CARDIOLOGY REVIEW

2019

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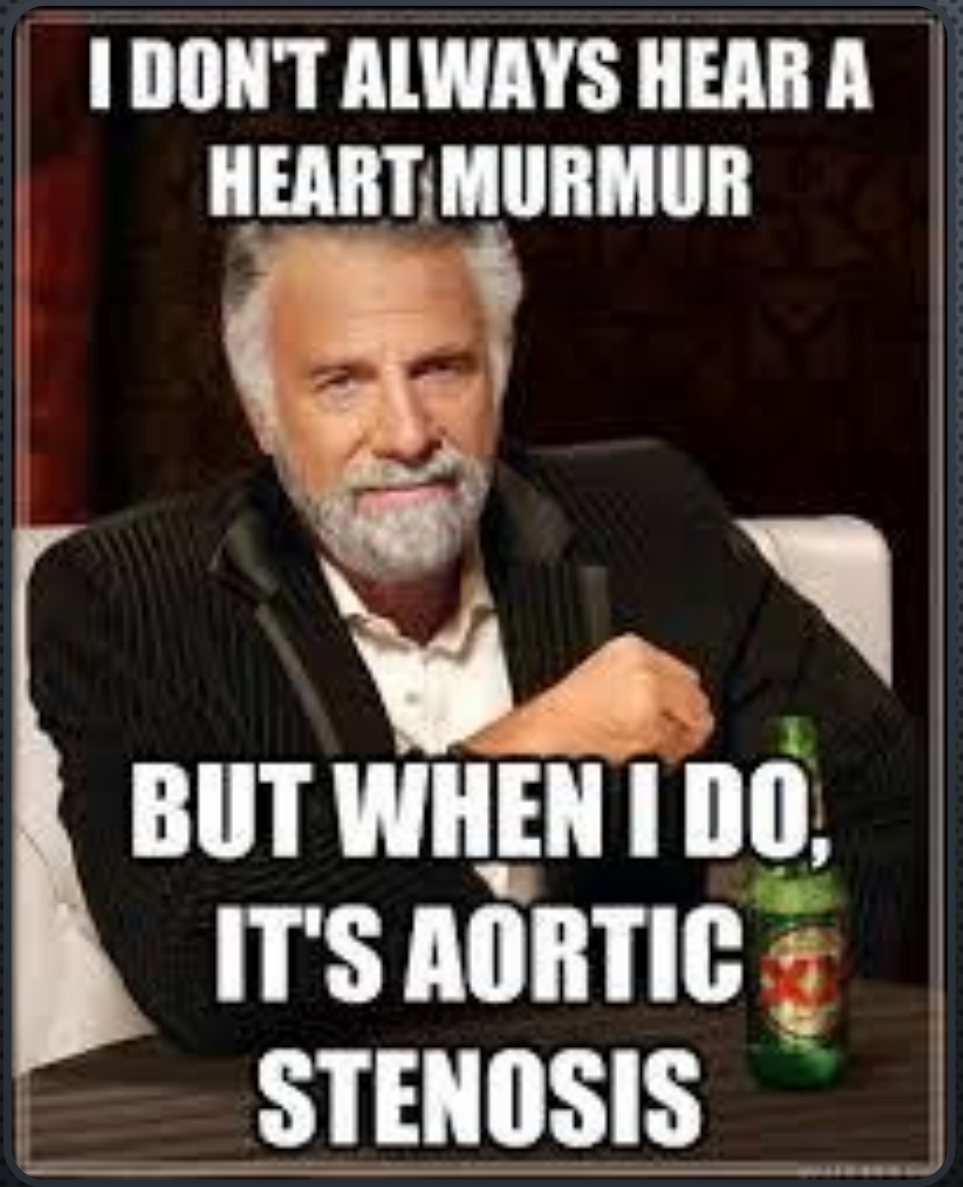
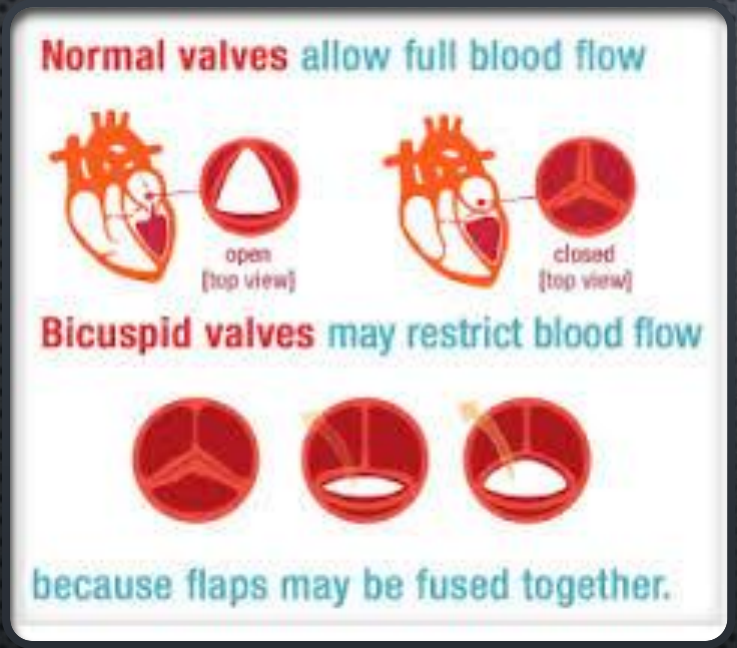
Question #1 (MKSAP 10)

- An 80-year-old woman is evaluated for a 6-month history of worsening exertional dyspnea. Two nights ago, she awoke with sudden-onset dyspnea that was relieved with ambulation. She has not had chest pain. Medical history is significant for myocardial infarction 8 years ago. She also has a history of left ventricular dysfunction but has been previously well compensated. Her medications are lisinopril, aspirin, metoprolol, and rosuvastatin.
- On physical examination, temperature is normal, blood pressure is 95/60 mm Hg, pulse rate is 56/min, and respiration rate is 18/min. The lungs are clear. The carotid upstroke is low in volume. The apical impulse is laterally displaced and enlarged. S_1 is soft; the aortic component of S_2 is diminished. There is no S_3 or S_4. A grade 2/6 mid-peaking systolic murmur is heard throughout the precordium. The remainder of the examination is normal.
- An echocardiogram demonstrates a left ventricular ejection fraction of **32%**. The aortic valve is slightly calcified. The stroke volume is markedly decreased (23 mL/m^2). The mean aortic gradient is 20 mm Hg (consistent with mild to moderate stenosis), and the aortic valve area is calculated to be 0.7 cm^2 (consistent with severe stenosis).
- Which of the following is the most appropriate next step in management?



#1 – C: DOBUTAMINE ECHO

SEVERE AORTIC STENOSIS



- CAN BE CONGENITAL (BICUSPID VALVE) OR ACQUIRED – AGING, RADIATION, OR RHEUMATIC (ALMOST ALWAYS WITH MITRAL INVOLVEMENT) TYPICALLY PROGRESSES WITH A DECREASE IN THE AORTIC VALVE AREA OF APPROXIMATELY 0.12 CM^2 PER YEAR
- ASYMPTOMATIC PATIENTS WITH SEVERE AORTIC STENOSIS, 75% WILL DIE OR DEVELOP SYMPTOMS WITHIN 5 YEARS.
- ONCE SYMPTOMS OCCUR IN PATIENTS WITH SEVERE AORTIC STENOSIS, LIFE EXPECTANCY IS GENERALLY ONLY 1 TO 2 YEARS. THUS, WE MONITOR VERY CLOSELY – 6-12 MOS

Pseudo Aortic Stenosis

- Definition: a small valve area (≤1.0 cm^2) and either high peak velocity (>4 m/s) or high mean gradient (>40 mm Hg). (Thumb on the garden hose)
- Pseudostenosis = a small valve area BUT still low velocity and/or low gradient, essentially because their low EF/severe LV dysfunction causes the ventricle shape to decrease the valve area, but doesn't have enough "oomph" to create high velocity and/or gradient. This can be revealed with a dobutamine stress test.
- Can also be seen in people with small LV (low output) and other myocardial dsz
- With pseudostenosis, dobutamine increases cardiac output and the opening forces on the aortic valve, causing the jet to increase (and causing the valve area to increase out of the severe range). With true aortic stenosis, the calculated valve area remains in the severe range despite the ventricle re-shaping and sqeezing with dobutamine administration, and the aortic valve gradient and velocity increase with increased stroke volume.
- Ultimately, they still have better survival with surgery, but we'd certainly optimize first

High value reminder – spend the money on diseases with high mortality!

Factors Considered	Lesion Severity	Frequency of Evaluation
Aortic Stenosis		
Stenosis severity; rate of progression; LV systolic function; ascending aorta dilation if associated with bicuspid aortic valve	At risk (V_{max} <2 m/s)	
[Asymptomatic]	Mild (V_{max} 2.0-2.9 m/s or mean gradient <20 mm Hg)	Clinical evaluation yearly; echo every 3-5 y
	Moderate (V_{max} 3.0-3.9 m/s or mean gradient 20-39 mm Hg)	Clinical evaluation yearly; echo every 1-2 y
	Severe (V_{max} ≥4 m/s or mean gradient ≥40 mm Hg, AVA ≤1.0 cm^2)	Clinical evaluation yearly; echo every 6-12 mo
	Very severe (V_{max} ≥5 m/s or mean gradient ≥60 mm Hg)	Clinical evaluation yearly; echo every 6-12 mo

Summary of recommendations for AS: Timing of intervention

Recommendations	Class of recommendation	Level of evidence
AVR is recommended for symptomatic patients with severe high-gradient AS who have symptoms by history or on exercise testing (stage D1)	I	B
AVR is recommended for asymptomatic patients with severe AS (stage C2) and LVEF <50%	I	B
AVR is indicated for patients with severe AS (stage C or D) when undergoing other cardiac surgery	I	B
AVR is reasonable for asymptomatic patients with very severe AS (stage C1, aortic velocity ≥5.0 m/s) and low surgical risk	IIa	B
AVR is reasonable in asymptomatic patients (stage C1) with severe AS and decreased exercise tolerance or an exercise fall in BP	IIa	B
AVR is reasonable in symptomatic patients with low-flow/low-gradient severe AS with reduced LVEF (stage D2) with a low-dose dobutamine stress study that shows an aortic velocity ≥4.0 m/s (or mean pressure gradient ≥40 mmHg) with a valve area ≤1.0 cm^2 at any dobutamine dose	IIa	B
AVR is reasonable in symptomatic patients who have low-flow/low-gradient severe AS (stage D3) who are normotensive and have an LVEF ≥50% if clinical, hemodynamic, and anatomic data support valve obstruction as the most likely cause of symptoms	IIa	C
AVR is reasonable for patients with moderate AS (stage B) (aortic velocity 3.0 to 3.9 m/s) who are undergoing other cardiac surgery	IIa	C
AVR may be considered for asymptomatic patients with severe AS (stage C1) and rapid disease progression and low surgical risk	IIb	C

QUESTION #2 (MKSAP 63)

- A 73-YEAR-OLD MAN IS EVALUATED DURING A ROUTINE EXAMINATION. HE IS PHYSICALLY ACTIVE AND PARTICIPATES REGULARLY IN CHARITABLE RUNNING EVENTS. HE HAS NO CARDIAC SYMPTOMS, AND HIS MEDICAL HISTORY IS UNREMARKABLE.
- ON PHYSICAL EXAMINATION, VITAL SIGNS ARE NORMAL. THE LUNGS ARE CLEAR. JUGULAR VENOUS PULSE IS NORMAL. CAROTID UPSTROKES ARE NORMAL. THE APICAL IMPULSE IS PALPABLE AND NOT DISPLACED OR SUSTAINED. THERE IS A GRADE 3/6 DIASTOLIC DECRESCENDO MURMUR BEST HEARD AT THE LEFT LOWER STERNAL BORDER. THE REMAINDER OF THE EXAMINATION IS NORMAL.
- A TRANSTHORACIC ECHOCARDIOGRAM SHOWS SEVERE AORTIC REGURGITATION. THE LEFT VENTRICULAR EJECTION FRACTION IS 65%. THE LEFT VENTRICLE IS MINIMALLY DILATED WITH AN END-SYSTOLIC DIMENSION OF 40 MM.
- WHICH OF THE FOLLOWING IS THE MOST APPROPRIATE NEXT STEP IN MANAGEMENT?

#2 – D: CLINICAL AND ECHO FOLLOW UP IN 6-12 MONTHS

AORTIC REGURG MANAGEMENT

- Acute aortic regurgitation due to aortic dissection is a surgical emergency. For other acute causes, the indications for surgery depend on severity, presence of symptoms, and the hemodynamic stability of the patient.
- Who needs surgery?
  - symptoms (typically, dyspnea or angina)
  - LV dysfunction (ejection fraction <50%)
  - already undergoing other cardiac surgery
  - reasonable in significant LV dilatation (end-systolic diameter >50 mm or indexed end-systolic dimension >50 mm/m^2)

  Aortic valve repair without valve replacement may be performed in centers of expertise.

  Follow-up of asymptomatic patients is based on severity of regurgitation and other factors

Natural history of chronic aortic regurgitation mostly based upon data from nine series with a total of 593 patients followed for a mean of 6.6 years

Asymptomatic patients with normal left ventricular (LV) systolic function	
Progression to symptoms and/or LV dysfunction	Less than 6 percent/year
Progression to symptoms, LV dysfunction, or death	
According to LV end-systolic dimension	
>50 mm	19 percent/year
40 to 50 mm	6 percent/year
<40 mm	0 percent/year
Progression to asymptomatic LV dysfunction	Less than 3.5 percent/year
Sudden death	Less than 0.2 percent/year
Asymptomatic patients with LV systolic dysfunction	
Progression to cardiac symptoms	More than 25 percent/year
Symptomatic patients	
Mortality rate	More than 10 percent/year

Aortic Regurgitation		
Regurgitation severity; rate of progression; LV ejection fraction; LV chamber size; ascending aorta dilation if bicuspid aortic valve	Mild (VC <0.3 cm, ERO <0.10 cm^2, RV <30 mL/beat, RF <30%); normal EF	Clinical evaluation yearly; echo every 3-5 y
	Moderate (VC 0.3-0.6 cm, ERO 0.10-0.29 cm^2, RV 30-59 mL/beat, RF 30%-49%)	Clinical evaluation yearly; echo every 1-2 y
	Severe (VC >0.6 cm, ERO >0.3 cm^2, RV ≥60 mL/beat, RF ≥50%)	
	EF ≥50%; LVESD ≤50 mm	Clinical evaluation every 6-12 mo; echo every 6-12 mo, more frequently for dilating LV
	EF <50%; LVESD >50 mm	Clinical evaluation every 6-12 mo; echo every 6-12 mo, more frequently for dilating LV

ERO = effective regurgitant orifice; MVA = mitral valve area; PASP = pulmonary artery systolic pressure; RF = regurgitant fraction; RV = regurgitant volume; VC = vena contracta width; V_{max} = maximum aortic jet velocity.

Question #3 (MKSAP 50)

- A 48-year-old woman is evaluated during a new-patient visit. She reports no symptoms. She is fairly sedentary but is trying to become more active by joining the local health club. She has noticed that she is "out of shape" but can cycle on a stationary bike with moderate intensity to the end of her 30-minute workout. Medical history is otherwise unremarkable. She takes no medications.
- On physical examination, vital signs are normal. The estimated central venous pressure is 6 cm H_2O. The apical impulse is not palpable. Cardiac examination reveals a grade 2/6 midsystolic murmur localized to the left sternal border without radiation. The murmur does not change with respiration or handgrip but does diminish in intensity with standing. The S_2 is physiologically split. There are no clicks. The lungs are clear to auscultation. Peripheral pulses are normal in volume and contour. No edema is present.
- Which of the following is the most appropriate management?

#3 – D: ROUTINE CLINICAL FOLLOW UP WITHOUT IMAGING

[Benign flow murmur]

#4 MURMURS (MKSAP 110)

- A 48-year-old woman is evaluated during a new-patient visit. She reports no symptoms. She runs 5 miles a day 5 days per week. Medical history is otherwise unremarkable. She takes no medications.
- On physical examination, vital signs are normal. The estimated central venous pressure is 6 cm H_2O. Cardiac examination reveals a grade 2/6 holosystolic murmur that is best heard at the apex and radiates toward the axilla. An ejection click is not audible. The lungs are clear to auscultation. No edema is present.
- Which of the following is the most appropriate management?

#4 - C – TRANSTHORACIC ECHO

[MITRAL REGURG]

High value reminder: don't spend money on benign findings!

