

**TOPIC:** Hypertensive disorders & pregnancy

*A 38-year-old female is taking lisinopril for hypertension. She is contemplating pregnancy and is told to stop her lisinopril if she plans to get pregnant. What complication is the patient trying to avoid by stopping lisinopril?*

**Answer: Renal malformations**

Taking an ACE inhibitor during the first trimester can result in organ malformations. Taking one in the second or third trimester can cause renal malformations and/or renal failure. This patient should discontinue lisinopril and may start a safer alternative such as nifedipine or hydralazine.

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**TOPIC:** Identify contraindications to antiarrhythmic medications

*A 70-year-old man seeks a second opinion regarding frequent episodes of paroxysmal atrial fibrillation that were detected on a 48-hour Holter monitor. He is markedly symptomatic with frequent palpitations and presyncope. Each episode can last from 30 minutes to 2 hours. His PMH is significant for old anterior wall MI, and his LVEF is 20%. His medications include enalapril, carvedilol, digoxin, and warfarin. On physical examination, his BP is 120/80 mmHg, and his heart rate is 78 beats/minute. He appears well compensated and is free of signs of CHF. Which of the following is most appropriate antiarrhythmic agent?*

**Answer: Amiodarone**

This patient had a previous MI and has depressed LV systolic function. He is symptomatic with his atrial fibrillation and must be treated aggressively. Amiodarone, a class III antiarrhythmic medication, is a potent agent that exerts its effect broadly on all phases of the action potential. It is ideal in this situation because it has negligible negative inotropic effect. Patients are orally loaded in the hospital and are observed for the development of symptomatic bradycardia and Torsade de Pointe due to QT prolongation. The only other viable option in this patient is dofetilide, a new class III antiarrhythmic therapy that is given to patients with a low EF who have a contraindication to amiodarone.

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**TOPIC:** The Tachyarrhythmias

*A 77-year-old male with a history of COPD and diabetes mellitus presents to the ED with palpitations. He is atrial fibrillation with rapid ventricular response. He has been feeling palpitations for about 3 days but is unsure. The patient has never had an abnormal rhythm before but had a TIA in the past. Otherwise, he feels fatigued and has palpitations, but no chest pain, shortness of breath, or any other symptoms. Currently his vitals are as follows: HR 133 and irregular, BP 129/82, and SpO2 97% on RA. Lungs are clear but distant, and HR is irregularly irregular. There is no peripheral edema. EKG shows atrial fibrillation. CXR shows cardiomegaly. Labs are as follows: K 4.2, CO2 25, Na 141, BUN 8, Cl 101, Cr 0.8, Mg 2.1, glucose 121. Which of the following is the next step after anticoagulation?*

**Answer: Control and decrease ventricular rate with beta-blocker or calcium channel blocker**

Atrial fibrillation is the most common sustained arrhythmia. It is characterized by a rapid and irregular atrial beat. Rates can vary from 120 to as high as 200+. Ventricular rate is dependent on AV junction conduction and will be irregular as well. The cause of atrial fibrillation appear to originate from musculature that enters the pulmonary veins and is a focus of abnormal automaticity or firing that may be regulated by autonomic stimuli. Symptoms from atrial fibrillation vary widely from none to dramatic hypotension and shock. EKG findings reflect poor atrial organization with chaotic P-wave morphology or lack of a P-wave and an irregularly irregular rhythm. This patient is experiencing new onset atrial fibrillation with rapid ventricular response with unknown duration. With an unknown duration and at a high risk of an embolic event from atrial fibrillation, the patient will be anti-coagulated. Early goals of therapy in atrial fibrillation are to rate control with beta-blocker (verpamil or diltiazem) and to evaluate for anticoagulation. In the AFFIRM trial of rate versus rhythm control, there was no difference in mortality. A mortality benefit was shown in those age 65 and older and those with heart failure. Patients with risk factors for stroke (history of CVA/TIA, systemic embolic events, age >75, history of CHF, DM, HTN) should be evaluated for anticoagulation and placed on appropriate pharmacotherapy.

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**TOPIC:** Anti-hypertensive and Lipid-lowering Treatment to Prevent Heart Attach Trial (ALLHAT)

*A 47-year old black male with a history of GERD presents for a follow-up. At his last visit 3 months ago, he was started on omeprazole for GERD. His symptoms have improved, and he denies any acute complaints. On physical exam, the patient's temperature is 37.8, respiratory rate is 12 breaths/minute, and blood pressure is 158/85 mmHg with a BMI of 29. The rest of his exam is within normal limits. His blood pressure at the last visit was 160/78 mmHg. Besides lifestyle modifications, what other interventions are recommended?*

**Answer: Hydrochlorothiazide**

This patient has had 2 blood pressure readings with systolic pressures >140 mmHg. In addition to lifestyle modifications, an antihypertensive medication should be started to prevent serious cardiovascular and cerebrovascular outcomes. The JNC8 released updated guidelines for the management of high blood pressure in adults. It is recommended that for patients <60 years, the goal BP should be <140/90 mmHg. Losartan, hydrochlorothiazide, and lisinopril are appropriate first line anti-hypertensive medication, and a thiazide-type diuretic or calcium channel blocker is recommended in the black population.

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**TOPIC:** Understand commonly seen congenital heart disease findings and presentations

A 36-year-old man presents to the ER with sudden onset of atrial fibrillation. He is hemodynamically stable but has a systolic murmur at the left upper sternal border radiating to the back, a widely fixed split second heart sound, and a diastolic flow rumble along the right lower sternal border. The most likely diagnosis is:

Answer: **Atrial septal defect**

ASD commonly presents in the adult, and the first symptom may be the sudden onset of atrial flutter or atrial fibrillation. At least 12-15% of adult patients have atrial fibrillation pre-operatively. Physical findings that demonstrate this is an ASD include the murmur of increased pulmonary blood flow at the left upper sternal border radiating to the back, the pathognomonic finding of a fixed split-second heart sound, and the diastolic flow rumble along the right mid-right lower sternal border (functional tricuspid stenosis), which suggests that this patient has a large left-to-right shunt at the atrial level. Adult patients with ASD tend to have large defects that raise the question of whether somewhat smaller defects in childhood actually stretch and become larger defects in adults with significant left-to-right shunts. ASDs are also more common in women, with a female-to-male ratio of 2 to 3:1.

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**TOPIC:** Digoxin Toxicity

You are evaluating a 78-year-old female with congestive heart failure. She is complaining of nausea, anorexia, weakness, chromatopsia, and hallucinations. Which of the following findings would you expect to be consistent with this presentation?

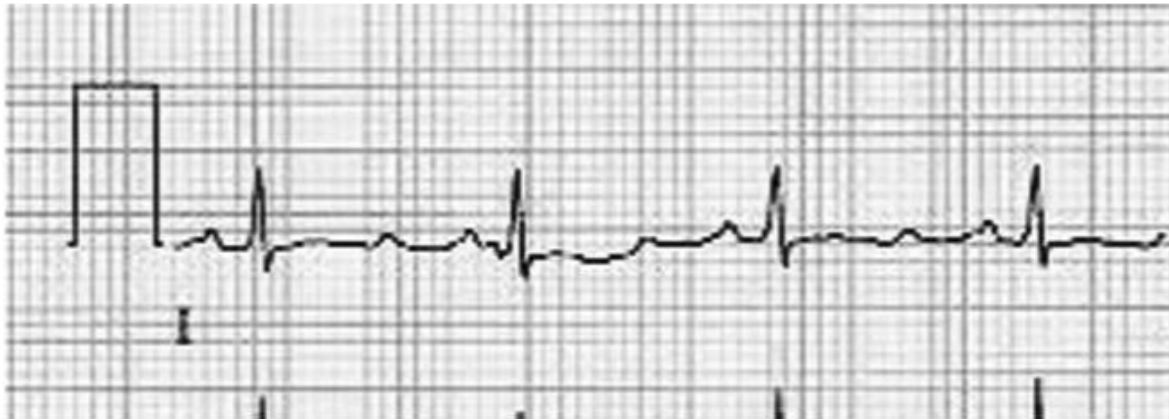
Answer: **Hypokalemia**

The patient's history and presentation suggest possible chronic digoxin toxicity, which often occurs in elderly patients with impaired renal function. Hypokalemia is more common in chronic toxicity but in acute toxicity, hyperkalemia is often seen. Ventricular tachyarrhythmia, premature ventricular contractions, and atrioventricular block are the dysrhythmias most frequently associated with chronic digoxin toxicity. Acute toxicity more frequently manifests with bradycardia and atrioventricular blocks, although there are occasional atrial or ventricular dysrhythmias. Digoxin increases the potassium release from the cell and also increases the influx of calcium. It works through inactivation of the ATPase-dependent sodium potassium pump and has a positive inotropic effect on the myocardium. It also slows atrioventricular conduction. Digoxin is indicated for treatment of CHF and supraventricular tachydysrhythmias.

