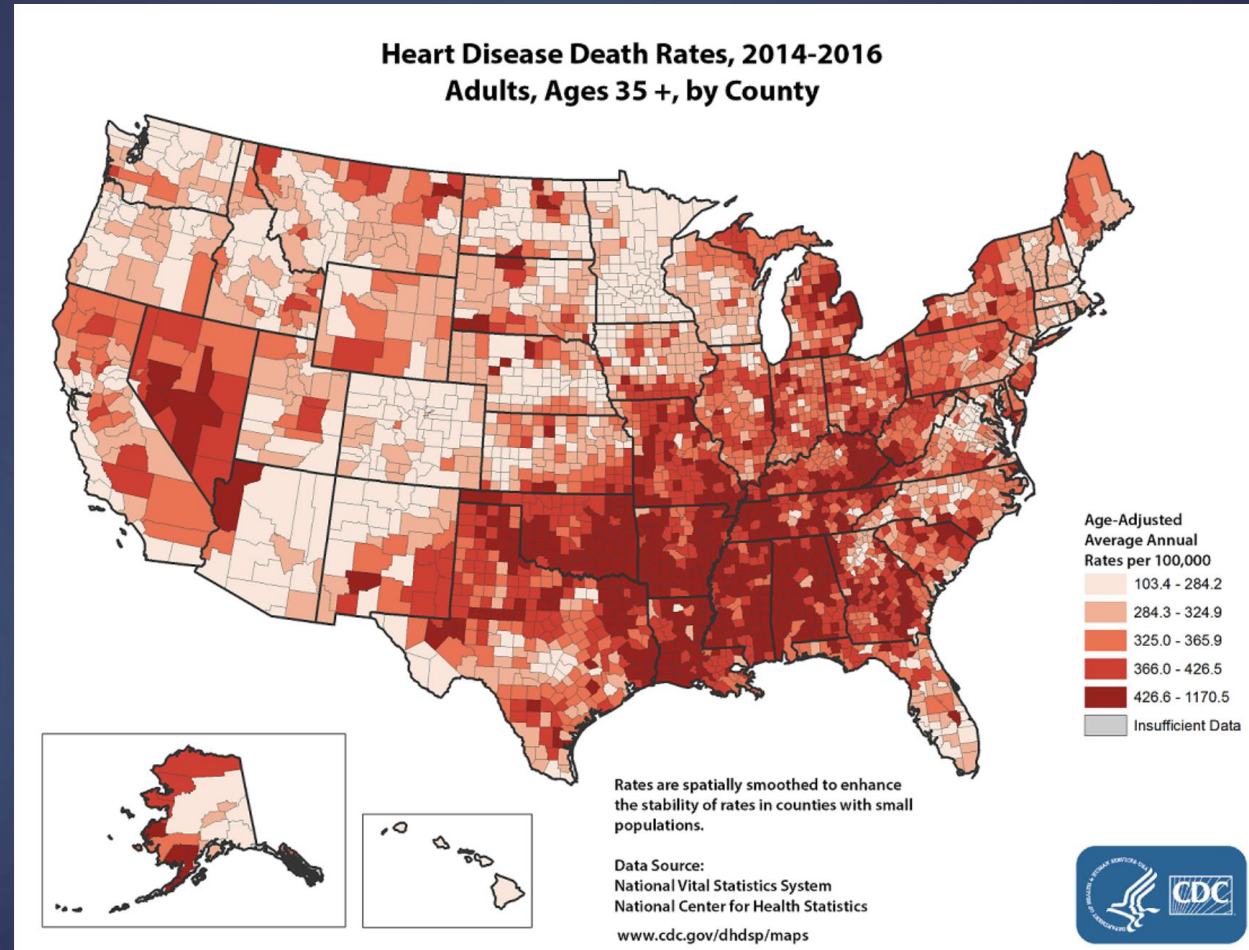
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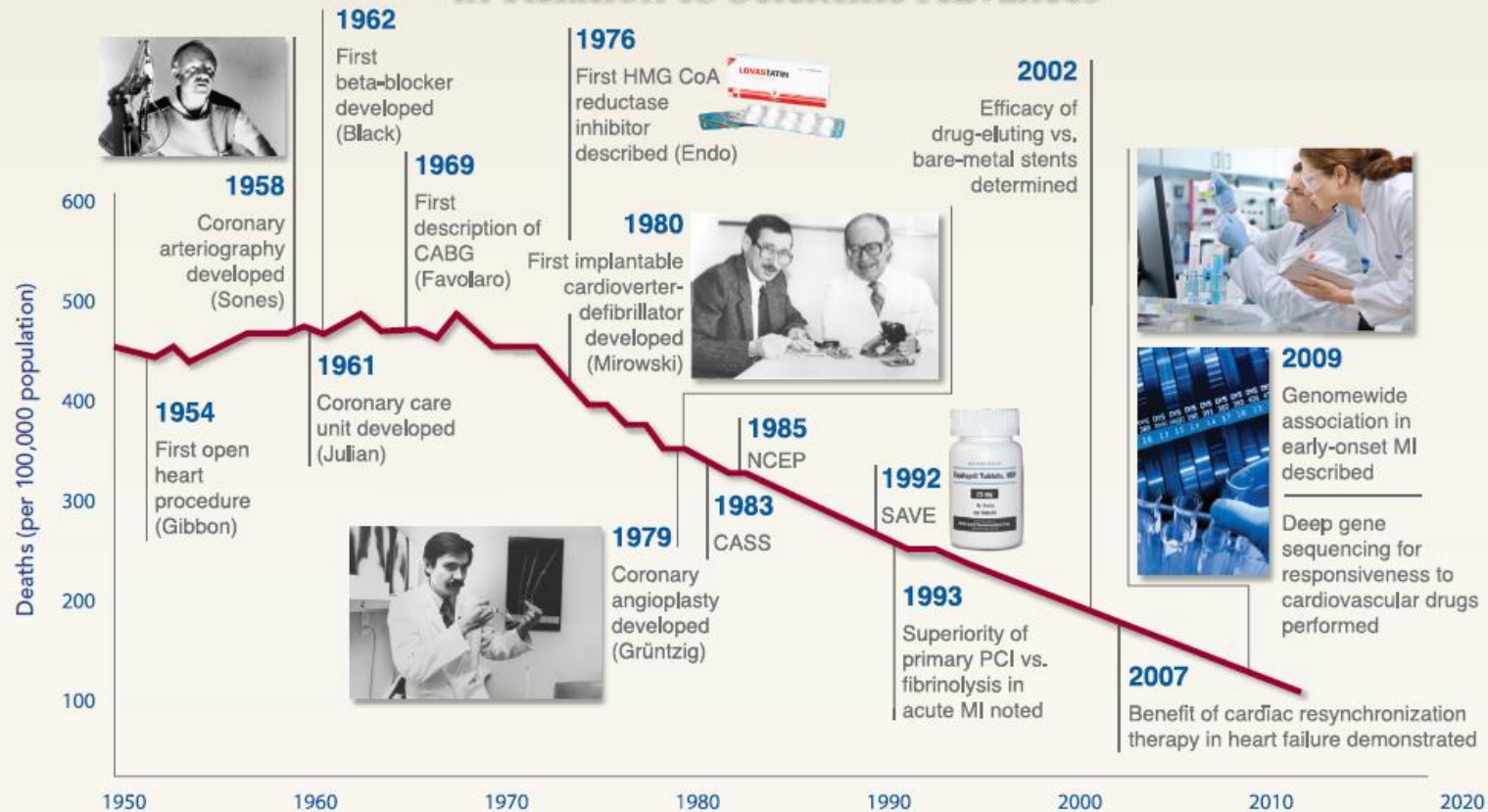
# Statistics

- ▶ 16.5 million persons  $\geq 20$  years of age in the US have CAD
- ▶  $>17$  million worldwide deaths/yr due to CVD
- ▶ Mortality rates are declining, but CAD still accounts for  $\geq 1/3$  of deaths in people  $\geq 35$  years old, 55% male, 10 year lag in females
- ▶ Variables associated with a higher incidence of CHD include lower education and income (2x).
- ▶ In the United States, someone has a heart attack every 40 seconds. Each minute, more than one person in the United States dies from a heart disease-related event.
- ▶ It is estimated that  $\sim 720,000$  Americans will have a new coronary event, and  $\sim 335,000$  will have a recurrent event this year. Heart disease costs the United States about \$200 billion each year. This total includes the cost of health care services, medications, and lost productivity.
- ▶ Thankfully, mortality rate has reduced by  $\sim 30\%$  over the latter part of the 20<sup>th</sup> century.

# Geography

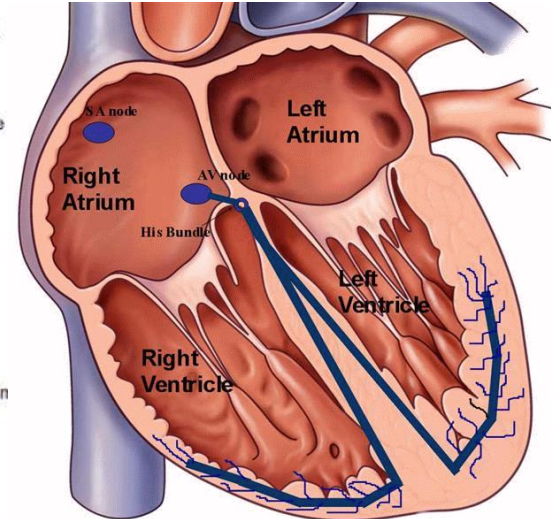
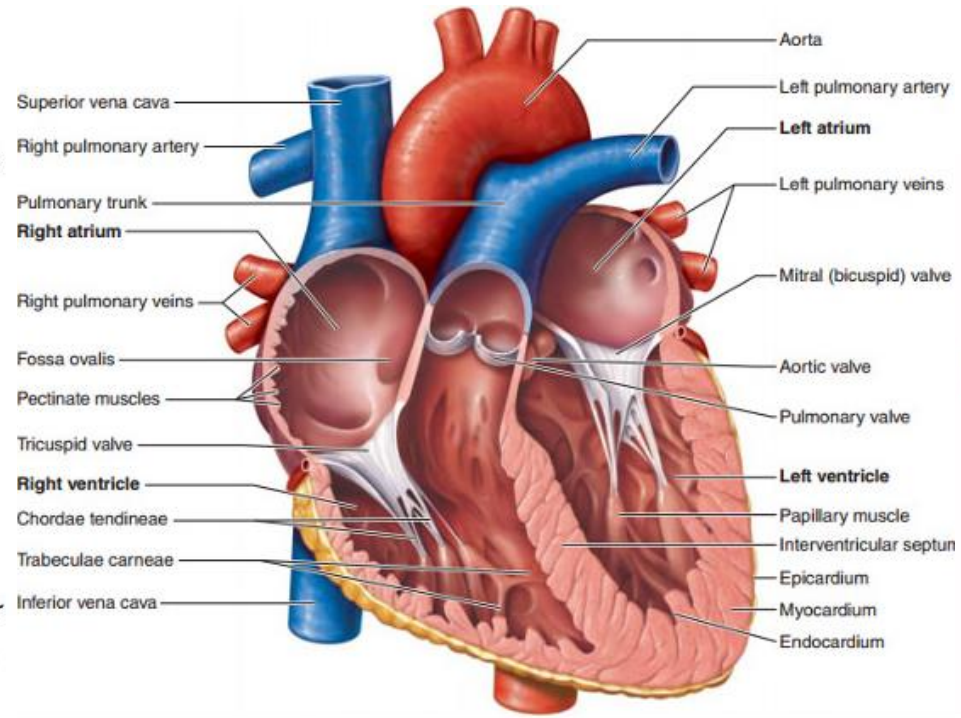
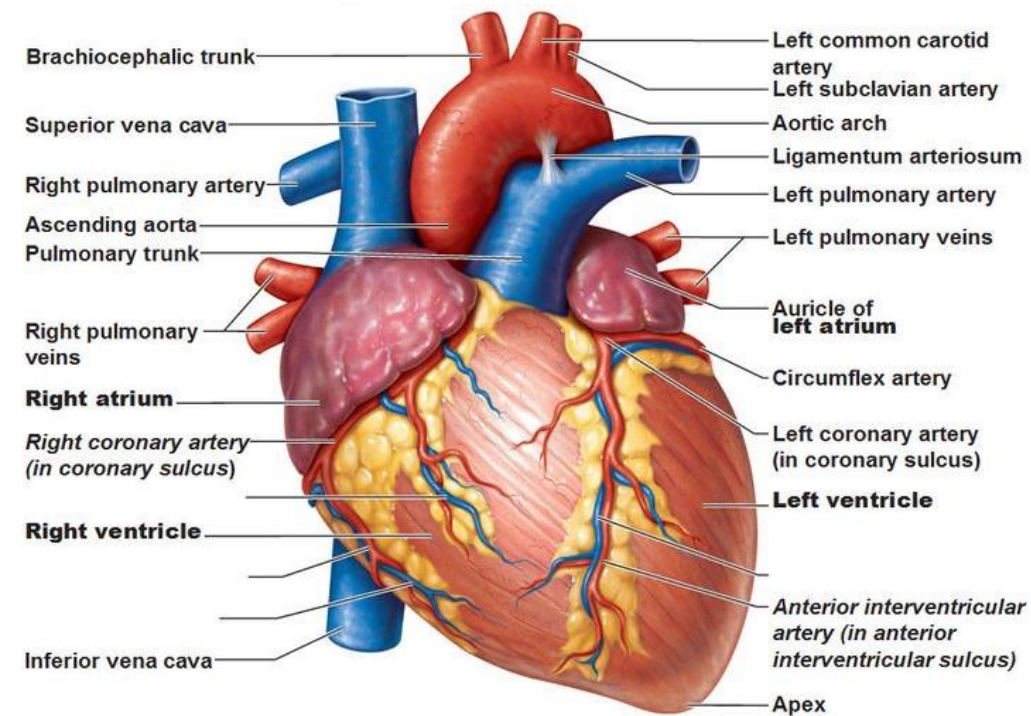