HEART MURMURS

- Transthoracic echocardiography is indicated for:
  - systolic murmurs grade 3/6 or higher
  - late or holosystolic murmurs
  - diastolic or continuous murmurs
  - murmurs with accompanying symptoms (chest pain, dyspnea, syncope
  - Abnormalities on exam (clicks, abnormal S2, abnormal pulses)

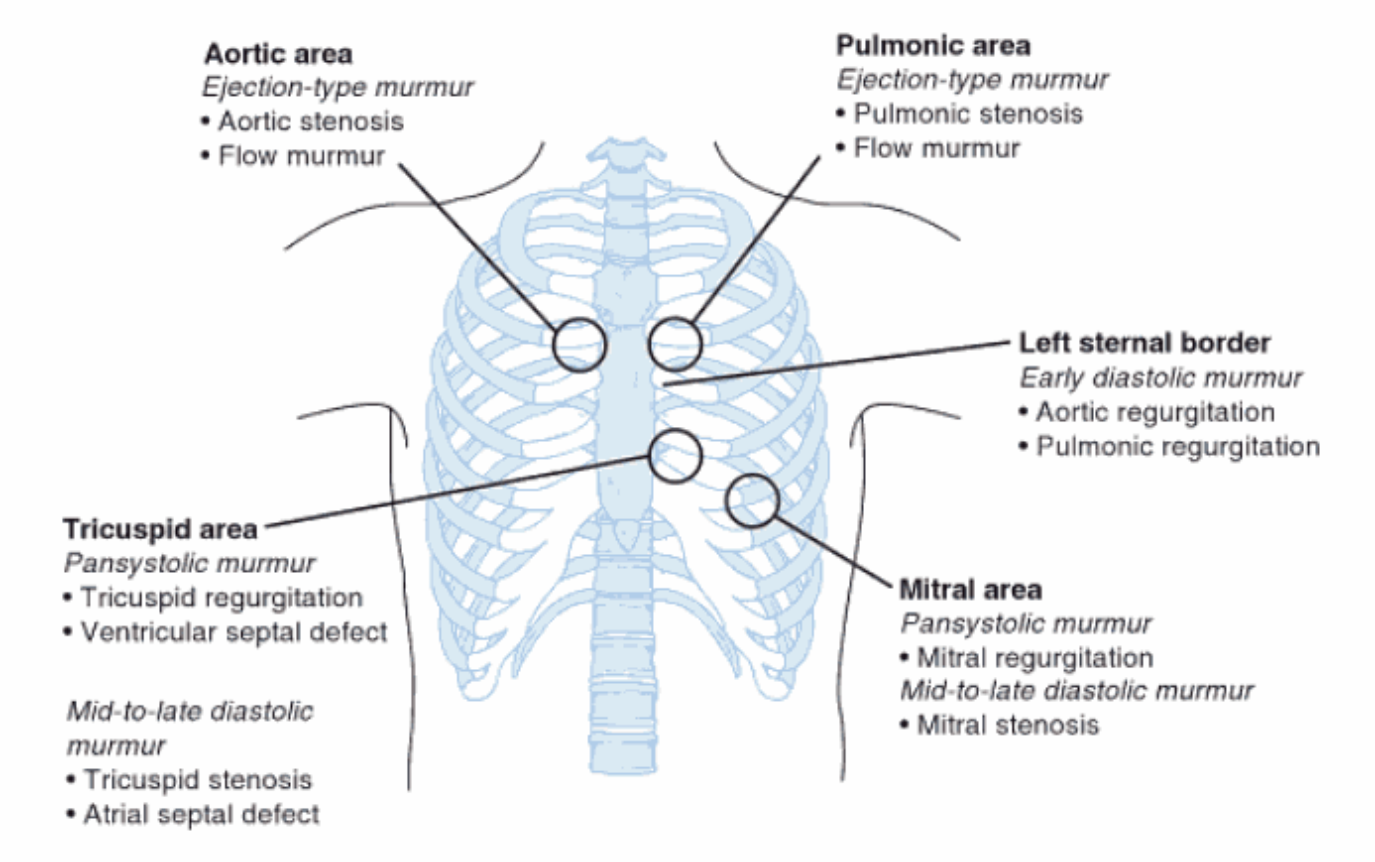
Short, soft systolic murmurs (grade <3) that are well localized to the left sternal border and are not associated with symptoms often do not require further investigation.

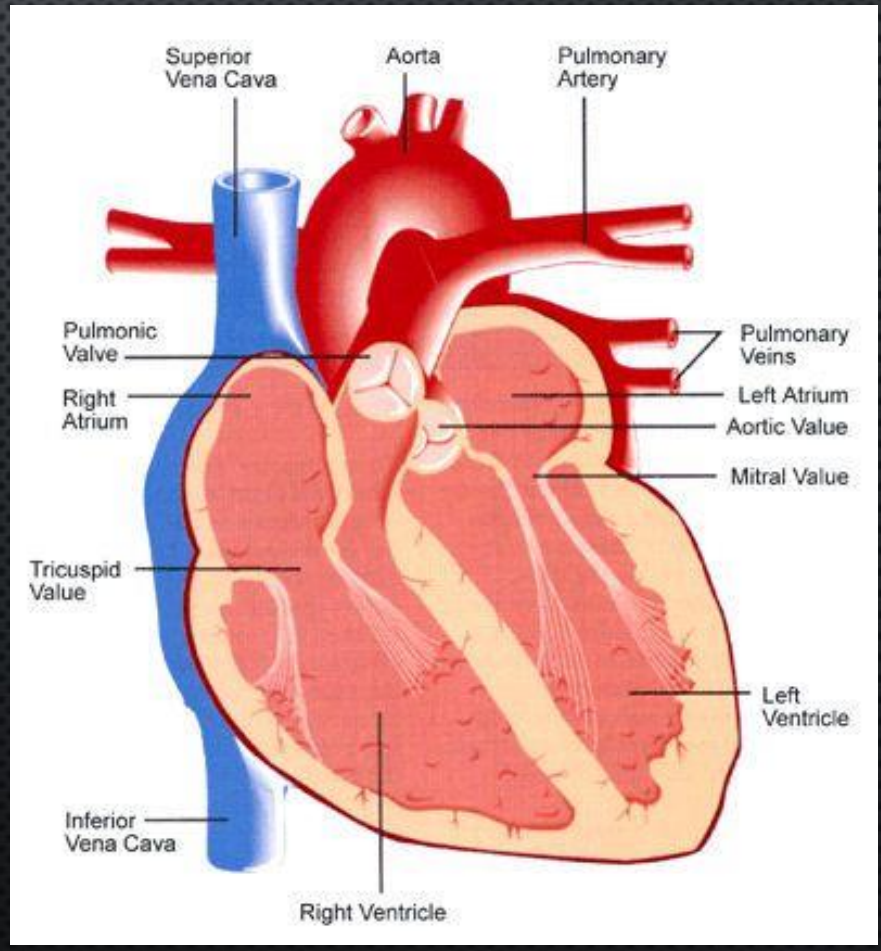
Benign murmurs typically decrease in intensity with standing.

Grade	Intensity
1	"The slightest possible murmur". Frequently overlooked.
2	Slight murmur. Should not be missed under optimal conditions.
3	Moderate murmur. No palpable thrill.
4	Loud murmur with a palpable thrill.
5	Very loud murmur with an easily palpable thrill.
6	Extremely loud murmur. Can be heard with the stethoscope not even touching the chest wall. Extremely rare.

WHAT IS MURMURING?

- INCREASED BLOOD FLOW ACROSS A NORMAL ORIFICE (SUCH AS WITH ANEMIA, THYROTOXICOSIS, PREGNANCY, OR ATRIAL SEPTAL DEFECT)
- TURBULENT FLOW THROUGH A NARROWED ORIFICE (SUCH AS WITH AORTIC STENOSIS OR MITRAL STENOSIS)
- REGURGITANT FLOW THROUGH AN INCOMPETENT VALVE (SUCH AS WITH AORTIC REGURGITATION OR MITRAL REGURGITATION).
- BENIGN MURMURS THOUGHT TO BE VIBRATIONS IN THE PULMONARY VEINS.





HEART MURMURS

A. Presystolic murmur of mitral or tricuspid stenosis.

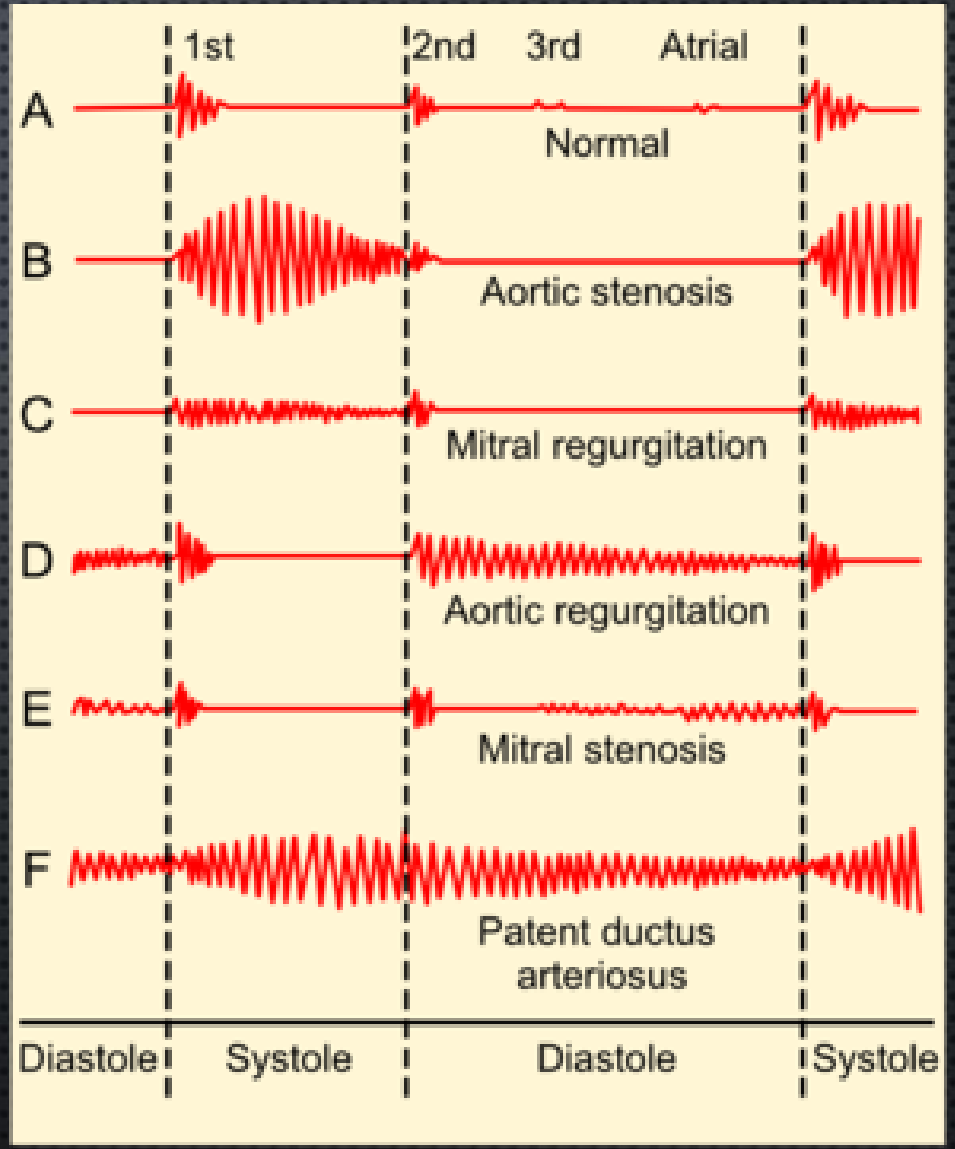
B. Holosystolic (pansystolic) murmur of mitral or tricuspid regurgitation or of ventricular septal defect. Radiates to axilla.

C. Aortic ejection (stenosis) murmur beginning with an ejection click and fading before the second heart sound.

D. Systolic murmur in pulmonic stenosis spilling through the aortic second sound, pulmonic valve closure being delayed.

E. Aortic or pulmonary (regurg) diastolic murmur.

F. Continuous murmur of patent ductus arteriosus.



Phonocardiograms from normal and abnormal heart sounds

Effects of physiologic maneuvers on heart murmurs

Respiration
Right-sided murmurs (eg, tricuspid regurgitation) increase with inspiration due to increased venous return to the right heart.
Abrupt standing
Most murmurs diminish in intensity with standing due to reduced venous return to the heart and subsequently reduced right and left ventricular diastolic volumes. In contrast, the murmur of hypertrophic cardiomyopathy becomes louder, and the murmur of mitral valve prolapse lengthens and often is intensified.
Squatting
Most murmurs become louder with squatting (or passive leg raising). In contrast, the murmur of hypertrophic cardiomyopathy becomes softer. The murmur of mitral valve prolapse may shorten with squatting, although as mitral regurgitation becomes more severe, the murmur may increase in intensity with squatting due to increase in afterload.
Valsalva maneuver
Most murmurs decrease in intensity during the Valsalva maneuver. Two exceptions are the systolic murmur of hypertrophic cardiomyopathy, which becomes louder, and the systolic murmur of mitral valve prolapse, which becomes longer and often louder.
Sustained hand grip
Hand grip (sustained for 20 to 30 seconds) is most useful in differentiating the ejection systolic murmur of aortic stenosis from the murmur of mitral regurgitation: The intensity of the murmur of aortic stenosis tends to decrease, while the murmur of mitral regurgitation increases.
Postextrasystolic potentiation
During the cardiac cycle following a premature beat (or in the beat after a long cycle length in atrial fibrillation), the murmur of aortic stenosis increases in intensity, as does the ejection systolic murmur in hypertrophic cardiomyopathy. Carotid pulse volume increases in the former and decreases or remains unchanged in the latter. The murmur of mitral regurgitation does not usually change. However, the murmur of mitral regurgitation associated with mitral valve prolapse is prolonged since the click and onset of murmur occur earlier.

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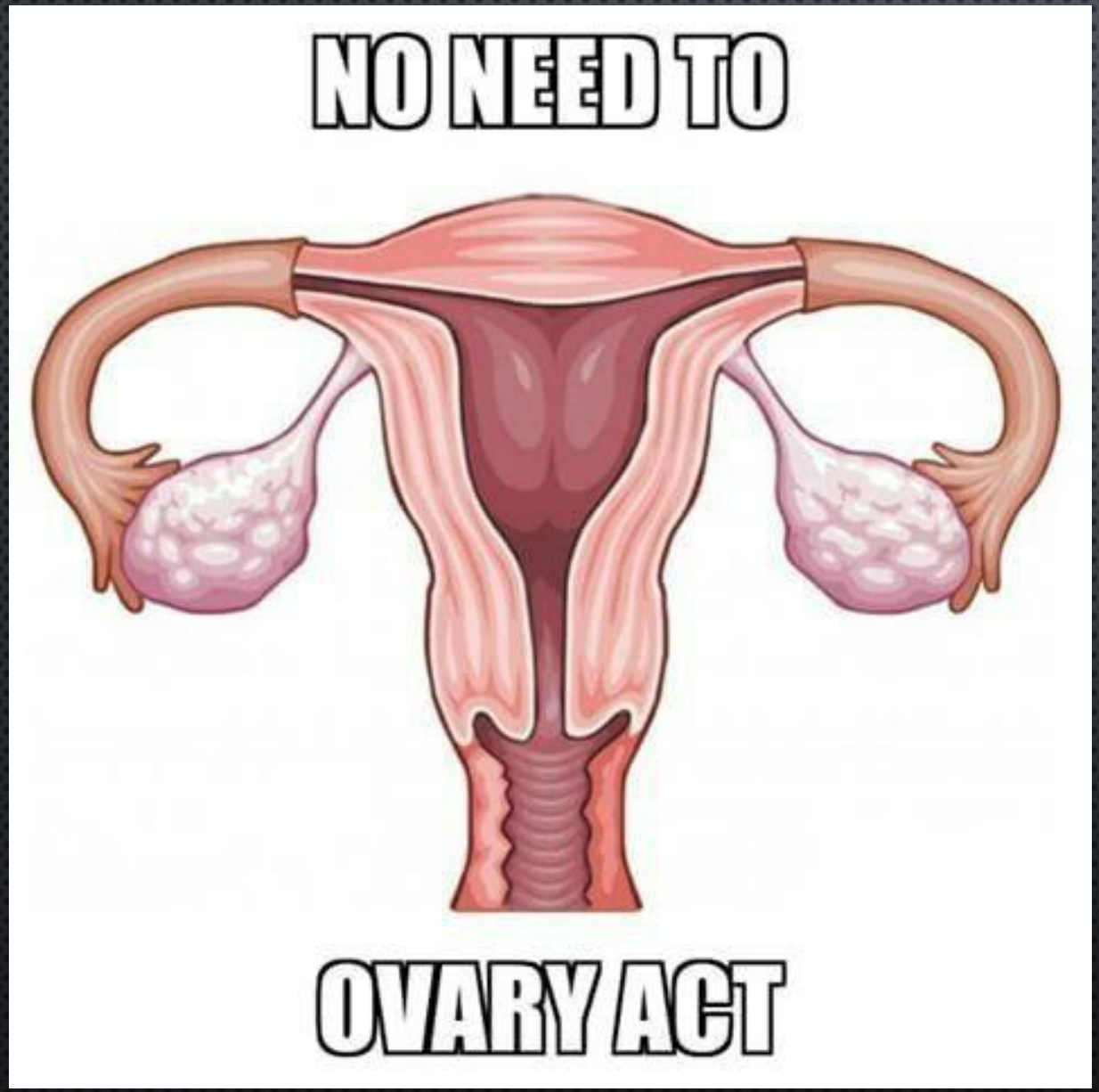
HOCM → may increase with standing or Valsalva maneuver; both decrease venous return, which decreases left ventricular chamber size and increases the degree of obstruction.
MVP → The click and murmur may move earlier in systole and increase in intensity as left ventricular volume decreases (standing or Valsalva maneuver).
AS → increases in the next beat due to increased left ventricular volume
MR, VSD, and AR → increase with handgrip because of increased peripheral resistance
TS and PS → increase during inspiration due to increased venous return.

A fixed split of S_2 (present during inspiration and expiration instead of only inspiration) results from a delay in right ventricular emptying and is strongly associated with atrial septal defect.
A paradoxical split of S_2 (present during expiration) indicates a delay in left ventricular emptying, such as with severe aortic stenosis. Presence of a physiologic split (present during inspiration) is helpful for excluding severe aortic stenosis.

Question #5 (MKSAP 80)

- A 26-year-old woman seeks preconception counseling. She has a history of mitral stenosis and underwent mitral valve replacement with a tilting-disc mechanical prosthesis 5 years ago. She is asymptomatic. Medications are warfarin, 4 mg/d, and low-dose aspirin.
- On physical examination, a normal mechanical S_1 and normal S_2 are appreciated. The remainder of the examination is unremarkable.
- Laboratory studies reveal an INR of 3.0 (therapeutic target, 3.0).
- An electrocardiogram demonstrates normal sinus rhythm.
- In addition to continuing low-dose aspirin, which of the following is the most appropriate anticoagulation regimen for this patient during the first trimester?