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**TOPIC:** Identify appropriate management of polymorphic ventricular tachycardia in the setting of electrolyte disturbances

A 40-year-old obese, nulliparous woman is seen for evaluation of acute-onset abdominal pain that began shortly after she finished dinner. Her vital signs include temperature of 38.8 °C, BP of 96/58 mmHg, respiratory rate of 26 breaths/minute, and heart rate of 115 beats/minute. She reports moderate to severe abdominal pain in the midepigastrium radiating to her back on physical examination. The lungs are clear, and there are no murmurs elicited on auscultation of the precordium. After volume resuscitation with isotonic saline is initiated, the below ECG is obtained. Shortly after this EKG is obtained, she collapses and is returned to sinus rhythm after successful defibrillation of polymorphic ventricular tachycardia. What is the next best step in managing this patient?



Answer: **Obtain IV access and administer 2 amps of calcium gluconate and 4g magnesium sulfate**

This woman presents with pancreatitis likely due to an entrapped gallstone. The ECG demonstrates a prolonged QT interval likely due to the presence of hypocalcemia. Hypocalcemia accompanies pancreatitis largely due to free fatty acid precipitation of calcium. The preferred agent for correcting hypocalcemia is calcium gluconate and, in addition to correcting possible hypomagnesemia in this situation, represents the best course of action.

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**TOPIC:** Understand the physical examination findings found in aortic stenosis

The most reliable physical finding in predicting severe aortic stenosis is:

Answer: **Delayed carotid upstroke**

The carotid pulse is normally characterized by a smooth and rapid upstroke. Compare the pulse timing with the cardiac point of maximum impulse to determine if it is delayed.

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**TOPIC:** Acute pericarditis

*What is the main reason for declining cases of post-MI pericarditis and Dressler syndrome?*

**Answer: Early reperfusion**

Early reperfusion via thrombolytics and cardiac catheterization is the main reason for the decline in post-MI pericarditis and Dressler syndrome. The other choices are beneficial in the prevention and/or treatment of CAD and acute MI. Dressler syndrome (also known as post-MI syndrome) is a secondary form of pericarditis resulting from injury to the heart or the pericardium. It is believed to result from an autoimmune inflammatory reaction to the products of myocardial injury.

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**TOPIC:** Recognize the signs and symptoms of an atrial septal defect

*A 32-year-old Vietnamese female nurse requested a routine physical examination and an EKG because of a strong family history of CAD. She is asymptomatic. On examination, she appears healthy, with a BP reading of 122/76 mmHg and a heart rate of 76 beats/minute. Her cardiac examination is notable for a regular rate and rhythm with normal S2 and a widely fixed split S2. She has a 2/6 systolic ejection murmur that is heard best at the left upper sternal border, third interspace, and no gallops or diastolic murmurs are present. Her lungs are clear, and she has no evidence of ascites or peripheral edema. No cyanosis or clubbing is present. Her chest radiograph demonstrates enlarged pulmonary arteries with increased vascularity in both lung fields. Her EKG reveals right ventricular hypertrophy. What is the patient's most likely diagnosis?*

**Answer: ASD**

This patient has evidence of right-sided volume overload with EKG changes consistent with right ventricular hypertrophy. The fixed split S2 is the key distinguishing feature that is pathognomonic for ASD.

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**TOPIC:** Acute MI

*A 61-year-old insurance executive has just been hospitalized with an ST-elevation myocardial infarction. About 1 year ago, elective angiography revealed 60-70% concentric stenosis of the mid left anterior descending artery, a right coronary artery with luminal irregularities and <50% stenosis, and a tortuous left circumflex coronary artery. Which of the following is the most likely precipitant of this patient's acute MI?*

**Answer: <50% RCA lesion**

The pathophysiology of STEMI is acute plaque rupture and occlusive thrombin formation. Several observational studies, most notably the PROSPECT study, have demonstrated that plaque instability, not the degree of stenosis, drives the risk of plaque rupture. The classic high-risk lesion is an eccentric, <50% stenosis with a metabolically active fibroatheroma encased by a thin, fragile cap. This is in contrast to non-ST elevation MI/ACS, where plaque rupture is often a feature but at-risk territories supplied by high-grade stenoses are particularly susceptible.

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**TOPIC:** Infective endocarditis

*A patient who is an IV drug user presents with intermittent visual loss and fundoscopic eye exam showing white-centered hemorrhages in the retinal artery. Which of the following conditions does this patient most likely have?*

**Answer: Infective endocarditis**

White-centered hemorrhages in the retinal artery on a fundoscopic examination are known as Roth spots. In association with intermittent visual loss – especially in a patient with IV drug use history – this finding is seen in endocarditis. The initial diagnostic test would be a transthoracic echocardiogram but blood cultures would help in confirming the diagnosis.

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**TOPIC:** 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery

*A 58-year-old male visits his primary care provider for a preoperative evaluation before undergoing elective left total knee arthroplasty in 1 week after a recent injury. His past medical history include coronary artery disease, DM, HTN, HLD, and obesity (BMI 37.4). The patient has been complaining of exertional angina and underwent balloon angioplasty to the obtuse marginal coronary artery 4 weeks ago. He denies any chest pain or shortness of breath. He used to be able to walk 1 mile without symptoms, but recently this has been difficult due to his left knee pain. He hopes the surgery will help resolve his pain.*

*On physical examination, his temperature is 37.4 °C, pulse rate 76/min, blood pressure is 131/81 mmHg, and respiration rate is 18/min with an oxygen saturation of 98% on room air. There is a grade II/VI soft early peaking systolic murmur over the right second intercostal space but without radiation to the carotid arteries. Jugular venous pressure is 6cm. There is no lower extremity edema. The rest of his physical examination is normal. Current medications include: Aspirin 81mg daily, Clopidogrel 75mg daily, metoprolol 25mg twice daily, lisinopril 20mg daily, isosorbide mononitrates 30mg every morning, simvastatin 40mg before bed,*

metformin 1000mg twice daily, and oxycodone 10mg every 4 hours as needed. His laboratory workup is shown in the table below. EKG shows a normal sinus rhythm. What is the next step in management?

Complete blood count	
White blood cells	7.2 $10^9$ /L
Red blood cells	3.5 $10^9$ /L
Hemoglobin	13.8 g/dL
Hematocrit	42.4%
MCV	88.7 fL
MCH	32.5 pg
MCHC	34.4 g/dL
RDW	12.1%
Platelets	251 $10^9$ /L
Neutrophils	69.5%
Lymphocytes	17.5%
Monocytes	11.0%
Eosinophils	1.1%
Basophils	0.4%
Chemistry Panel	
Sodium	141 mEq/L
Potassium	4.1 mEq/L
Chloride	101 mEq/L
Bicarbonates	27 mEq/L
Blood urea nitrogen	11 mg/dL
Creatinine	0.9 mg/dL
Glucose	127 mg/dL
Calcium	9.2 mg/dL
Hemoglobin A1c	6.8%

Answer: **Proceed with surgery**

Elective non-cardiac surgery should be delayed for 14 days after balloon angioplasty. Since this patient had coronary angioplasty 4 weeks ago, he can proceed to surgery.

**TOPIC:** Understand an approach to supraventricular arrhythmias

A 75-year-old man reports the acute onset of shortness of breath to a 911 operator and is transported to the ER with tachycardia. Upon arrival to the ER, his BP is 112/78 mmHg, and his respiratory rate is 28 breaths/minute. An EKG is obtained, and the results are shown below. Which of the following statements is most true about the EKG findings?



Answer: **Administration of IV adenosine may aid identification of the rhythm.**

The EKG demonstrates 2:1 atrial flutter with rapid ventricular response. P waves are clearly seen in leads V2-V3 following the QRS complex, confirming the diagnosis. The administration of IV adenosine briefly blocks transmission of atrial activity at the level of the AV node, allowing visualization of the flutter waves that may be buried in the QRS complex.

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**TOPIC:** Therapy for Cardiac Arrhythmias

*A patient has chronic atrial fibrillation and wants another trial of medication before pursuing ablation. The cardiologist agrees to try dofetilide. What is the next step in the management of this patient?*

**Answer: Hospital admission with serial EKG's**

This patient has presumably already tried other antiarrhythmics to control his or her atrial fibrillation. Dofetilide is a Class III antiarrhythmic that is often used as one of the last medications before ablation is attempted. Initiating dofetilide has stringent requirements. Electrolytes must be checked and in the normal range. The QTc must also not be prolonged, as the major side effect of dofetilide is QTc prolongation. For this reason, initiating dofetilide requires hospital admission with serial EKG's for the first 5 doses to monitor the QTc.