## Decline in Deaths from Cardiovascular Disease in Relation to Scientific Advances



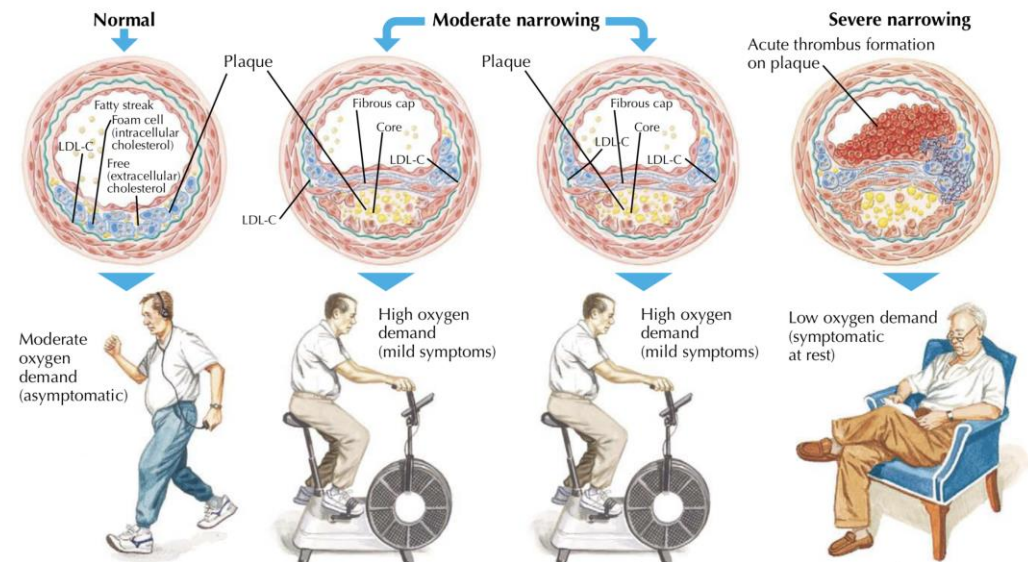
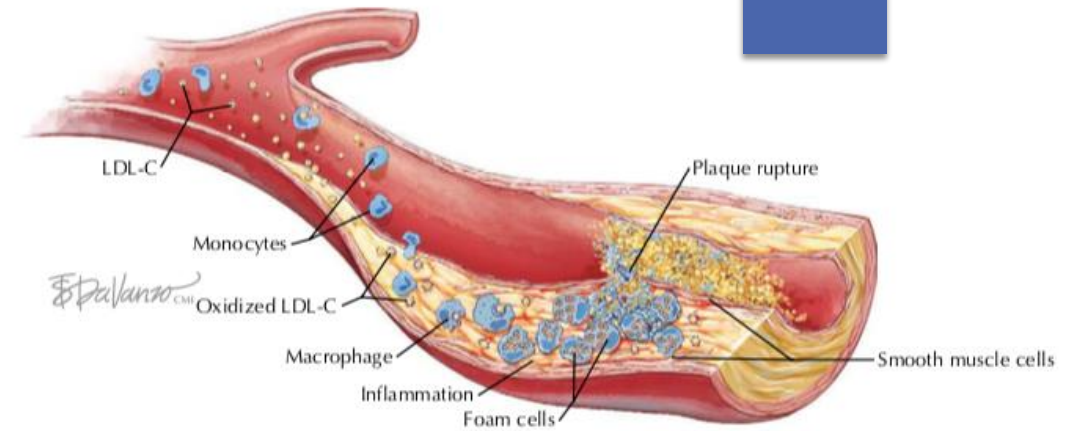


# The Heart



# What is Coronary Artery Disease?

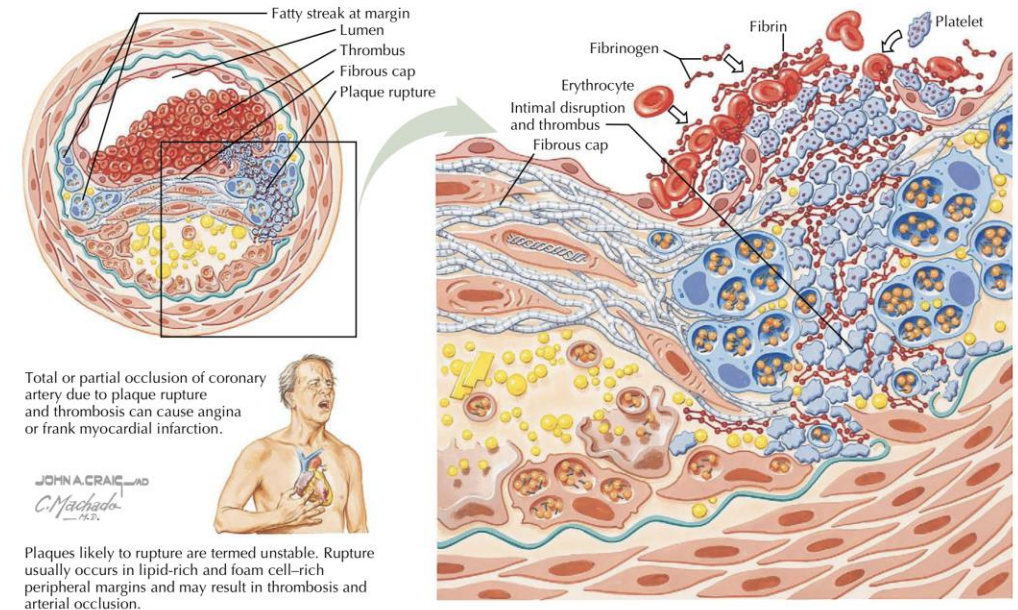
- ▶ Complex inflammatory process leading to plaque formation and narrowing of arterial lumen
- ▶ Stable
  - ▶ Asymptomatic
  - ▶ Symptomatic
- ▶ Unstable





# What is a Heart Attack?

- ▶ Injury to the heart due to reduced blood supply or increased/unmet demand for blood.
- ▶ Types
  - ▶ STEMI
  - ▶ NSTEMI
    - ▶ Type I
    - ▶ Type II
- ▶ Outcomes
  - ▶ Current overall mortality is ~2-3% at 30 days
  - ▶ STEMI has worse short term outcomes (30 day mortality may be between 2.5-10%)
  - ▶ NSTEMI has worse long term outcomes
  - ▶ Median survival of those  $\geq 45$  years after first MI is 8.4 years for white males, 5.6 years for white females, 7.0 years for black males, and 5.5 years for black females.
  - ▶ 30 day rehospitalization rate after acute MI is ~17-25%, higher in women



# What Happens After a Heart Attack?

- ▶ Primary effect: Some heart muscle dies and pumping function may be affected
- ▶ Secondary effects
  - ▶ Cardiomyopathy, heart failure
  - ▶ Arrhythmias, ICD
- ▶ Not all heart attacks are equal
- ▶ >30% increase in mortality and recurrent CV events as compared to general population

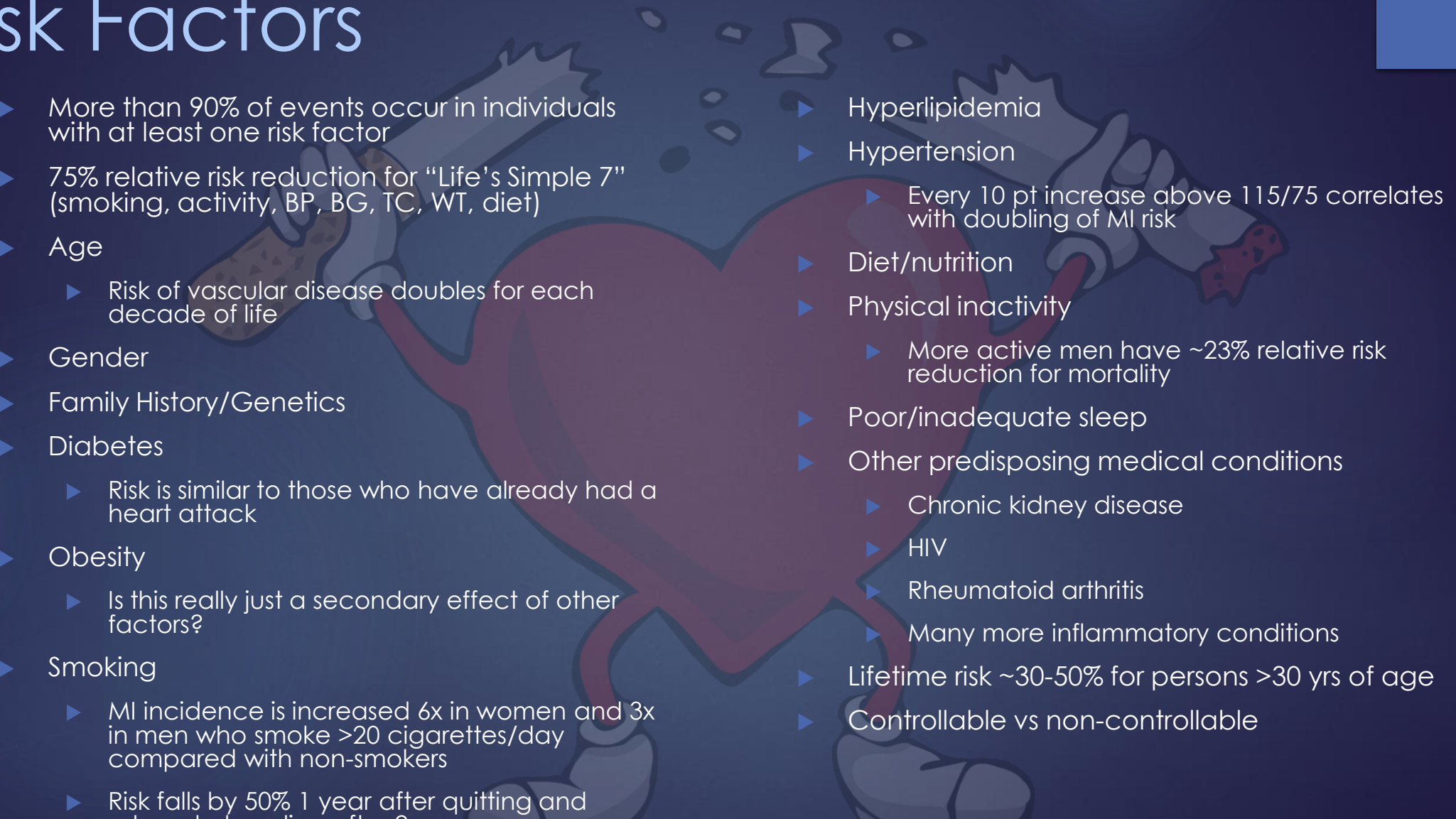


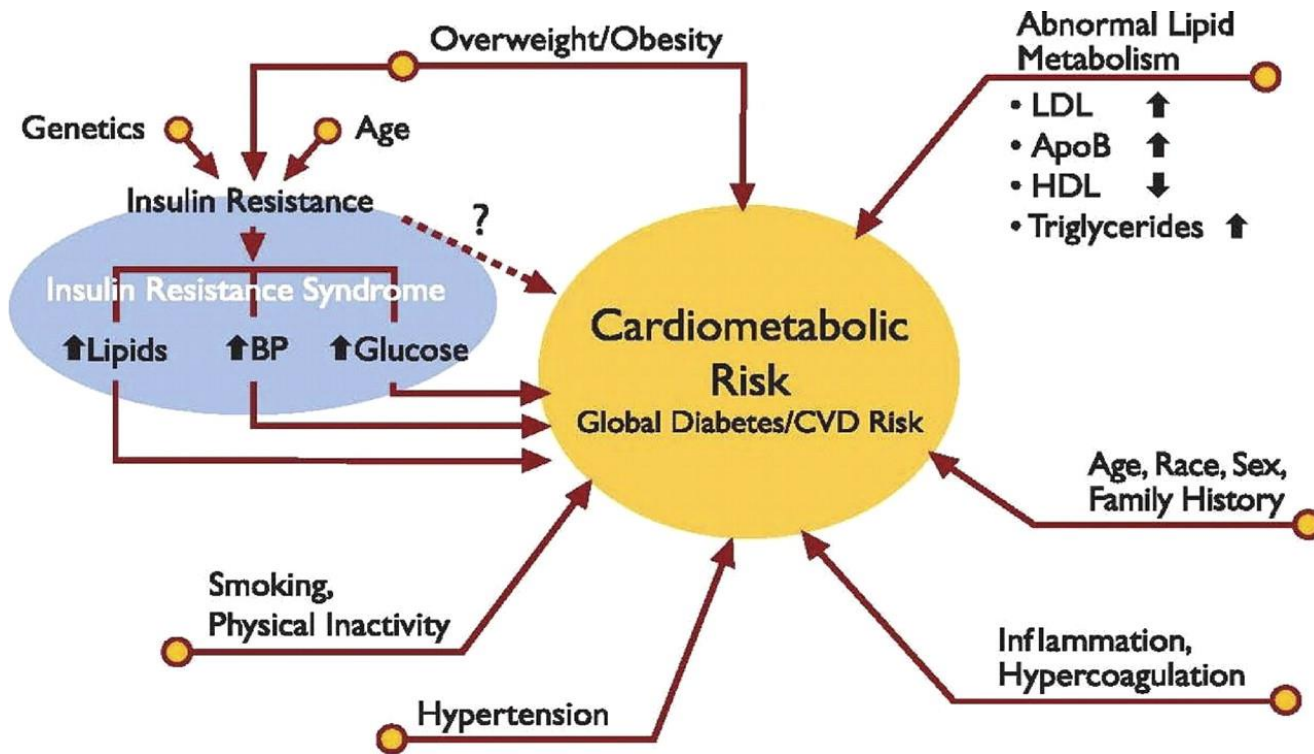
# How Do We Treat a Heart Attack?