#5 - A – CONTINUE INR-ADJUSTED WARFARIN

AC MECHANICAL VALVES IN PREGNANCY

- Warfarin, unfractionated heparin, and low-molecular-weight heparin can all be used during pregnancy
- First trimester: warfarin if dose <5mg at conception, LMWH if >5mg
- Warfarin is best at preventing prosthetic valve thrombosis, but risks are teratogenicity, miscarriage, and fetal loss to due to intracranial hemorrhage
- Heparin and LMWH both safe, but high risk thrombosis. DOACs not proven yet.
- During the second and early third trimesters, warfarin therapy is preferred. LMWH the week the baby is born.
- Weekly INR
- Recommend c section to prevent intracranial hemorrhage to fully anticoagulated babies

Weeks of Gestation	Recommended Regimen
Venous Thromboembolism	
Weeks 6-12	Warfarin (if dose to attain INR 2-3 is ≤5 mg) UFH (IV or SQ; aPTT 2 × control) Weight-based LMWH
Weeks 13-37	UFH (SQ; aPTT 2 × control) Weight-based LMWH Warfarin (INR 2-3)
Weeks 37 to term	UFH (IV; aPTT 2 × control)

Mechanical Valve Prosthesis	
Weeks 6-12	Warfarin dose ≤5 mg for therapeutic INR Continue warfarin (class IIa recommendation) UFH: IV; aPTT 2 × control (class IIb recommendation) Anti–factor Xa adjusted LMWH (class IIb recommendation) Warfarin dose >5 mg for therapeutic INR UFH: IV; aPTT 2 × control (class IIa recommendation) Anti–factor Xa adjusted LMWH (class IIa recommendation)
Weeks 13-37	Warfarin (therapeutic INR)
Weeks 37 to term	UFH (IV; aPTT 2 × control)

Atrial Fibrillation	
Weeks 6-12	Warfarin (if dose to attain INR 2-3 is ≤5 mg) UFH (IV or SQ; aPTT 2 × control) Weight-based LMWH
Weeks 13-37	UFH (SQ; aPTT 2 × control) Weight-based LMWH Warfarin (INR 2-3)
Weeks 37 to term	UFH (IV; aPTT 2 × control)

HEART DISEASE IN PREGNANCY

- Pregnancy is contraindicated in:
  - patients with ventricular outflow tract obstruction (for example, aortic stenosis or coarctation of aorta)
  - left ventricular systolic dysfunction (ejection fraction <40%) + NYHA class III or IV
- Women with severe pulmonary hypertension are at high risk for maternal death, with a mortality rate of up to 30%.

Question #6 (MKSAP 35)

- A 60-year-old man is evaluated in the hospital for a 2-day history of intermittent chest pain and dyspnea on exertion. Medical history is significant for type 2 diabetes mellitus, hypertension, hyperlipidemia, COPD, and peripheral neuropathy. His ability to exercise is limited by his COPD. Medications are metformin, simvastatin, low-dose aspirin, lisinopril, amlodipine, and an albuterol-ipratropium inhaler.
- On physical examination, temperature is normal, blood pressure is 128/78 mm Hg, pulse rate is 80/min, and respiration rate is 16/min. Oxygen saturation is 94% breathing ambient air. Pulmonary examination reveals expiratory wheezing bilaterally. Heart sounds are distant. No edema is present.
- Serial serum troponin I measurements are negative.
- An electrocardiogram demonstrates left ventricular hypertrophy with repolarization abnormalities.
- Which of the following is the most appropriate diagnostic test to perform next?

#6: C – CORONARY CT ANGIO

SELECTING A STRESS TEST IN INTERMEDIATE RISK PTS

Stress:	Review:
Exercise	EKG
Adenosine/ Ragadenosine	Nuclear imaging
Dobutamine	Echocardiogram

Inability to exercise

Baseline EKG abnl – LBBB, pacer, etc

Bronchospasm, SSS, hypotension, AV block, caffeine

Radiation, breast tissue

HTN, tachy-arrhythmias, HOCM, AS, AAA

Tough in obese, less accurate in single-vessel disease, tough with baseline wall motion abnl

Or… CTA!

CTA FOR CORONARY DISEASE

- In symptomatic patients with an intermediate risk for CAD, CTA may be helpful in ruling out CAD.
- In the PROMISE trial, 10,000 symptomatic patients suspected of having CAD were evaluated with an initial strategy of anatomic testing with CTA or functional testing. In patients with an intermediate pretest probability of CAD, the composite cardiovascular event rate was low (<1% per year) in both groups, and outcomes (death, myocardial infarction, hospitalization for unstable angina, or major procedural complication) at 2 years did not differ between groups.
- Note – this is not a head-to-head! Looking forward to journal club.

- Expensive, radiation, contrast exposure

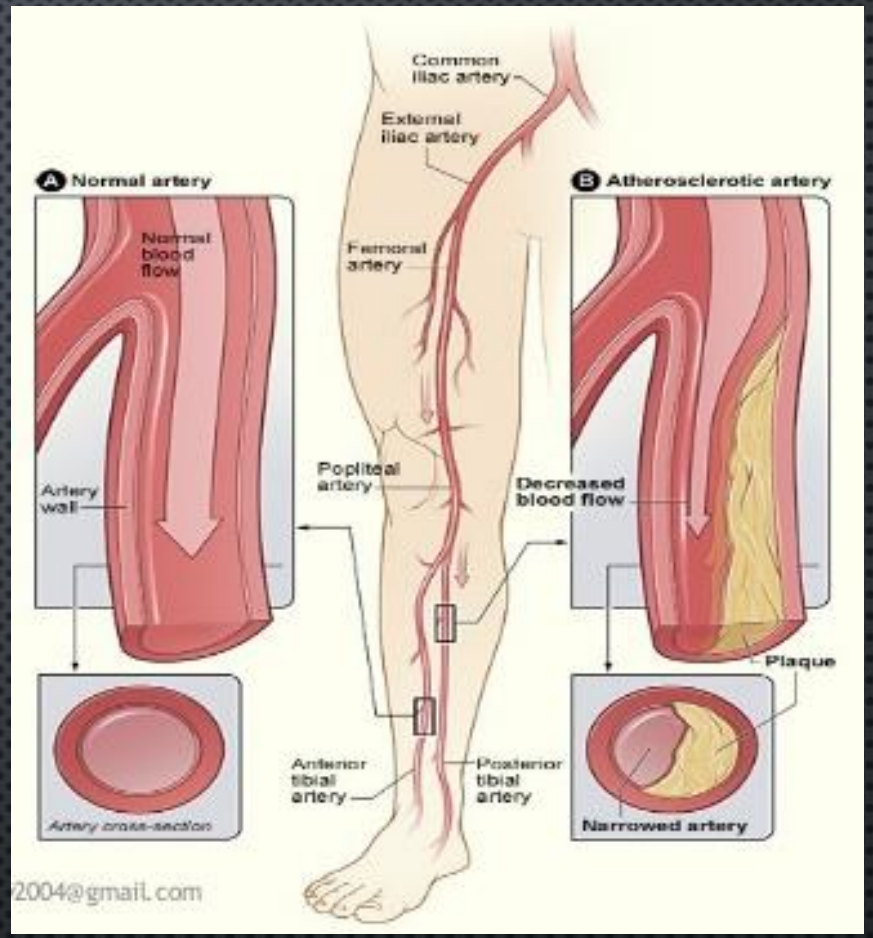
Question #7 (MKSAP 97)

- A 68-year-old man is evaluated for a 4-month history of intermittent left calf pain. He has a history of cigarette smoking but quit 6 months ago. Medical history is otherwise significant for hyperlipidemia. Medications are low-dose aspirin and high-intensity atorvastatin.
- On physical examination, vital signs are normal. BMI is 29. Femoral pulses are diminished bilaterally. Popliteal, right dorsalis pedis, and right posterior tibialis pulses are faint. The left dorsalis pedis and posterior tibialis pulses are not palpable. Cardiac examination is normal.
- The ankle-brachial index is 0.67 on the left and 0.91 on the right.
- He is enrolled in a supervised exercise program. Three months later, the patient calls to report that despite adherence to the exercise program, his symptoms have progressed.
- Which of the following is the most appropriate next step to reduce this patient's leg pain?

#7: C – INITIATE CILOSTAZOL

CLAUDICATION

- PAD IS A CAD RISK EQUIVALENT!!
- RFS: SMOKING (CURRENT OR PAST), DM, AND AGE.
- WOMEN LIVE LONGER SO HIGHER INCIDENCE –
- 10% AT AGE 70
  - SCREENING ABI:
    - 1) AGE 65 YEARS AND OLDER
    - (2) AGE 50 TO 64 YEARS WITH RISK FACTORS FOR ATHEROSCLEROSIS OR FAMILY HISTORY OF PAD
    - (3) AGE YOUNGER THAN 50 YEARS WITH DIABETES AND ONE ADDITIONAL RISK FACTOR FOR ATHEROSCLEROSIS
    - (4) KNOWN ATHEROSCLEROTIC DISEASE IN ANOTHER VASCULAR BED (CORONARY, CAROTID, SUBCLAVIAN, RENAL, OR MESENTERIC ARTERY STENOSIS, OR ABDOMINAL AORTIC ANEURYSM)



CLAUDICATION - ABI

- How to check ABI:
- Sensitivity and specificity approaching 90%.
- Rest for 10 minutes supine, measure both arms and in both legs at the dorsalis pedis and posterior tibial
- The higher ankle pressure in each leg is divided by the higher brachial artery pressure. Healthy ratio = 1
- Exercise ABI if results normal but your suspicion remains high: Abnl = a post-exercise ankle pressure decrease of more than 30 mm Hg or a postexercise ABI decrease of more than 20%
- TOE ABI for ABI >1.4 per the test writers…

ABI Value	Interpretation	Recommendation
Greater than 1.4	Calcification / Vessel Hardening	Refer to vascular specialist
1.0 - 1.4	Normal	None
0.9 - 1.0	Acceptable	
0.8 - 0.9	Some Arterial Disease	Treat risk factors
0.5 - 0.8	Moderate Arterial Disease	Refer to vascular specialist
Less then 0.5	Severe Arterial Disease	Refer to vascular specialist

CLAUDICATION - TREATMENT

- MANAGE DM, HTN, AND SMOKING
- START AT LEAST ONE ANTIPLATELET AGENT – USUALLY ASPIRIN
- SUPERVISED EXERCISE TRAINING HAS BEEN ASSOCIATED WITH IMPROVED FUNCTIONAL PERFORMANCE
- SUPERVISED EXERCISE TRAINING IS LIMITED BY LACK OF INSURANCE COVERAGE AND UNAVAILABILITY OF THESE PROGRAMS FOR PATIENTS WITH CLAUDICATION.
- CILOSTAZOL = A PHOSPHODIESTERASE INHIBITOR WITH ANTIPLATELET AND VASODILATOR ACTIVITY
- INCREASES IN PAIN-FREE WALKING DISTANCE AND OVERALL WALKING DISTANCE IN PATIENTS WITH CLAUDICATION, AND CLINICAL GUIDELINES RECOMMEND THAT PATIENTS WITH CLAUDICATION BE CONSIDERED FOR A THERAPEUTIC TRIAL OF CILOSTAZOL
- BLACK BOX WARNING IN PATIENTS WITH HEART FAILURE

CLAUDICATION - TREATMENT

CONFERENCE COVERAGE

Cilostazol plus aspirin or clopidogrel reduces the risk of recurrent stroke

Publish date: February 7, 2019

Author(s): Erik Greb; MDedge News

REPORTING FROM ISC

HONOLULU – A combination of cilostazol and aspirin or clopidogrel reduces the risk of recurrent ischemic stroke, compared with aspirin or clopidogrel alone, among patients at high risk for recurrent stroke. The combination also entails a similar risk of major bleeding, compared with aspirin and clopidogrel alone, according to results from the Cilostazol

recruiting patients. They enrolled 1,884 and randomized 1,879 of an anticipated 4,000 patients. At randomization, 41% in the dual-therapy group received aspirin and 59% clopidogrel, and in the monotherapy group, 40% received aspirin and 60% clopidogrel. Baseline characteristics were similar between the treatment groups. The population's mean age was 70. Approximately 30% of patients were women.

During a median follow-up period of 17 months, ischemic stroke recurred in 29 of 932 patients receiving dual therapy including cilostazol for an annual rate of 2.2% and in 64 of 947 patients receiving monotherapy for an annual rate of 4.5% (hazard ratio, 0.49; 95% confidence interval, 0.31-0.76; $P = .001$). Severe or life-threatening bleeding occurred in 8 patients (0.6% per year) receiving dual therapy and 13 patients (0.9% per year) receiving monotherapy (HR, 0.66; 95% CI, 0.27-1.60; $P = .354$).

Question #8 (MKSAP 33)

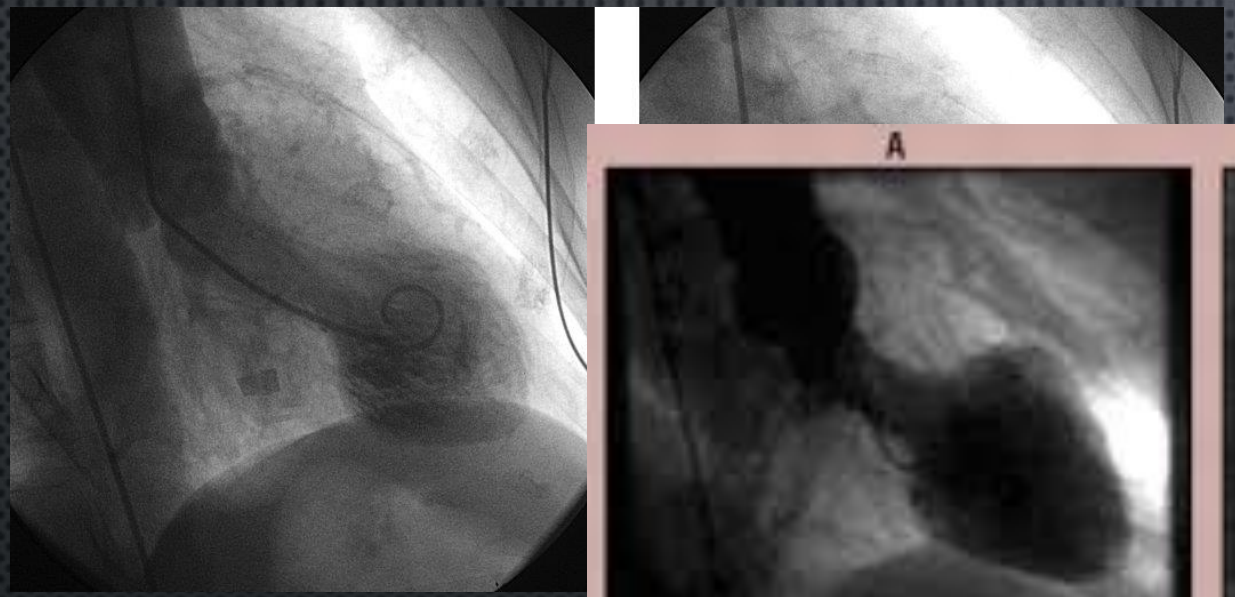
- A 68-year-old woman is evaluated in the emergency department for acute-onset dyspnea, palpitations, and chest pain. The symptoms began shortly after her dog was attacked by another dog. She is otherwise healthy and takes no medications.
- On physical examination, the patient is afebrile, blood pressure is 150/78 mm Hg, and pulse rate is 88/min. Cardiac examination reveals no evidence of increased central venous pressure. There is no heart murmur, but an S_3 is present. The lungs are clear to auscultation.
- Laboratory studies are significant for a serum troponin I level of 5.2 ng/mL (5.2 mg/L).
- An electrocardiogram demonstrates sinus rhythm and anterior hyperacute T-wave elevations suggestive of an ST-elevation myocardial infarction. Cardiac catheterization shows normal coronary arteries. Systolic (*left panel*) and diastolic (*right panel*) images from left ventriculography are shown.
- What is the most likely diagnosis?

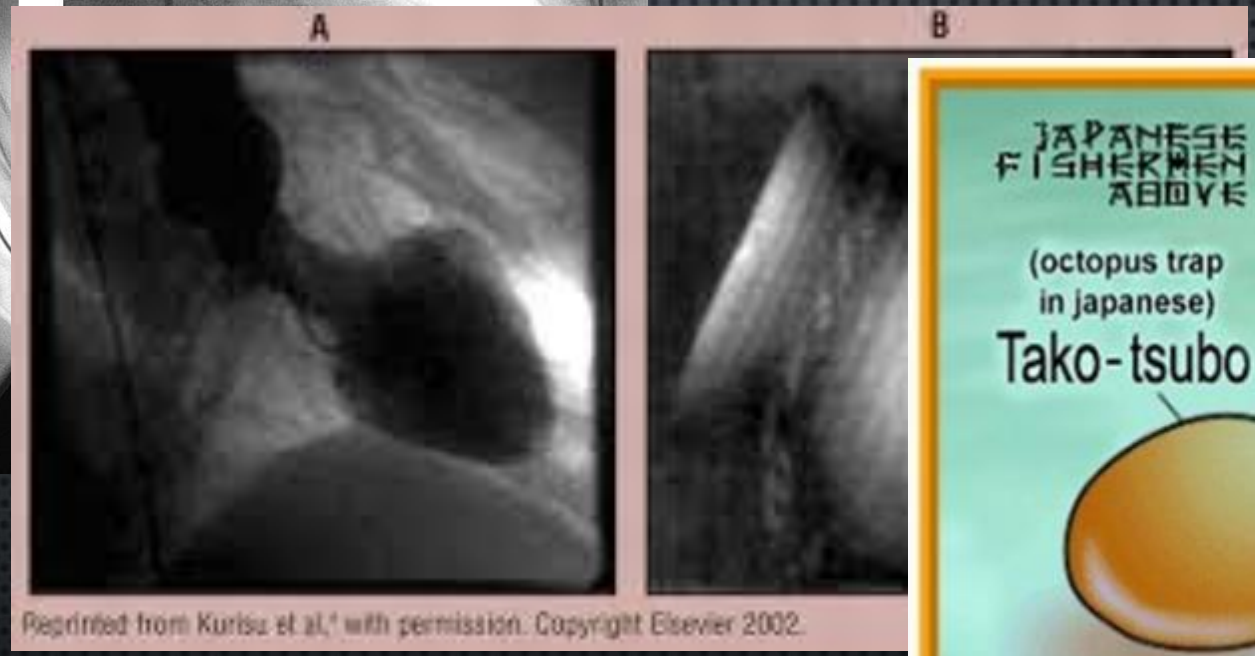
#8: D – TAKOTSUBO CARDIOMYOPATHY

TAKOTSUBO CARDIOMYOPATHY

- REVERSIBLE VENTRICULAR SYSTOLIC DYSFUNCTION
- USUALLY PRECIPITATED BY AN ACUTE EMOTIONAL OR PHYSIOLOGIC STRESSOR
- WALL MOTION ABNORMALITIES THAT EXTEND BEYOND A SINGLE CORONARY TERRITORY
- EKG LOOKS LIKE ACUTE MI
- TROPONIN CAN BE MARKEDLY ELEVATED
- NORMAL OR NEAR-NORMAL CORONARY ARTERIES (<50% STENOSIS)
- TREATED WITH STANDARD HEART FAILURE MEDICATIONS AND TYPICALLY HAVE RAPID RECOVERY OF LEFT VENTRICULAR FUNCTION.