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**TOPIC:** Review of indications for IE prophylaxis

*A 70-year old man presents for a routine medical examination. Five years earlier, he underwent aortic valve replacement with a bioprosthetic valve for severe calcific aortic stenosis. His most recent ECHO performed 1 year ago showed normal LV function with a well-seated aortic valve prosthesis, peak transaortic gradient of 20 mmHg, and mean gradient of 12 mmHg. He reports feeling well and denies any symptoms. His PMH is notable for an adenomatous colon polyp removed 3 years prior. His gastroenterologist recommends a repeat colonoscopy given his history of adenomatous polyps. What is your recommendation regarding infective endocarditis prophylaxis for this patient's upcoming colonoscopy?*

**Answer: Routine antibiotic prophylaxis to prevent IE is not necessary for GI tract procedures**

The revised 2007 guidelines from the AHA represented a dramatic shift in position on IE prophylaxis when compared with prior consensus statements. On careful review of literature, the AHA committee concluded that bacteremia is far more common from daily activities such as brushing than from dental or other procedures. Given the dearth of data showing that antibiotic prophylaxis significantly reduced the risk of IE, the committee recommended prophylaxis in only a limited number of situations. Specifically, only patients with prosthetic cardiac valves, prior endocarditis, certain types of congenital heart disease, or cardiac transplantation with valvulopathy now warrant prophylaxis. The patient in this case does have a prosthetic aortic valve, which places him in a higher risk group for IE. However, the recent guidelines state that IE prophylaxis is not needed for any routine diagnostic GU or GI procedures. Accordingly, antibiotics would not be recommended in this case. While the patient likely does warrant a repeat ECHO to assess his prosthetic valve, the status of the valve has no bearing on the decision to give IE prophylaxis.

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**TOPIC:** Pericardial diseases

*Cholesterol-rich ("gold paint") effusions are typically seen in patients with which condition?*

**Answer: Hypothyroidism**

Patients with hypothyroidism have impaired lipid and cholesterol metabolism. One manifestation of this can be "gold paint" pericardial effusions that contain large quantities of cholesterol.

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**TOPIC:** Evolving options in the management of esophageal perforation

*A 40-year old male presents to the emergency department with chest discomfort. This symptom started 2 days ago while lifting heavy objects, then he developed dyspnea, subjective fevers, fatigue, odynophagia, and decreased appetite. He reports mild nausea but no vomiting. Past medical history include heavy alcohol use. The patient does not take any medications and has not traveled recently.*

*On physical examination, his temperature is 38.4 °C, pulse rate is 84/min, blood pressure is 141/88 mmHg, and respiration rate is 18/min. BMI is 29. There is a grade II/VI early peaking systolic murmur over the left sternal border without rubs. There is no edema or tenderness of the calves. Initial EKG is normal. Chemistry panel is normal. Complete blood count shows a WBC count of 14,215/mm<sup>3</sup>. Initial troponin T level is normal. D-dimer level is normal. After receiving 1 sublingual nitroglycerin, his chest discomfort persists, and he reports lightheadedness. What is the most appropriate next step?*

**Answer: Order chest CT with IV contrast**

Although the pretest probability of coronary artery disease in this patient is intermediate, the chest discomfort is unlikely to be ischemic in origin. It is still necessary to rule out cardiac etiologies; however, other noncardiac etiologies should always be considered and evaluated. The onset was related to weightlifting, and the patient had signs of sepsis with other non-cardiac symptoms such as odynophagia. Esophageal perforation should be in the differential diagnosis. It is due to a sudden increase in intraesophageal pressure while the intrathoracic pressure is negative, which result in a tear of the esophageal wall. This can happen from vomiting, coughing, and weightlifting. The perforation can result in contamination of the mediastinum with esophageal flora and cause acute bacterial mediastinitis and chest discomfort. This can be life-threatening condition if the diagnosis is missed and antimicrobial therapy is delayed. Risk factors include chronic alcoholism. Chest CT scan with IV contrast has very high sensitivity and specificity in diagnosis, as it can detect signs of esophageal perforation and mediastinitis.

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**TOPIC:** AHA/ACC/HRS Guideline for the Management of Patients with Atrial Fibrillation

An 81-year old female presents to the emergency department with dyspnea and chest discomfort that started 15 hours ago. Her past medical history includes coronary artery disease, DM, HTN, HLD, CKD stage 3, and stroke. On physical examination, her temperature is 37.6 °C, pulse rate is 141/min, blood pressure is 91/45 mmHg, and respiration rate is 25/min with an oxygen saturation of 95% on room air. The patient is in respiratory distress. EKG shows atrial fibrillation. What is the next step in management?

**Answer: Arrange direct-current cardioversion**

Fast tachyarrhythmias decrease left ventricular filling time, compromise cardiac output, and result in hypotension. Management includes resolution of tachyarrhythmia if possible. Direct-current cardioversion should be attempted to restore sinus rhythm.

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**TOPIC:** Pericardial diseases

On physical examination of a patient with constrictive pericarditis, which of the following findings is most likely?

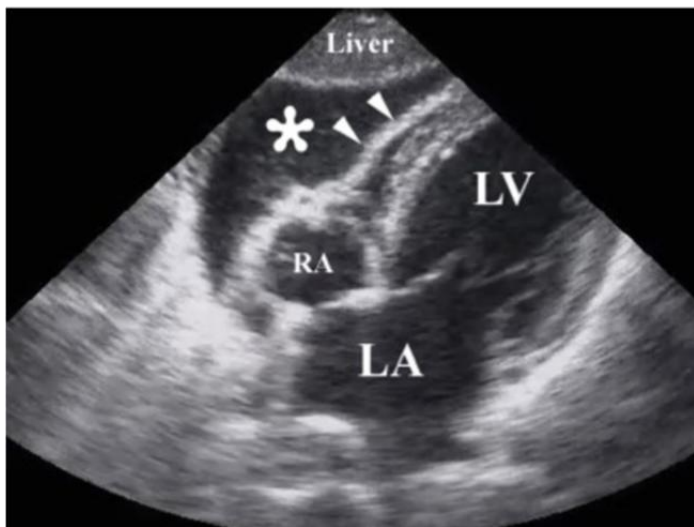
**Answer: Pericardial knock**

The most notable cardiac finding on physical examination of patients with constrictive pericarditis is the pericardial knock, an early diastolic sound best heard at the left sternal border or the cardiac apex.

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**TOPIC:** Cardiac tamponade

A 55-year-old female with metastatic breast cancer presents to her local ED with a 1-week history of progressively worsening lightheadedness and dyspnea on exertion. Physical exam is notable for HR of 110 beats/minute, BP of 85/60, RR of 16 breaths/minute, and oxygen saturation of 98% on room air. She has distended neck veins, muffled heart sounds, and pulsus paradoxus. CXR reveals a widened mediastinum. A bedside transthoracic ECHO is done, and a representative image is shown below. What should be done next?



**Answer: Start IV fluids and prepare for urgent pericardiocentesis**

The patient's history and physical exam are consistent with a cardiac tamponade that needs rapid treatment. This is confirmed by the bedside transthoracic ECHO image, which reveals pericardial effusion (marked with a \*) that is causing right ventricular diastolic collapse, which is a specific sign for cardiac tamponade. The etiology of the pericardial effusion is likely metastatic breast carcinoma. Delaying for confirmation would delay life-saving pericardiocentesis. Her presentation is not consistent with pericarditis at the present time.

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**TOPIC:** Cardiogenic shock

Emergency medical services bring a 55-year-old man with a previous history of CAD and a prior MI to the emergency department with severe substernal chest pain radiating to his left shoulder and jaw. The pain has been persistent for approximately 20 minutes. On questioning, the patient has experienced similar pain intermittently throughout the previous 48 hours, as well as shortness of breath, diaphoresis, and nausea.

His pain improves somewhat after 2 nitroglycerin tablets given sublingually. Vital signs are stable, and his ECG reveals changes consistent with an anterior MI. He is admitted to the coronary ICU. While there, he develops severe systemic hypotension (BP 80/30 mmHg) and dyspnea. He is given vasopressor and inotrope support, and a pulmonary artery catheter is placed. The patient's pulmonary artery wedge pressure is 18mmHg, and the cardiac index is 2.0L/min/m<sup>2</sup>. Which of the following statements regarding this man's diagnosis is incorrect?

Answer: **10% of patients develop cardiogenic shock with AMI, and this is usually present in those patients on admission**  
Cardiogenic shock, clinically described as severe systemic hypotension, cool extremities, and respiratory distress, occurs in approximately 6-7% of patients with acute MI. These patients are often older and female and have an anterior or large infarction, previous MI, or DM. In the Global Utilization of Streptokinase and t-PA for Occluded Coronary Arteries I trial, however, only 0.8% of patients presented with shock to the hospital, and shock developed either suddenly (as in this patient) or gradually in the remaining 5.3% after admission. Most cases occur within 24 hours to days afterward; cases occurring 1 week afterward are rare.