- ▶ Simple. Address the cause(s). Okay, not so simple.
- ▶ Revascularization
  - ▶ Thrombolytics
  - ▶ Percutaneous coronary intervention
  - ▶ Coronary artery bypass surgery
- ▶ Medical Therapy
  - ▶ Statins
    - ▶ "For every ~40 mg/dL LDL-C reduction with statin therapy, the relative risk of major adverse cardiovascular events is reduced by ~20-25%, and all-cause mortality is reduced by 10% and more intense statin regimens yield a 15% further proportional reduction in major adverse cardiovascular events compared to less intense regimens."
  - ▶ Antihypertensives, antianginals
    - ▶ Beta blockers
    - ▶ ACE inhibitors
    - ▶ Others
  - ▶ Antiplatelet agents
    - ▶ Aspirin, ticagrelor, clopidogrel, prasugrel



# Risk Factors

- 
- ▶ More than 90% of events occur in individuals with at least one risk factor
  - ▶ 75% relative risk reduction for “Life’s Simple 7” (smoking, activity, BP, BG, TC, WT, diet)
  - ▶ Age
    - ▶ Risk of vascular disease doubles for each decade of life
  - ▶ Gender
  - ▶ Family History/Genetics
  - ▶ Diabetes
    - ▶ Risk is similar to those who have already had a heart attack
  - ▶ Obesity
    - ▶ Is this really just a secondary effect of other factors?
  - ▶ Smoking
    - ▶ MI incidence is increased 6x in women and 3x in men who smoke >20 cigarettes/day compared with non-smokers
    - ▶ Risk falls by 50% 1 year after quitting and returns to baseline after 2 years
  - ▶ Hyperlipidemia
  - ▶ Hypertension
    - ▶ Every 10 pt increase above 115/75 correlates with doubling of MI risk
  - ▶ Diet/nutrition
  - ▶ Physical inactivity
    - ▶ More active men have ~23% relative risk reduction for mortality
  - ▶ Poor/inadequate sleep
  - ▶ Other predisposing medical conditions
    - ▶ Chronic kidney disease
    - ▶ HIV
    - ▶ Rheumatoid arthritis
    - ▶ Many more inflammatory conditions
  - ▶ Lifetime risk ~30-50% for persons >30 yrs of age
  - ▶ Controllable vs non-controllable



# CV Risk Factors



# ASCVD 10 yr Risk Calculation

<b>Current Age</b> ⓘ *	<b>Sex</b> *	<b>Race</b> *		
<input type="text"/>	<input type="button" value="Male"/> <input type="button" value="Female"/>	<input type="button" value="White"/>	<input type="button" value="African American"/>	<input type="button" value="Other"/>
<small>Age must be between 20-79</small>				
<b>Systolic Blood Pressure (mm Hg)</b> *	<b>Diastolic Blood Pressure (mm Hg)</b> ○			
<input type="text"/>	<input type="text"/>			
<small>Value must be between 90-200</small>				
<b>Total Cholesterol (mg/dL)</b> *	<b>HDL Cholesterol (mg/dL)</b> *	<b>LDL Cholesterol (mg/dL)</b> ⓘ ○		
<input type="text"/>	<input type="text"/>	<input type="text"/>		
<small>Value must be between 130 - 320</small>				
<small>Value must be between 20 - 100</small>				
<small>Value must be between 30-300</small>				
<b>History of Diabetes?</b> *	<b>Smoker:</b> ⓘ *			
<input type="button" value="Yes"/> <input type="button" value="No"/>	<input type="button" value="Yes"/> <input type="button" value="Former"/> <input type="button" value="No"/>			
<b>On Hypertension Treatment?</b> *	<b>On a Statin?</b> ⓘ ○		<b>On Aspirin Therapy?</b> ⓘ ○	
<input type="button" value="Yes"/> <input type="button" value="No"/>	<input type="button" value="Yes"/> <input type="button" value="No"/>		<input type="button" value="Yes"/> <input type="button" value="No"/>	

# Lifestyle Modification for BP

Modification	Recommendation	Approximate SBP Reduction Range
Weight reduction	Maintain normal body weight (BMI=18.5-24.9 kg/m <sup>2</sup> )	5-20 mmHg/10 kg weight lost
DASH eating plan	Diet rich in fruits, vegetables, low fat dairy and reduced in fat	8-14 mm Hg
Restrict sodium intake	Consume no more than 2.4 grams of sodium daily; 1.5 grams desirable for greater BP reduction	2-8 mm Hg
Physical activity	Regular aerobic exercise for at least 30 minutes most days of the week	4-9 mm Hg
Moderate alcohol	≤2 drinks/day for men and ≤1 drink/day for women	2-4 mm Hg

# This is SAD

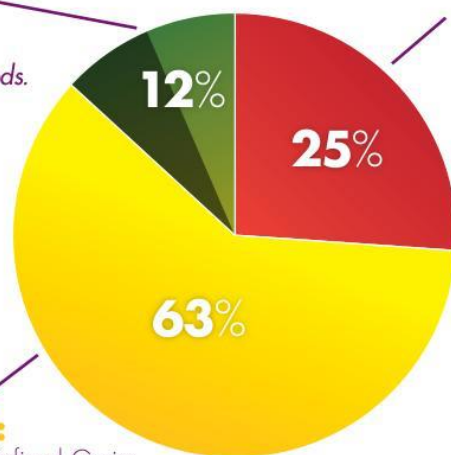
## U.S. FOOD CONSUMPTION AS A % OF CALORIES

### PLANT FOOD:

Vegetables, Fruits, Legumes,  
Nuts & Seeds, Whole Grains

**Fiber** is only found in plant foods.

**NOTE:** Up to half of this category may be processed, for example almonds in candy bars, apples in apple pies or spinach in frozen spinach soufflé, and of course these would not be healthy choices. The focus should be on whole unprocessed vegetables, fruits, legumes, nuts and seeds and whole grains.



### PROCESSED FOOD:

Added Fats & Oils, Sugars, Refined Grains

### ANIMAL FOOD:

Meat, Dairy, Eggs, Fish, Seafood

**Cholesterol** is only found in animal foods. Animal foods are the **PRIMARY** source of saturated fat.

### GUIDE TO HEALTHY EATING:

Much easier to understand than the USDA Food Pyramid, with no food industry influence.

Eat **LESS** from the animal and processed food groups and **MORE** whole foods from the plant food group.

In general, food from the animal and processed food group contribute to disease, while **WHOLE** foods from the plant group contribute to good health.



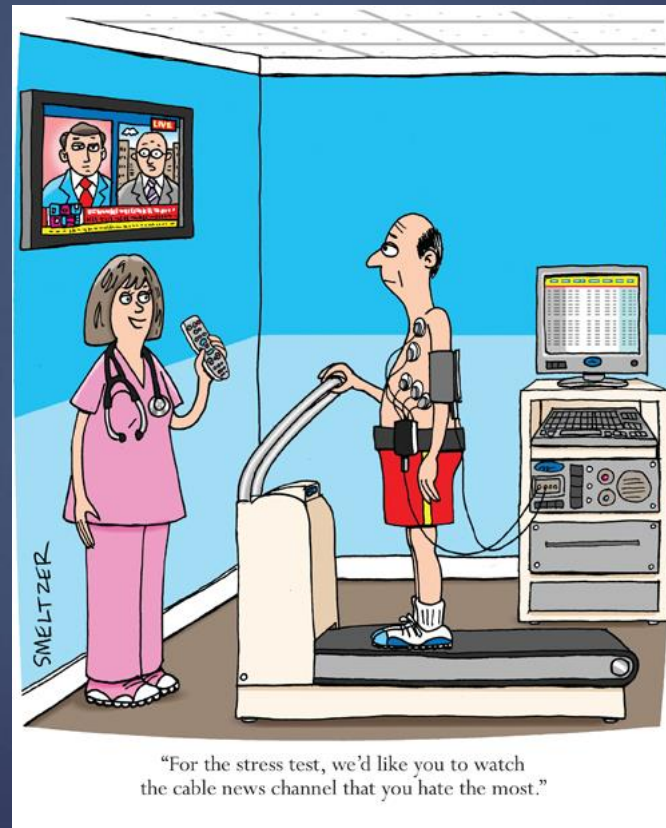




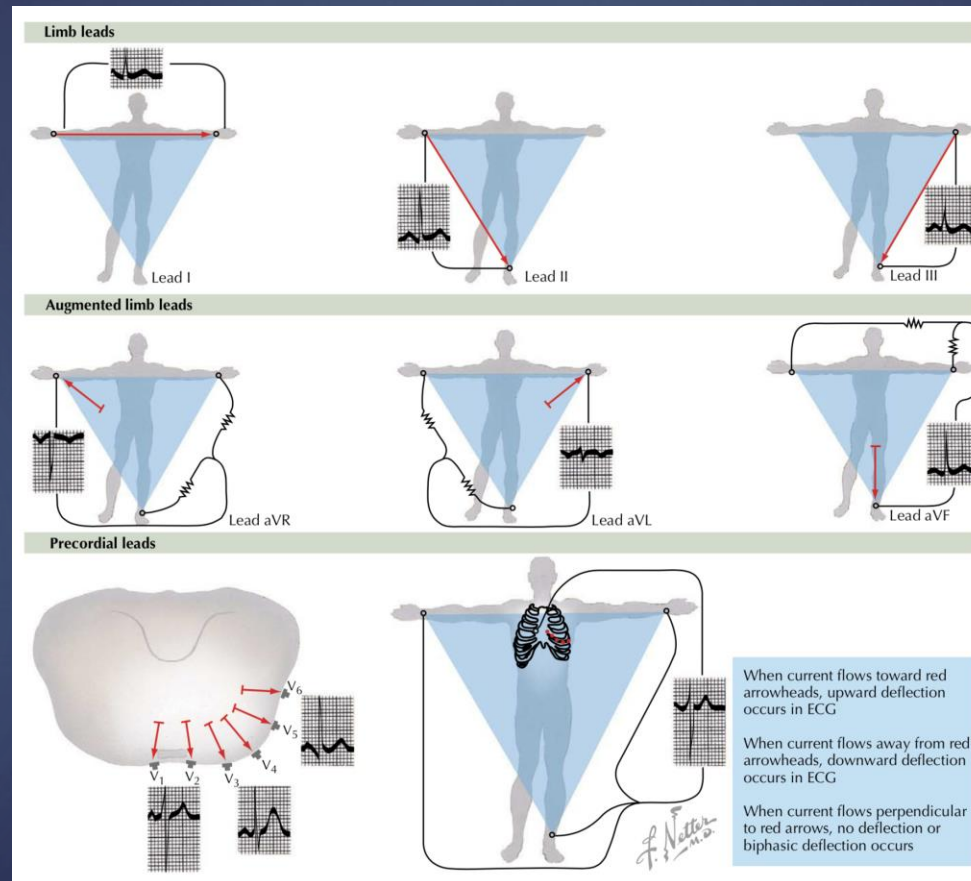
- ▶ Simple
- ▶ Stop eating before you get full
- ▶ Plant based diet
- ▶ Minimize added sugars and processed foods
- ▶ Minimize animal products
- ▶ Tinker with fasting