TAKOTSUBO CARDIOMYOPATHY





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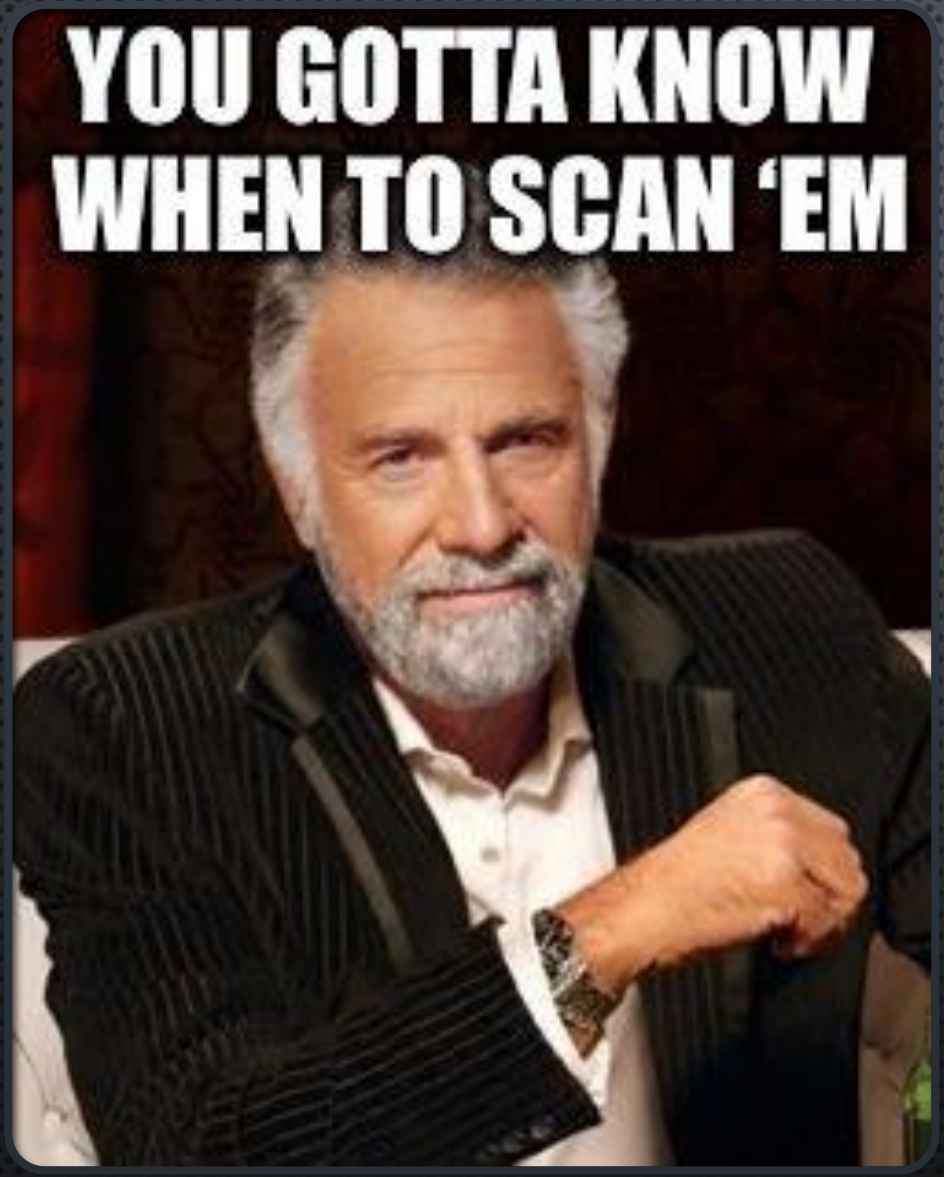
Question #9 (MKSAP 16)

- A 69-year-old man is evaluated during a routine examination. He is asymptomatic. Medical history is significant for hypertension. He has a 50-pack-year smoking history but quit smoking 7 years ago. Medications are aspirin, lisinopril, and amlodipine.
- On physical examination, vital signs are normal. A bruit is heard over the abdomen, and a pulsatile mass is present in the epigastrium. The remainder of the examination is unremarkable.
- A Duplex ultrasound of the abdomen shows an abdominal aortic aneurysm with transverse diameter of 6.2 cm.
- What is the most appropriate next step in management?



#9: A – CT ANGIOGRAPH OF THE ABDOMINAL AORTA AND ILIAC VESSELS

MONITORING AAA

Once the aortic diameter meets the threshold for aortic repair, anatomic imaging tests, such as CTA or MRA, are indicated to determine the exact location of the AAA (suprarenal, juxtarenal, or infrarenal) in planning for repair.

Annual Rupture Risk of Abdominal Aortic Aneurysm by Diameter

Aneurysm Diameter	Annual Rupture Risk
<4.0 cm	<0.5%
4.0-4.9 cm	0.5%-5%
5.0-5.9 cm	3%-15%
6.0-6.9 cm	10%-20%
7.0-7.9 cm	20%-40%
≥8.0 cm	30%-50%

4.0 cm or less = duplex every 2 to 3 year

4.1 to 5.4 cm, = every 6 to 12 months

5.5 = repair (5 in females)

AAA SCREENING

- The USPSTF recommends one-time abdominal ultrasonography to screen for abdominal aortic aneurysm (AAA) in all men aged 65 to 75 years who have ever smoked (grade B). Ever-smokers are commonly defined as persons who have smoked more than 100 cigarettes in their lifetime.
- The number needed to screen (NNS) to prevent one death from AAA = 667
- The number needed to treat (NNT) with surgery to prevent one death is 1.5!!
- In men aged 65 to 75 years who have never smoked, selective screening is recommended (grade C), especially in those with a first-degree relative with a history of treated or ruptured AAA.
- The USPSTF makes no recommendation regarding screening for AAA in women who have smoked and specifically recommends AGAINST routine screening in women who have never smoked (grade D).

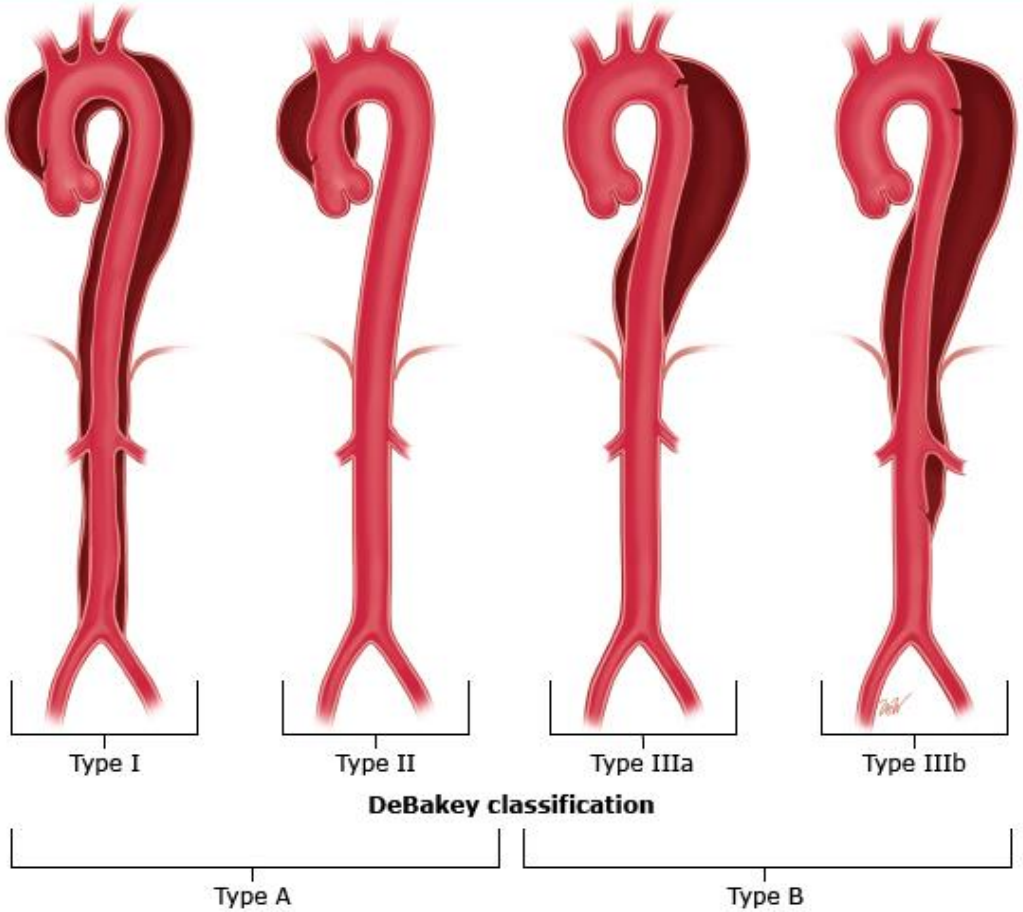
Question #10 (MKSAP 30)

- A 64-year-old woman is evaluated in the emergency department 4 hours after the abrupt onset of sharp, tearing chest and back pain. Medical history is significant for hyperlipidemia. Her only medication is atorvastatin.
- On physical examination, temperature is 36.8 °C (98.2 °F), blood pressure is 173/99 mm Hg, and pulse rate is 90/min. Blood pressure measurements in both arms are equal. The remainder of the physical examination is unremarkable.
- CT angiography shows a descending thoracic aortic aneurysm with a maximal diameter of 6.8 cm and aortic dissection originating just distal to the left subclavian artery and extending to just below the diaphragm; there is no involvement of the renal arteries.
- Which of the following is the most appropriate initial management?

#10: C – MEDICAL THERAPY

Aortic Dissections

Classification of aortic dissection



Stanford classification

In the DeBakey classification of aortic dissection:

- Type I involves the ascending aorta, arch, and descending thoracic aorta and may progress to involve the abdominal aorta.
- Type II is confined to the ascending aorta.
- Type IIIa involves the descending thoracic aorta distal to the left subclavian artery and proximal to the celiac artery.
- Type IIIb dissection involves the thoracic and abdominal aorta distal to the left subclavian artery.

In the Stanford classification of aortic dissection:

- Type A involves the ascending aorta and may progress to involve the arch and thoracoabdominal aorta.
- Type B involves the descending thoracic or thoracoabdominal aorta distal to the left subclavian artery without involvement of ascending aorta.

UpToDate®

AORTIC DISSECTION MGMT. - STANDING AT BEDSIDE

Acute aortic dissection: Rapid overview

Treatment of acute aortic dissection depends on the type/location. **Aortic dissection involving the ascending aorta is a cardiac surgical emergency**. Aortic dissection limited to the descending thoracic and/or the abdominal aorta can often be managed medically, unless there is evidence of end-organ ischemia, progression, or rupture.

Clinical features and evaluation

- Acute onset of severe, sharp, or knife-like pain in the anterior chest, with radiation to the neck, back, or abdomen. Pain may be migratory.
- Assess risk factors for TAAD*.
- Palpate carotid, subclavian, and femoral pulses; note any significant differences between sides. Obtain blood pressure in both arms.
- Auscultate for diastolic cardiac murmur of aortic regurgitation; assess for tamponade (muffled heart sounds, jugular venous distention, pulsus paradoxus).
- Evaluate for signs of ischemic stroke, spinal cord ischemia, ischemic neuropathy, hypoxic encephalopathy.
  - Findings suggesting involvement of the **ascending aorta** include back pain, anterior chest pain, hemodynamic instability, diastolic cardiac murmur, tamponade, syncope or stroke (persistent or transient¶; right hemispheric stroke is most common, but bilateral can occur), Horner syndrome (typically partial with ptosis/miosis), weak or absent carotid or subclavian pulse, upper extremity pain/paresthesia/motor deficit.
  - Findings suggesting involvement of the **descending aorta** include back pain, chest pain, abdominal pain, weak or absent femoral pulses, lower extremity pain/paresthesia/motor deficit, acute paraplegia.

Findings on initial studies

- Obtain ECG. Look for signs of ACS; extension of type A dissection to coronary ostia can cause coronary ischemia (right coronary artery most commonly affected).
- Obtain D-dimer, CBC, basic electrolytes, LDH, cardiac markers, coagulation parameters, and type and crossmatch. D-dimer <500 [illegible] is less likely to be aortic dissection.
- Chest radiograph: Widened mediastinum and/or unexplained pleural effusion are consistent with dissection, particularly if unilateral.

AORTIC DISSECTION MGMT. – WHAT TO ORDER

Vascular imaging
For hemodynamically stable patient without suspicion for ascending aortic involvement: Obtain thoracic CT angiography or MR angiography, depending upon **resources and speed** of acquisition. Dissection is confirmed by presence of intimal flap separating true and false lumen. If these are not readily available or there is a contraindication, obtain transesophageal echocardiogram.
For hemodynamically unstable patient or for strong suspicion of ascending aortic involvement: Obtain transesophageal echocardiogram. **If not immediately available, obtain CT angiography.** Transthoracic echocardiography may be useful for identifying complications of ascending aortic dissection (eg, aortic valve regurgitation, hemopericardium, inferior ischemia) but is not sensitive for identification of dissection.
Management
Place two large bore IVs; monitor heart rate and blood pressure continuously, preferably using an arterial line.
Control heart rate and blood pressure[Δ]. Maintain heart rate <60 BPM and systolic blood pressure between 100 and 120 mmHg.
Administer esmolol (250 to 500 mcg/kg IV loading dose, then infuse at 25 to 50 mcg/kg/minute; titrate to maximum dose of 300 mcg/kg/minute) or labetalol (20 mg IV initially, followed by either 20 to 80 mg IV boluses every 10 minutes to a maximal dose of 300 mg, or an infusion of 0.5 to 2 mg/minute IV). If beta blockers are not tolerated, alternatives are verapamil or diltiazem.
Once heart rate is consistently <60 BPM, give vasodilator therapy. **IF** the systolic blood pressure remains above 120 mmHg, initiate nitroprusside infusion (0.25 to 0.5 mcg/kg/minute titrated to a maximum of 10 mcg/kg/minute) or nicardipine infusion (2.5 to 5 mg/hour titrated to a maximum of 15 mg/hour). Vasodilator therapy (eg, nitroprusside, nicardipine) should **not** be used without first controlling heart rate with beta blockade.
Give IV opioids for analgesia (eg, fentanyl).
Place Foley catheter for assessment of urine output and kidney perfusion.
Surgical consultation
Obtain immediate surgical consultation (cardiothoracic surgery, vascular surgery) as soon as the diagnosis is strongly suspected (particularly for involvement of the ascending aorta) or confirmed.
Aortic dissection involving the ascending aorta is a cardiac surgical emergency. Transesophageal echocardiography should be routinely performed in the operating room to **assess aortic valve function, left ventricular function, aortic root and ascending aortic diameter, and evidence of hemopericardium/tamponade.**
Aortic dissection involving only the descending thoracic aorta or abdominal aorta **and with** evidence of malperfusion is treated with urgent aortic stent-grafting or surgery.
Aortic dissection involving only the descending thoracic aorta or abdominal aorta **without** evidence for ischemia is admitted to the ICU for medical management of hemodynamics and serial aortic imaging.
If appropriate surgical services[◇] are not available, initiate emergent transfer to nearest available cardiovascular center.

THORACIC AORTIC ANEURYSM SCREENING

- Screening for abnormalities of the thoracic aorta with aortic imaging is indicated in asymptomatic patients with genetic conditions (such as Marfan or Ehlers-Danlos syndrome), a bicuspid aortic valve, or a family history of TAA or aortic dissection. Screening is NOT RECOMMENDED in other asymptomatic persons.

- Patients with a thoracic aortic aneurysm smaller than 5.0 cm in diameter should undergo annual echocardiography to monitor aortic aneurysm growth.

- Thoracic endovascular aortic repair is recommended in patients with a descending aortic aneurysm when the diameter is greater than 6.0 cm, has exhibited rapid growth (>0.5 cm/year), or has caused end-organ damage.

Question #11 (MKSAP 17)

- 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.
- Lipids: Total Chol 200, HDL 30, LDL 130, Trig 200
- Which of the following risk factors most increases this patient's risk for cardiovascular disease?

