Coronary Artery Disease Diagnosis & Treatment

Kris Kawamoto, MD
Interventional Cardiologist
Assistant Professor JABSOM

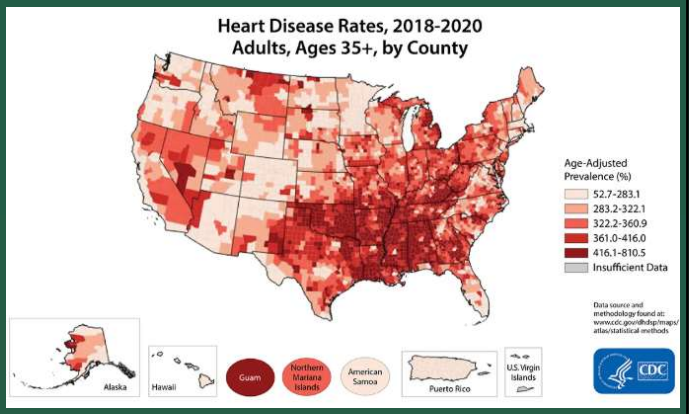
Learning Objectives

- Review coronary artery disease (CAD) statistics
- Evaluate prevention strategies for CAD
- Define the basic anatomy of the heart and coronary arteries
- Discuss diagnostic modalities and treatment of CAD

2

Coronary Artery Disease (CAD) Facts

- Most common type of heart disease
- Heart disease is the leading cause of death for people of most racial and ethnic groups in the US
- ~1 in 20 adults age 20 and older have CAD
- In the US, someone has a heart attack every 40 seconds



3

Risk Factors for CAD

- Hypertension (high blood pressure): BP ≥130 / ≥ 80
- Overweight: BMI 25-29 Obesity: BMI >30
- Diabetes: Hemoglobin A1c ≥ 6.5 on two occasions
- Dyslipidemia (abnormal levels of fats in the blood)
- Genetics
- Age
- Race and ethnicity

4

Heart Healthy Lifestyle

- Smoking cessation
- Healthy diet
  - Good: vegetables, fruits, fiber, whole grains, legumes, nuts, lean protein
  - Not Good: sugar, ultra-processed foods, high sodium foods, high cholesterol foods
- Physical activity: 20 minutes of moderate intensity daily
- Limit alcohol use:
  - ≤1 drink/day for non-pregnant females and males aged 65 years and older
  - ≤2 drinks/day for males under age 64 years
- Adequate sleep: 7-8 hours nightly

5

Aspirin

U.S. Preventive Services TASK FORCE

- Adults 40-59 years with ≥ 10% 10-year cardiovascular disease risk
  - Likely benefit from taking low dose aspirin (81 mg)
- Adults ≥ 60 yrs
  - Do not take aspirin

6

Statins

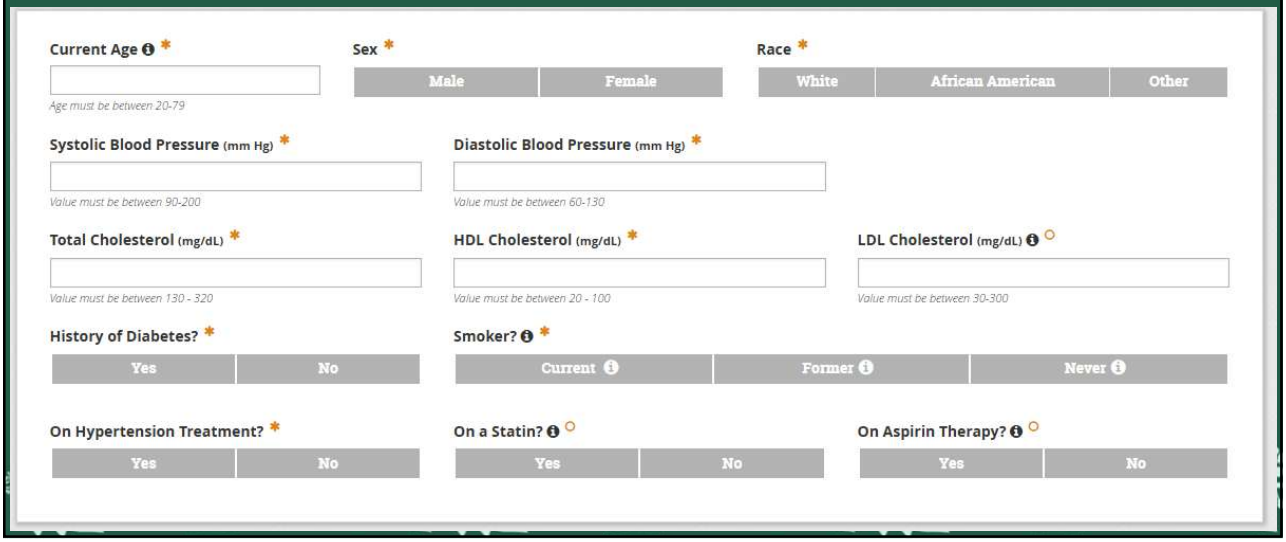
U.S. Preventive Services TASK FORCE

- Adults 40-75 years with ≥ 1 risk factor and an estimated 10-year CVD risk of ≥ 10%
  - YES, prescribe a statin
- Adults 40-75 years with ≥ 1 risk factor and an estimated 10-year CVD risk of 7.5-10%
  - Selectively offer statin
- Adults ≥ 76 years
  - No evidence

7

Atherosclerotic Cardiovascular Disease (ASCVD) Risk Calculator

https://tools.acc.org/ascvd-risk-estimator-plus/#!/calculate/estimate/



AMERICAN COLLEGE of CARDIOLOGY

ASCVD Risk Estimator Plus

Current Age * 70

▲ Lifetime Risk Calculator only provides lifetime risk estimates for individuals 20 to 59 years of age.

Age must be between 20-79

Sex * ✔ Male | Female

Race * White | African American | ✔ Other

▲ See the Estimate Warning below

Note: These estimates may *underestimate* the 10-year and lifetime risk for persons from some race/ethnic groups, especially American Indians, some Asian Americans (e.g., of south Asian ancestry), and some Hispanics (e.g., Puerto Ricans), and may *overestimate* the risk for others, including some Asian Americans (e.g., of east Asian ancestry) and some Hispanics (e.g., Mexican Americans). Because the primary use of these risk estimates is to facilitate the very important discussion regarding risk reduction through lifestyle change, the imprecision introduced is small enough to justify proceeding with lifestyle change counseling informed by these results.

Systolic Blood Pressure (mm Hg) * 150

Value must be between 90-200

Diastolic Blood Pressure (mm Hg) * 90

Value must be between 60-130

Total Cholesterol (mg/dL) * 222

Value must be between 130 - 320

HDL Cholesterol (mg/dL) * 47

Value must be between 20 - 100

LDL Cholesterol (mg/dL) 129

Value must be between 30-300

History of Diabetes? * Yes | ✔ No

Smoker? * ✔ Current | Former | Never

On Hypertension Treatment? * ✔ Yes | No

On a Statin? Yes | ✔ No

On Aspirin Therapy? Yes | ✔ No

**10-year risk for ASCVD is categorized as:

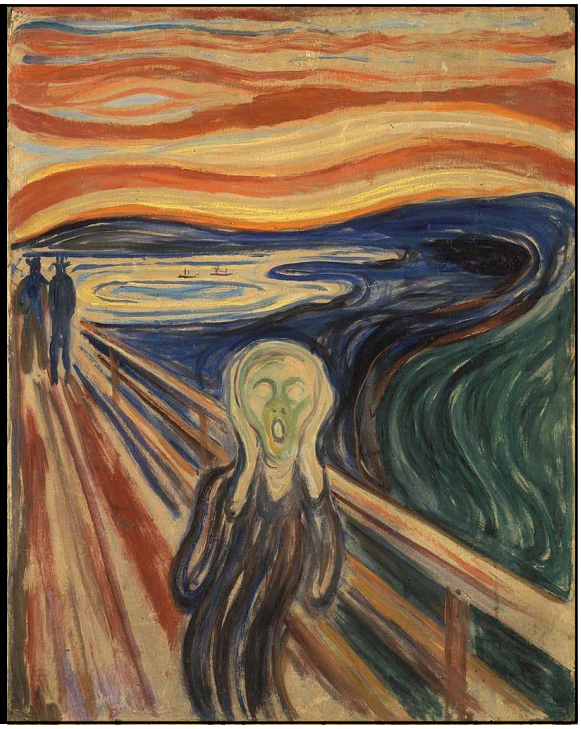
Low-risk (<5%)

Borderline risk (5% to 7.4%)