# Overview of Cardiac Testing

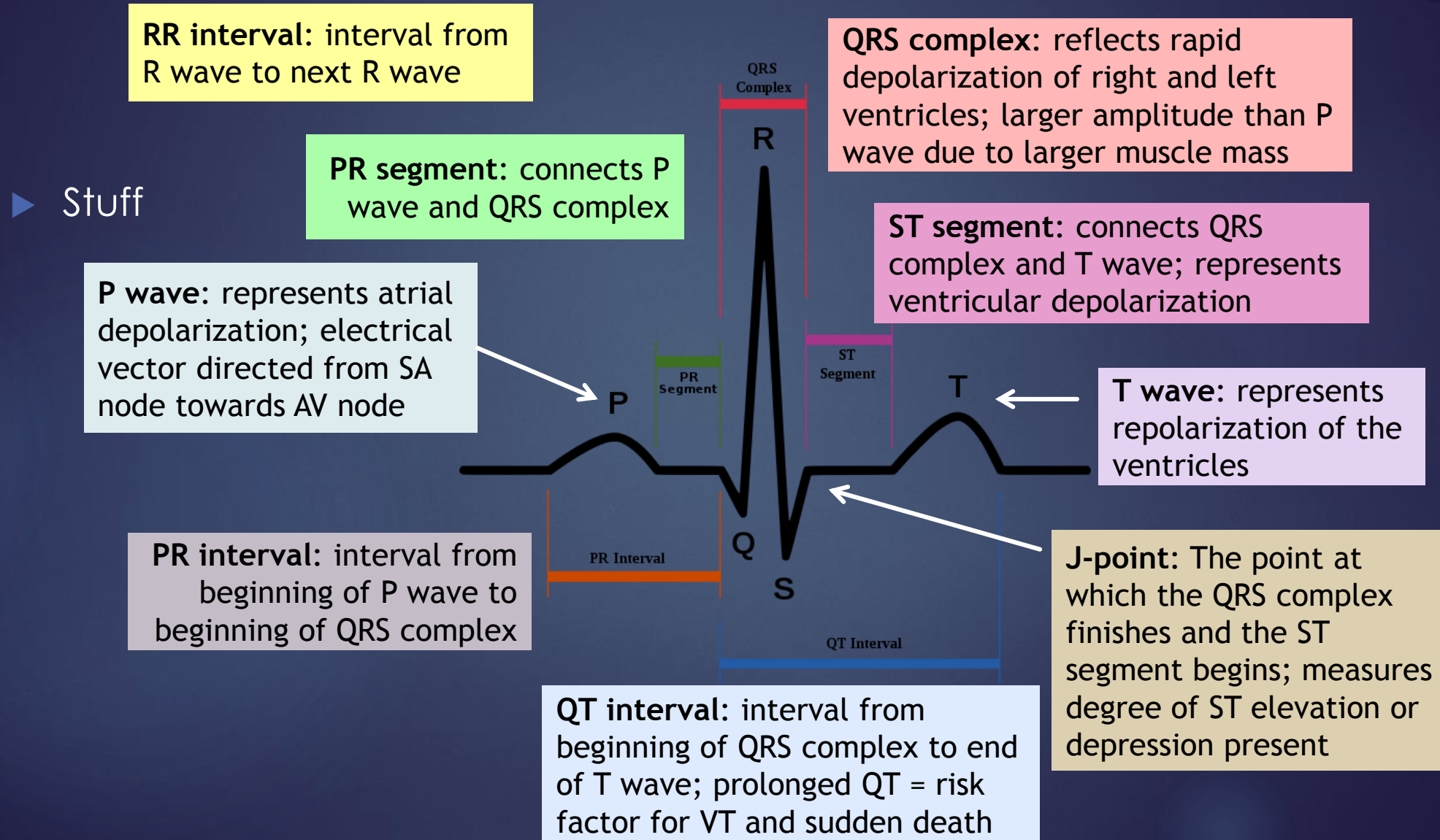


# Electrocardiography (ECG)

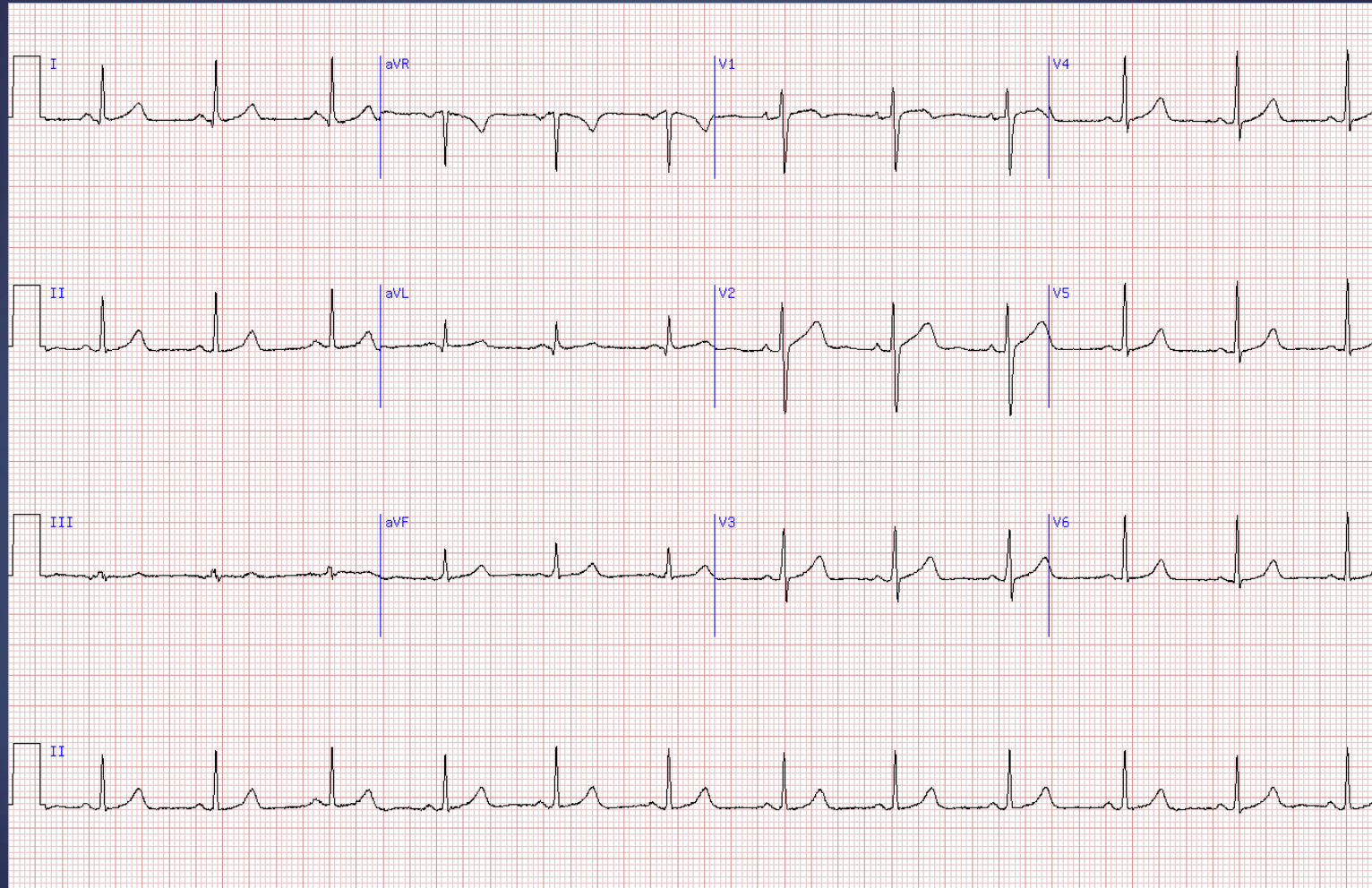




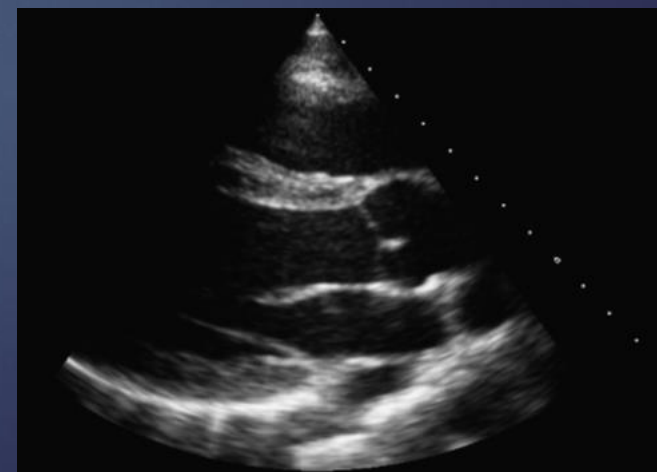
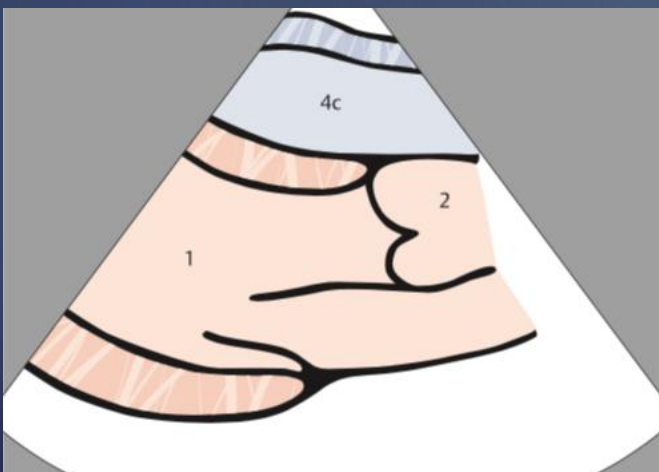
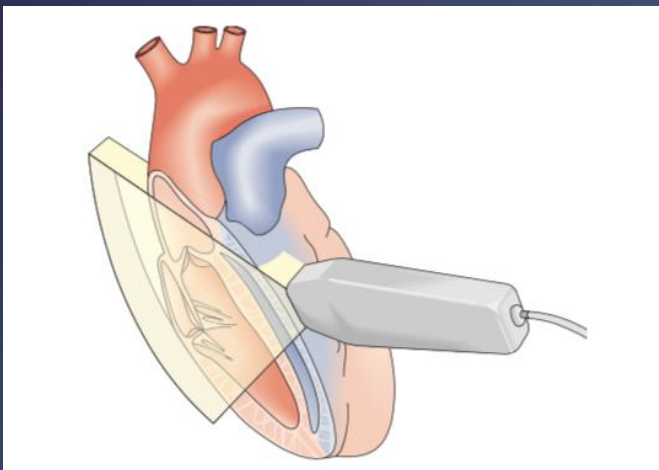
# Electrocardiography (ECG)