#11: D – HYPERLIPIDEMIA

Risk factor[b]	Risk factor –	Risk factor +	P-Value[c]
Men			
High risk age	4.2 (3.2–5.4)	19.5 (17.3–22.0)	<0.001
Family history of cardiovascular diseases	11.4 (10.2–12.9)	14.5 (11.1–18.9)	0.107
Smoking	10.4 (8.9–12.2)	13.7 (11.7–15.9)	0.012
Hypertension	8.8 (7.6–10.1)	23.2 (19.6–27.5)	<0.001
Diabetes Mellitus	9.6 (8.4–10.9)	31.4 (25.5–38.7)	<0.001
High total cholesterol	9.7 (8.5–11.1)	19.5 (16.2–23.4)	<0.001
Low HDL cholesterol	10.9 (9.0–13.3)	12.4 (10.8–14.1)	0.283
Women			
High risk age	3.3 (2.7–4.0)	16.4 (13.9–19.3)	<0.001
Family history of cardiovascular diseases	5.6 (4.9–6.6)	10.2 (8.0–12.9)	<0.001
Smoking	6.3 (5.5–7.2)	8.5 (5.5–13.2)	0.196
Hypertension	3.4 (2.8–4.2)	14.9 (12.6–17.5)	<0.001
Diabetes Mellitus	4.0 (3.4–4.8)	22.9 (18.9–27.6)	<0.001
High total cholesterol	3.8 (3.1–4.7)	11.9 (10.1–14.0)	<0.001
Low HDL cholesterol	6.2 (5.2–7.3)	6.9 (5.7–8.5)	0.367

[a] Incidence density per 1000 person-years among participants with at least one year of follow-up (2889 men and 3803 women).
[b] Definition of risk factors is according to the Adult Treatment Panel III.
[c] Based on Log Rank test for equality of event free survival between groups.
doi:10.1371/journal.pone.0105804.t002

CVD RISK FACTORS

- Most cardiovascular risk can be attributed to modifiable risk factors,
- Treatment goal is a reduction in the LDL cholesterol level of at least 50% in high-risk patients and a reduction of 30% to 50% in moderate-risk patients
- Moderate alcohol intake (one to two drinks daily for men, one drink daily for women) has been linked with decreased incidence of CVD; however, heavy alcohol consumption has been shown to increase cardiovascular risk
- The prevalence of heart disease is lower in Hispanic ethnicity than in most other ethnic groups, and Hispanics tend to have lower rates of traditional modifiable risk factors.
- Family history of premature CVD is an independent cardiovascular risk factor but typically adds little precision when included in multivariate risk models. In most studies, premature CVD is defined as CVD in a first-degree male relative younger than 55 years or a first-degree female relative younger than 65 years. A family history of premature CVD doubles the risk for myocardial infarction in men and increases the risk by 70% in women.
- smoking cessation substantially reduces cardiovascular risk within 2 years, with risk returning to the level of a nonsmoker at approximately 10 years.

Question #12 (MKSAP 71)

- A 64-year-old man is evaluated following coronary angiography. He initially presented several weeks ago for progressive exertional chest pain and shortness of breath. Nuclear stress testing demonstrated a large anterior stress defect and an ejection fraction of 33%. Coronary angiography was significant for 90% stenosis of the proximal left anterior descending artery, a chronically occluded right coronary artery, and 80% stenosis of the left circumflex artery. He currently has stable dyspnea and chest pressure with moderate activity. Medical history is significant for hyperlipidemia, hypertension, and type 2 diabetes mellitus. He is taking optimal doses of aspirin, lisinopril, carvedilol, amlodipine, atorvastatin, and metformin.
- On physical examination, temperature is normal, blood pressure is 125/70 mm Hg, pulse rate is 60/min, and respiration rate is 18/min. The remainder of the physical examination is unremarkable.
- Which of the following is the most appropriate next step in management?

#12: B – CORONARY ARTERY BYPASS GRAFT SURGERY

INDICATIONS FOR CABG

- ●In patients with single-vessel disease, we usually perform PCI with drug-eluting stents.
- ●In patients with two-vessel disease involving the right and circumflex coronary arteries, we usually perform PCI with drug-eluting stents. For patients with disease of the left anterior descending and either right or circumflex coronary arteries, we prefer CABG in those with diabetes or those with a large amount of myocardium supplied by the diseased vessels.
- ●For patients with three-vessel disease, we prefer CABG. For these individuals with a low SYNTAX score and no diabetes, PCI is reasonable.
- ●For patients with two- or three-vessel disease in whom **complete revascularization** cannot be accomplished by PCI, we prefer CABG.
- For patients with Left main disease, we prefer CABG
- Diabetics with multi-vessel disease OR low EF with MVD = no syntax scoring

SYNTAX SCORING

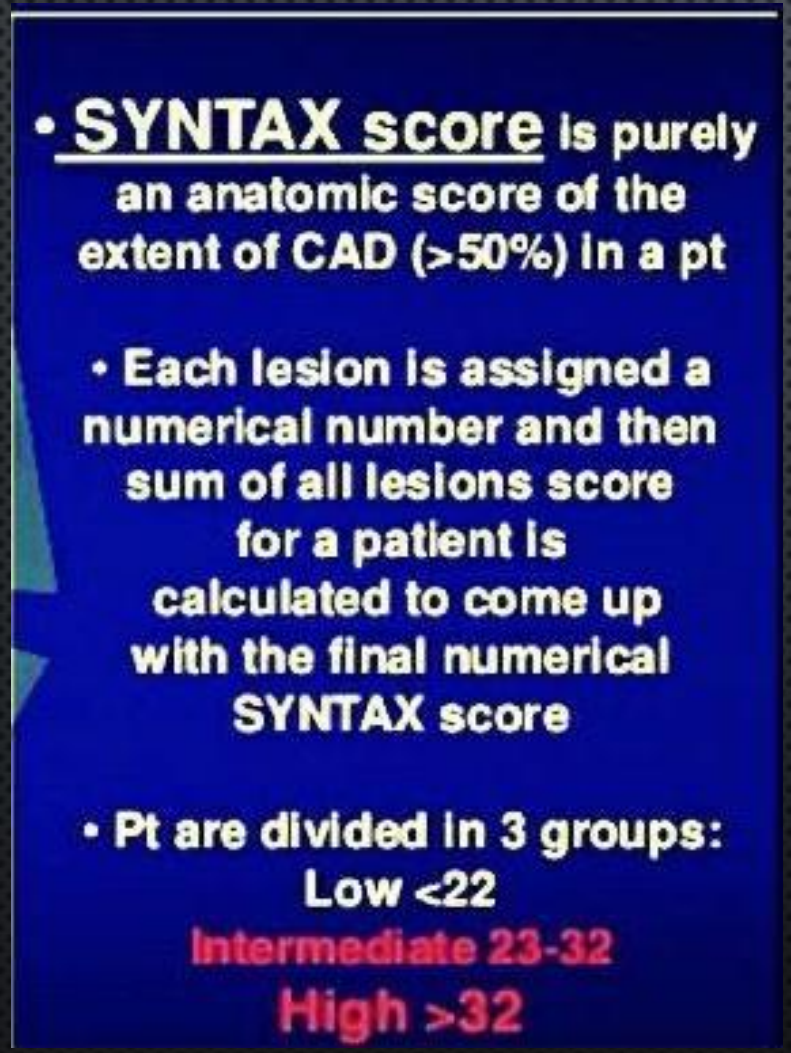


Table 1: Factors Affecting Lesion Scoring in the SYNTAX Score

Lesion Characteristic	Impact On Lesion Score
Diameter Reduction	
Total occlusion	x5
Significant lesion (diametric stenosis 50–99 %)	x2
Total Occlusion	
• Age >3 months or unknown	+1
• Blunt stump	+1
• Bridging	+1
• First segment visible beyond total occlusion	+1 per non-visualized segment
• SB Yes, SB <1.5 mm	+1
Yes, SB both < and ≥1.5 mm	+1
Trifurcations	
• 1 diseased segment	+3
• 2 diseased segments	+4
• 3 diseased segments	+5
• 4 diseased segments	+6
Bifurcations	
• Type A, B, C	+1
• Type D, E, F, G	+2
• Angulation <70°	+1
Aorto-ostial stenosis	+1
Severe tortuosity	+2
Length >20 mm	+1
Heavy calcification	+2
Thrombus	+1
'Diffuse disease'/small vessels	+1 per segment number

A significant lesion is defined as >50 % diametric luminal reduction by visual assessment in vessels larger than 1.5 mm. A multiplicative factor of 2 (designated above by 'x') is assigned to stenoses of 50–99 % severity and a multiplicative factor of 5 to total (100 %) occlusions. Other relevant lesion characteristics are assigned additive values, as denoted above by '+'. The total SYNTAX score reflects the cumulative lesion scores. SB = Side branch.

Question #13 (MKSAP 46)

- A 66-year-old man has just received an aortic valve replacement with a mechanical prosthesis. He is otherwise healthy and takes no medications.
- On physical examination, vital signs are normal. There is a regular rhythm with a normal S_1, a mechanical S_2, and no murmurs. The remainder of the physical examination is normal.
- Which of the following is the most appropriate antithrombotic therapy?

#13: D – WARFARIN AND ASPIRIN

AC FOR VALVES: MECHANICAL GUIDELINES

Table 1: ACCP Recommendations for Antithrombotic Therapy in Patients With Mechanical Heart Valves[12]

VKA Therapy
• VKA therapy is recommended over no VKA therapy for long-term management *(Grade 1B recommendation)*
• With mechanical aortic valve, VKA therapy with a target INR of 2.5 (range 2.0 to 3.0) is recommended *(Grade 1B recommendation)*
• With mechanical mitral valve, VKA therapy with a target INR of 3.0 (range 2.5 to 3.5) is recommended *(Grade 2C recommendation)*
• With mechanical valves in both the aortic and mitral position, a target INR of 3.0 (range 2.5 to 3.5) is recommended *(Grade 2C recommendation)*
Antiplatelet Therapy
• With mechanical mitral or aortic valve at low risk of bleeding, an antiplatelet agent such as low-dose aspirin (50 to 100 mg/day) is recommended in addition to long-term VKA therapy *(Grade 1B recommendation)*

Table 2: ACC/AHA Recommendations for Antithrombotic Therapy in Patients With Mechanical Heart Valves[13]

VKA Therapy
• With mechanical aortic valve, VKA therapy with a target INR of 2.5 if no risk factors (atrial fibrillation, prior thromboembolism, left ventricular dysfunction, or hypercoagulable state) are present *(Class I recommendation; Level of evidence: B)*
• VKA therapy with a target INR of 3.0 after:
○ Mechanical aortic valve replacement if risk factors are present *(Class I recommendation; Level of evidence: B)*
○ Mechanical aortic valve replacement with Starr-Edwards or disc valves other than Medtronic Hall if no risk factors are present *(Class I recommendation; Level of evidence: B)*
○ Mechanical mitral valve replacement with any type of valve *(Class I recommendation; (Level of evidence: B)*
Antiplatelet Therapy
• At a dose of 75 to 100 mg/day in addition to warfarin in all patients with mechanical valves *(Class I recommendation; Level of evidence: A)*

AC FOR VALVE, BIOPROSTHETIC

Table 3: ACCP Recommendations for Antithrombotic Therapy in Patients With Bioprosthetic Heart Valves[12]

VKA Therapy
• VKA therapy with a target INR of 2.5 (range 2.0 to 3.0) is suggested over no VKA therapy for the first three months after bioprosthetic mitral valve replacement therapy *(Grade 2C recommendation)*
Antiplatelet Therapy
• Aspirin (50 to 100 mg/day) is suggested over VKA therapy for the first three months after bioprosthetic aortic valve replacement in patients who are in sinus rhythm and have no other indication for VKA therapy *(Grade 2C recommendation)*
• Aspirin is suggested over no aspirin therapy after the first three months following bioprosthetic valve replacement in patient in sinus rhythm *(Grade 2C recommendation)*
• Aspirin (50 to 100 mg/day) plus clopidogrel (75 mg/day) is suggested over VKA therapy for the first three months after transcatheter aortic bioprosthetic valve replacement *(Grade 2C recommendation)*

Table 4: ACC/AHA Recommendations for Antithrombotic Therapy in Patients With Bioprosthetic Heart Valves[13]

VKA Therapy with target INR of 2.5 (range 2.0 to 3.0):
• For the first 3 months after bioprosthetic aortic valve replacement *(Class IIb recommendation; Level of evidence B)*
• For the first 3 months after bioprosthetic mitral valve replacement *(Class IIa recommendation; Level of evidence C)*
Antiplatelet Therapy
• After bioprosthetic aortic or mitral valve replacement at a dose of 75 to 100 mg/day *(Class IIa recommendation; Level of evidence: B)*

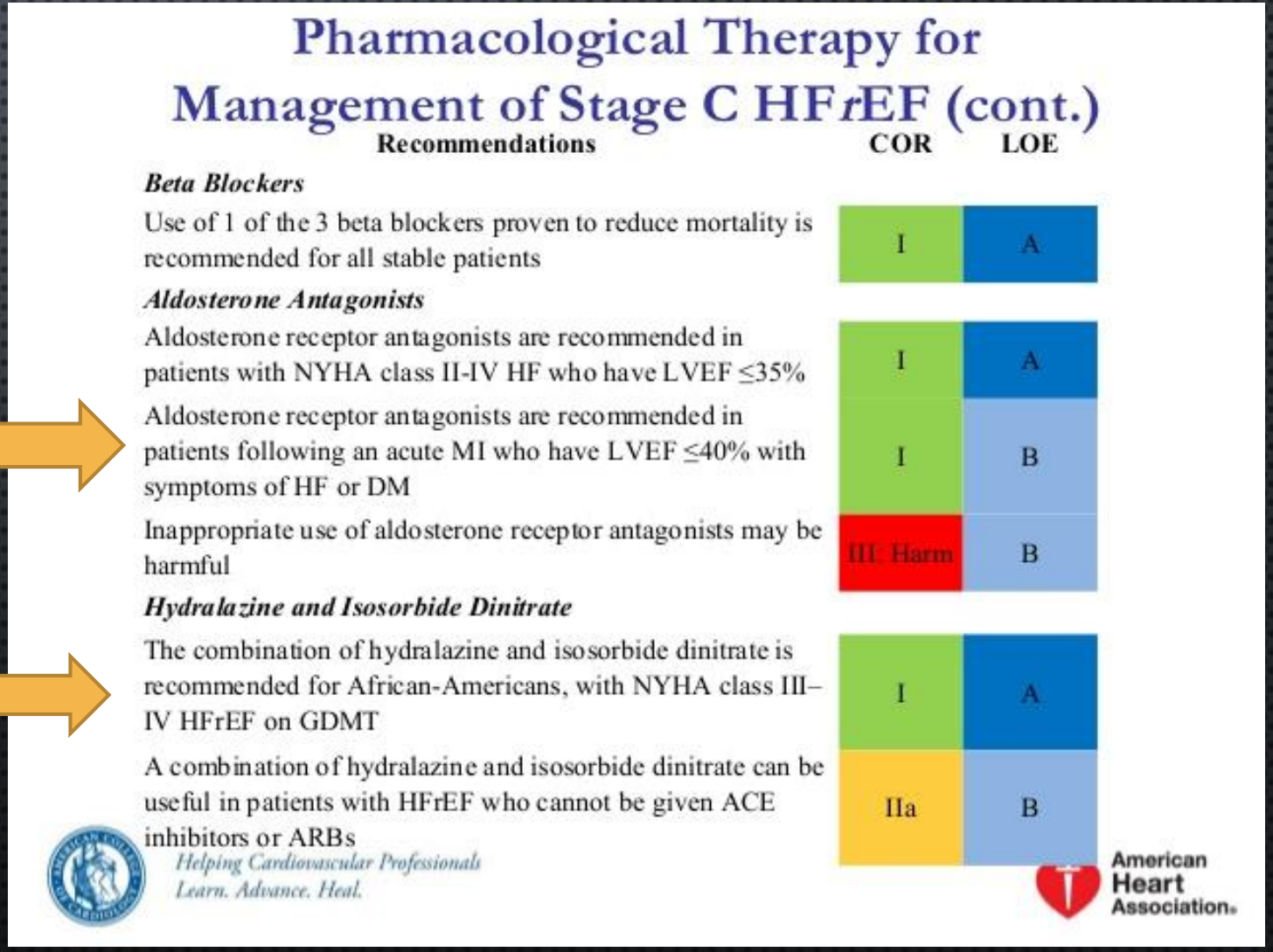
Question #14 (MKSAP 28)

- A 72-year-old man is evaluated in the hospital for heart failure. In the past month, he has developed progressive dyspnea, such that he cannot walk 50 meters without stopping to catch his breath. He has a history of hypertension and ischemic cardiomyopathy. During the hospitalization, a perfusion imaging study demonstrated no ischemia, and an echocardiogram revealed a left ventricular ejection fraction of 20%. Medications are aspirin, ramipril, isosorbide mononitrate, and furosemide.
- On physical examination, the patient is afebrile, blood pressure is 120/68 mm Hg, pulse rate is 73/min, and respiration rate is 22/min. The estimated central venous pressure is 9 cm H_2O. A paradoxical split S_2 and an S_3 are present. Lungs are clear to auscultation.
- A 12-lead electrocardiogram is shown.
- In addition to diuresis, which of the following is the most appropriate treatment before discharge?

#14: A – ADD CARVEDILOL

HEART FAILURE GUIDELINES

- GUIDELINE-DIRECTED MEDICAL THERAPY FOR HEART FAILURE INCLUDES TREATMENT WITH AN ACE INHIBITOR, B-BLOCKER (SPECIFICALLY, METOPROLOL SUCCINATE, CARVEDILOL, OR BISOPROLOL), AND AN ALDOSTERONE ANTAGONIST.
- B-BLOCKERS IMPROVE REMODELING, INCREASE EJECTION FRACTION, AND REDUCE HOSPITALIZATION AND MORTALITY WHEN ADDED TO AN ACE INHIBITOR AND DIURETIC THERAPY.
- THIS PATIENT IS NOT TAKING A B-BLOCKER; THEREFORE, THE MOST IMPORTANT INTERVENTION WOULD BE INITIATION OF CARVEDILOL TO OPTIMIZE THE PATIENT'S MEDICAL THERAPY.



Pharmacological Therapy for Management of Stage C HF*r*EF (cont.)