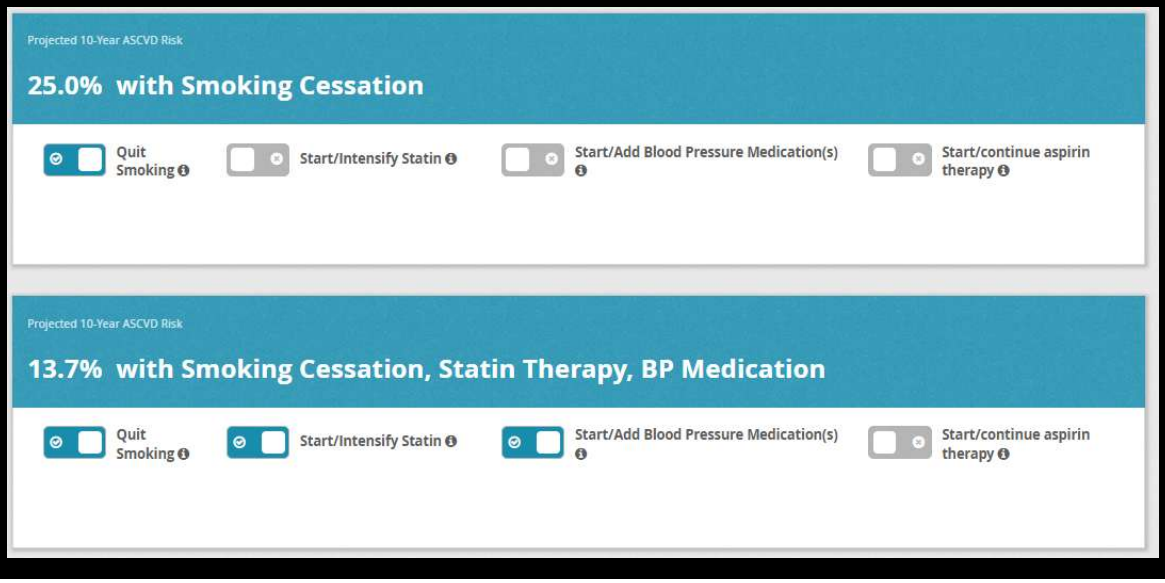
Intermediate risk (7.5% to 19.9%)

High risk (≥20%)

34.2% High — **Current 10-Year ASCVD Risk****



Therapy Impact



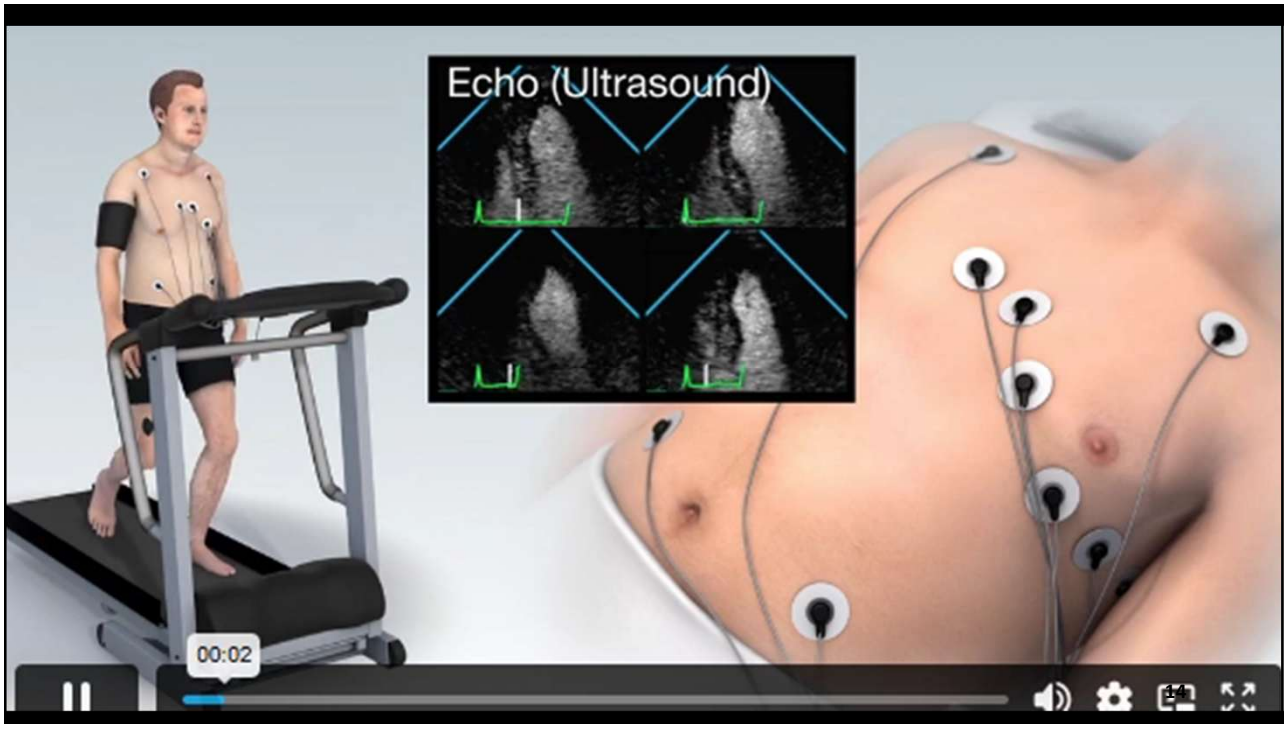
Case Scenario 1

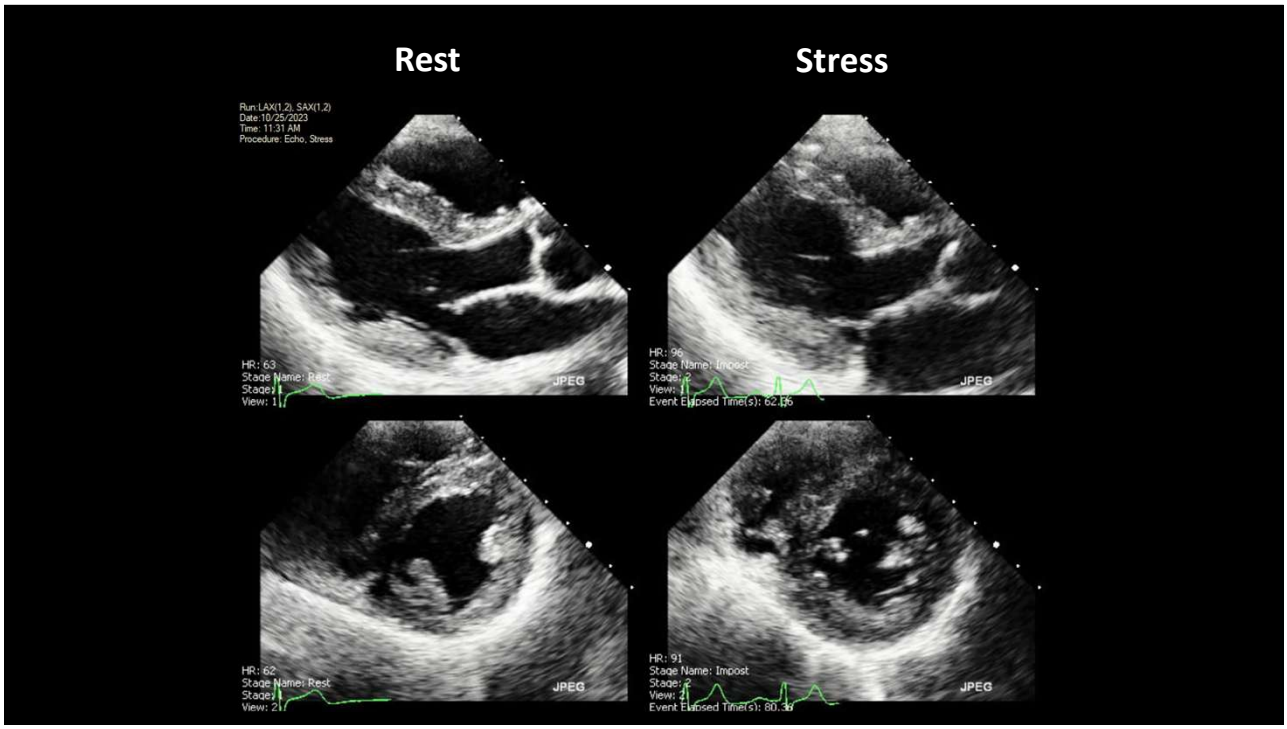
72 year-old gentleman with high blood pressure and dyslipidemia develops intermittent chest pain while playing pickle ball.