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**TOPIC:** Management of hypertension in pregnant and postpartum women  
*Which of the following medications is the safest during pregnancy?*

Answer: **Methyldopa**

This question is essential for all practitioners who will care for pregnancy patients, as many anti-hypertensive medications are teratogenic. Both ACE inhibitors and ARB can cause organ malformations, especially renal. They are classified as pregnancy Category D. Calcium-channel blockers, such as nifedipine, have little data concerning safety in pregnant patients. Amlodipine, in particular, has little data in pregnancy and is Category C. Methyldopa, although not used commonly in non-pregnant patients, has excellent data and is safe in pregnancy.

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**TOPIC:** Identify and treat postpartum cardiomyopathy

*An active 32-year-old woman presents with a chief complaint of fatigue and exercise intolerance. She had an uncomplicated pregnancy and delivered her second child 2 months ago. On examination, her BP is 110/80 mmHg, and her heart rate is 86 beats/minute. Her neck veins are flat, without elevation of jugular venous pressure, and her point of maximal intensity is enlarged and laterally displaced. A 2/6 holosystolic murmur is present at the apex, without an S3 gallop. The rest of the examination is unremarkable. Her chest radiograph shows cardiomegaly. An EKG reveals normal sinus rhythm with complete left bundle branch block. Her two-dimensional echo shows biventricular enlargement with an LVEF of 30% and 2+ MRs. Which of the following agents is first line therapy in this patient?*

Answer: **Enalapril**

The patient's diagnosis is postpartum cardiomyopathy, and she has moderate LV systolic dysfunction and moderate MR. She is clinically well compensated and has mild limitation in her activities of daily living. The first-line therapy for her is the ACE inhibitor enalapril. The Studies of Left Ventricular Dysfunction (SOLVD) trial demonstrated a significant reduction in both mortality and rate of hospitalization in both symptomatic and asymptomatic patients with reduced LV systolic function regardless of etiology.

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**TOPIC:** Pericardial diseases

*Which of the following findings can distinguish constrictive pericarditis from cardiac tamponade?*

Answer: **Cardiac tamponade is characterized by an increase in systemic venous return with inspiration, but in constrictive pericarditis, systemic venous return does not increase with inspiration.**

Cardiac tamponade is characterized by an increase in systemic venous return with inspiration, enlarging the right heart and encroaching on the left, while in constrictive pericarditis, systemic venous return does not increase with inspiration under resting conditions. Cardiac tamponade typically presents with paradoxical pulse, equal left and right-sided filling pressures, and absent y descent. Constrictive pericarditis rarely presents with a paradoxical pulse. Similar to cardiac tamponade, constrictive pericarditis presents with equal left and right-sided filling pressures. Constrictive pericarditis presents with a prominent y descent and the rigid pericardium prevents the normal inspiratory decrease in intrathoracic pressure from being transmitted to the heart.

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**TOPIC:** Colchicine as first-choice therapy for recurrent pericarditis

*For patients at increased risk for recurrences of acute pericarditis, which of the following medications is useful for prophylaxis?*

Answer: **Colchicine**

Perhaps 15-30% of patients with acute pericarditis suffer a relapse. Women and other patients who fail initial therapy with NSAID's are at increased risk. There is now substantial evidence that prophylaxis with colchicine can reduce episodes of relapses.

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**TOPIC:** Composition of normal pericardial fluid and its implications for diagnosing pericardial effusions

*What is the predominant cell type in normal pericardial fluid?*

Answer: **Lymphocyte**

Normal pericardial fluid has features of a plasma ultrafiltrate. However, the lactate dehydrogenase level is typically 2.4x that of plasma, and the mean protein level is 0.6x that of plasma. The predominant cell type in normal pericardial fluid is lymphocytes. None of the other cell types are typically seen in normal pericardial fluid.

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**TOPIC:** Understand commonly seen congenital heart disease findings and presentations

A 20-year-old female who is joining an intermural team at her college was noted to have an unusual murmur on her sports physical before the season began. The doctor thought he heard a continuous murmur at the left upper sternal border associated with a slightly widened pulse pressure and brisk to bounding pulses. Which of the following is the most likely diagnosis?

Answer: **PDA**

Many adult patients with PDA are asymptomatic, depending on the size of the left-to-right shunt and the size of the ductus. Frequently, the condition is discovered by the unusual quality of a continuous murmur at the left upper sternal border that can sound like an innocent venous hum. Because a patent ductus is an aortopulmonary runoff, however, the pulse pressure frequently is widened, and the pulses are brisk to bounding. Today, most lesions of ductus can be closed in the catheterization lab without surgery.

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**TOPIC:** Genesis of cardiac arrhythmias

A 33-year-old female presents to the emergency department within 1 hour of palpitations. She has never experienced this before and is beginning to feel anxious that the symptoms are not passing. On physical exam, she is extremely tachycardic with a heart rate of 174. EKG is consistent with SVT. Which physiological mechanism explains this rhythm?

Answer: **Circular electrical conduction**

This young female is experiencing a tachyarrhythmia that is common in emergency departments. SVT is a pathologic tachycardia stimulated by a focus above the AV node, and it presents with a narrow QRS complex on EKG. Traditionally, the treatment is with adenosine. Mechanically, most SVT occurs by way of re-entry. Re-entry is a phenomenon of an electrical impulse traveling in a circular direction by 2 different conduction pathways. One conduction pathway has a short conduction time with a long refractory period, while the other has a long conduction time with a short refractory period. Thus, the electrical stimulus is blocked in the pathway with a long refractory period and travels down the pathway with a long conduction time. By the time it makes it through, the other pathway will no longer be refractory and can then conduct the impulse. This sets a continuous loop that can cause extreme tachycardia.

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**TOPIC:** Therapy for Cardiac Arrhythmias

What is the Vaughan Williams antiarrhythmic classification of procainamide?

Answer: **Class IA**

Procainamide is a Class IA medication. Class IA medications decrease the rate of rise of phase 0 of the action potential, prolong action potential duration, and are intermediate kinetics compared to IB and IC

Class I, sodium channel blockers

Class II, beta-blockers

Class III, potassium channel blockers

Class IV, calcium channel blockers

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**TOPIC:** Therapy for Cardiac Arrhythmias

A patient with atrial fibrillation is undergoing direct current cardioversion. The medical student on hand is assigned the task of delivering the shock. Just before he pushes the button, the cardiology fellow stops him and asks if the defibrillator is synchronized. What post-shock complication could occur if the defibrillator is not synchronized?

Answer: **ventricular fibrillation**

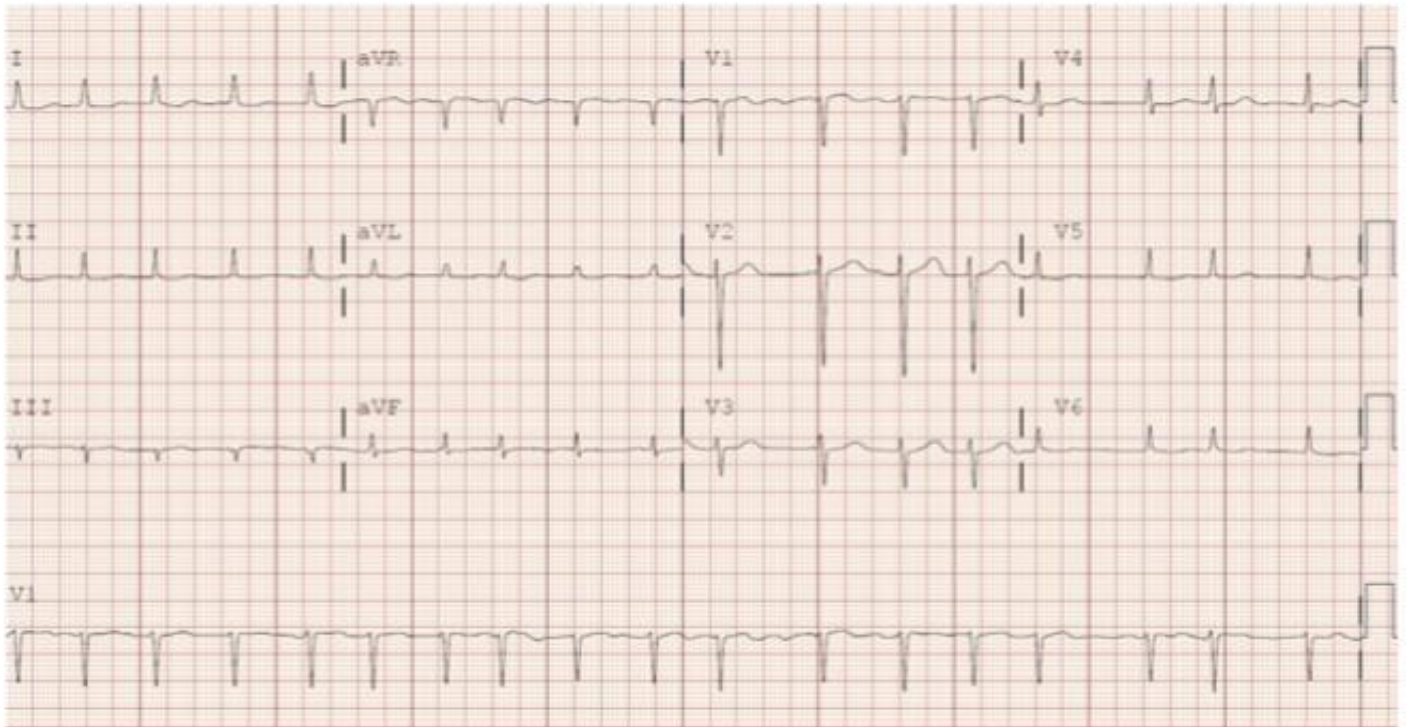
This situation illustrates a critical concept for anyone who will ever have to use a defibrillator. When a patient is pulseless with ventricular tachycardia or ventricular fibrillation, unsynchronized cardioversion is used. However, other tachyarrhythmias require synchronized cardioversion to avoid more malignant rhythms. When delivering a synchronized defibrillation, the shock should be synchronized with the R-waves of the QRS complex. Most defibrillators will have a synchronize button that can automatically do this. Defibrillation will essentially "reset" that heart's electrical system since all cells are depolarized and then become refractory. This disrupts any re-entrant circuits or ectopic cardiac pacemakers, allowing the SA node once again to take over. By not synchronizing, this electrical stimulus could be delivered during cardiac repolarization and can induce ventricular fibrillation