Recommendations	COR	LOE
Beta Blockers		
Use of 1 of the 3 beta blockers proven to reduce mortality is recommended for all stable patients	I	A
Aldosterone Antagonists		
Aldosterone receptor antagonists are recommended in patients with NYHA class II-IV HF who have LVEF ≤35%	I	A
Aldosterone receptor antagonists are recommended in patients following an acute MI who have LVEF ≤40% with symptoms of HF or DM	I	B
Inappropriate use of aldosterone receptor antagonists may be harmful	III: Harm	B
Hydralazine and Isosorbide Dinitrate		
The combination of hydralazine and isosorbide dinitrate is recommended for African-Americans, with NYHA class III–IV HFrEF on GDMT	I	A
A combination of hydralazine and isosorbide dinitrate can be useful in patients with HFrEF who cannot be given ACE inhibitors or ARBs	IIa	B

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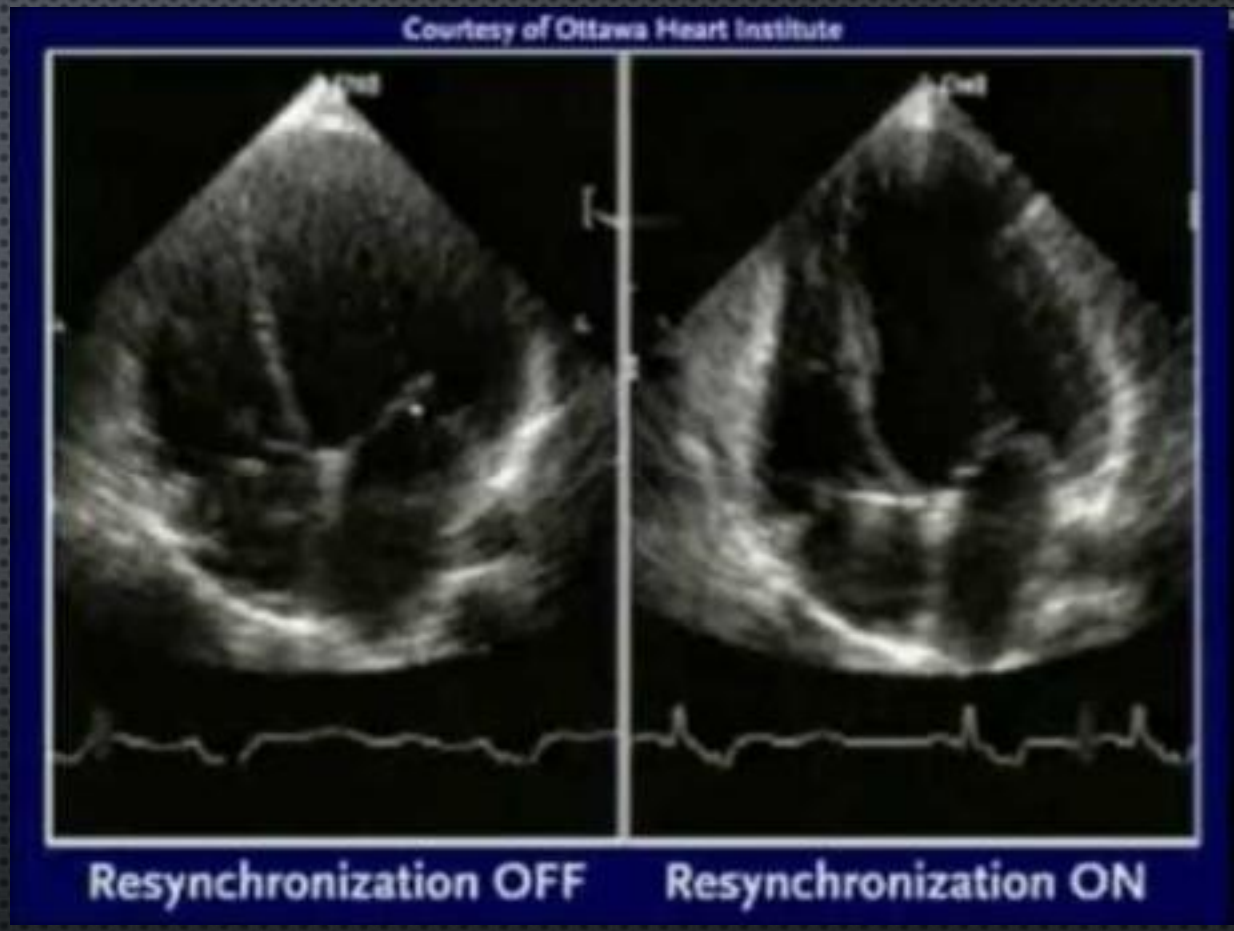
WHAT PERCENTAGE OF HF PATIENTS ARE OPTIMIZED?

IVABRADINE

- NEGATIVE CHRONOTROPIC EFFECT ON THE SINOATRIAL NODE =SELECTIVELY INHIBITS THE FUNNY CURRENT (I_F)
- DOES NOT TARGET THE NEUROHORMONAL SYSTEM = THE ABSENCE OF CLINICALLY SIGNIFICANT NONELECTROPHYSIOLOGICAL EFFECTS.
- "IVABRADINE IS BEST VIEWED BY CLINICIANS AS A SECOND-LINE DRUG FOR SYSTOLIC HEART FAILURE AND CHRONIC STABLE ANGINA"
- FOR PATIENTS WITH SYMPTOMATIC CHRONIC STABLE HF WITH LEFT VENTRICULAR EJECTION FRACTION ≤35 PERCENT, IN SINUS RHYTHM WITH A RESTING HEART RATE ≥70 BEATS PER MINUTE (BPM), AND WHO EITHER ARE ON A MAXIMUM TOLERATED DOSE OF A BETA BLOCKER OR HAVE A CONTRAINDICATION TO BETA BLOCKER USE, CONSIDER IVABRADINE
- "THE SHIFT TRIAL FOUND THAT IVABRADINE REDUCED A COMPOSITE OF CARDIOVASCULAR DEATH OR HOSPITAL ADMISSION FOR WORSENING HF IN PATIENTS WITH HFREF AND THIS CLINICAL BENEFIT WAS ASSOCIATED WITH REDUCTION IN HEART RATE."
- ADVERSE EFFECTS OF IVABRADINE INCLUDE SYMPTOMATIC BRADYCARDIA AND VISUAL SIDE-EFFECTS (PHOSPHENES), HYPERTENSION, AND 15% INCREASE IN RELATIVE RISK FOR A FIB.

CRT

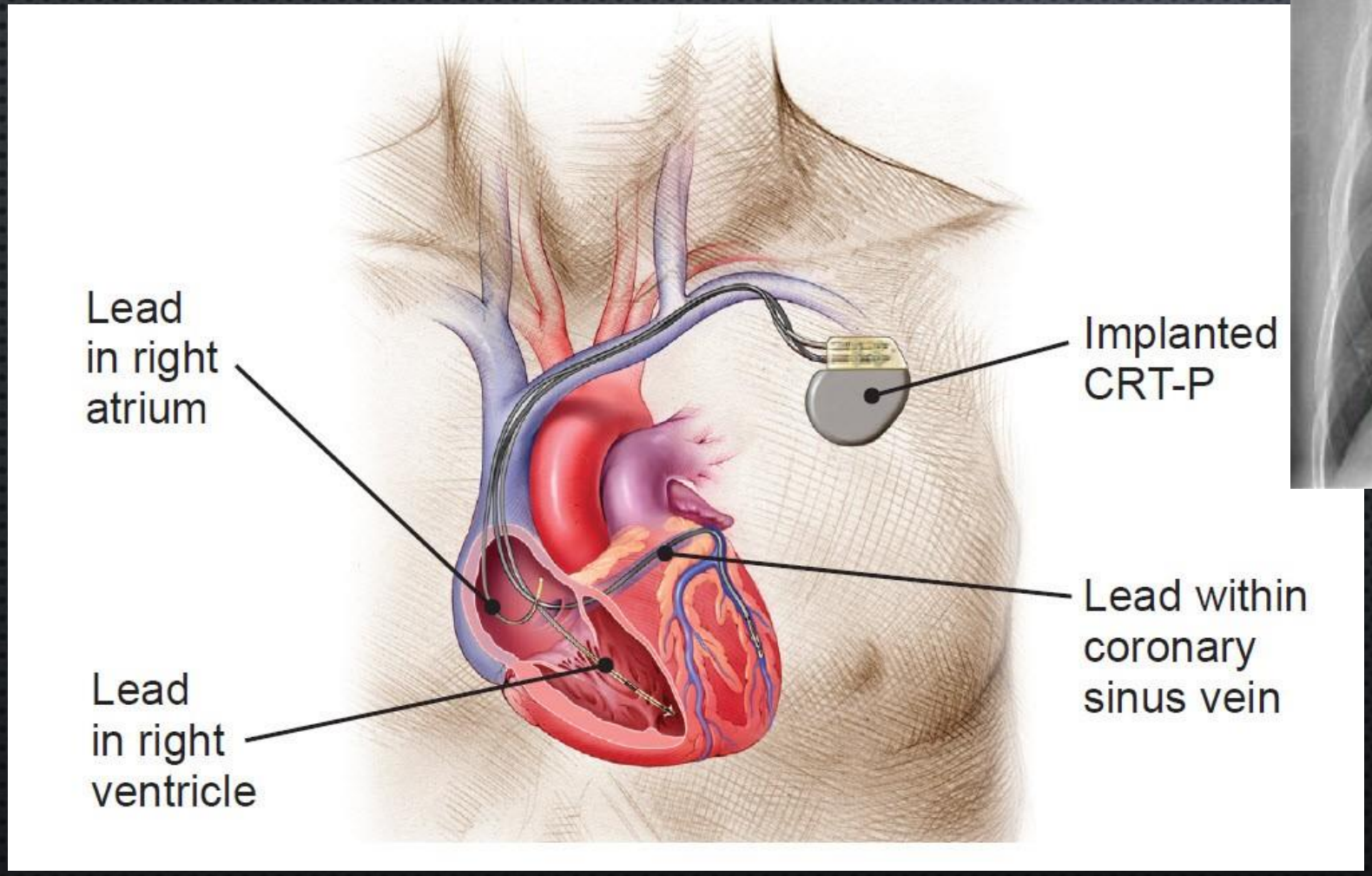
- Cardiac resynchronization therapy (CRT) = biventricular pacing = pacing of the right ventricular apex + left ventricular lateral wall via a lead inserted through the coronary sinus into a lateral cardiac vein
- Improves EF, reduces sx, and reduces mortality
- Prolongs diastole, decreases septal motion, reduces severity and duration of MR

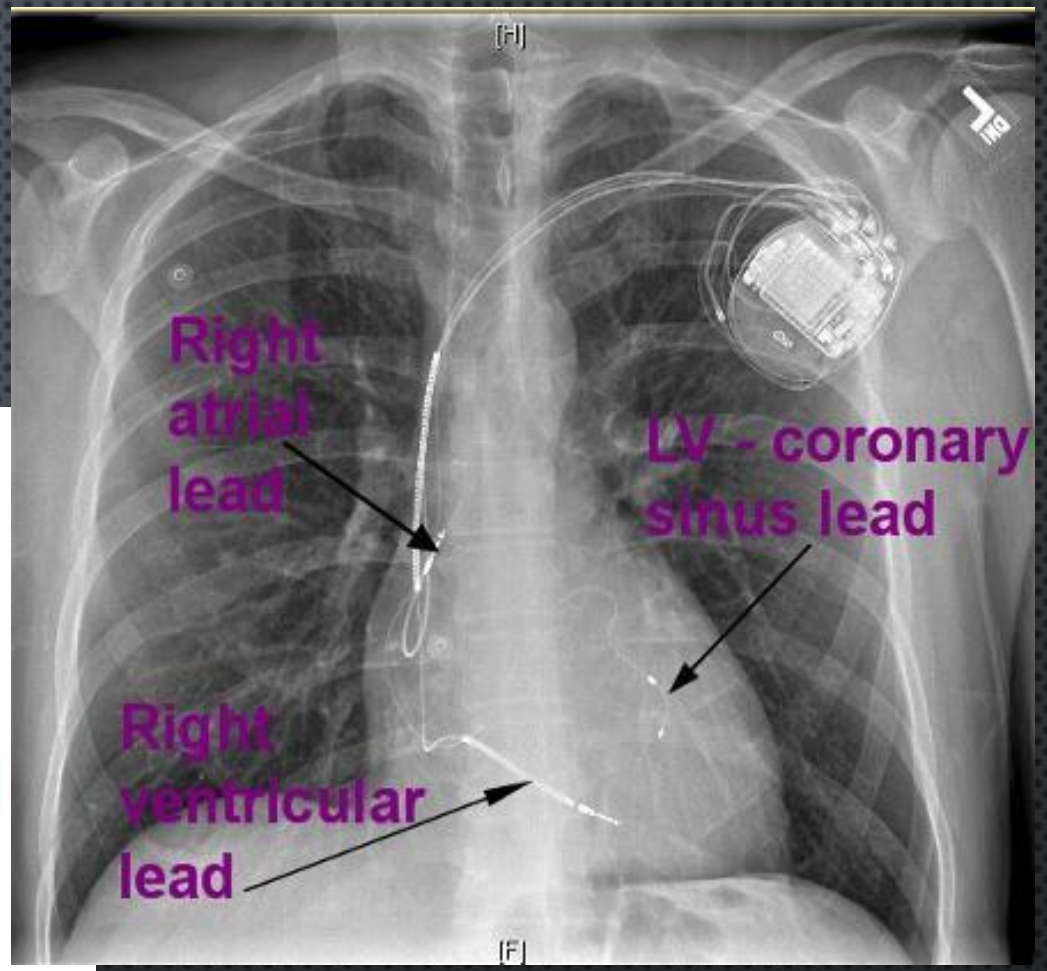


Indicated in patients with an ejection fraction less than or equal to 35%, NYHA functional class II to IV heart failure symptoms despite guideline-directed medical therapy, sinus rhythm, and LBBB with a QRS complex of 150 ms or greater. Patients with no LBBB but a QRS complex of 150 ms or greater may derive a lesser benefit from CRT.

20-40% of HF pts eligible. 30% non-responders to CRT

CRT


Lead
in right
atrium
Implanted
CRT-P
Lead within
coronary
sinus vein
Lead
in right
ventricle


Right
atrial
lead
LV - coronary
sinus lead
Right
ventricular
lead


A
B

IMPLANTED CARDIOVERTER-DEFIBRILLATORS

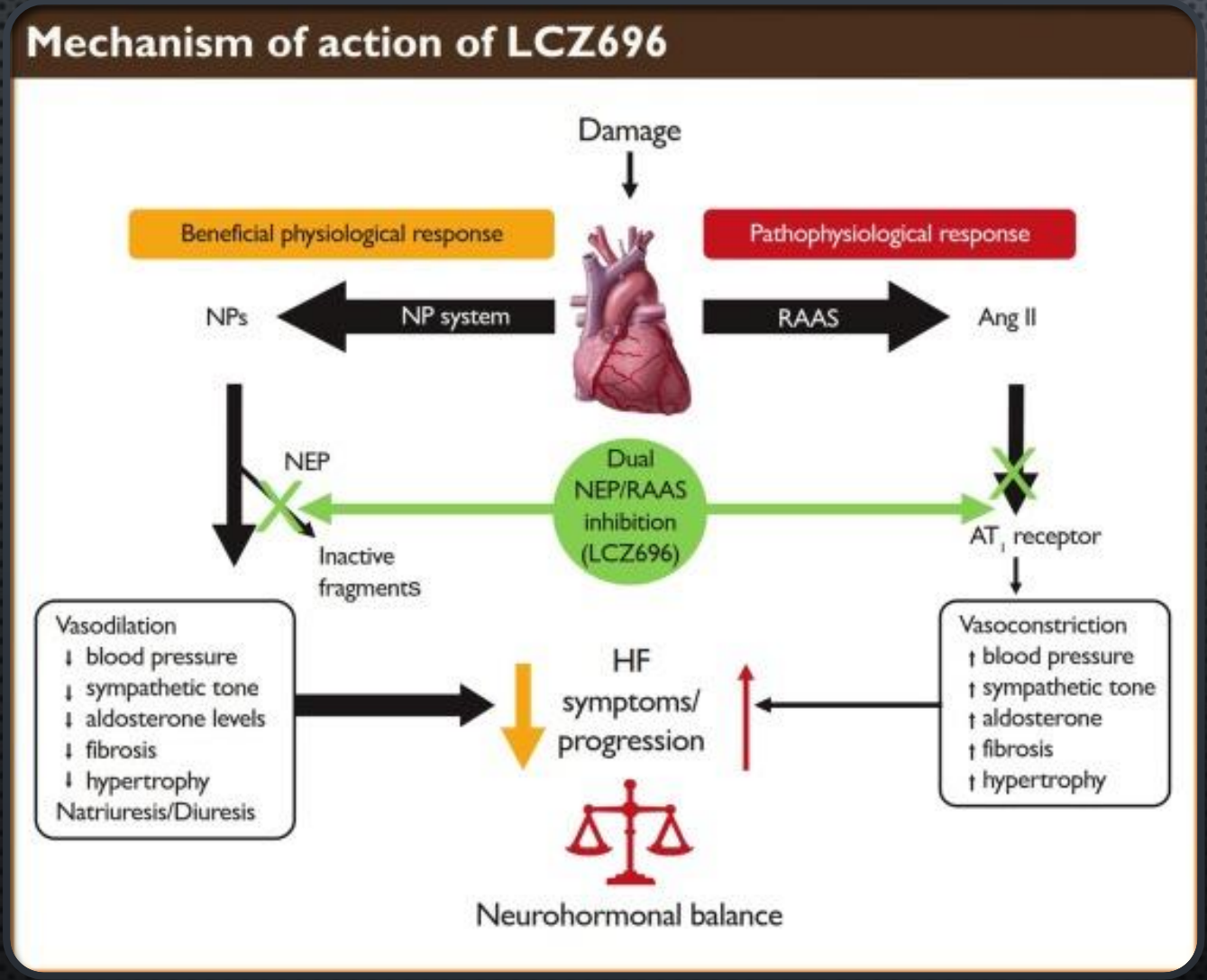
- IMPROVE SURVIVAL FOR BOTH PRIMARY AND SECONDARY PREVENTION OF ARRHYTHMIAS
- REC FOR PTS ON GDMT WITH EF </=35% + NYHA FUNCTIONAL CLASS II OR III
- PATIENTS WITH CLASS IV SYMPTOMS SHOULD ONLY UNDERGO ICD PLACEMENT IF THEY ARE CANDIDATES FOR HEART TRANSPLANT OR LEFT VENTRICULAR ASSIST DEVICE (LVAD) PLACEMENT (OR EXPECTED TO LIVE >1 YEAR)
- REMEMBER TO REASSESS BOTH EJECTION FRACTION AND SYMPTOMS AFTER GUIDELINE-DIRECTED MEDICAL THERAPY (40 DAYS AFTER MYOCARDIAL INFARCTION, 3 MONTHS IN ALL OTHERS)

Question #15 (MKSAP 114)

- A 72-year-old woman is evaluated during a follow-up visit. She has a 3-year history of heart failure with a left ventricular ejection fraction of 25% and New York Heart Association functional class III symptoms. She has an implantable cardioverter-defibrillator. She reports manageable lightheadedness with standing. Medications are lisinopril, carvedilol, and spironolactone at maximally tolerated doses.
- On physical examination, the patient is afebrile, blood pressure is 98/64 mm Hg, and pulse rate is 68/min. The estimated central venous pressure is 6 cm H_2O. An S_3 is present. The lungs are clear to auscultation. There is no lower extremity edema.
- Which of the following is the most appropriate management?