# Electrocardiography (ECG)



# Echocardiography (ultrasound)

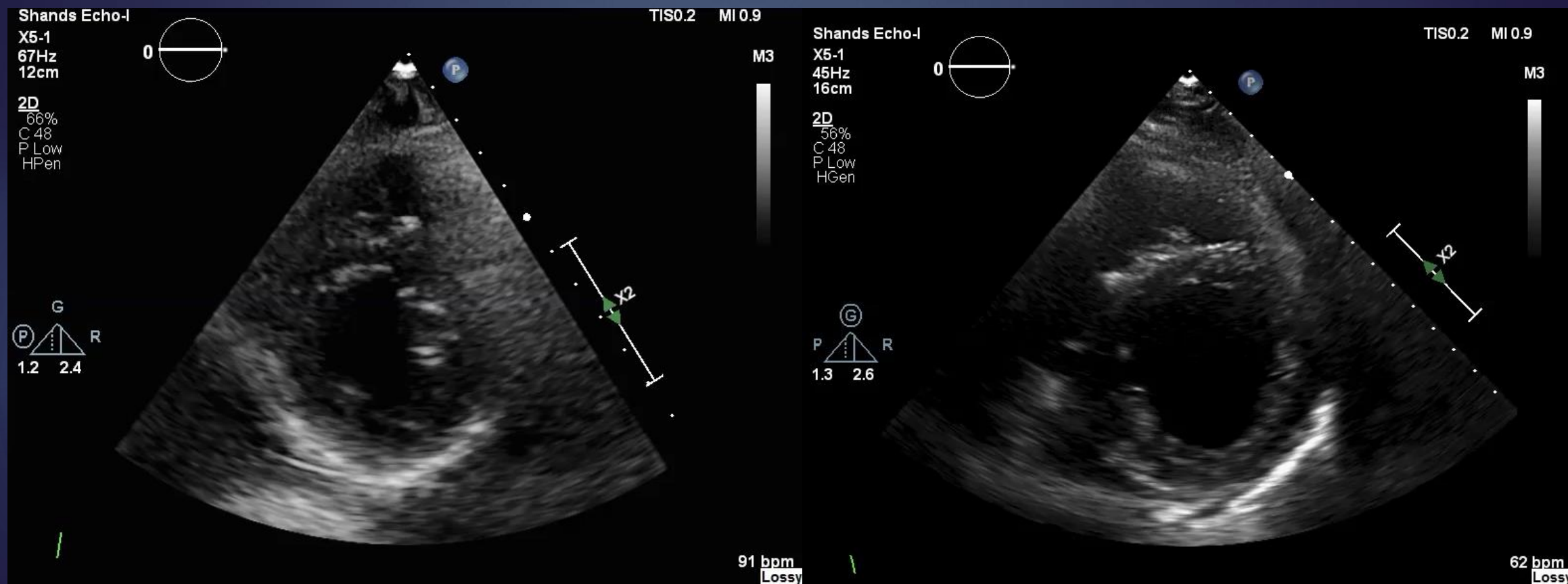




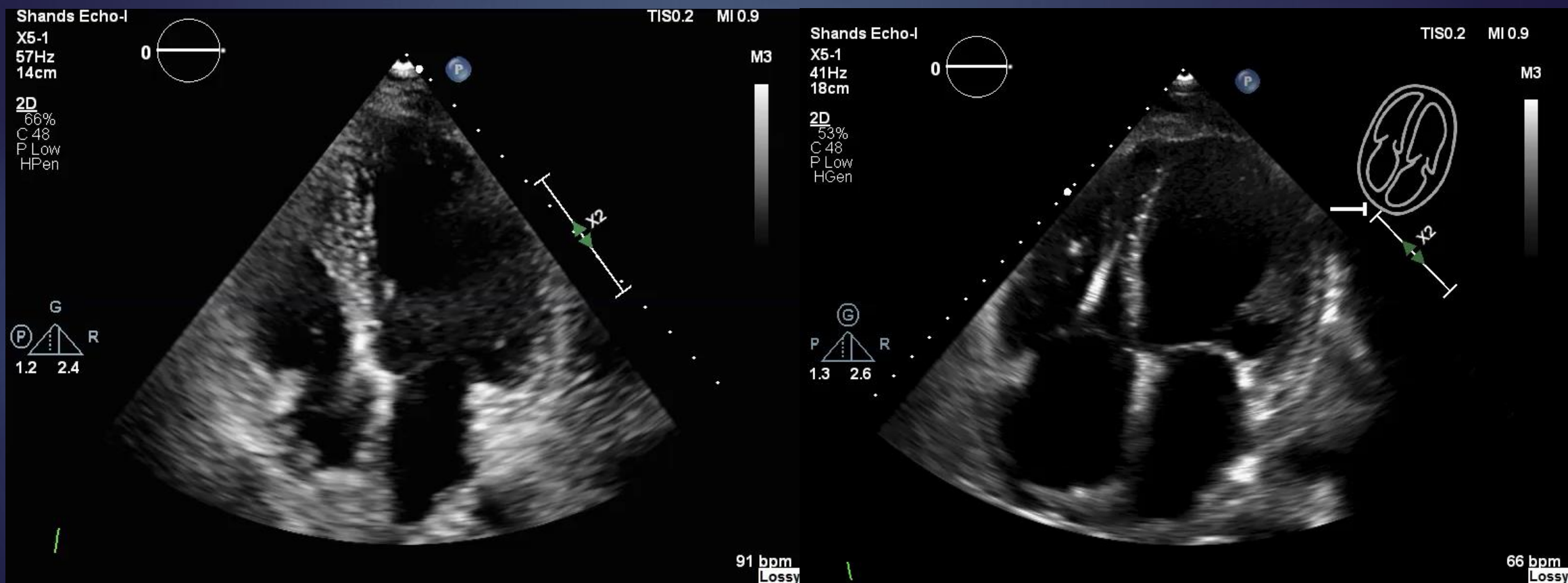
# Echocardiography



# Echocardiography



# Echocardiography





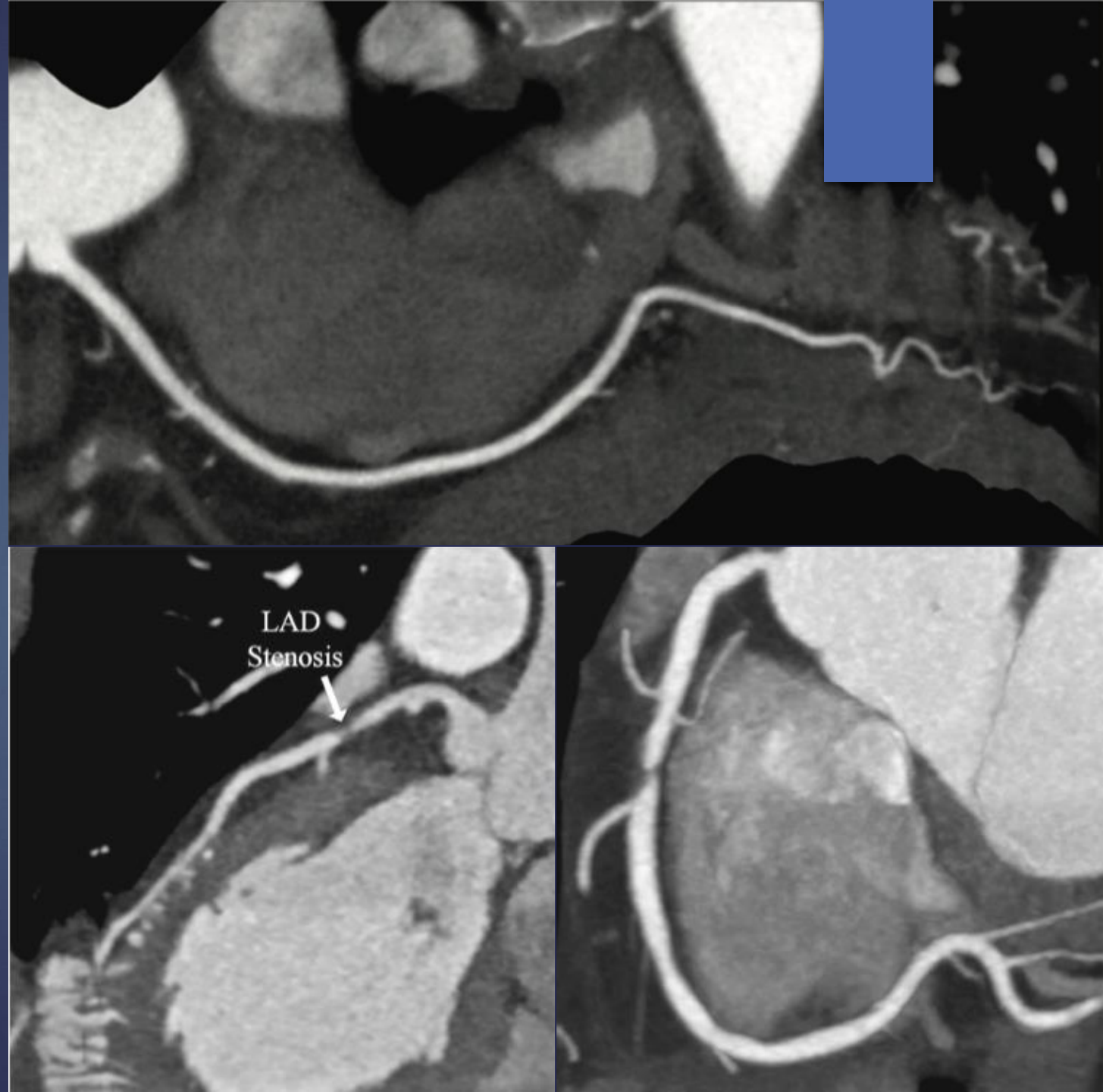
# Coronary Calcium Score

- ▶ Helps identify presence but not necessarily severity of CAD
- ▶ Good tie breaker test for patients with borderline risk
- ▶ Degree of risk correlates with amount of calcification
- ▶ A normal study predicts a very low 3 year event rate
- ▶ In one study, CAC score  $>0$  was associated with a significantly higher event rate in men (6.1 vs 0.4%) and women (3.3 vs 1.0%)



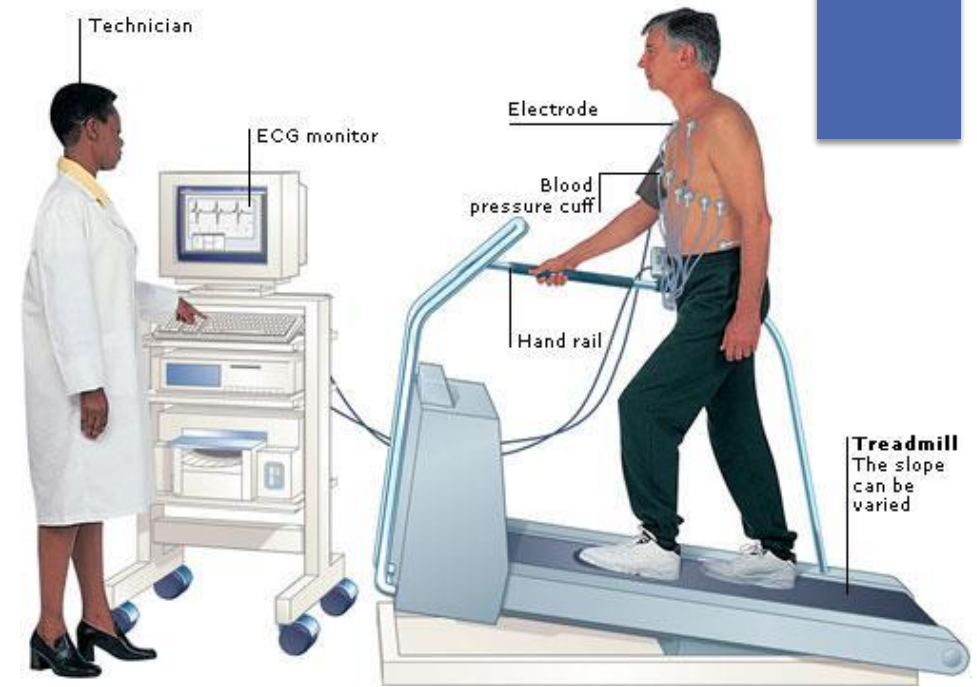
# Coronary CT Angiography (cCTA)

- ▶ Technical aspects
  - ▶ Strengths
  - ▶ Limitations
- ▶ Helps by giving anatomy of disease (LM vs OM)
- ▶ Good negative predictive value, but sometimes grey when abnormal



# Stress Testing – Treadmill

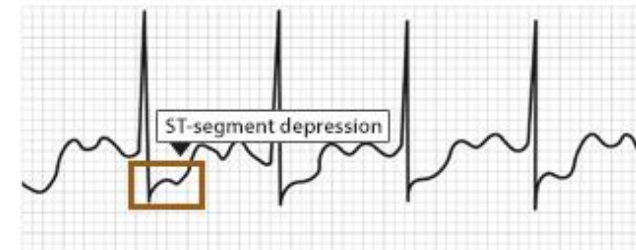
- ▶ Simplest type of stress test
- ▶ Good for determining overall risk, but does not give anatomic information
- ▶ Many useful metrics
  - ▶ Functional capacity
  - ▶ HR, HRR
  - ▶ BP
  - ▶ ST change
  - ▶ Arrhythmia