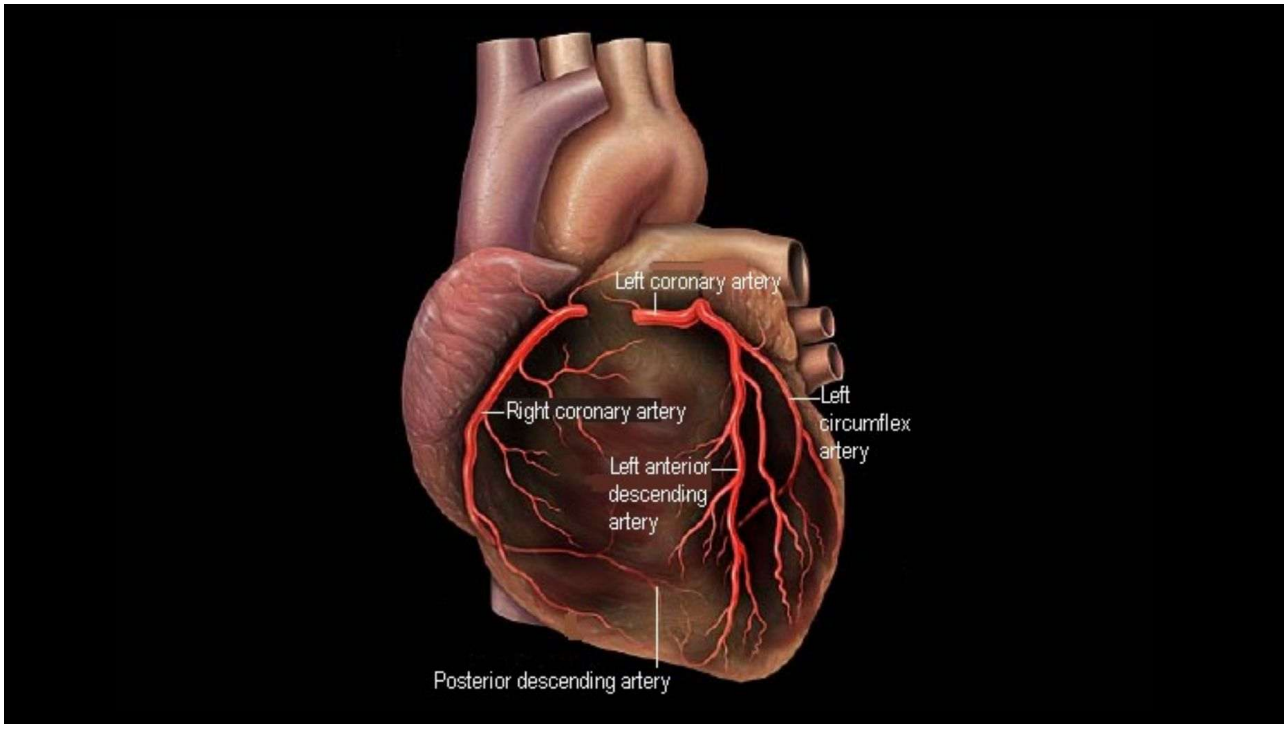
He sees his primary care physician.

12

PCP refers him for an exercise stress echocardiogram.




Rest
Stress
Run:LAX(1,2), SAX(1,2)
Date:10/25/2023
Time: 11:31 AM
Procedure: Echo, Stress
HR: 63
Stage Name: Rest
Stage: 1
View: 1
JPEG
HR: 96
Stage Name: Impost
Stage: 2
View: 1
Event Elapsed Time(s): 62.66
JPEG
HR: 62
Stage Name: Rest
Stage: 1
View: 2
JPEG
HR: 91
Stage Name: Impost
Stage: 2
View: 2
Event Elapsed Time(s): 80.36
JPEG

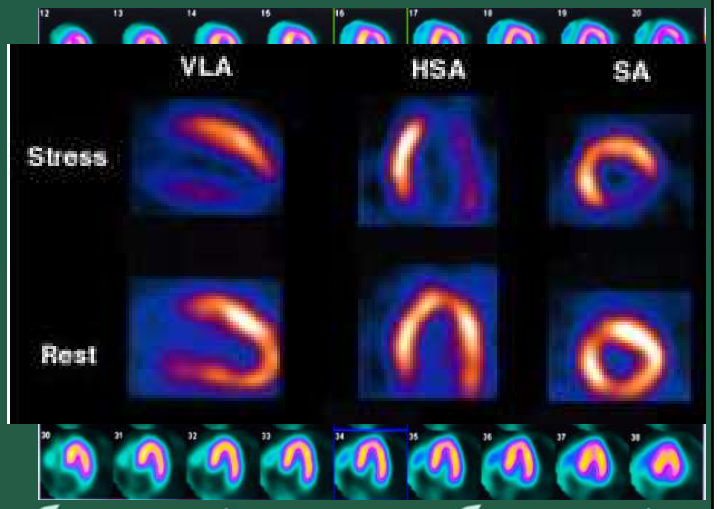

Left coronary artery
Right coronary artery
Left circumflex artery
Left anterior descending artery
Posterior descending artery

Other Diagnostic Modalities for CAD

- Nuclear medicine stress test
- Coronary CTA (CT angiogram)
- Cardiac stress MRI

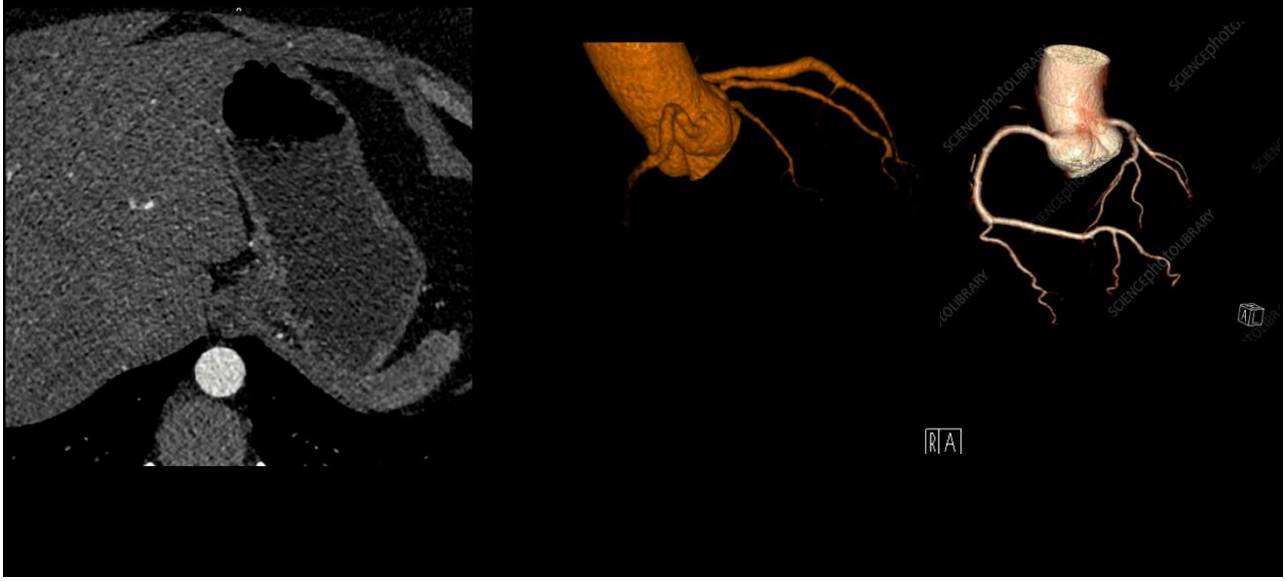
Nuclear Medicine Stress Test

- Stress
  - Treadmill
  - Medication (i.e. regadenoson)
- Imaging
  - Injected with radioactive tracer