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**TOPIC:** Atrial fibrillation

A 49-year-old female presents to the ED with dyspnea on exertion that started 1 week ago. Her condition started after influenza-like symptoms. She denies chest pain or shortness of breath at rest. History includes morbid obesity (BMI 41) and sleep apnea. She does not take medication and has no known allergies. On physical examination, her temperature is 37.6 °C, pulse rate is 121/min, blood pressure is 151/85 mmHg, and respiration rate is 20/min with an oxygen saturation of 99% on room air. Jugular venous pressure is 7cm. There is trace pedal edema. Physical exam is otherwise normal. EKG and lab results are shown below. Which of the following is the next step?





Chemistry Panel	
Sodium	139 mEq/L
Potassium	4.1 mEq/L
Chloride	100 mEq/L
Bicarbonates	31 mEq/L
Blood urea nitrogen	11 mg/dL
Creatinine	0.9 mg/dL
Glucose	268 mg/dL
Calcium	8.5 mg/dL
Hemoglobin A1c	9.2%

Answer: **Start diltiazem**

The EKG shows atrial fibrillation at a rate of 110 bpm. The patient would benefit from rate control with diltiazem. The EKG does not show wide-complex tachycardia that is concerning for ventricular tachycardia, therefore lidocaine is not indicated. Since the atrial fibrillation started over 48 hours ago, anticoagulation should be started for 3 weeks before cardioversion to minimize the risk of thromboembolic events. Therefore, cardioversion, whether electrical or pharmacological, is currently contraindicated

**TOPIC:** Anti-hypertensive medications & pregnancy

*A 32-year old woman presents to the emergency room with nausea and vomiting for 1 week. She has a history of hypertension, hyperlipidemia, and a pulmonary embolism once 2 months ago. She takes lisinopril 20mg daily, simvastatin 20mg daily, and warfarin. Her INR is 2.2 and her chemistry and CBC are normal. Amylase is slightly elevated and lipase is normal. Urine pregnancy test is positive. What change to her medications should be made?*

Answer: **Stop warfarin and start subcutaneous LMWH for 4 months. Stop lisinopril and continue labetalol for management of hypertension during pregnancy. Stop simvastatin and obtain fasting lipid panel, as patient may not need to continue any drug therapy for hyperlipidemia during pregnancy.**

Warfarin, ACE inhibitors, ARB, and simvastatin are all teratogens and contraindicated during pregnancy. The alternative option for warfarin is twice daily subcutaneous injection of LMWH. Hypertension control is important during pregnancy, and labetalol is a safe choice. Other choices for hypertension treatment during pregnancy include methyldopa, hydralazine, and nifedipine. Other calcium channel blockers and beta-blockers may not have been studied or may not be safe during pregnancy. Simvastatin can often be stopped during pregnancy, as an interruption of treatment rarely affects the long-term outcome.

**TOPIC:** Heart murmurs

A 27-year-old woman has recent onset of shortness of breath going upstairs and a history of palpitations. Physical examination reveals a regular pulse, a loud S1, and an apical diastolic murmur. The most likely diagnosis is:

Answer: **Mitral stenosis**

The physical findings associated with MS can be subtle, but in addition to clinical history can help in making a diagnosis that is confirmed by ECHO. A loud S1 and an apical diastolic murmur that is low-pitched are classic findings. Pink-to-purple colored patches (mitral facies) and signs of CHF can also be seen

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**TOPIC:** AHA/ACC/HRS Guidelines for the Management of Patients with Atrial Fibrillation

A 71-year old female presents to the emergency department with dyspnea and chest discomfort. Her family came to visit and found her in this condition. They are not sure how long these symptoms have persisted. The patient's past medical history includes dementia, CAD, DM, hypertension, hyperlipidemia, CKD stage 3 and stroke. On physical examination, her temperature is 37.6 °C, pulse rate is 148/min, blood pressure is 92/41 mmHg, and respiration rate is 26/min with an oxygen saturation of 95% on room air. She is in respiratory distress. EKG shows atrial fibrillation. The patient undergoes direct-current cardioversion, which successfully restores sinus rhythm. What is the next step in management?

Answer: **Start heparin and warfarin**

Patients who have atrial fibrillation or atrial flutter for >48 hours may develop left atrial thrombus. Cardioversion can place them at higher risk for thromboembolism and strokes. Unfortunately, if these patients are not hemodynamically stable, it is not possible to perform TEE to rule out left atrial thrombus. Furthermore, TEE after cardioversion would not change management. For patients with atrial fibrillation or atrial flutter for >48 hours or unknown duration that requires immediate cardioversion for hemodynamic instability, anticoagulation should be initiated as soon as possible and continued for at least 4 weeks after cardioversion unless contraindicated.

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**TOPIC:** Describe common murmurs

A 55-year-old woman presents to clinic. She states she is feeling well and denies any symptoms. During her physical examination, you discover that she has a 3/6 holosystolic murmur. The murmur does decrease in intensity when doing the Valsalva maneuver. What do you suspect in this patient?

Answer: **Mitral regurgitation**

MR murmur is a holosystolic murmur heard best at the apex, it will decrease in intensity when venous return is reduced. (standing or Valsalva maneuver)

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**TOPIC:** Cardiac physiology during pregnancy

Which of the following is true for normal physiologic hemodynamic changes during pregnancy?

Answer: **Increased blood volume, decreased SVR and PVR, increased HR, increased CO**

In pregnancy, there is an increase in plasma volume with a lower increase in erythrocyte count, leading to relative anemia, but increased whole blood volume by about 40%. This, in addition to decreased systemic vascular resistance (SVR) and pulmonary vascular resistance (PVR) from hormonal effects, with a minimal to mild increase in heart rate at rest (HR), leads to approximately 30% increased total cardiac output (CO). This may be an issue in a patient with known cardiovascular disease but otherwise is well tolerated. Further hemodynamic changes occur at the time of delivery (e.g. increased cardiac output and venous return from uterine contractions)

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**TOPIC:** Understand the management of mitral stenosis

A 40-year-old woman presents to you for evaluation of a cardiac murmur first noted several years ago. She denies any symptoms but has not been very active. She was born in Mexico and reports having had a febrile illness in childhood. She has otherwise been healthy and reports no additional PMH. Physical examination reveals no acute distress. BP is 120/60 mmHg, and heart rate is 75 beats/minute. Neck examination reveals normal carotid pulses and jugular venous pulsations. Her cardiac examination reveals a regular rhythm and a non-displaced PMI. There is a pronounced S1, a prominent P2, and an early diastolic sound followed by a low-pitched rumbling holodiastolic murmur at the apex. Her lungs are clear to auscultation, and extremities show no edema and normal peripheral pulses. A TTE is performed and reveals moderate MS with a valve area of 1.4 cm<sup>2</sup> and pulmonary artery pressure of 35 mmHg. Mitral valve leaflet tips are calcified, but the remainder of the valve is fairly pliable (splitability score = 5). Which of the following is the next appropriate step in management?

Answer: **Order stress ECHO to assess mitral valve gradients and PA pressure with exercise**

As in this patient's case, rheumatic heart disease is the most common etiology of MS. Pathologically, rheumatic disease is manifested as thickening of the mitral valve leaflets with fusion of the commissures and progressive fibrosis. As the mitral valve area narrows from 4-5cm<sup>2</sup> to <2cm<sup>2</sup>, a gradient begins to form between the left atrium and left ventricle. With time and further narrowing of the valve, the elevated left atrial pressure will be transmitted to the pulmonary circulation and right heart, producing pulmonary congestion and hypertension as well as right-sided pressure overload. This patient's examination and ECHO indicate she has moderate MS, but she remains ostensibly asymptomatic. Her pulmonary pressure is only mildly elevated at rest, but it is important to pursue exercise testing

to ascertain whether she develops severe pulmonary hypertension (pulmonary artery pressure systolic pressure >60 mmHg) or limitation to exercise. Given her favorable MV anatomy, these findings would constitute class I indications for PBMV.