Resting ECG



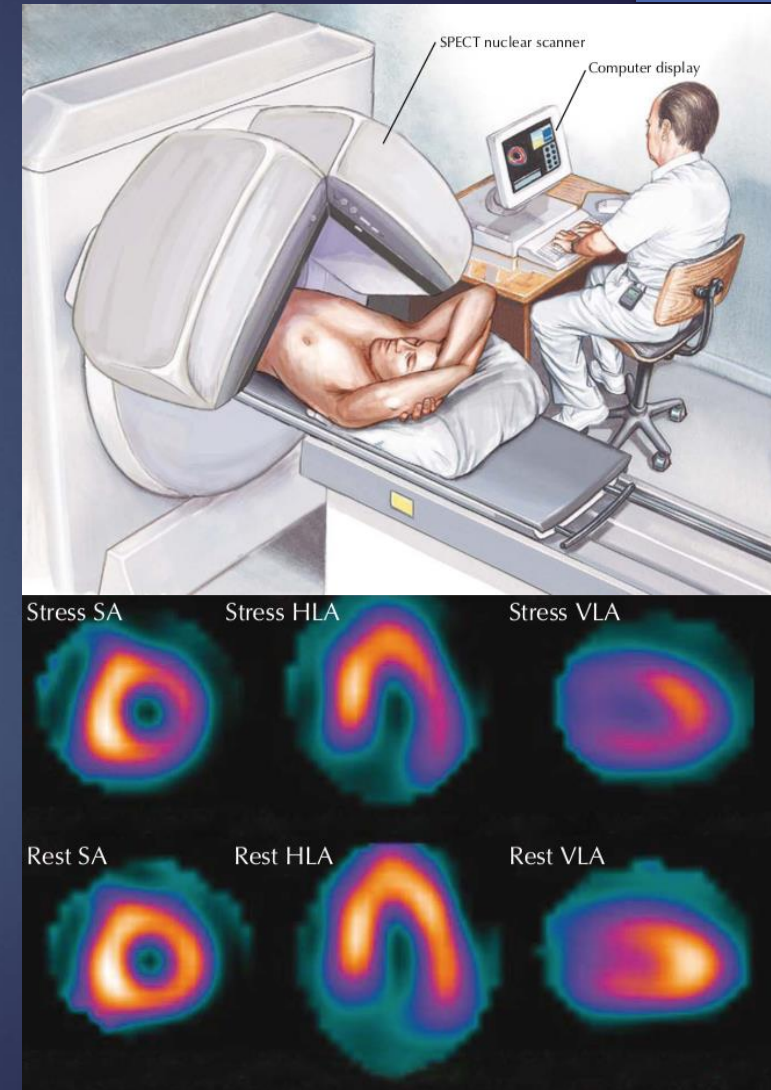
Exercise ECG



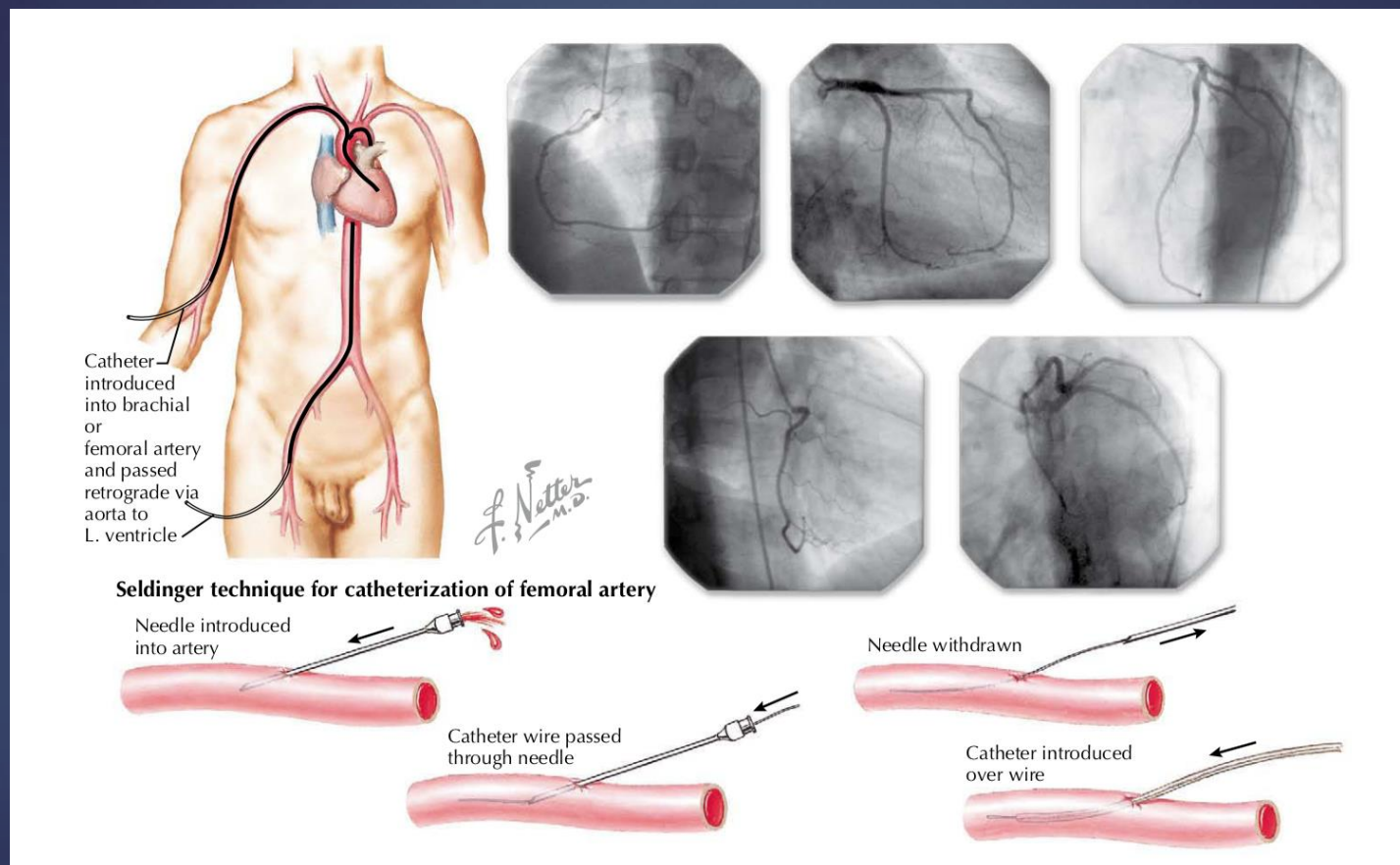


# Nuclear Stress Test

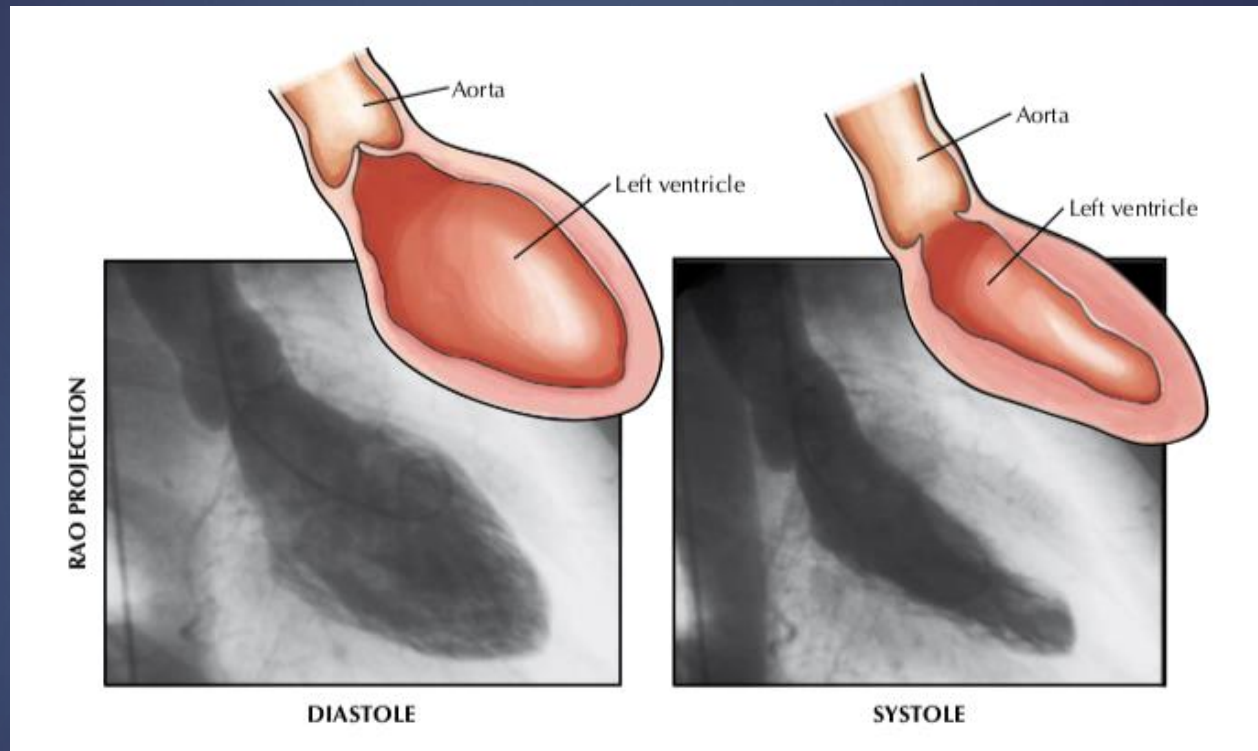
- ▶ More radiation than the other modalities
- ▶ Can also quantify abnormality to determine risk
  - ▶ Low Risk:  $<1\%$  event rate/yr (cardiac events, death)
  - ▶ Intermediate Risk: 1-5%
  - ▶ High Risk:  $>5\%$
- ▶ False positives



# Heart Catheterization

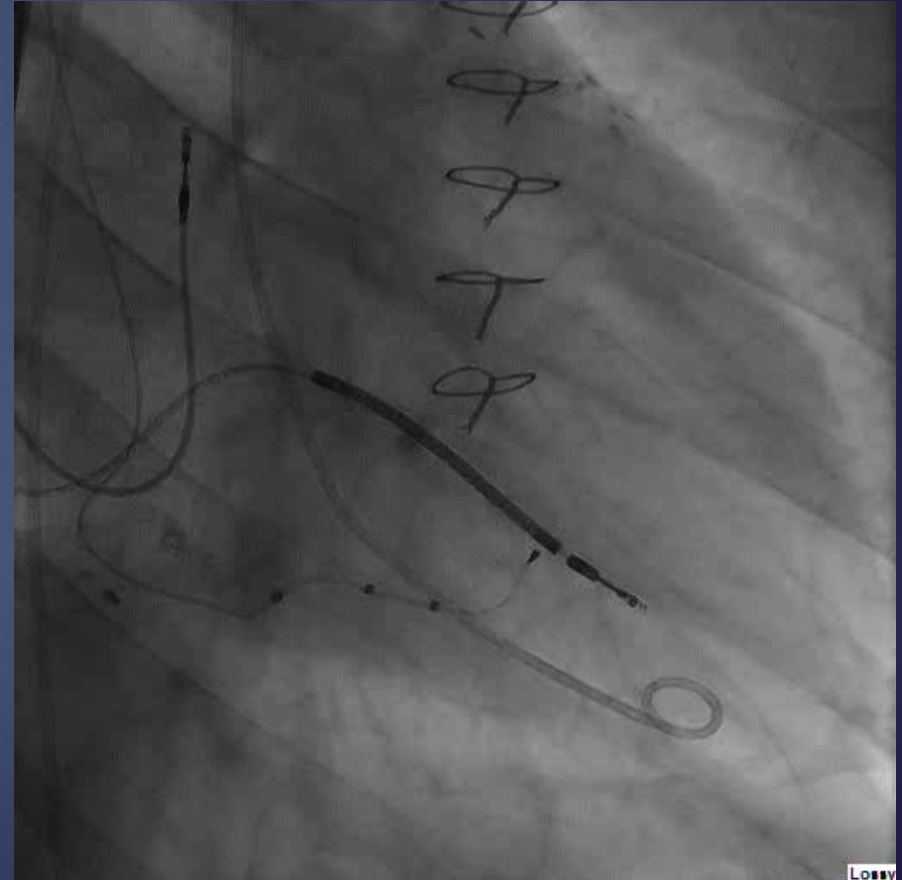
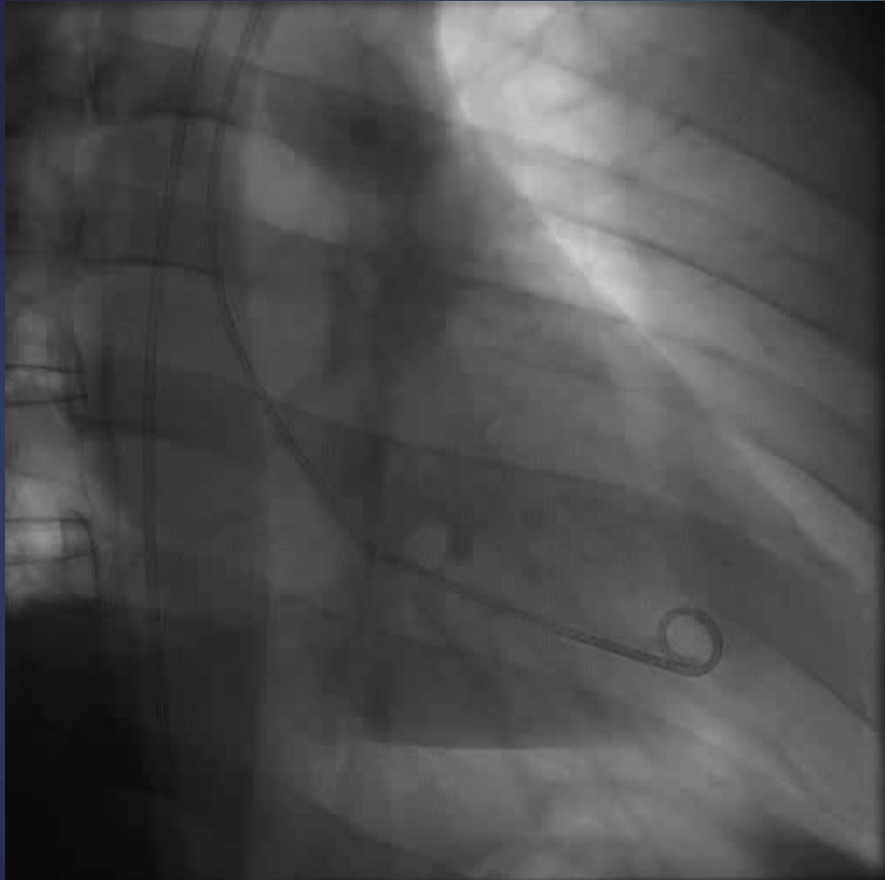


# LV Angiography

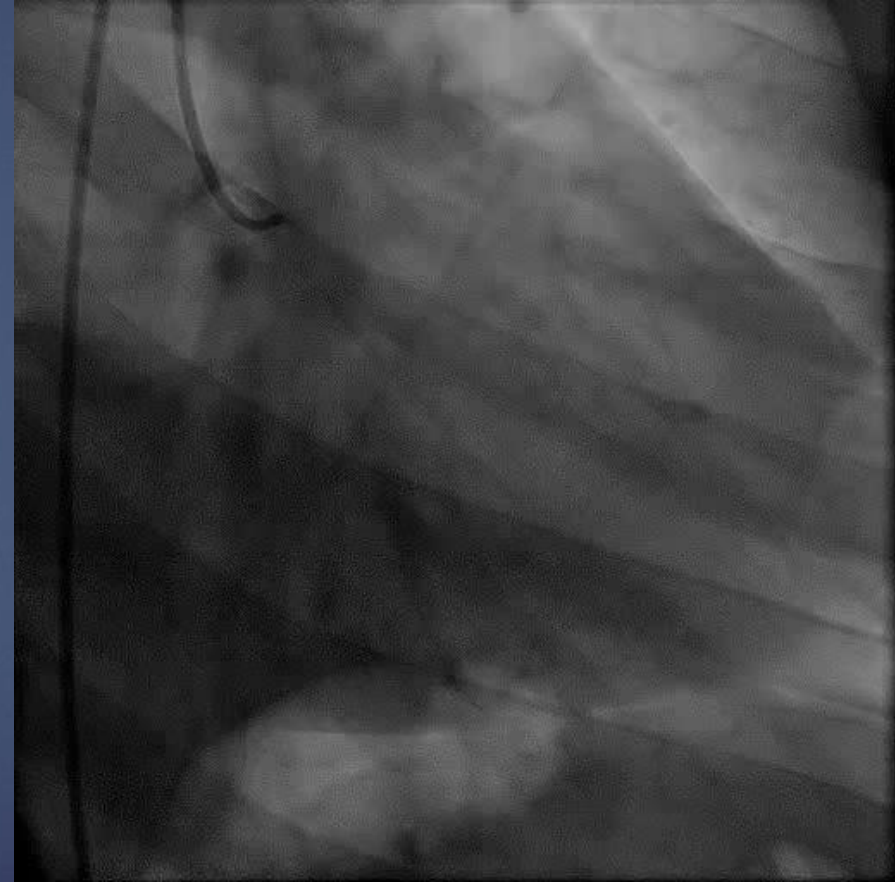
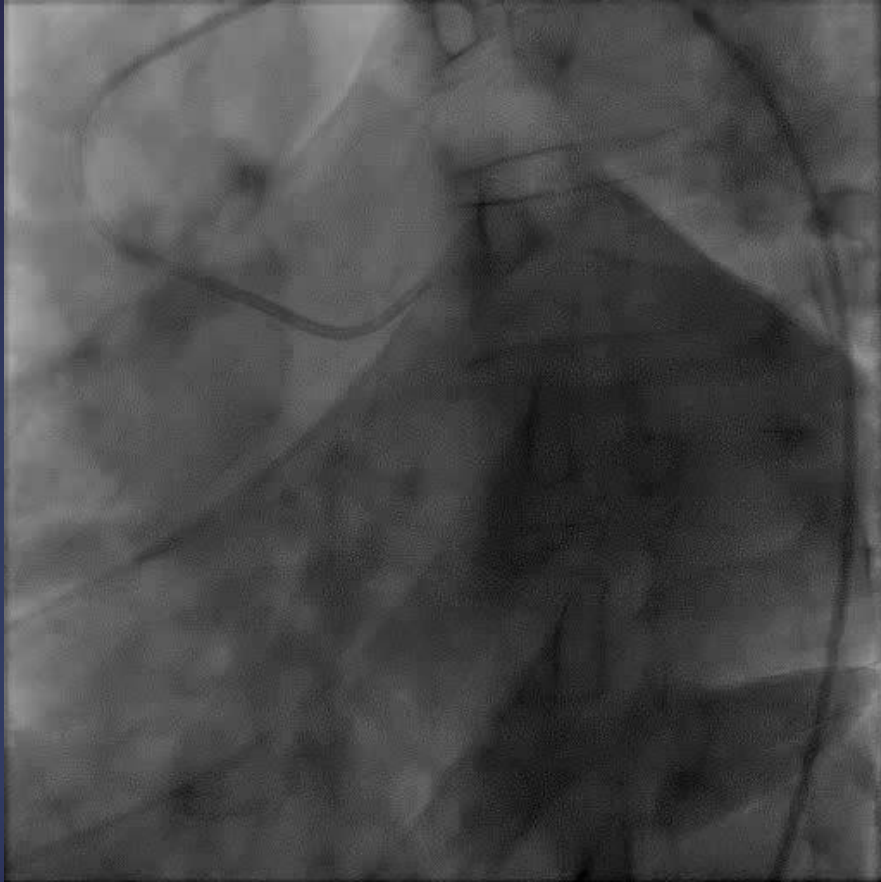