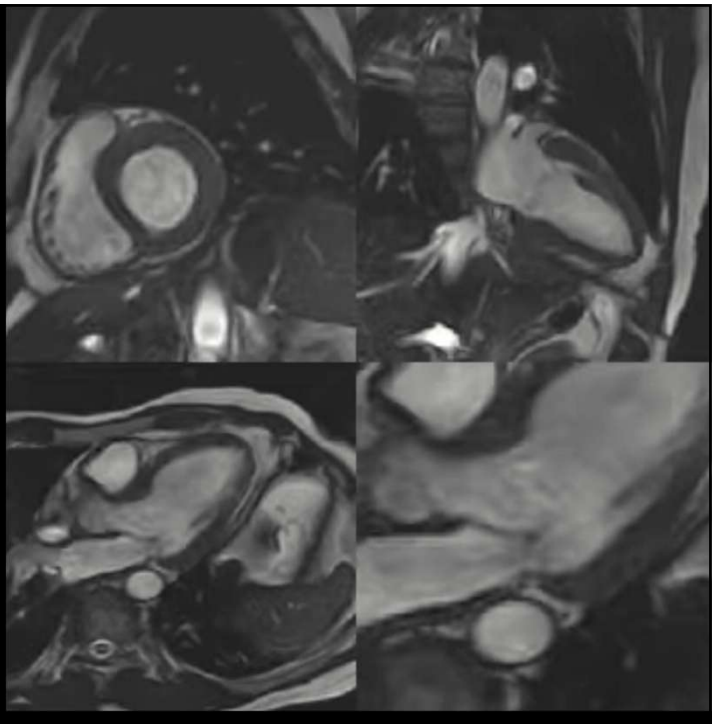
18

Coronary CTA



Cardiac Stress MRI

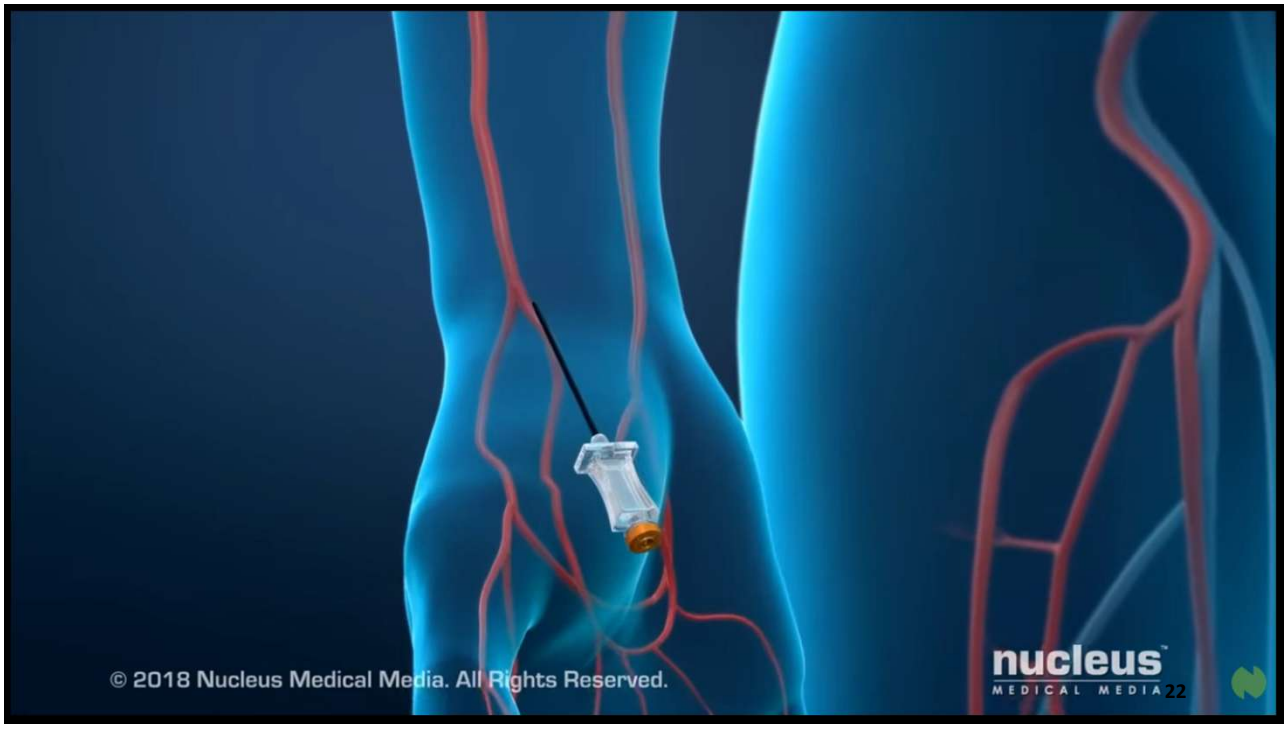
Stress: medication (regadenoson)



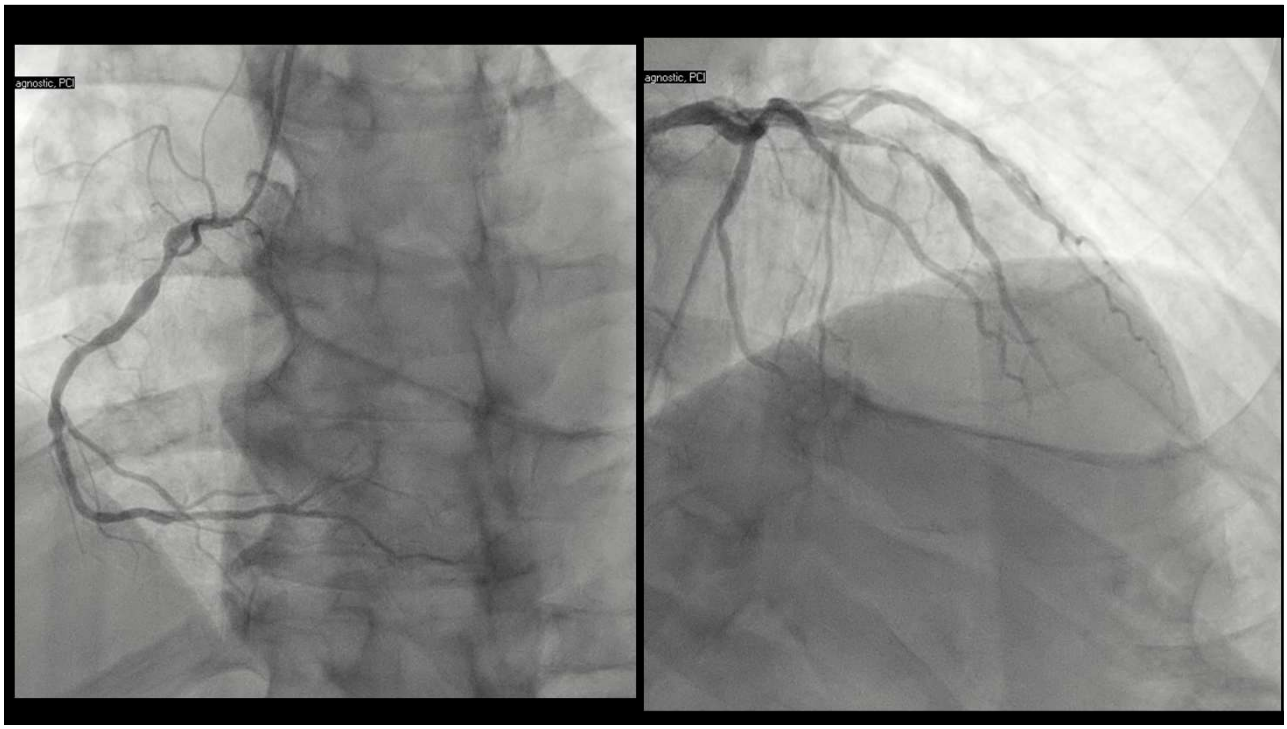
Back to the case…

- Patient is referred for cardiac catheterization

21

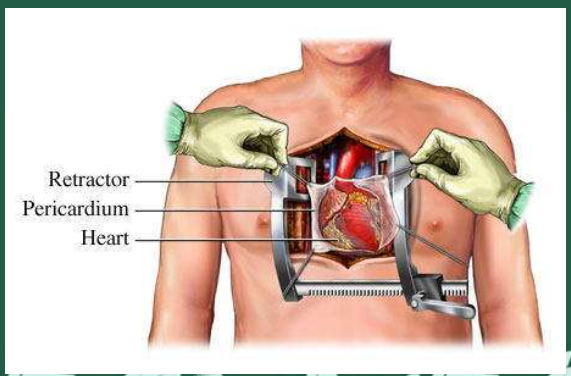


22



CABG vs PCI

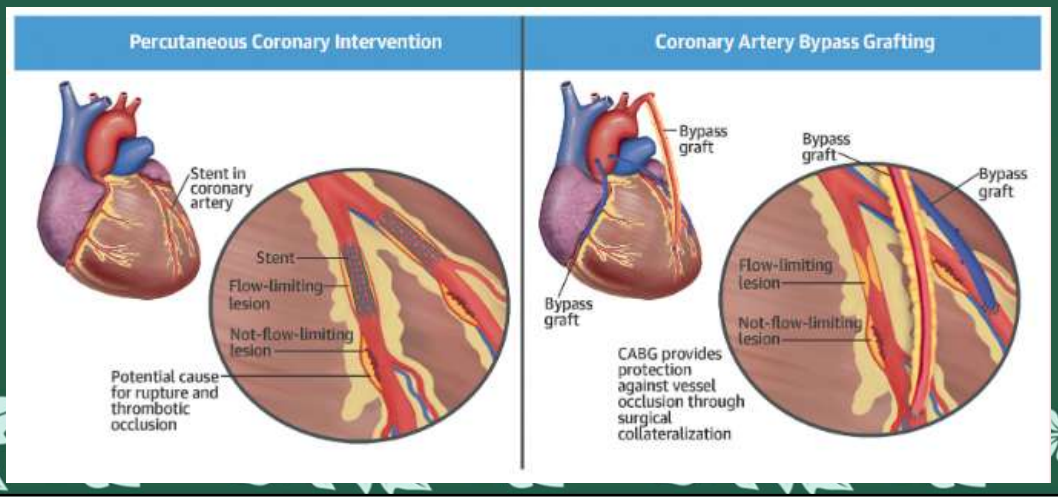
CABG = Coronary Artery Bypass Grafting (aka bypass surgery)