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**TOPIC:** Identify the common symptoms and manifestations of aortic stenosis

*Common symptoms of aortic stenosis include all of the following, EXCEPT:*

**Answer: Ankle edema**

The cardinal features of symptomatic aortic stenosis are heart failure, syncope, and angina. Other common findings are dyspnea on exertion, decreased exercise tolerance, and dizziness. Ankle edema and other signs of right heart failure are uncommon in aortic stenosis.

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**TOPIC:** Understand commonly seen congenital heart disease findings and presentations

*A 32-year-old woman reports increasing shortness of breath. On examination, her pulse is regular, and a parasternal heave is noted. On auscultation, a continuous machinery-type murmur is present, with systolic accentuation that is best heard at the second intercostal space and left sternal border; it is also heard posteriorly. Clubbing and cyanosis of the toes are present, but not of the fingers. All of the following are true of this condition, EXCEPT:*

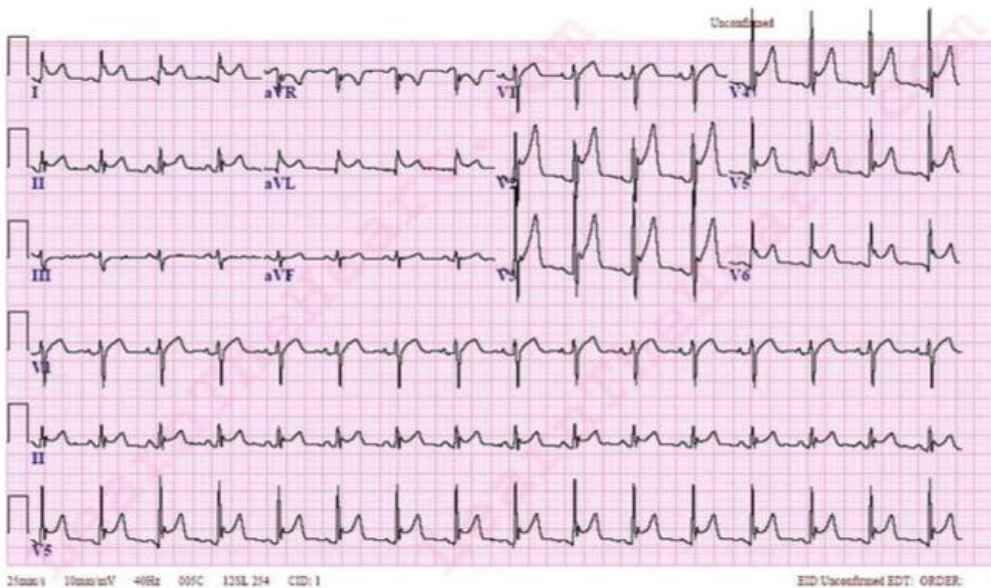
**Answer: Endocarditis prophylaxis is indicated before dental procedures**

PDA is more common in women than in men (3:1). It is associated with maternal rubella. Complications include infective endocarditis and Eisenmenger syndrome. For patients with untreated PDA, antibiotic prophylaxis is not necessary for medical or dental procedures. After percutaneous closure, antibiotic prophylaxis is indicated for six months. Severe pulmonary vascular disease leads to a reversal of flow and shunting of deoxygenated blood to the lower extremities, resulting in differential cyanosis. Once Eisenmenger syndrome has developed, corrective surgical intervention is no longer an option. The ductus is patent in the fetus but normally closes immediately after birth

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**TOPIC:** Acute pericarditis

*A bedside transthoracic echocardiogram of a patient with this ECG tracing is most likely to show which of the following findings?*



**Answer: Small pericardial effusion**

The EKG shows diffuse ST-segment elevation in almost all leads except for aVR as well as PR depression. This is most consistent with acute pericarditis. Acute pericarditis may be secondary to infection, an autoimmune process, neoplasm, and metabolic derangement as well as several other things. The ECG in acute pericarditis evolves through 4 stages. In stage 1 (hours to days), there are diffuse ST-segment elevation and PR-segment depressions. In stage 2, there is normalization of the ST- and PR-segments. In stage 3, there are diffuse T-wave inversions. In stage 4, the ECG either becomes normal, or the T-wave inversions persist.

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**TOPIC:** 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery

*A 58-year-old male visits his primary care provider for a pre-operative evaluation before undergoing an elective left total knee arthroplasty in 4 weeks. His past medical history include CAD, DM, hypertension, hyperlipidemia, and obesity (BMI 37.4). The patient has been hospitalized for a non-ST-segment MI 5 months ago and received a drug-eluting stent to the proximal left circumflex coronary artery. He denies any chest pain or shortness of breath. He used to be able to walk 1 mile without symptoms, but recently this has been difficult due to left knee pain. The patient hopes the surgery will help resolve his pain. The patient's current medications include aspirin 81mg daily, clopidogrel 75mg daily, metoprolol 25mg twice daily, lisinopril 20mg daily, isosorbide*

mononitrates 30mg every morning, simvastatin 40mg before bedtime, metformin 1000mg twice daily, and oxycodone 10mg every 4 hours as needed. EKG shows normal sinus rhythm. What is the most appropriate next step?

Answer: **Cancel surgery**

The patient received a drug-eluting stent, and dual anti-platelet therapy (with aspirin and clopidogrel) should be continued for 12 months to decrease the risk of stent thrombosis. Because the surgery elective, it is recommended to delay surgery until dual anti-platelet therapy is completed for 1 year total.

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**TOPIC:** Therapy for Cardiac Arrhythmias

*A 44-year-old female presents with acute onset of new palpitations. EKG is obtained in the emergency room shows the following. After discussion with the patient, electrical cardioversion is chosen. Unfortunately, it is unsuccessful. The cardiologist immediately orders a medication to attempt to convert the patient. Which medication was ordered?*

Answer: **Ibutilide**

This patient presents with palpitations and an EKG consistent with atrial flutter. Notice the distinct saw-tooth pattern of p-waves and 4:1 conduction present in the rhythm strip portion of the EKG. This EKG shows a heart rate close to 75. Keep in mind that atrial flutter always has an atrial rate of 300, and a ventricular rate is determined by the degree of AV nodal block. This is a 1:4 block here, which fits a ventricular rate of 75. Atrial flutter can be managed with either a rate control or rhythm control strategy, just like atrial fibrillation. The physician has elected to try rhythm control with cardioversion in this case. Unfortunately, this was unsuccessful. If this happens, it is common to attempt acute chemical cardioversion with the Class III antiarrhythmic ibutilide. This can be given in 1mg doses with a maximum dosage of 2mg. About 70% of patients with atrial flutter should convert using up to 2mg of this medication.

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**TOPIC:** Identify the indications for surgery in the treatment of severe aortic stenosis

*Surgical intervention is indicated in severe aortic stenosis for all of the following, EXCEPT:*

Answer: **Associated significant AR**

AR does not affect the decision regarding surgery in aortic stenosis. Surgery is indicated for symptomatic severe aortic stenosis, severe aortic stenosis undergoing coronary artery bypass grafting, or other surgical procedure on the aorta or cardiac valves, or severe aortic stenosis with an EF less than 50%. Untreated, these patients have decreased 2-year survival rates and higher likelihood of sudden cardiac death.

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**TOPIC:** Pericardial diseases

*Which of the following rhythms is most commonly seen with acute pericarditis?*

Answer: **Sinus tachycardia**

Many patients with pericarditis present with pain, fever, and possibly intravascular volume depletion. Therefore the typical patient presents with sinus tachycardia.

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**TOPIC:** Systemic hypertension

*Thiazide diuretics and thiazide-like diuretics are incompletely understood, but the decrease in blood pressure appears to be a response to initial volume loss. This fall in blood pressure is blunted by the action of the RAAS, but the blood pressure will still remain low or continue to fall slowly over as long as 12 weeks. What mechanism explains this continued blood pressure lowering after urinary sodium returns to normal?*

Answer: **Decreased peripheral vascular resistance**

Immediately upon initiation of a thiazide diuretic, patients experience diuresis and reduction in blood pressure due to volume loss. It is common to counsel patients that this will decrease within a few weeks. This decrease in diuresis is secondary to upregulation of the RAAS, which will increase sodium reabsorption in the kidney. It is likely fortunate that the diuresis slows, as it can lead to patients discontinuing the medication. After the initial diuretic effect, blood pressure continues to be improved even after the patient is no longer urinating more than normal. This is due to an overall decreased peripheral vascular resistance. Overall expect a drop of about 10 mmHg with thiazide diuretics.