#15: E – CONTINUE CURRENT MEDS

ARNI (ANGIOTENSIN RECEPTOR-NEPRILYSIN INHIBITOR) ENTRESTO



- VALSARTAN-SACUBITRIL = ANGIOTENSIN RECEPTOR–NEPRILYSIN INHIBITOR
- NEPRILYSIN INHIBITOR PREVENTS THE BREAKDOWN OF B-TYPE NATRIURETIC PEPTIDE, LEADING TO ENHANCED DIURESIS, NATRIURESIS, AND MYOCARDIAL RELAXATION
- REDUCE CARDIOVASCULAR DEATH OR HEART FAILURE HOSPITALIZATION BY 20% IN SYMPTOMATIC PATIENTS WITH HFREF
- MAJOR CAUSE OF WITHDRAWAL WAS HYPOTENSION (AND THIS PATIENT IS ORTHOSTATIC, OTHERWISE IT WOULD BE OK)
- ACE INHIBITORS SHOULD BE DISCONTINUED AT LEAST 36 HOURS BEFORE INITIATING VALSARTAN-SACUBITRIL
- PROBABLY OK TO START WHILE DECOMPENSATED IN THE HOSPITAL

ARNI (ANGIOTENSIN RECEPTOR-NEPRILYSIN INHIBITOR) ENTRESTO

Costco		$512.43 with free coupon	GET FREE COUPON
Albertsons		$528.80 with free coupon	GET FREE COUPON
Safeway	$591 est retail price	$528.80 with free coupon	GET FREE COUPON
Kroger Pharmacy	$562 est retail price	$529.17 with free coupon	GET FREE COUPON

Question #16 (MKSAP 90)

- A 76-year-old woman is evaluated before discharge. She was diagnosed with a non–ST-elevation myocardial infarction 3 days ago. She declined angiography, and nuclear stress testing revealed a small lateral perfusion defect and normal left ventricular ejection fraction. She has had no further discomfort since admission. Medical history is significant for hyperlipidemia, hypertension, and transient ischemic attack. Medications are low-dose aspirin, ramipril, metoprolol, and atorvastatin.
- On physical examination, vital signs and the remainder of the examination are unremarkable.
- In addition to low-dose aspirin, which of the following is the optimal antithrombotic regimen for this patient?

#16: B – TICAGRELOR

P2Y12 INHIBITORS

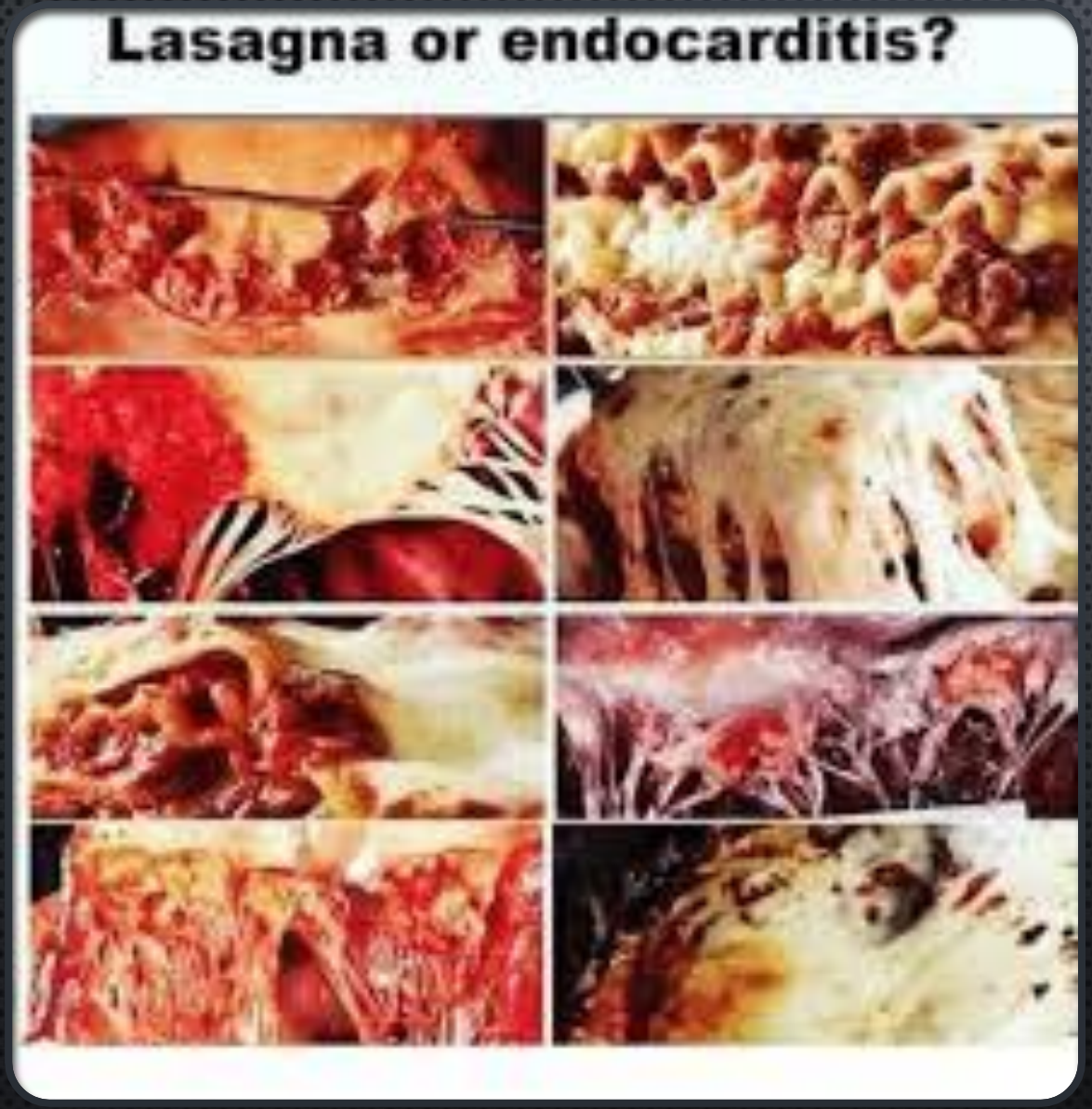
- In the PLATO trial, the combination of low-dose aspirin and ticagrelor was superior to aspirin and clopidogrel in reducing the incidence of cardiovascular death, myocardial infarction, and stroke following ACS (PCI and med mgmt.)
- Prasugrel only in patients with ACS who undergo percutaneous coronary intervention - no more effective than clopidogrel, and it carries a higher risk for bleeding
- Dyspnea is a well-recognized side effect of ticagrelor in 15-20%, although only 5% to 7% required cessation of the drug. In most cases, dyspnea is self-limited, but it often results in additional testing.
- Ticagrelor is the only BID option (and is still more expensive)

WHO NEEDS DAPT?

- BARE METAL STENT (BMS) IN-STENT RETHROMBOSIS RISK IS GREATEST IN THE FIRST DAYS TO WEEKS AFTER IMPLANTATION. THUS, A MINIMUM DURATION OF DAPT FOR 1 MONTH IS GENERALLY RECOMMENDED IN STABLE ISCHEMIC HEART DISEASE (SIHD) PATIENTS TREATED WITH A BMS.
- THE RISK OF STENT THROMBOSIS IN SIHD PATIENTS TREATED WITH CURRENTLY USED DRUG ELUTING STENTS (DES) IS GREATEST IN THE FIRST 3 TO 6 MONTHS AFTER IMPLANTATION. ACCORDINGLY, IN SIHD PATIENTS WITH NEWER GENERATION DES, THE RECOMMENDED MINIMUM DURATION OF DAPT IS 6 MONTHS. THIS DIFFERS FROM PREVIOUS RECOMMENDATIONS OF SIHD PATIENTS TREATED WITH FIRST-GENERATION DES WHERE THE RECOMMENDED MINIMUM DURATION OF DAPT WAS 12 MONTHS.
- MEDICAL MANAGEMENT = 12 MONTHS

Question #17 (MKSAP 78)

- A 46-year-old man is evaluated in the hospital for a 6-week history of fatigue and worsening dyspnea. Medical history is significant for a bicuspid aortic valve. He takes no medications.
- On physical examination, temperature is 38.1 °C (100.6 °F), blood pressure is 118/58 mm Hg, pulse rate is 92/min, and respiration rate is 18/min. Oxygen saturation is 98% breathing 2 L of oxygen by nasal cannula. Cardiac examination reveals a grade 2/6 diastolic murmur heard best at the left lower sternal border. There are crackles at the lung bases bilaterally. Conjunctival hemorrhage is present in the left eye.
- Laboratory studies are notable for a leukocyte count of 15,000/mL (15×10^9/L). Three sets of blood cultures are positive for gram-positive cocci.
- An electrocardiogram shows sinus rhythm, a PR interval of 220 ms, and QRS duration of 100 ms.
- Which of the following is the most appropriate diagnostic test to perform next?



#17: C – TRANSESOPHAGEAL ECHOCARDIOGRAM

Modified Duke criteria for diagnosis of infective endocarditis - Table A

Definite IE is established in the presence of any of the following:
Pathologic criteria
Pathologic lesions: vegetation or intracardiac abscess demonstrating active endocarditis on histology **OR**
Microorganism: demonstrated by culture or histology of a vegetation or intracardiac abscess
Clinical criteria
Using specific definitions listed in **Table B:**
2 major clinical criteria **OR**
1 major and 3 minor clinical criteria **OR**
5 minor clinical criteria
Possible IE*
Presence of 1 major and 1 minor clinical criteria **OR** presence of 3 minor clinical criteria
Rejected IE
A firm alternate diagnosis is made **OR**
Resolution of clinical manifestations occurs after ≤4 days of antibiotic therapy **OR**
No pathologic evidence of infective endocarditis is found at surgery or autopsy after antibiotic therapy for four days or less
Clinical criteria for possible or definite IE not met

1 major and 3 minor!

Major criteria
Positive blood cultures for IE (one of the following):
Typical microorganisms consistent with IE from two separate blood cultures:
Staphylococcus aureus
Viridans streptococci
Streptococcus gallolyticus (formerly *S. bovis*), including nutritional variant strains (*Granulicatella* spp and *Abiotrophia defectiva*)
HACEK group: *Haemophilus* spp, *Aggregatibacter* (formerly *Actinobacillus actinomycete comitants*), *Cardiobacterium hominis*, *Eikenella* spp, and *Kingella kingae*
Community-acquired enterococci, in the absence of a primary focus; **OR**
Persistently positive blood culture:
For organisms that are typical causes of IE: At least two positive blood cultures from blood samples drawn >12 hours apart
For organisms that are more commonly skin contaminants: Three or a majority of ≥4 separate blood cultures (with first and last drawn at least one hour apart)
Single positive blood culture for *Coxiella burnetii* or phase I IgG antibody titer >1:800*
Evidence of endocardial involvement (one of the following):
Echocardiogram positive for IE:
Vegetation (oscillating intracardiac mass on a valve or on supporting structures, in the path of regurgitant jets, or on implanted material, in the absence of an alternative anatomic explanation) **OR**
Abscess **OR**
New partial dehiscence of prosthetic valve
New valvular regurgitation
Increase in or change in preexisting murmur not sufficient
Minor criteria
Predisposition: Intravenous drug use or presence of a predisposing heart condition (prosthetic heart valve or a valve lesion associated with significant regurgitation or turbulence of blood flow)
Fever: Temperature ≥38.0°C (100.4°F)
Vascular phenomena: Major arterial emboli, septic pulmonary infarcts, mycotic aneurysm, intracranial hemorrhage, conjunctival hemorrhages, or Janeway lesions
Immunologic phenomena: Glomerulonephritis, Osler nodes, Roth spots, or rheumatoid factor
Microbiologic evidence: Positive blood cultures that do not meet major criteria **OR** serologic evidence of active infection with organism consistent with IE

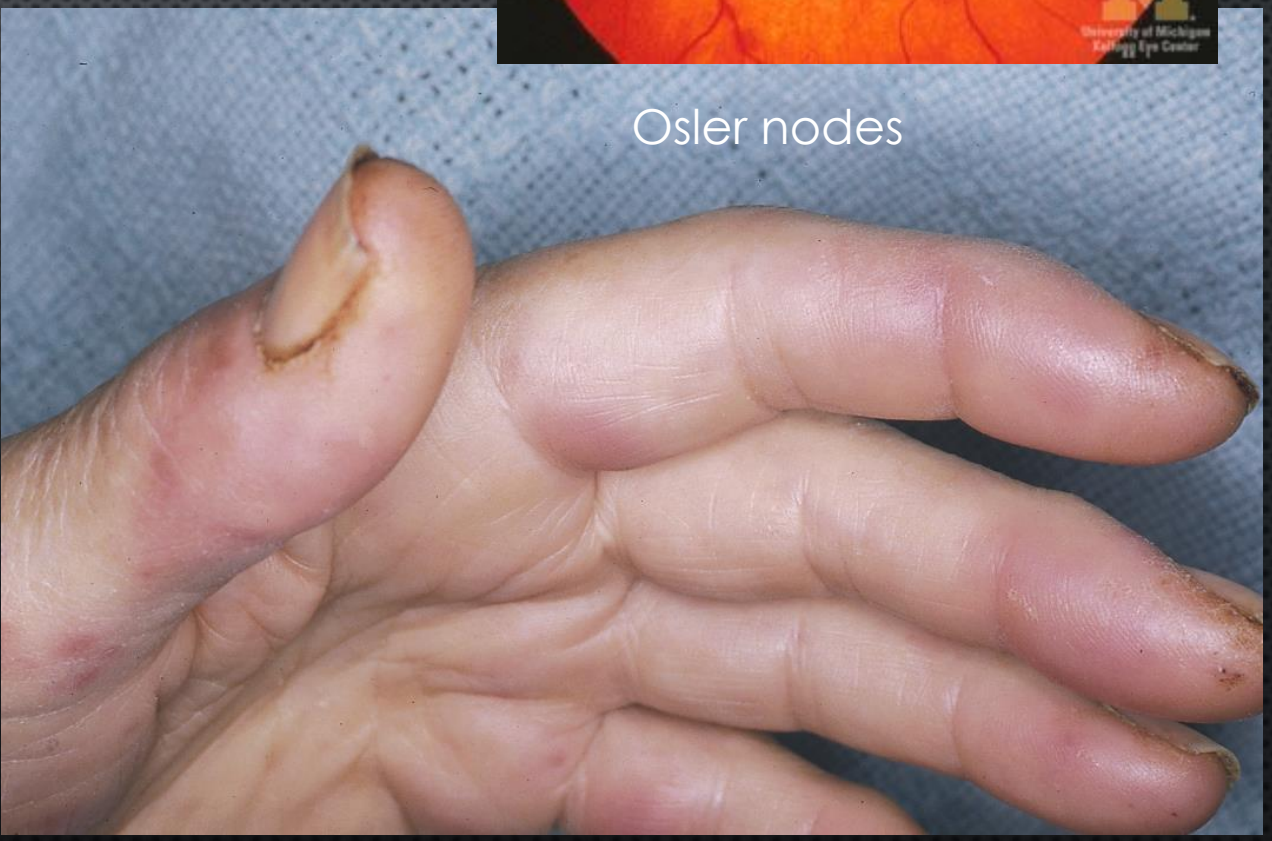
INFECTIVE ENDOCARDITIS

Subconjunctival hemorrhage

Janeway lesions

Roth spots

Osler nodes



Infective endocarditis and perivalvular abscess

- Perivalvular abscess should be suspected in the setting of conduction abnormalities ECG (especially PR prolongation) and/or persistent bacteremia or fever despite appropriate antimicrobials. 30-40% incidence – higher in aortic valve lesions
- Can cause heart block by extending into conduction tissue, especially with aortic valves when there is involvement of the valve ring between the right and non-coronary cusp where the proximal ventricular conduction system resides – can also cause MI!
- 2x risk of embolization (64%) and 10% higher mortality (23%)
- Sensitivity, specificity, and positive and negative predictive values of TEE were 87, 95, 91, and 92 percent, respectively. The sensitivity of TTE was much lower (28%), although the specificity was 99 percent.