PCI = Percutaneous Coronary Intervention (aka stents)

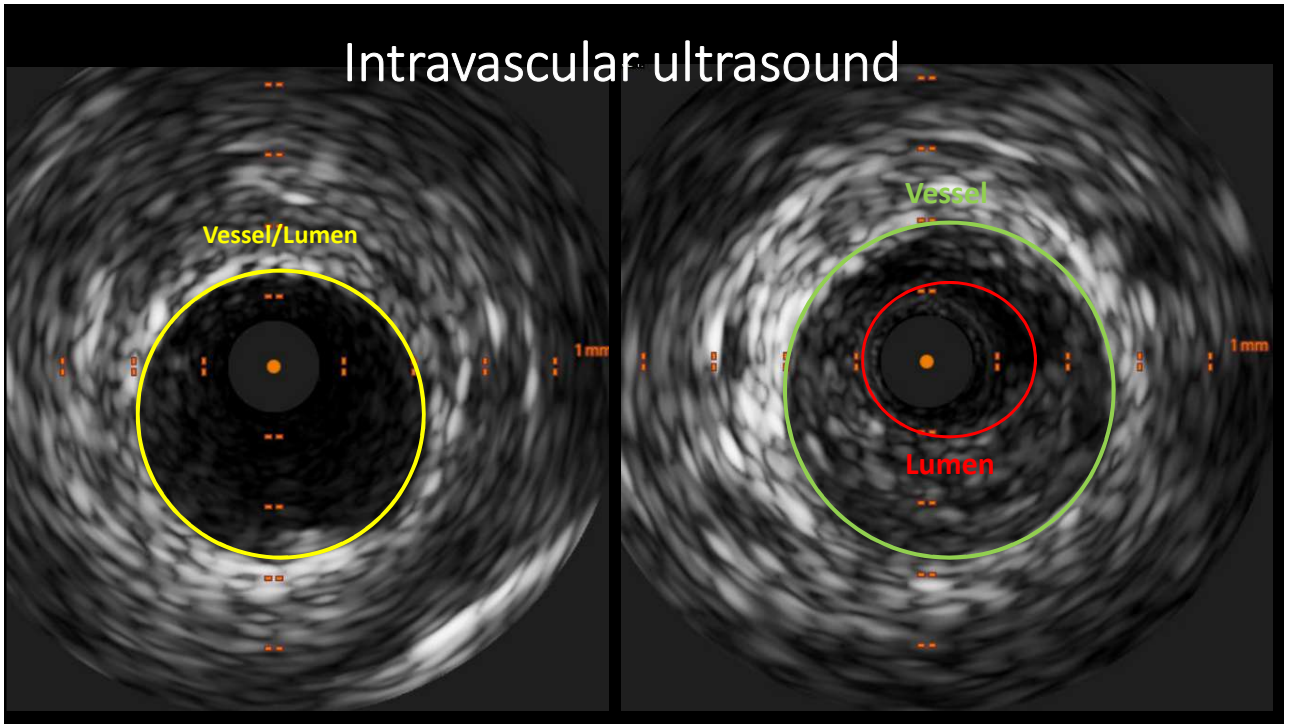
CABG vs PCI

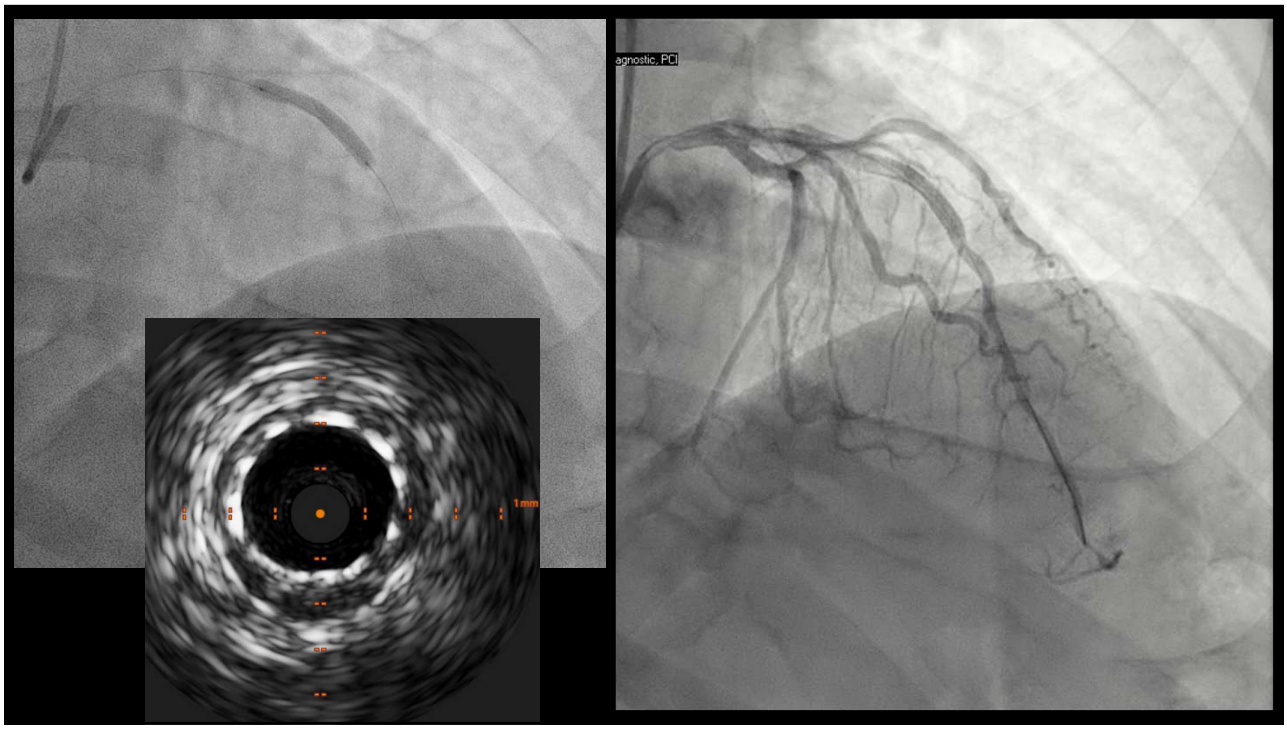
- CABG is best for:
  - Complex/multivessel CAD in patients with diabetes