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**TOPIC:** 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery

*A 65-year-old male visits his primary care provider for a preoperative evaluation before undergoing a femoropopliteal bypass surgery in 4 weeks for claudication. His past medical history includes hypertension. He smokes 2 packs of cigarettes per day and denies any chest pain, shortness of breath, orthopnea, or other complaints. The patient's exercise capacity is limited by pain in the lower extremities. A recent myocardial perfusion scan was normal. He takes only amlodipine 5mg every day. On physical examination, his temperature is 37.6 °C, pulse rate is 66/minute, blood pressure is 134/79 mmHg, and respiration rate is 18/min with an oxygen saturation of 99% on room air. Jugular venous pressure is 7cm. There is trace pedal edema. Physical exam is otherwise*

normal. Laboratory workup is shown in the following tables. EKG shows a normal sinus rhythm. Which of the following is the next step?

Complete blood count	
White blood cells	6.2 $10^9$ /L
Red blood cells	3.5 $10^9$ /L
Hemoglobin	13.8 g/dL
Hematocrit	42.4%
MCV	88.7 fL
MCH	32.5 pg
MCHC	34.4 g/dL
RDW	12.1%
Platelets	251 $10^9$ /L
Neutrophils	69.5%
Lymphocytes	17.5%
Monocytes	11.0%
Eosinophils	1.1%
Basophils	0.4%
Chemistry Panel	
Sodium	139 mEq/L
Potassium	4.1 mEq/L
Chloride	100 mEq/L
Bicarbonates	25 mEq/L
Blood urea nitrogen	11 mg/dL
Creatinine	0.9 mg/dL
Glucose	127 mg/dL
Calcium	9.2 mg/dL
Hemoglobin A1c	6.3%
Total cholesterol	150 mg /dL
Low-density lipoprotein	69 mg /dL
High-density lipoprotein	31 mg /dL

Answer: **Start atorvastatin**

Data increasingly suggests that statins have anti-inflammatory properties. Their benefits are beyond their effects on the lipid profile. The 2014 American College of Cardiology and American Heart Association Task Force Guidelines on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery recommend statin therapy in patients taking statins or those with CVD or equivalent risk. They also recommend initiating statins in patients undergoing vascular surgery.

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**TOPIC:** Therapy for Cardiac Arrhythmias

A 34-year-old female presents with extreme palpitations and near syncope. She had been at a bachelorette party with her friends for most of the previous evening. Immediate EKG shows the following result: Which medication is the treatment of choice for this patient?



Answer: **Procainamide**

At first glance, this patient's EKG appears to show ventricular tachycardia. Closer examination reveals several beats of narrow complex tachycardia in the middle of the rhythm strip at the bottom. These narrow complex beats have a slight slurring at the beginning of the QRS complex, consistent with a delta wave (blue arrow). In addition, the rhythm does not seem to be regular as would be expected from VT. Combining this finding with the patient's relatively young age and recent alcohol consumption, her EKG most likely represents Wolff-Parkinson-White syndrome with underlying atrial fibrillation. This changes the expected management. AV nodal blocking agents are the mainstay of therapy in atrial fibrillation. However, these medications would likely worsen the situation, as conduction will simply increase down the accessory pathway. Thus the best medication to decrease conduction primarily down the accessory pathway is procainamide

**TOPIC:** Systemic Hypertension

*Which of the following anti-hypertensive medications potentiates the effects of the others listed?*

Answer: **Hydrochlorothiazide**

There are multiple regulatory systems that monitor blood pressure, such as neurohormonal control and the RAAS. When a patient with hypertension receives a medication, the system being acted upon is inhibited, while other systems increase their activity to maintain the status quo. The most common physiology is reabsorption of sodium and water. Any medication that causes peripheral vasodilation (which most do) will trigger the kidney to do this. Thus, a synergistic way to use medications is to combine them with a low-dose diuretic to eliminate this compensatory mechanism. Hydrochlorothiazide is a thiazide diuretic and will potentiate the effects of lisopril, amlodipine, and losartan.

**TOPIC:** Identify possible etiologies for a paradoxical split second heart sound

A 65-year-old man with a past cardiovascular history of well-controlled hypertension presents to his PCP for annual physical. On examination, he has normal jugular venous pulsation. Cardiac examination is significant for a normal S1, paradoxically split S2, and 2/6 systolic ejection murmur. Paradoxical splitting of the second heart sound may be heard with which of the following?

Answer: **Aortic stenosis**

Because the LV systole may become prolonged in severe aortic stenosis, aortic valve closure may no longer precede pulmonic valve closure. This phenomenon causes paradoxical splitting in the second heart sound. Left-bundle branch block is another common cause of paradoxical splitting in S2. In right bundle branch block, however, the delayed activation of the right ventricle causes the S2 splitting, which normally occurs during inspiration to persist during expiration (fixed splitting).

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**TOPIC:** GRACE calculator

*A 60 year old woman presents to the ED with pressure-like chest pain. This also happened the previous night. Her PMH is significant for HTN, HLD, and DMII. She does not smoke, and consumes 2 glasses of red wine each week. There is no history of MI or Cardiac death in her family. Her home medications include amlodipine, simvastatin, aspirin, and insulin. In the ED her chest pain disappears with 3 sublingual nitro tabs. EKG shows ST-segment depression in V1, V2 & V3. Cardiac enzymes are negative. According to the Grace score calculator, which contributing factors about the patient may add to the risk of her experiencing MI, Revascularization, or death in the next 3-6 months?*

**Answer: GRACE ACS risk calculator criteria: age, HR, SBP, Cr, Cardiac arrest on admission, ST-segment deviation on EKG, Cardiac enzymes, rales, JVD on exam, Pulmonary Edema, Cardiogenic shock.**

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**TOPIC:** HTN Recommendations

*A 50-year-old AA M w/ PMH significant for CAD, HLD, and DMII presents for routine prescription refill w/ no new complaints. His Blood pressure is 150/90, HR 80, and RR 18. His exam is significant for morbid obesity. When concerned about Heart Failure, what initial blood pressure medication is recommended per the JNC 8 guidelines for this patient?*

**Answer: Thiazide Diuretics are more effective at improving cerebrovascular/cardiovascular combined outcomes in Heart Failure than either CCB's or ACEI's. CCB would be first line therapy if the goal was to reduce BP outside of HF in an AA.**

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**TOPIC:** Simvastatin

*Per the Heart Protection Study, Simvastatin lowers the risk of adverse cardiovascular outcomes by how much in patients with Peripheral Arterial Occlusive Disease?*

**Answer: 25% independently without other modification factors. Other modifying factors may include Tobacco cessation, regular exercise, control of lipid profile, diabetes, and HTN management.**

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**TOPIC:** TIMI Scoring

*A 45-year-old F presents w/ chest pain that has been worsening over the past hour. She has a history of Heartburn but says that it feels different than this. She denies any recent medication or drug use. She is morbidly obese. She does not have any other significant medical history and has never smoked. Her mother died of a MI at age 75, but she has never been worked up for cardiac issues. Her first cardiac troponins were negative. According to her presentation, what is her TIMI score?*

**Answer: her TIMI score is 0. Criteria include Age > 65 years, 3 or more CAD risk factors, known CAD, Aspirin use in the last 7 days, Severe Angina (2 episodes in 24 hrs), ST deviation >.5mm, & elevated Cardiac enzymes.**

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**TOPIC:** Med Side Effects

*A 55-year-old M presents to the ED w/ a hypertensive emergency and is started on IV medication. An hour later, he begins to complain of a burning throat and tingling scalp. What medication is causing his symptoms?*

**Answer: These are common side effects of Labetalol. Other side effects may include nausea, vomiting, heart block, or orthostatic hypotension.**

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**TOPIC:** Aortic Dissection

*What are the possible clinical manifestations of Aortic Dissection?*

**Answer: Severe, crushing back pain, left sided pleural effusions, dysphagia, hoarseness, upper airway obstruction, limb ischemia, superior vena cava syndrome, pulsatile neck or abdominal masses, hematemesis, hemoptysis, ischemic pancreatitis, or unexplained fever.**

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**TOPIC:** HOCM

*A 60-year old M is presenting w/ SOB after working out in a gym. EKG shows deeply inverted T waves across the precordium & Echo shows moderate outflow tract obstruction consistent w/ Hypertrophic cardiomyopathy. What is the first-line medical therapy for this condition?*

**Answer: Beta-Blockers are the first line therapy for HOCM. In cases that do not respond to BB's or in patients with contraindications to BB's, Verapamil therapy is recommended. Diuretics should be completely avoided.**

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**TOPIC:** Amiodarone

*Pt was recently diagnosed with atrial fibrillation. Before receiving treatment he was asked about past history of lung disease and given pulmonary function testing. The pt is receiving this testing because he will likely start what medication?*

**Answer: Amiodarone**

Amiodarone is used for rhythm control in **a-fibb**. A major side effect is pulmonary fibrosis.