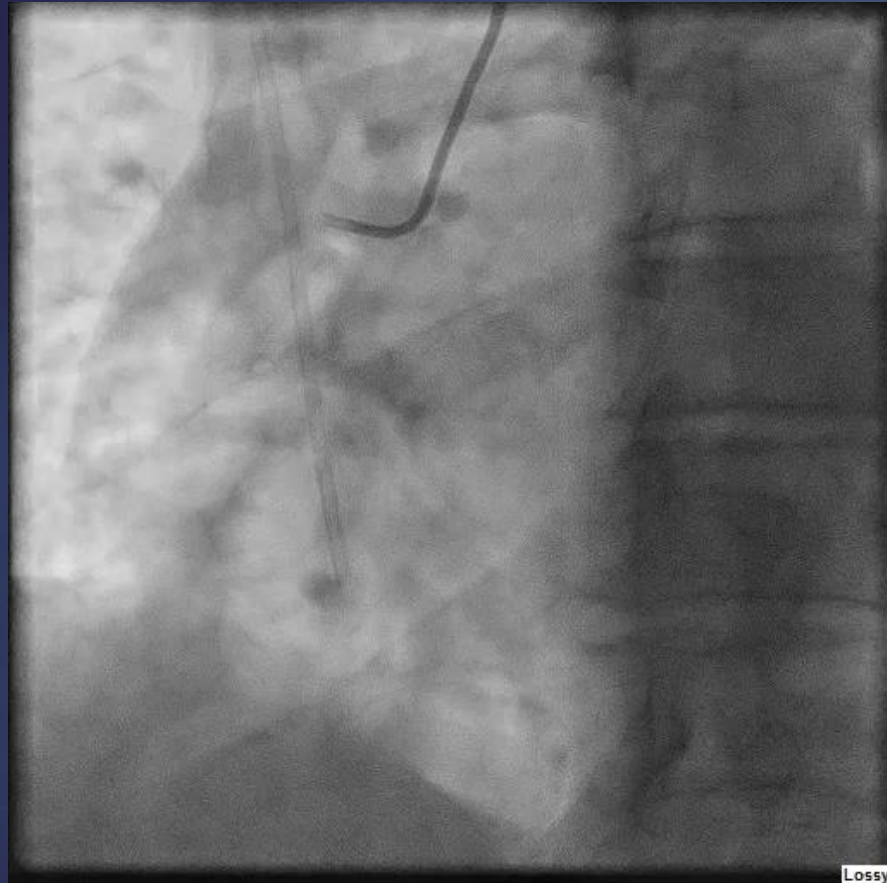
# LV Angiography



# Coronary Angiography



# Coronary Angiography





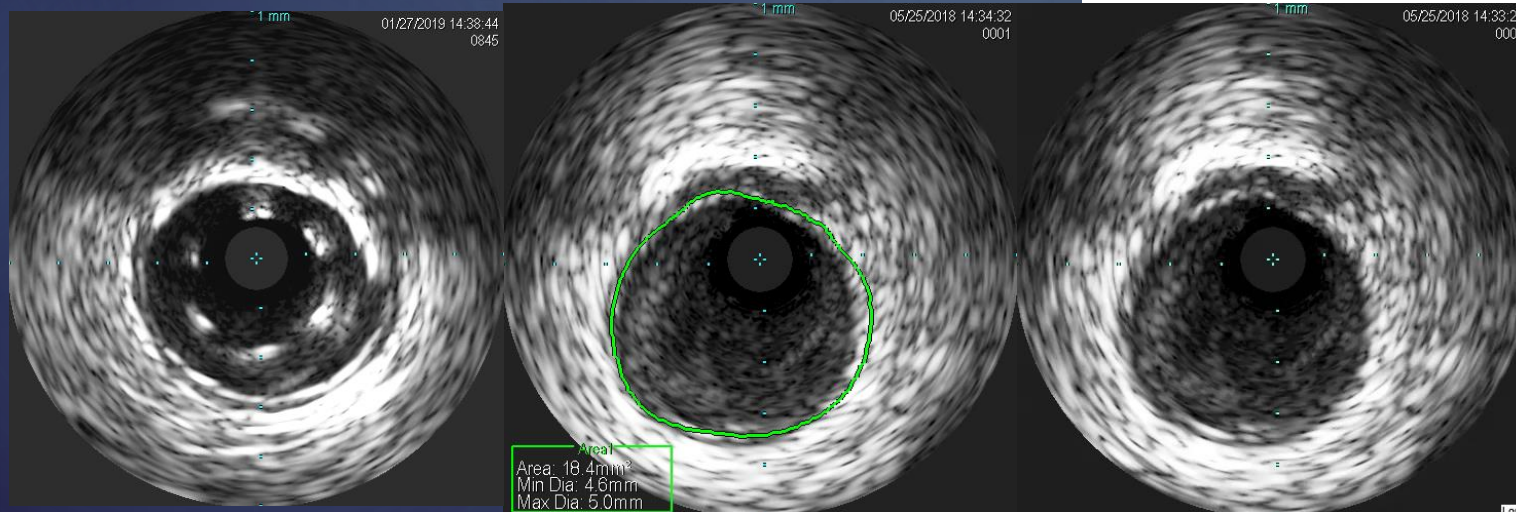
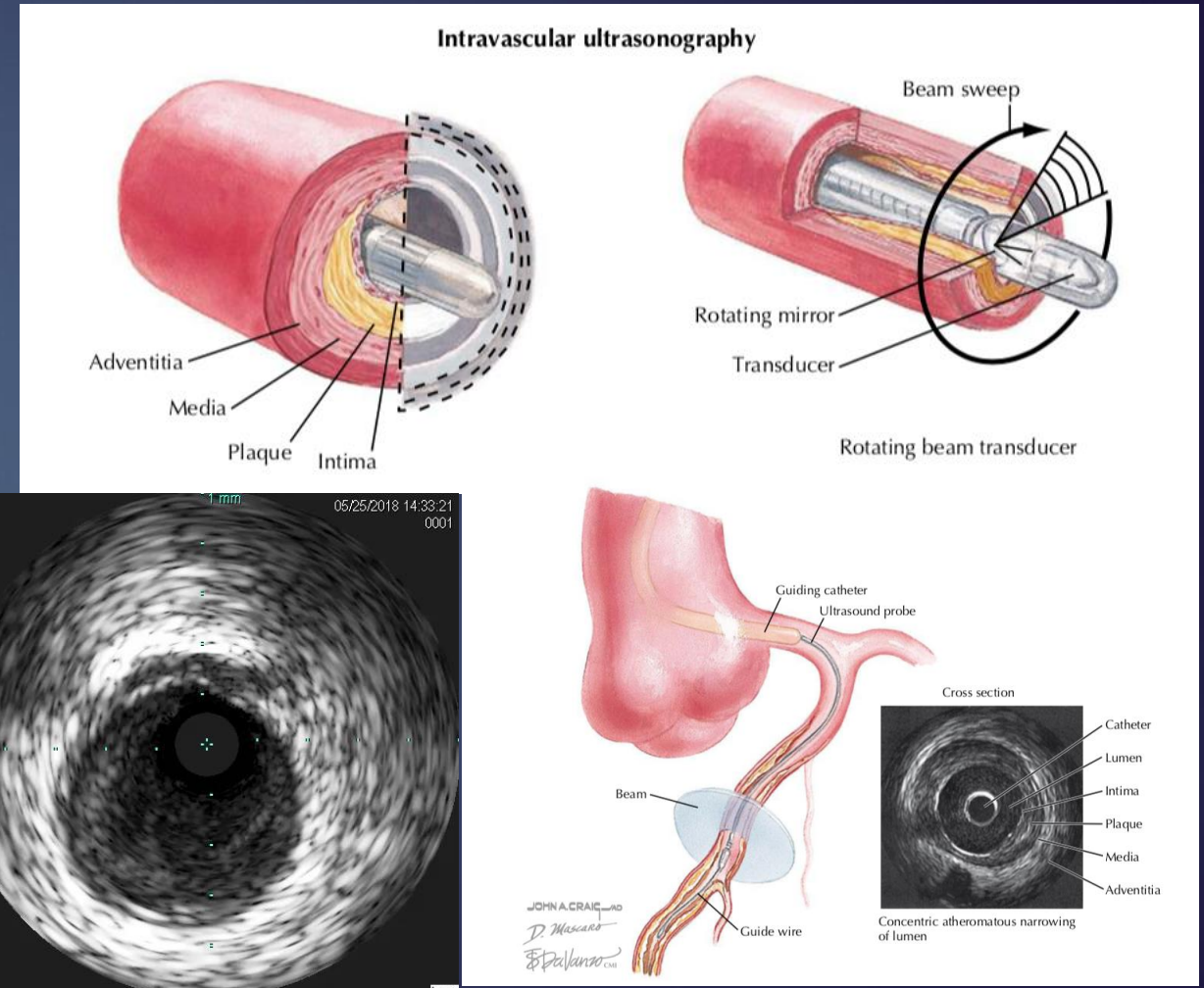
# Fractional Flow Reserve (FFR, iFR, Pd/Pa)

- Helps to achieve a more objective assessment of the hemodynamic significance of a stenosis.



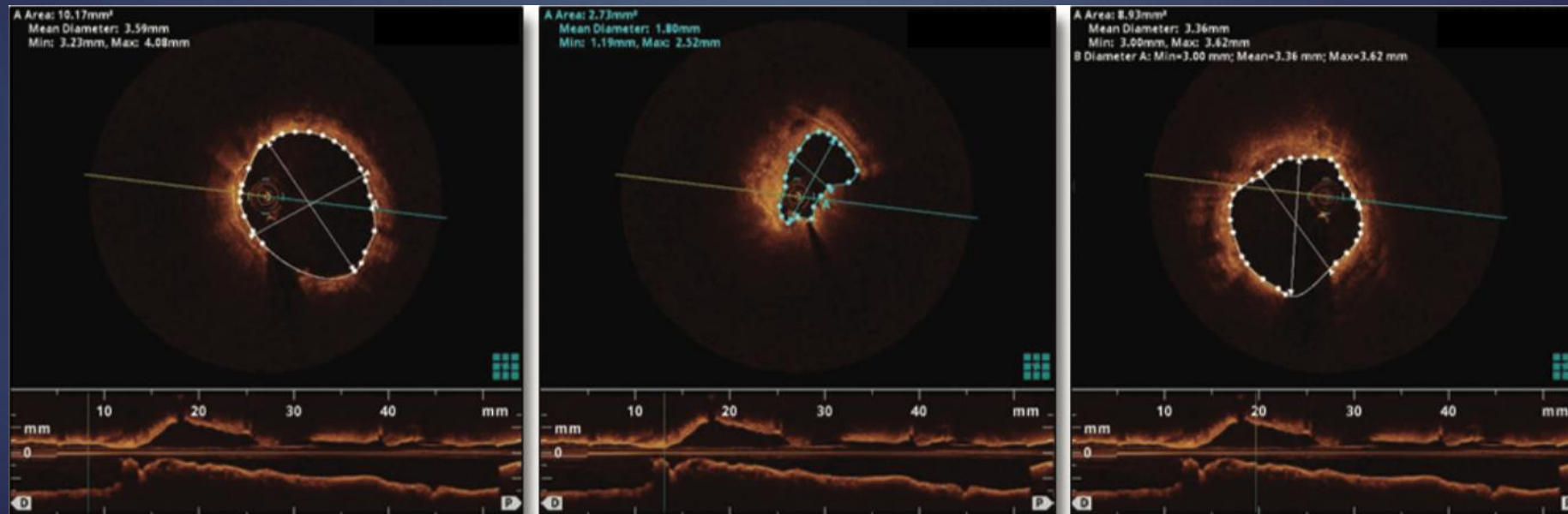
# Intravascular Ultrasound (IVUS)

- ▶ Helps to determine vessel anatomy, sizing, plaque burden and composition
- ▶ Can help to lower the risk of stent thrombosis and in stent restenosis



# Optical Coherence Tomography (OCT)

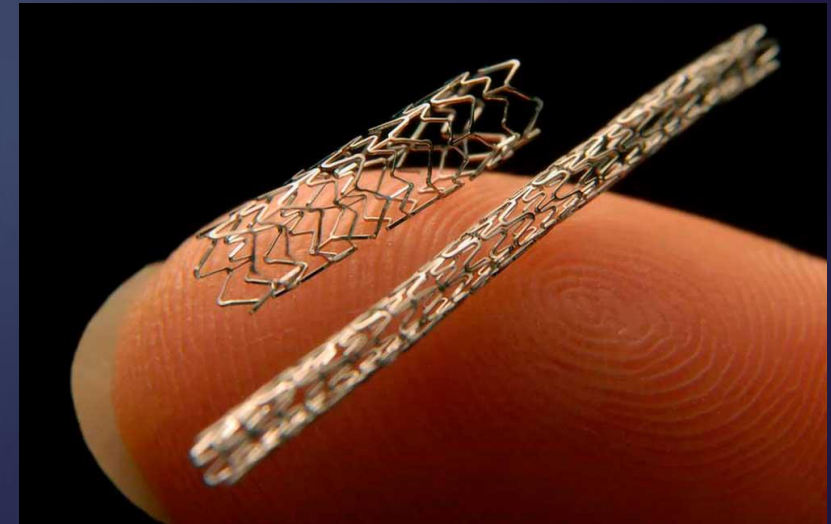
- ▶ Offers high resolution intravascular imaging for characterization of vessel anatomy and sizing
- ▶ Can help to lower the risk of stent thrombosis and in stent restenosis



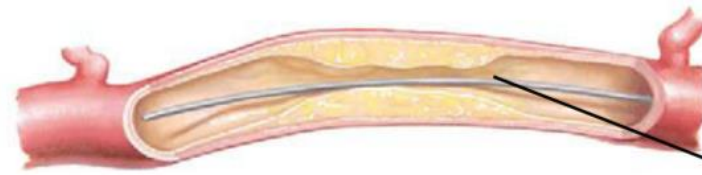


# STENTS

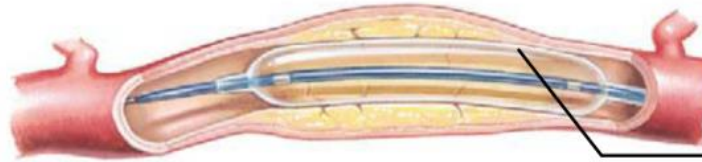
- ▶ Bare Metal Stent (BMS) vs Drug Eluting Stent (DES)
- ▶ Bioresorbable vascular scaffold (BVS)
- ▶ Thrombosis
- ▶ Restenosis



# PCI



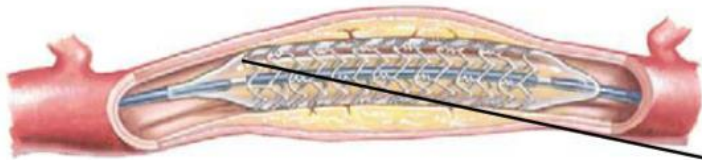
As the first step, a coronary guide wire is advanced across the stenotic atherosclerotic plaque.