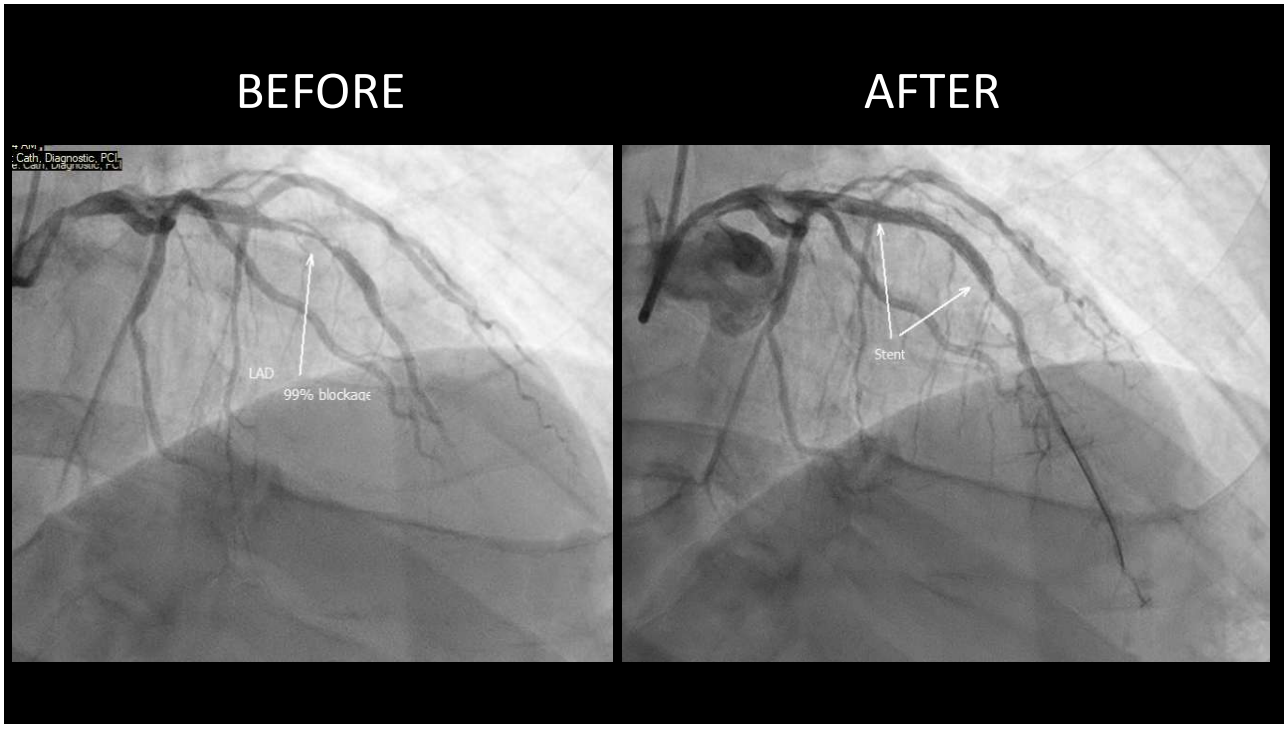


25

Intravascular ultrasound



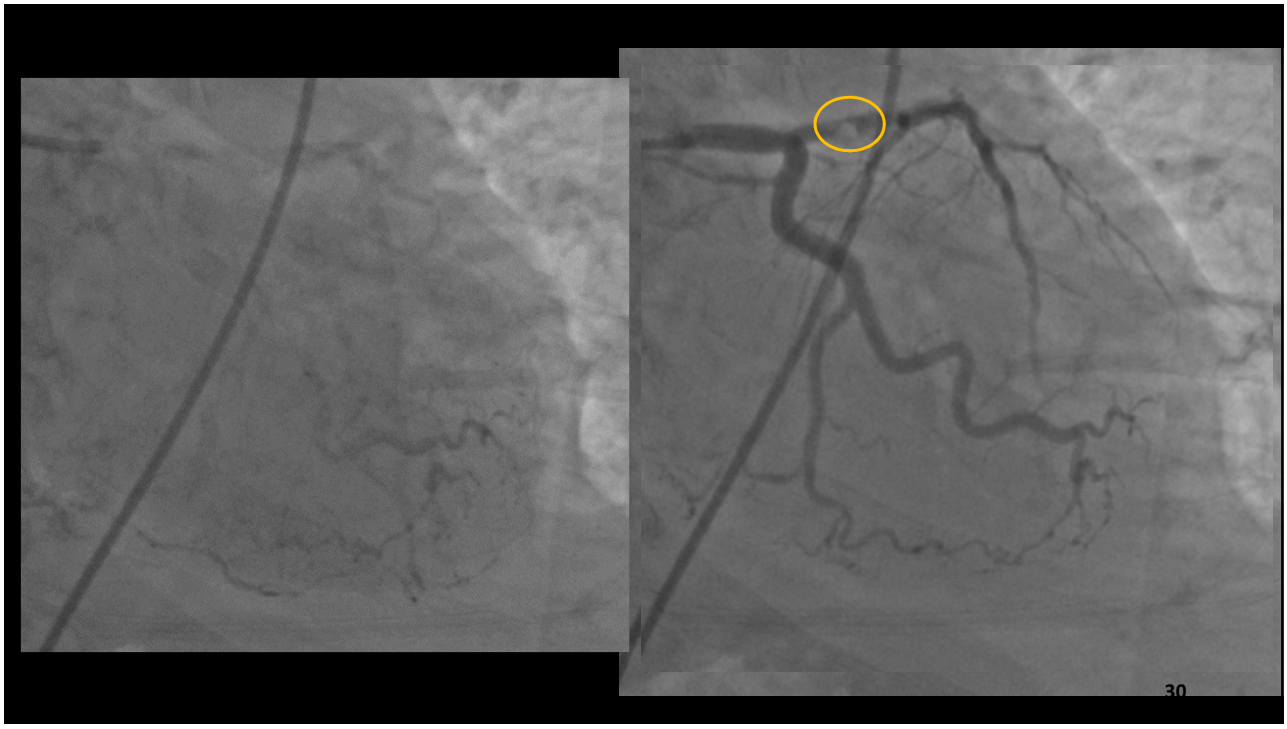

1mm
agnostic, PCI


BEFORE
AFTER
Cath, Diagnostic, PCI
LAD
99% blockage
Stent

Case Scenario 2

54 year-old gentleman with end-stage renal disease on dialysis with progressive substernal chest pain with exertion.

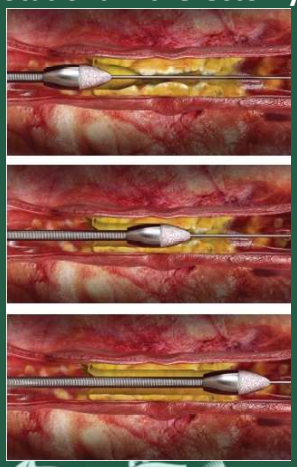
29



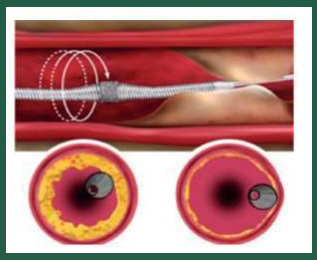
30

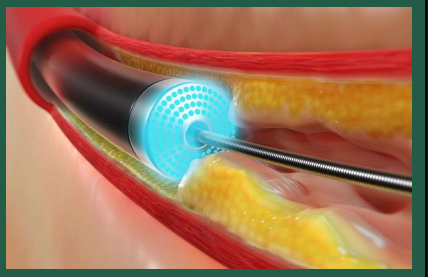
Coronary Atherectomy

Rotational Atherectomy

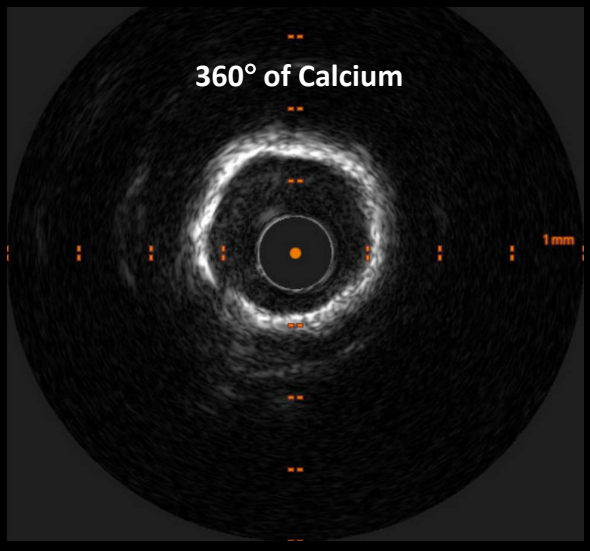


Orbital Atherectomy



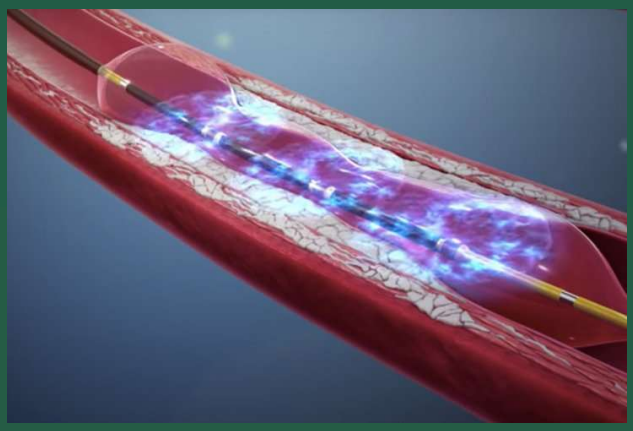


Intravascular ultrasound (IVUS)