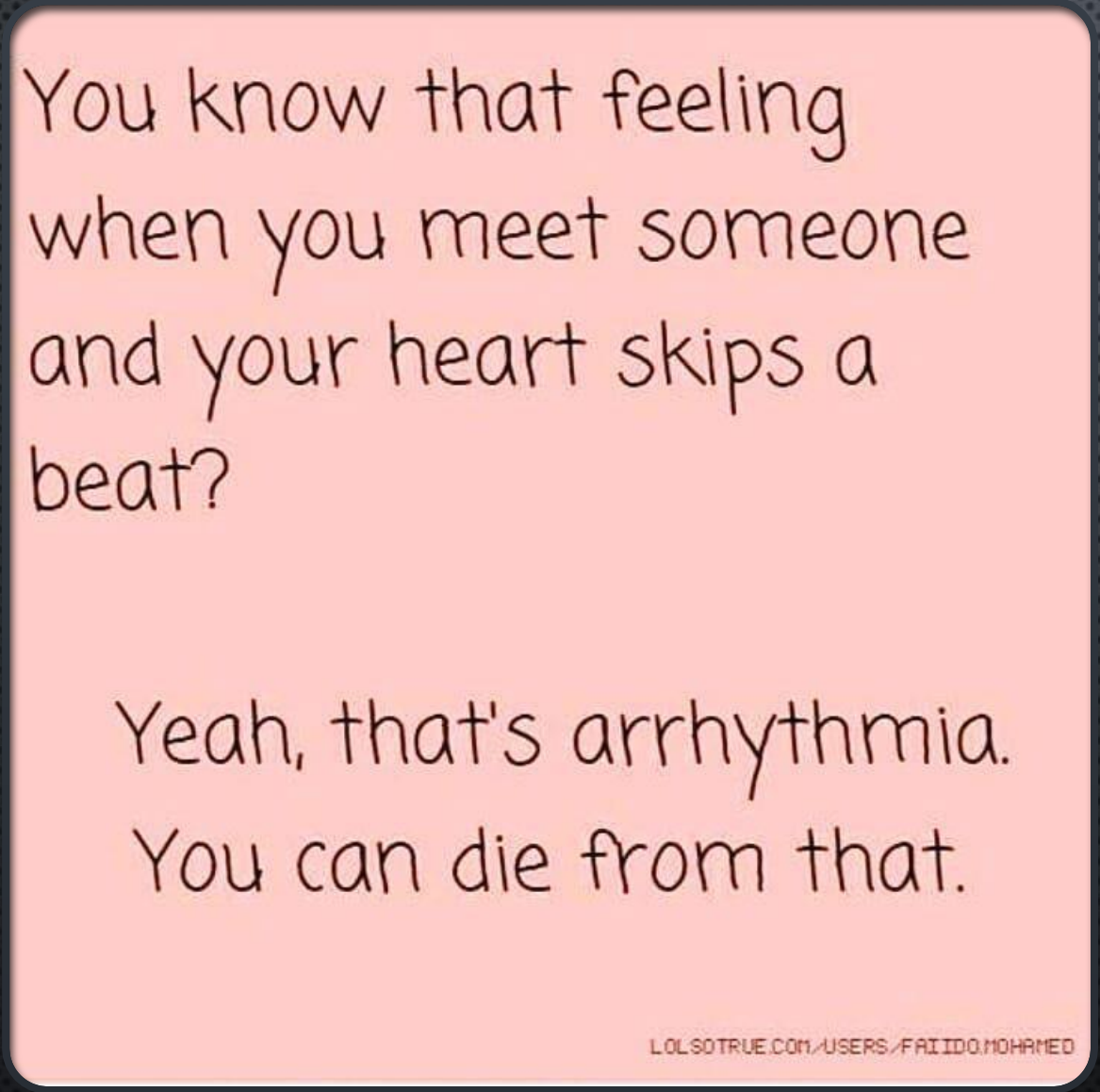
Question #18 (MKSAP 72)

A 42-year-old woman is evaluated for a 3-year history of palpitations and fatigue. She reports no chest pain, dizziness, near-syncope, or syncope. An exercise stress test and echocardiogram were normal when she was evaluated for palpitations 1 year ago. There is no family history of sudden cardiac death or heart failure. Her only medication is metoprolol.

On physical examination, vital signs and the remainder of the examination are unremarkable.

An electrocardiogram is shown. Ambulatory 24-hour electrocardiographic monitoring shows frequent monomorphic premature ventricular contractions (22% of all beats) and frequent ventricular bigeminy. An echocardiogram obtained 1 week ago showed mild to moderate global decreased left ventricular function with a left ventricular ejection fraction of 45%.

Which of the following is the most appropriate management?



#18: D – CATHETER ABLATION OF PVCS

PVCs

Common in:

- Hypertension
- LVH
- MI
- Structural heart disease

If no high risk features, no treatment necessary.

High risk features:

- Syncope
- FHx of sudden cardiac death
- Structural heart disease

Treatment of PVCs:

1) First line: Beta-blocker or CCB (only treat symptoms, no proven mortality benefit)

2) Class IC antiarrhythmics:

- Flecainide
- Propafenone
- (Contraindicated in CAD, increases mortality)
- Amiodarone

Working up palpitations:

1) EKG

2) 24-48 hr ambulatory EKG

- If >10,000 in 24 hours or >10% of beats:
  - Exercise stress test
  - Echo

Indications for catheter ablation:

- Persistent symptoms despite medical therapy
- LV dysfunction

Question #19 (MKSAP 92)

- A 35-year-old woman is evaluated for exertional dyspnea of 6 months' duration. She reports no other symptoms. Medical history is unremarkable, and she takes no medications.
- On physical examination, vital signs are normal. Oxygen saturation is 96% breathing ambient air. The estimated central venous pressure is elevated. Apical impulse is normal; a parasternal impulse is noted at the left sternal border. A soft systolic murmur is heard at the second left intercostal space, and a diastolic flow rumble is heard at the left sternal border. Fixed splitting of the S_2 is noted throughout the cardiac cycle. The remainder of the physical examination is normal.
- An electrocardiogram demonstrates right axis deviation and incomplete right bundle branch block.
- Which of the following is the most likely diagnosis?

#19 - A: ATRIAL SEPTAL DEFECT

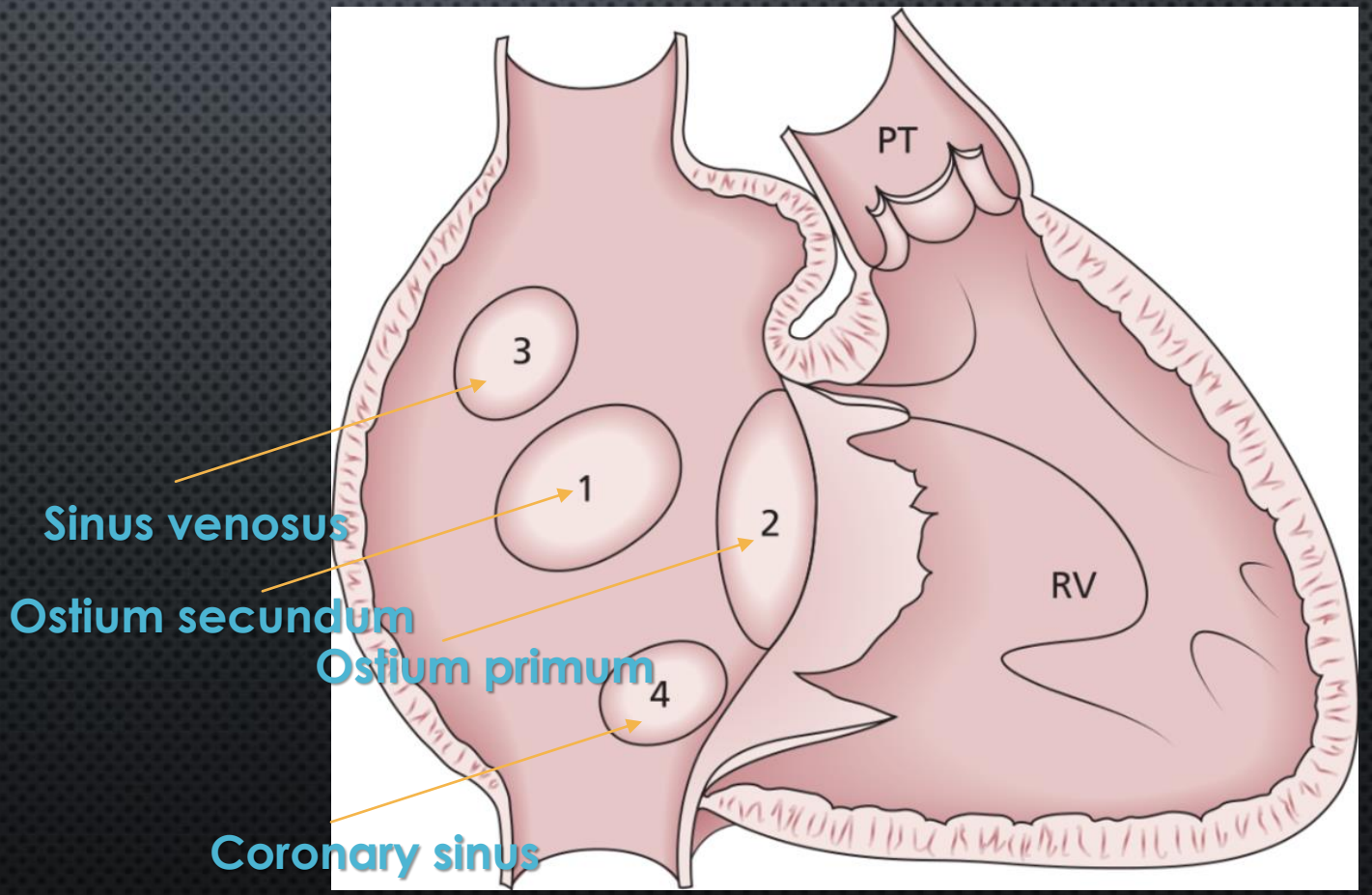
ATRIAL SEPTAL DEFECT

Exam findings common to all:
-Parasternal impulse
-Fixed split S2
-Pulmonary outflow murmur

Ostium secundum (75%)
- Incomplete RBBB
- RA enlargement
- Right axis deviation

Ostium primum (15-20%)
- Left axis deviation
- First degree AV block

Sinus venosus (5-10%)
- Abnormal P axis



Indication to close an ASD

Right-sided cardiac chamber enlargement

Symptomatic (Dyspnea or orthodeoxia-platypnea syndrome)

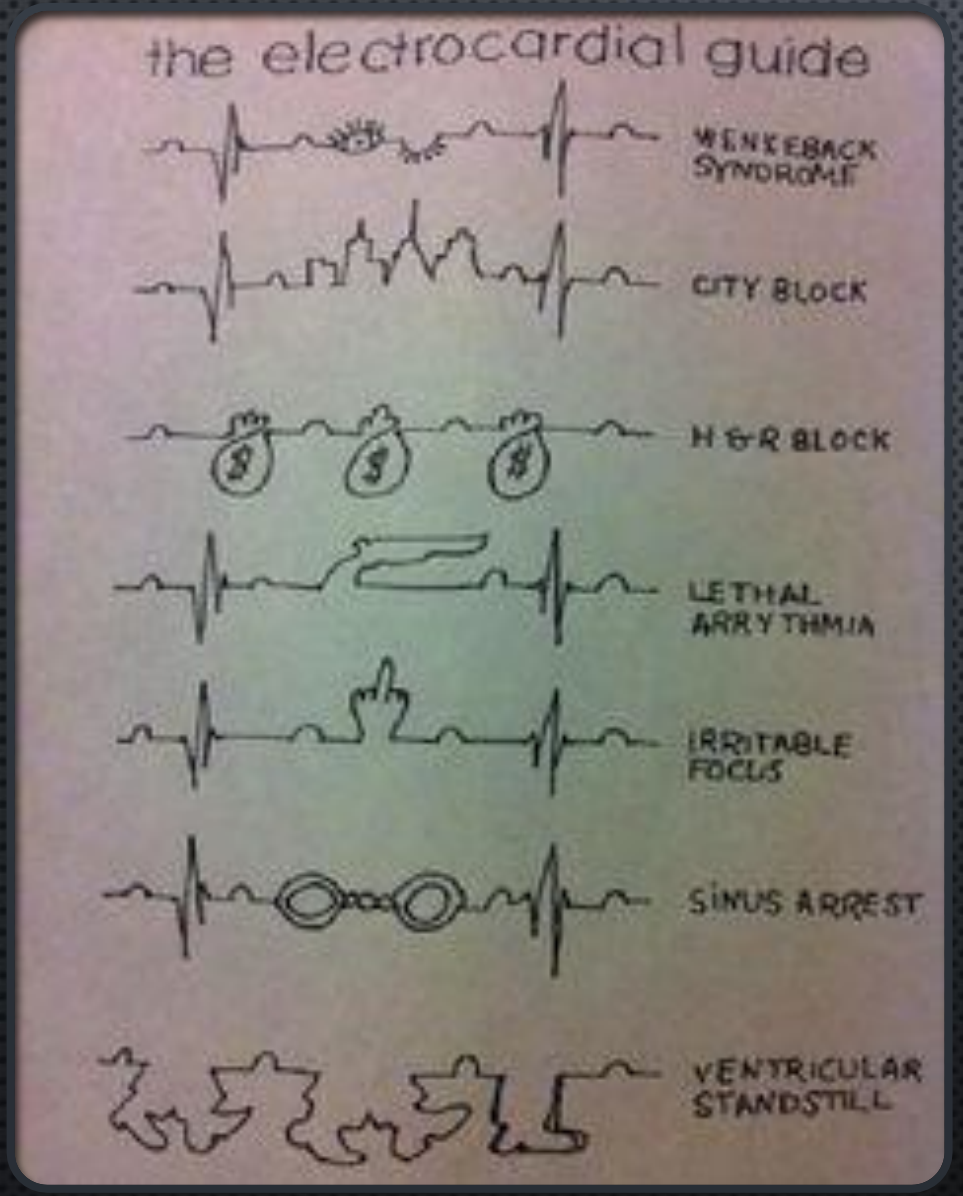
Prior to pacemaker placement (increased risk of thrombi)

Percutaneous closure for small isolated ostium secundum ASD only.

All others get surgical closure

Question #20 (MKSAP 67)

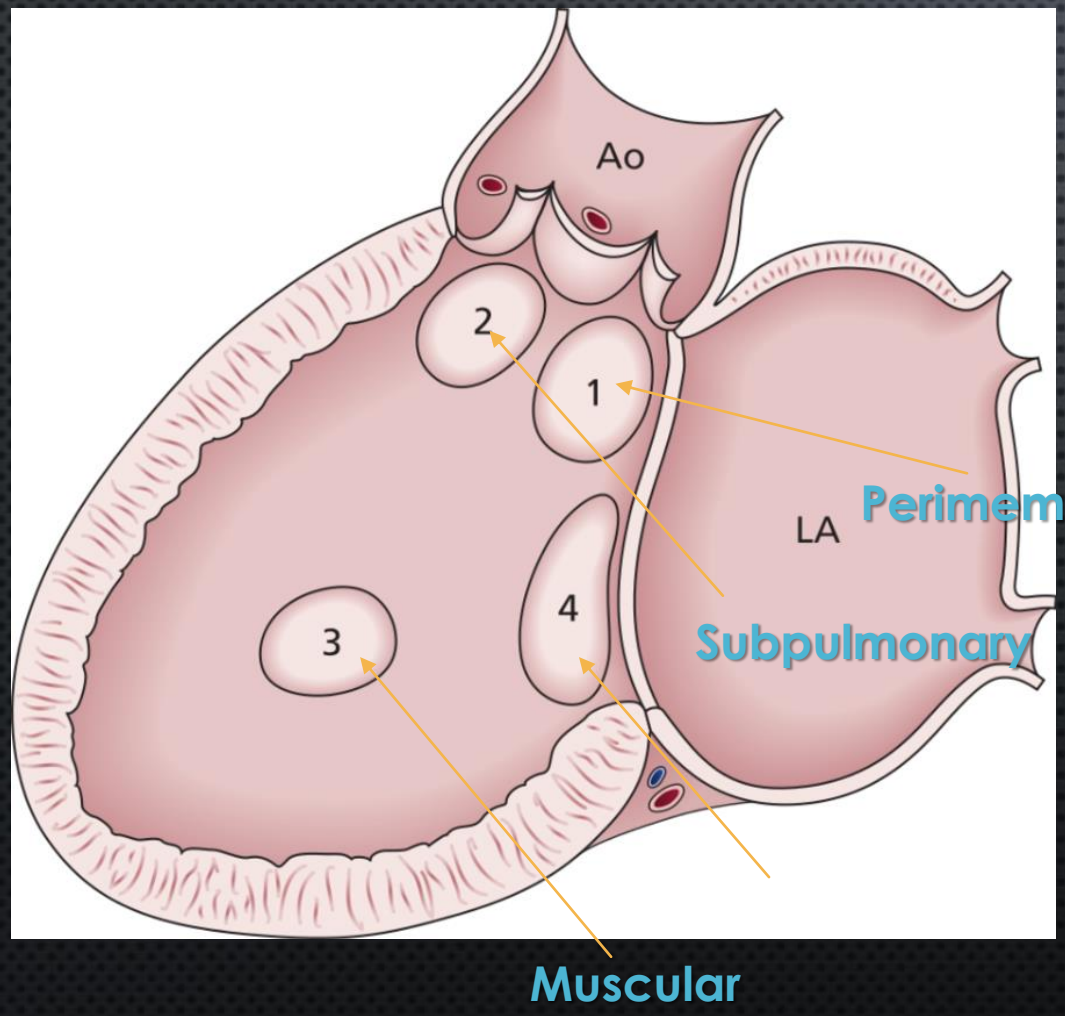
- A 24-year-old woman undergoes routine evaluation. She has not seen a physician recently but reports no symptoms. She was diagnosed with a ventricular septal defect at age 7 months. Regular evaluation was performed during childhood. Medical history is otherwise noncontributory, and she takes no medications.
- On physical examination, vital signs are normal. The jugular venous pressure and apical impulse are normal. No parasternal impulse is noted. The S_1 and S_2 are masked by a loud holosystolic murmur noted at the left lower sternal border. The remainder of the examination is unremarkable.
- An electrocardiogram and chest radiograph are normal. A transthoracic echocardiogram demonstrates a membranous ventricular septal defect with a small left-to-right shunt. The left ventricular size and function are normal, with an ejection fraction of 60%. The right heart chambers and valve function are normal. The estimated pulmonary artery pressure is normal.
- Which of the following is the most appropriate management?



20 - D: FOLLOW UP IN 3-5 YEARS

VENTRICULAR SEPTAL DEFECTS

Holosytolic murmur



- PERIMEMBRANOUS (80%)
- SUBPULMONARY (6%)
  - MORE COMMON IN ASIANS
  - ASSOCIATED WITH AORTIC REGURGITATION
- MUSCULAR (10%)
  - OFTEN CLOSE SPONTANEOUSLY
- INLET (4%)
  - COMMON IN DOWN SYNDROME

INDICATIONS FOR CLOSURE

- Qp:Qs ratio ≥2.0 (echocardiogram findings)

AND

- Evidence of LV overload or history of endocarditis

- Otherwise, periodic clinical re-evaluation

- DO NOT close VSDs with R-->L shunt or pulmonary hypertension (Eisenmenger syndrome). This reduces cardiac output.

THE END