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**TOPIC:** Syncopal management

71 y/o pt brought into the ER after passing out while exercising. He had a similar experience 5 weeks ago when he experienced dizziness while exercising. He has a holosystolic ejection murmur in the second intercostal space on the right. Cardiac enzymes are negative. What is the next best step?

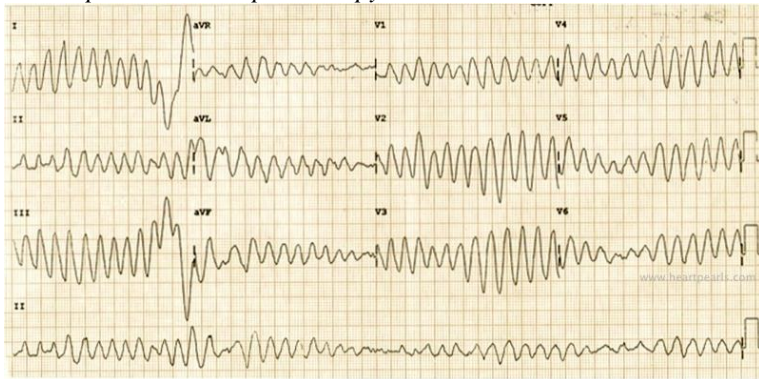
Answer: **Echocardiogram**

Echocardiogram should be given to all pt's experiencing syncope from structural heart disease such as **aortic stenosis**

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**TOPIC:** Torsades de pointes

Pt with chronic hx of cardiomyopathy develops this rhythm strip after starting fluconazole and moxifloxacin. What is the most important next step in therapy?



Answer: **Magnesium sulfate**

**Torsades de pointes** is a polymorphic ventricular tachycardia that occurs due to congenital or acquired prolonged QT. IV magnesium is first line therapy in stable pt's.

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**TOPIC:** Thromboembolic occlusion

Pt with extensive history of hypertension and hyperlipidemia presents to ER with right leg pain that started while exercising. He experiences chronic intermittent palpitations. The leg is numb, with sparse hair, pale and cold. It has no pulse present. Ankle dorsiflexion is weaker on that side. What is the best step in management?

Answer: **IV Heparin infusion**

This patient has acute arterial occlusion and should receive immediate anticoagulation. This pt has thromboembolic occlusion from his atrial fibrillation. **Heparin** prevents thrombus propagation and thrombosis of arterial circulation.

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**TOPIC:** Hypertrophic Cardiomyopathy

20 y/o passed out while playing lacrosse. Episode lasted 1 minute and he wasn't confused after. He is healthy with only light-headedness and chest discomfort. His grandfather died suddenly at age 35 of a "heart attack". Pt has a 4<sup>th</sup> heart sound at the apex. With a midsystolic murmur loudest at the LLSB that does not radiate. He would benefit from which medication?

Answer: **Metoprolol**

Beta-blockers are preferred for initial therapy of **HCM** as it decreases the left ventricle outlet obstruction and improves symptoms of angina. CCB can be used if symptoms persist.

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**TOPIC:** Mitral valve prolapse

37 y/o woman with chronic palpitations presents with a fast and irregular heart beat. She has had 4 episodes in the past 3 months, each lasting 1.5 hrs. She has no associated symptoms, medical problems, or recent sickness. She has a displaced apical impulse, a 3<sup>rd</sup> heart sound heard at the apex, and a holosystolic murmur at the apex. What is the cause of this condition?

Answer: **Myxomatous degeneration of the mitral valve**

**MVP** is the most common cause of chronic mitral regurg in developed countries. Pts will have a mid-systolic click, mid/late systolic murmur, holosystolic murmur if severe. This will cause left heart chamber enlargement and can lead to afibb, left ventricle dysfunction, and CHF

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**TOPIC:** Rheumatic Heart Disease

A 40 y/o Asian immigrant presents in the ER with acute dyspnea. She had rheumatic heart disease as a teen. She has an irregular pulse. She has a loud first heart sound and a mid-diastolic rumble at the apex. ECG shows an irregularly irregular heart rhythm with absence of P waves. What caused the abnormal heart rhythm?



Answer: **Left atrial dilatation**

Left atrial dilatation can result from mitral stenosis as a consequence of rheumatic heart disease. The left atrium dilates to compensate for the high resistance of the mitral stenosis. A dilated LA predisposes to the development of **a-fibb**.

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**TOPIC:** Cardiac myxoma

*70 y/o woman presents in ER with left-sided weakness, fatigue, fever. She has had occasional palpitations for the last 4 months and lost 7 lbs in this time. Pt has a mid-diastolic rumble at the apex. TTE shows a left atrial mass. What is the likely dx?*

Answer: **Intracardiac tumor**

Pt presents with cardiac **myxoma**, of which 80% are in the left atrium. Pt's can develop systemic embolization (TIA or ischemic stroke) and cardiovascular symptoms similar to a mitral valve disease (dyspnea, orthopnea, pulmonary edema)

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**TOPIC:** Post MI complications

*50 y/o man presents to the hospital s/p anterior wall MI 5 days ago with left sided CP. His cardiac cath had complete occlusion of LAD. He is agitated, then minutes later is unresponsive with non-palpable pulse and sinus tachy of 130/min on ECG. What is the most likely dx?*

Answer: **Ventricular free wall rupture**

Within 5 days to 2 weeks **after an acute MI**, the pt is predisposed to ventricular free wall rupture, esp after an anterior MI. Pts will have shock, pulseless heart activity and death.

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**TOPIC:** Management of pulmonary edema

*70 y/o pt presents to ER with chest pain, SOB, diaphoresis that began 1hr ago. It does not remit with sublingual nitro and radiates to his left arm. His ECG shows ST elevations on anterior leads. His lung exam show basilar crackles extending up to halfway up the lung fields. He is given aspirin, clopidogrel, atorvastatin. O2 by nasal canula is showing 90% sat. What is the next best step of management?*

Answer: **Furosimide**

**Diuretics** should be given to this pt for therapy of acute pulmonary edema 2/2 to acute MI. It will decrease cardiac preload and pulmonary capillary pressure. It will also cause venodilation which will further decrease the preload. This pt will still need revascularization (coronary angioplasty or thrombolytics).

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**TOPIC:** Premature atrial contractions

*Young adult male with premature atrial complexes seen on routine ECG. He has no cp, sob, lightheadedness. He has consumed 2 beers a day for the last 12 years and 2 packs of cigarettes daily. His father died of stroke and his mother had an MI. Vital signs are within normal limits. What is the next best step in management?*

Answer: **Advise to stop alcohol and tobacco**

Tobacco and alcohol are reversible risk factors for **PAC's**. Beta blockers are useful in symptomatic patients. PAC's are benign but can occur in sick patients. They can precede afibb. Stress should also be reduced.

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**TOPIC:** Atrial fibrillation

*35 y/o presents with palpitations for the past 4 hrs. His pmhx is significant for WPW syndrome and 3 prior episodes of SVT. Pulse is irregularly irregular. ECG shows A-fibb with a rate of 165/min. Next best step in management?*

Answer: **Procainamide**

Tx of afibb in **WPW** is focused on ventricular response of afibb and its termination. This is done by cardioversion or antiarrhythmics like procainamide. Other options will increase conduction through the accessory pathway as they block the AV node. IV ibutilide would also work.

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**TOPIC:** Aortic regurgitation

*40 y/o man with exertional SOB and a pounding heart for the past 6 months. He has an uncomfortable heartbeat while lying on his left side. He has a BP 150/45 and 73/min.*

Answer: **Aortic regurgitation**

**Aortic regurg** leads to increased LV end diastolic volume due to blood flow back into the heart, which creates a wide pulse pressure and "water hammer pulse" or Corrigan pulse. Most common cause of AR is rheumatic heart disease in developing countries. In developed countries is due to aortic root dilation or congenital bicuspid valve.

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**TOPIC:** Atrial fibrillation pharmacotherapy

60 y/o man with hx of HTN and T2DM presents to clinic with malaise and palpitations the past week. An echo last year showed mild left atrial dilation and left ventricular hypertrophy. His ECG shows afibb with RVR. What is the most appropriate next step in management?

Answer: **Diltiazem**

A patient with **afibb** with RVR should be initially rate controlled with beta blockers or calcium channel blockers. He would need synchronized electrical cardioversion if he was hemodynamically unstable.

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**TOPIC:** Thyrotoxicosis

27 y/o female pt presents to with a 3 month history of weight loss, irritability, insomnia, palpitations. She isn't on any medications. Physical exam shows lid retraction, dry skin, hand tremor. Which is the cause of the hypertension?

Answer: **increased catecholamines**

This pt has **thyrotoxicosis**, which has direct effects on muscle cells and increases sensitivity to circulating catecholamines. On the heart it causes increased inotropic and chronotropic effects.