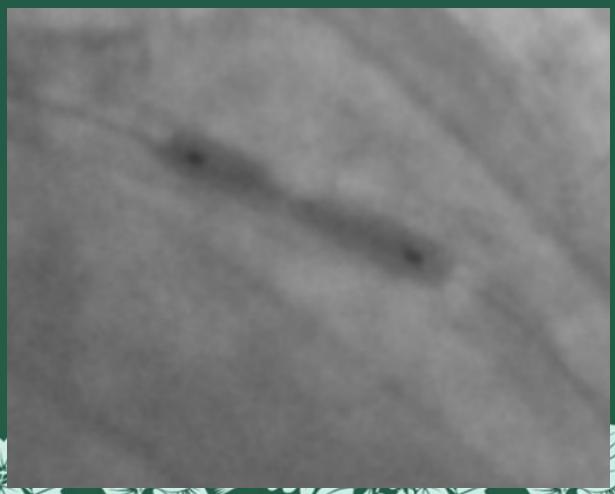


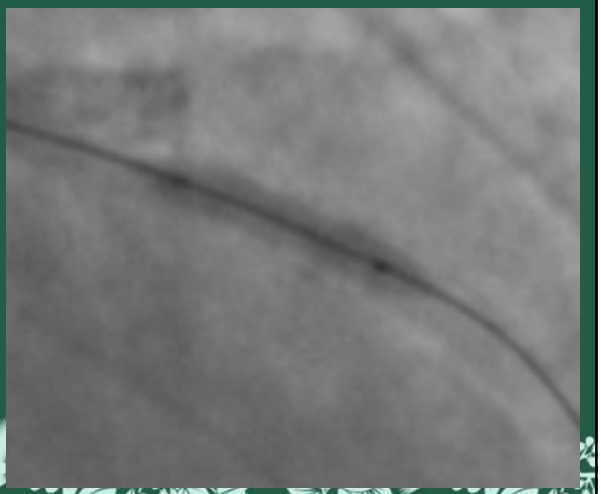
Intravascular lithotripsy (IVL)

- Electrical discharge from emitters vaporizes fluid in the balloon
- Creates rapidly expanding & collapsing bubble that generates sonic pressure waves
- Waves travel through soft tissue and crack calcium



Intravascular Lithotripsy (IVL)





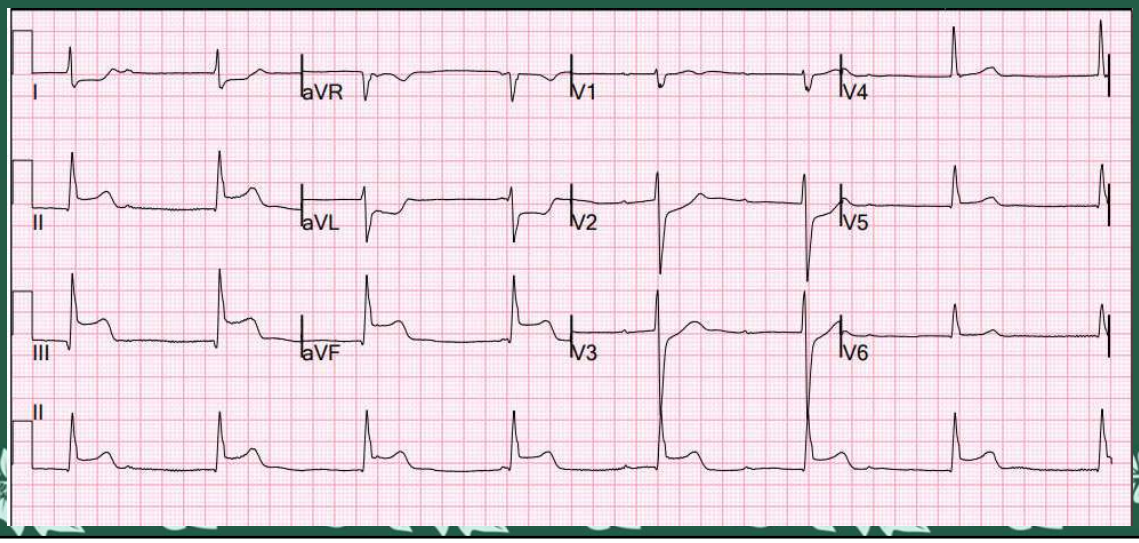
Case Scenario 3

67 year-old woman with HTN and diabetes who began to feel unwell during dinner. She developed nausea and chest pain. EMS was called. On arrival to the ED, she had a cardiac arrest (ventricular fibrillation) and received CPR. She was intubated and pulse returned.

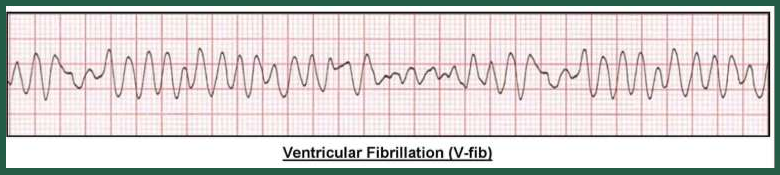
36

ECG

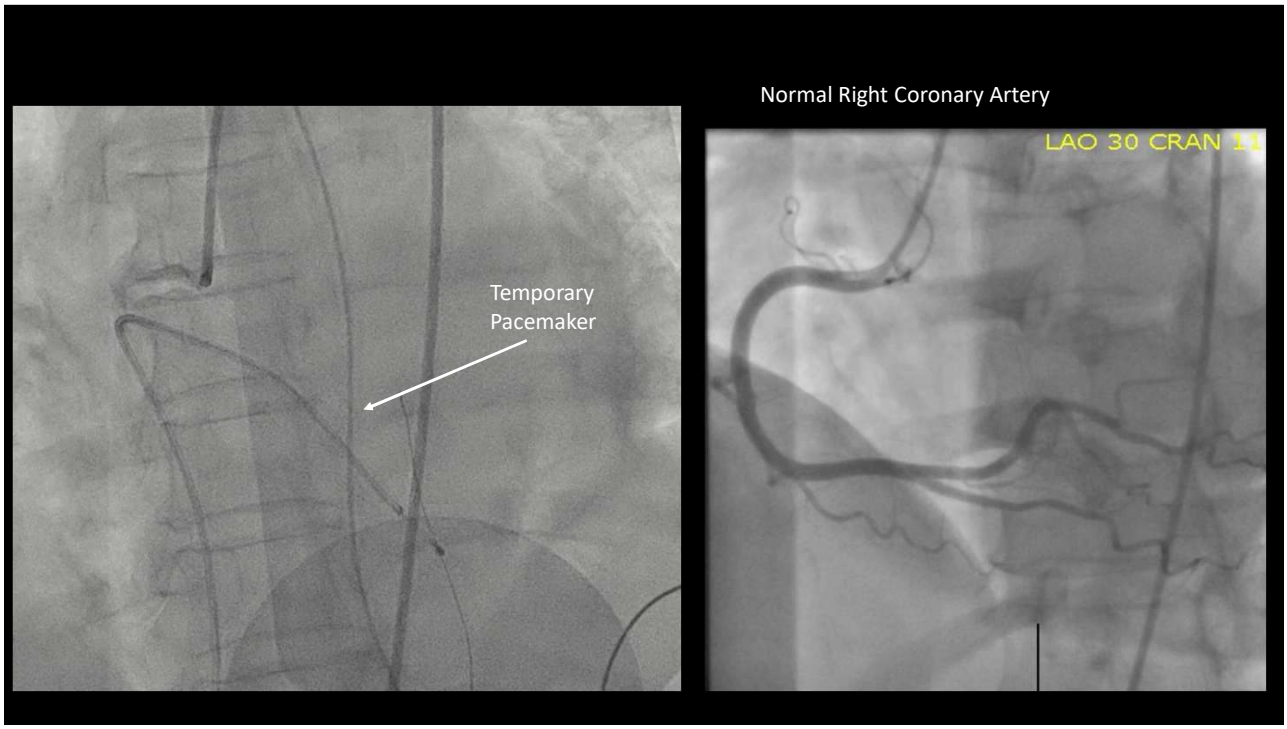
Inferior ST elevation myocardial infarction (STEMI or heart attack) and an abnormal heart rhythm called complete heart block.



She is urgently taken to the cardiac catheterization lab for coronary angiography. She has frequent ventricular arrhythmias requiring defibrillation (shock).