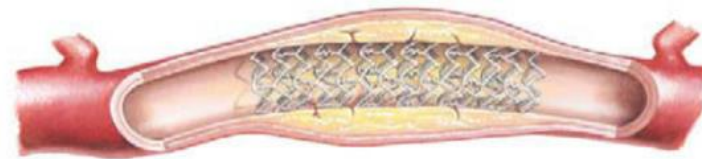
A double-lumen catheter with a balloon is slid over the guide wire; the balloon is inflated to compress the plaque and open the obstruction.



A balloon catheter containing the stent is placed in the dilated area.



The balloon is expanded, deploying the stent.



Once the stent has been deployed, the catheter and the guide wire are removed.

*C. Machado*  
— M.D.

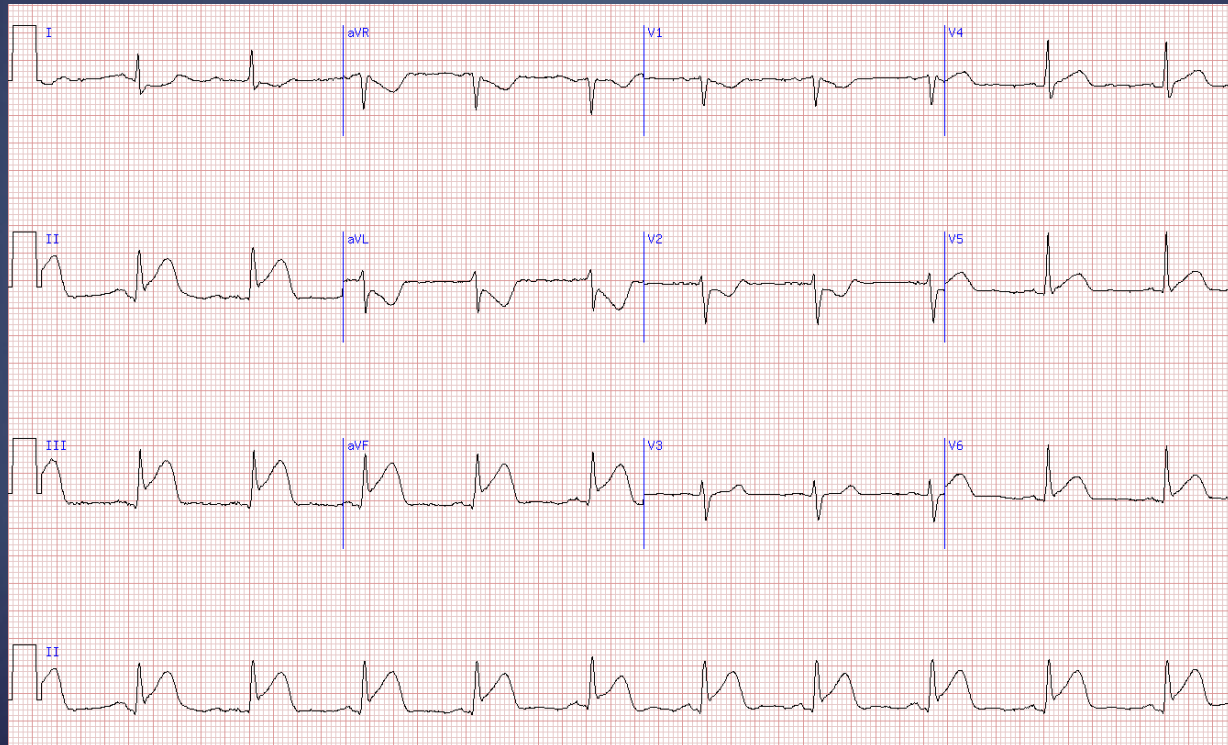
# Coronary Artery Bypass Surgery

- ▶ Dynamic field with complex, patient specific decision making
- ▶ Long term outcomes compared to PCI depend on patient selection
- ▶ In general, diabetic patients with multivessel disease (especially LM or proximal LAD) have favorable outcomes with surgery



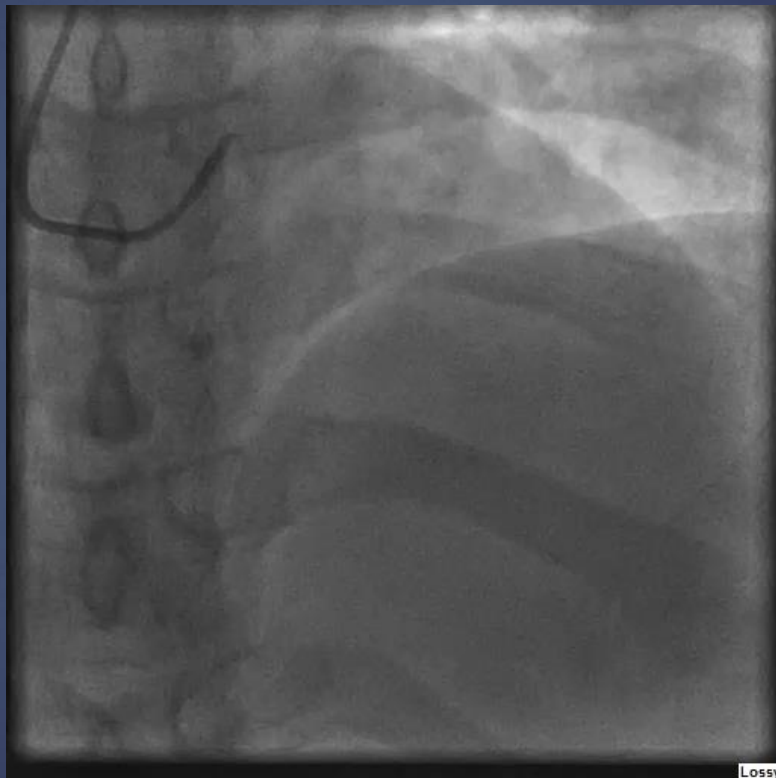
# Case Presentation

- ▶ 67 year old woman with high blood pressure, high cholesterol and diabetes presenting with chest discomfort for the past hour. She went out to smoke a cigarette to see if it would get better, but it didn't. She appears anxious and uncomfortable holding her hand over her chest.

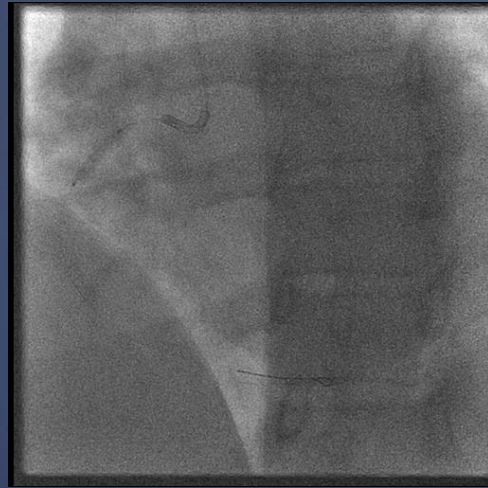




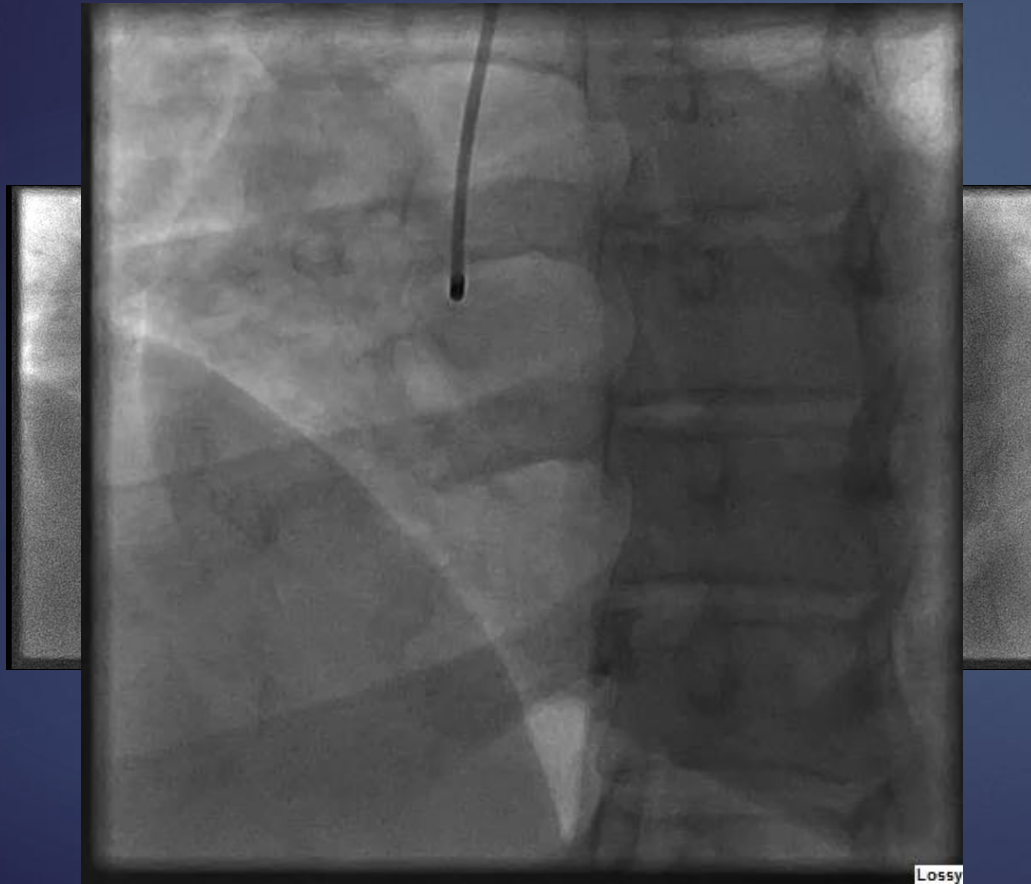
# Off to the cath lab...



# PCI



# PCI

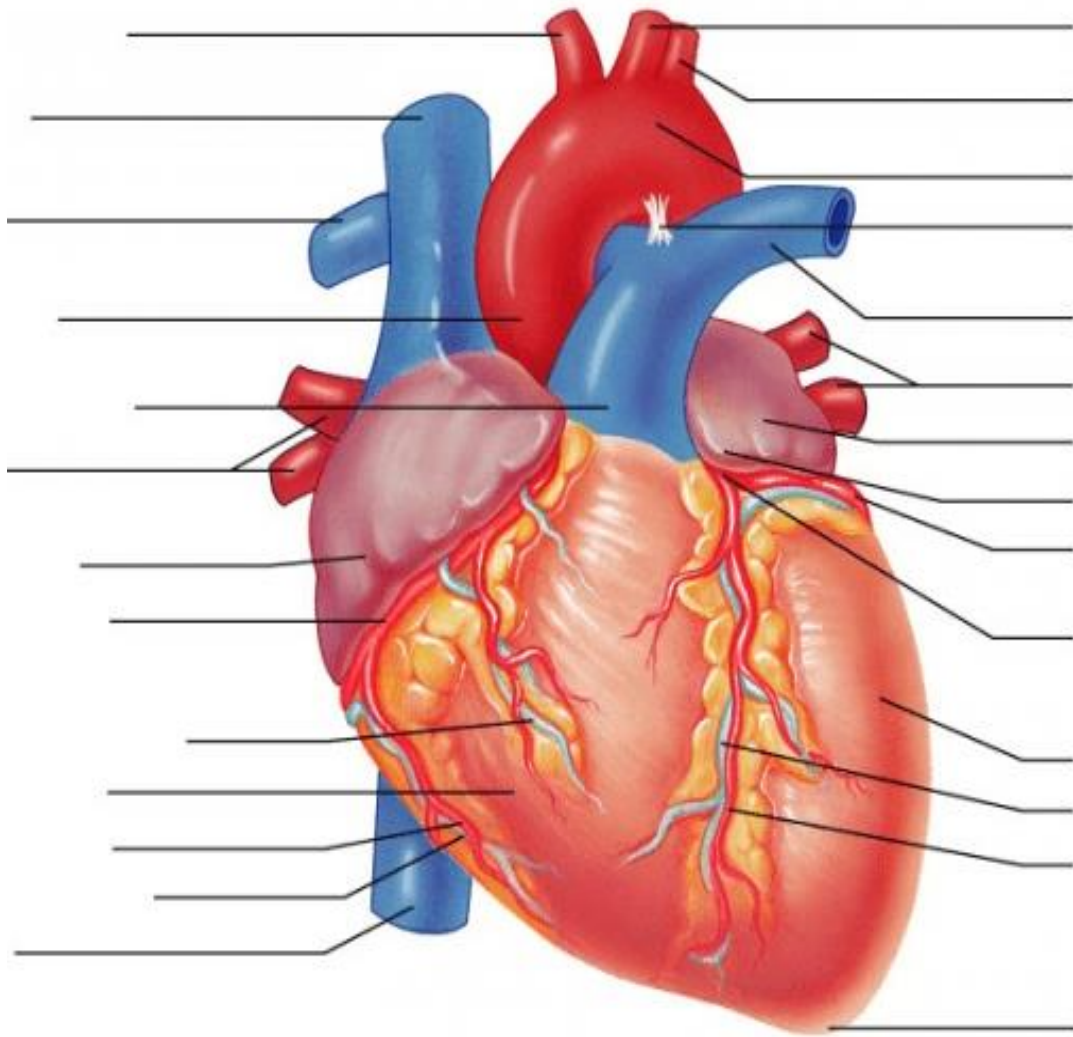


# What Next?

- ▶ Check echo, labs, monitor in the hospital for ~2 days or longer
- ▶ Discharge with medical therapy and risk factor modification
- ▶ Treat with
  - ▶ Aspirin, ticagrelor
  - ▶ Metoprolol, lisinopril
  - ▶ Atorvastatin
- ▶ Counsel regarding
  - ▶ Healthy diet
  - ▶ Physical activity
  - ▶ Weight loss
  - ▶ Smoking cessation
- ▶ Regular outpatient follow up







# Pop Quiz