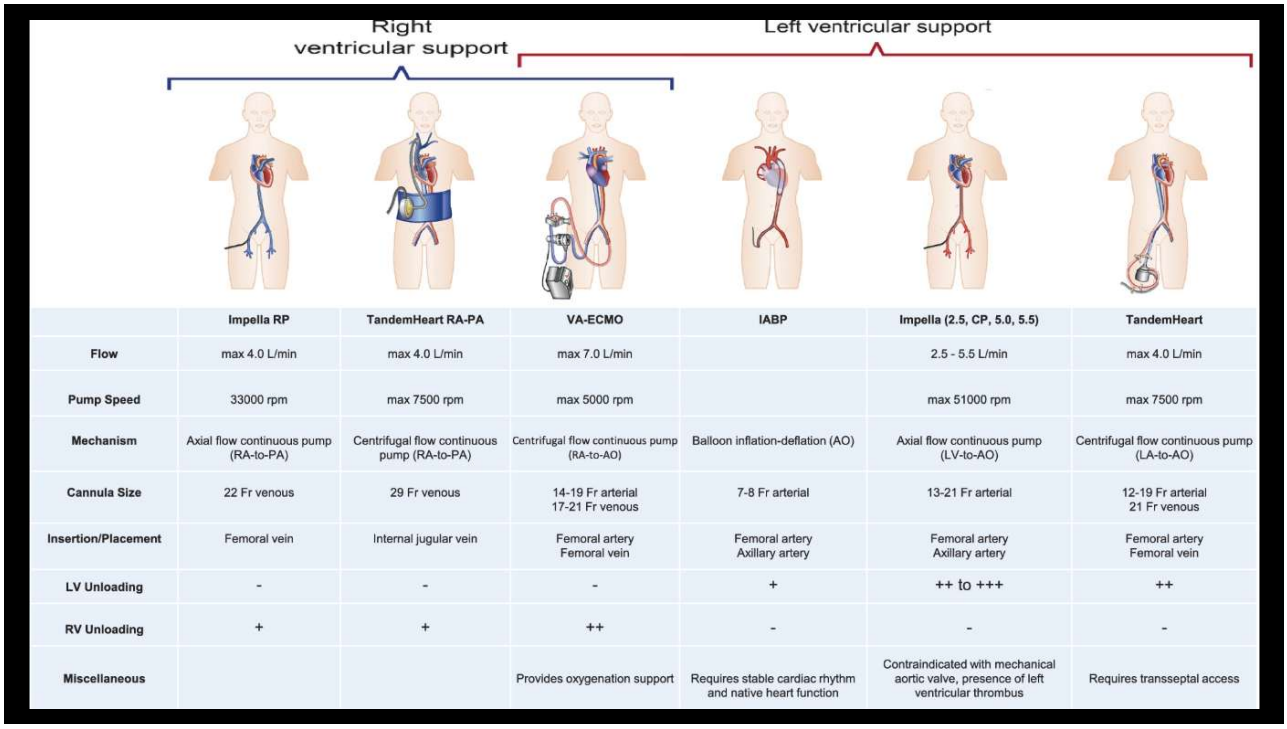
Ventricular Fibrillation (V-fib)



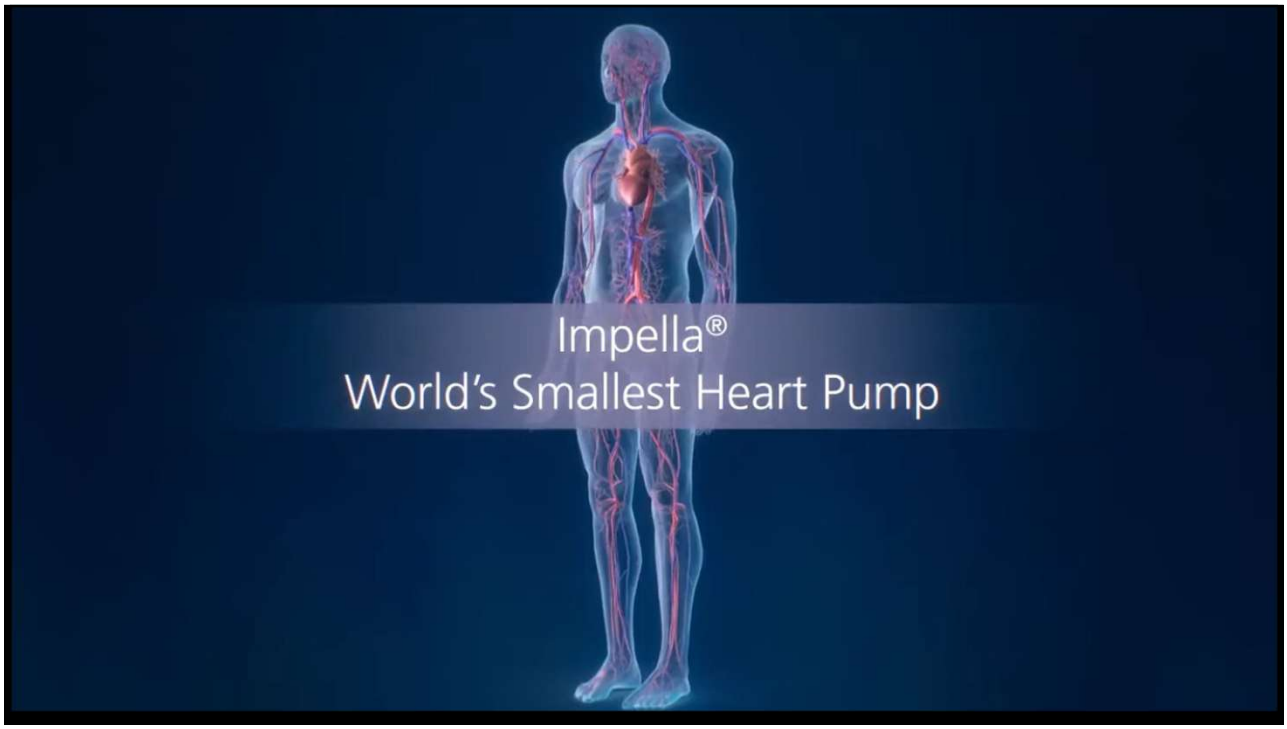
Percutaneous Coronary Intervention (PCI)

Post PCI

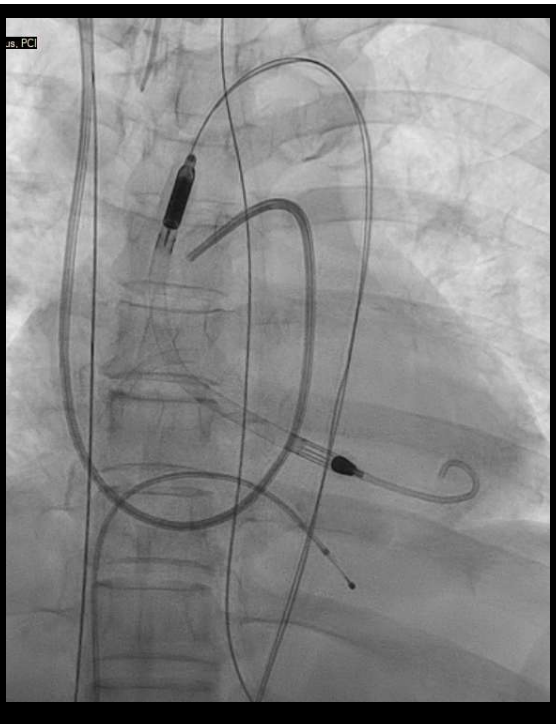
- Vessel is open, but she is in cardiogenic shock after being shocked > 20 times
- Decision is made to pursue mechanical circulatory support



	Impella RP	TandemHeart RA-PA	VA-ECMO	IABP	Impella (2.5, CP, 5.0, 5.5)	TandemHeart
Flow	max 4.0 L/min	max 4.0 L/min	max 7.0 L/min		2.5 - 5.5 L/min	max 4.0 L/min
Pump Speed	33000 rpm	max 7500 rpm	max 5000 rpm		max 51000 rpm	max 7500 rpm
Mechanism	Axial flow continuous pump (RA-to-PA)	Centrifugal flow continuous pump (RA-to-PA)	Centrifugal flow continuous pump (RA-to-AO)	Balloon inflation-deflation (AO)	Axial flow continuous pump (LV-to-AO)	Centrifugal flow continuous pump (LA-to-AO)
Cannula Size	22 Fr venous	29 Fr venous	14-19 Fr arterial 17-21 Fr venous	7-8 Fr arterial	13-21 Fr arterial	12-19 Fr arterial 21 Fr venous
Insertion/Placement	Femoral vein	Internal jugular vein	Femoral artery Femoral vein	Femoral artery Axillary artery	Femoral artery Axillary artery	Femoral artery Femoral vein
LV Unloading	-	-	-	+	++ to +++	++
RV Unloading	+	+	++	-	-	-
Miscellaneous			Provides oxygenation support	Requires stable cardiac rhythm and native heart function	Contraindicated with mechanical aortic valve, presence of left ventricular thrombus	Requires transseptal access



Impella CP placed



- Patient recovered and Impella CP device was removed after 4 days.
- She was discharged and attended cardiac rehab.

45

Summary

- Heart disease is the leading cause of death for most racial and ethnic groups and coronary artery disease is the most common type of heart disease
- Lifestyle modifications can decrease the risk of developing CAD
- There are multiple diagnostic modalities to diagnose CAD
- Treatment options for CAD include: PCI, CABG, and medical management

46