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Chapter 1: Diseases of the Cardiovascular System

1.
MC
A 64-year-old man presents to his doctor with complaints of chest pressure that occurs during heavy exertion and resolves within 5 minutes of rest. His medical history is significant for hypertension, diabetes, and tobacco use. His doctor orders a stress test, which is positive, and he is given a diagnosis of coronary artery disease. Which of the following is not an indicated treatment at this time?

A. Aspirin
B. Coronary angiography with revascularization
C. Nitroglycerin
D. Atorvastatin
E. Carvedilol

Correct Answer: B

Rationale: See pages 4 and 5. Treatment of all patients with coronary artery disease and stable angina consists of aspirin and lipid-lowering therapy. Medications that reduce myocardial oxygen demand (nitrates, β-blockers, calcium channel blockers, etc.) are also useful for preventing and treating symptoms. Revascularization is only appropriate if there are significant symptoms despite optimal medical therapy.

2.
MC
A 59-year-old woman is admitted with chest pain and found to be hypotensive. She is diagnosed with a right ventricular infarct. Which of the following should be avoided?

A. Atorvastatin
B. Clopidogrel
C. Aspirin
D. Nitroglycerin
E. IV fluids

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Correct Answer: D

Rationale: See page 8. When there is an infarction of the right ventricle, there is risk of failure and thus it can be a preload-dependent condition. IV fluids can be given to support adequate preload, but giving diuretics or nitroglycerin can cause a sudden drop in preload and result in worsening hypotension and shock.

3.
MC
A woman presents with an acute STEMI. The Emergency Department physician is deciding whether to transfer the patient to a facility that can perform percutaneous coronary intervention (PCI), or to administer thrombolytic therapy. Which of the following best represents the goal times from patient presentation to reperfusion for PCI and thrombolytic therapy, respectively?

A. PCI is always preferred, and thus there is no strict time goal
B. 60 minutes for PCI, and no time goal for thrombolytic therapy
C. 60 minutes for PCI, and 6 hours for thrombolytic therapy
D. 90 to 120 minutes for PCI, and 30 minutes for thrombolytic therapy
E. 90 to 120 minutes for PCI, and 12 hours for thrombolytic therapy

Correct Answer: D

Rationale: See page 11. PCI should ideally be performed in less than 90 minutes, though the most recent ACC/AHA guidelines say that it's reasonable to extend this time to 120 minutes. Thus, the goal "door-to-balloon time" is less than 90 minutes, and if transferring should ideally be less than 120 minutes. "Door-to-needle time" for giving thrombolytic therapy should be within 30 minutes of patient presentation. Data suggest that the best outcomes for thrombolytics occur within 6 hours of the patient's acute MI (from clinical onset, not patient presentation to the hospital), however the hospital should aim for administering thrombolytics within 30 minutes.

4.
MC

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A 71-year-old man is admitted to the hospital with an acute STEMI and undergoes PCI. Which of the following is the most common cause of death within the first few days of STEMI?

A. Ventricular arrhythmia
B. Stroke
C. Congestive heart failure
D. Recurrent infarction
E. Myocardial free wall rupture

Correct Answer: A

Rationale: See pages 12 to 14. The most common cause of death after an acute MI is ventricular fibrillation or ventricular tachycardia.

5.
MC
A 62-year-old man with a history of diabetes and hypertension presents with acute-onset chest pain. He describes the pain as sharp and substernal. On examination, his blood pressure is 188/94 mm Hg. His labs are unremarkable, and there are no ST elevations on ECG. Which of the following should be done next?

A. Start a proton-pump inhibitor (PPI)
B. Consult cardiology for PCI
C. Obtain a chest x-ray
D. Give hydralazine IV
E. Order an echocardiogram

Correct Answer: C

Rationale: See pages 14 and 15. Chest pain has a broad differential, and a chest x-ray should be performed to evaluate for mediastinal widening suggestive of aortic dissection. Blood pressures should be obtained from both arms to look for discrepancy, though if clinical suspicion is high enough for aortic dissection a CT would need to be performed. The workup is incomplete at this point, and thus starting a PPI for a GI cause of chest pain (e.g.,

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GERD), would be inappropriate. There is no evidence of ACS, thus consulting cardiology for PCI is premature. Hydralazine IV will lower the patient's blood pressure, but if the patient is having an aortic dissection this could cause a reactive increase in heart rate and contractility, worsening the shear stress and thus worsening the dissection. An echocardiogram may be helpful eventually, but is not an initial test to perform.

6.
MC
A 65-year-old woman presents with shortness of breath and chest pressure. Her medical history is notable for coronary artery disease and end-stage renal disease, and she gets hemodialysis through a relatively new AV fistula. On examination, the patient has bilateral lower extremity edema and bibasilar crackles. An ECG is normal. She receives furosemide IV and her symptoms begin to improve. Which of the following is the likely culprit of her decompensated heart failure?

A. New ischemia
B. AV fistula
C. Hypertension
D. Thyroid disease
E. Thiamine deficiency

Correct Answer: B

Rationale: See page 15. This patient likely acquired high-output heart failure in the setting of her new fistula. She may have had some predisposition to developing heart failure from her coronary artery disease, however the placement of an AV fistula may have tipped her over the edge. Hyperthyroidism and thiamine deficiency can also cause high-output heart failure, but there is no evidence that she has these conditions. There is also no evidence given to suggest that she is having ischemia.

7.
MC
A 68-year-old man with a history of diabetes and hypertension presents with shortness of breath and volume overload. He is eventually given a diagnosis of heart failure, and his

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ejection fraction is 55%. Which of the following has been shown to reduce mortality in this patient's condition?

A. Carvedilol
B. Benazepril
C. Spironolactone
D. A, B, and C
E. None of the above

Correct Answer: E

Rationale: See page 20. For heart failure with preserved ejection fraction (HFpEF), there are no medications that have been shown to reduce mortality. The other options reduce mortality in heart failure with reduced ejection fraction (HFrEF).

8.
MC
Which of the following is NOT a standard lifestyle recommendation for patients with HFrEF?

A. Exercise program
B. Fluid restriction
C. Weight loss
D. DASH diet
E. Smoking cessation

Correct Answer: D

Rationale: See page 19. A DASH diet is sometimes recommended as a lifestyle change for patients with hypertension, but is not necessarily a recommendation for patients with heart failure.

9.
MC
A 52-year-old woman with type 1 diabetes mellitus and chronic kidney disease presents with lower extremity swelling and shortness of breath. She eventually is started on

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appropriate therapy for heart failure, but despite therapy she continues to have daily symptoms that limit her activities. She is unable to climb up two flights of stairs without stopping to rest, or to carry her grandson while walking with her family. Which of the following best represents this patient's New York Heart Association (NYHA) class?

A. NYHA class I
B. NYHA class II
C. NYHA class III
D. NYHA class IV
E. None of the above

Correct Answer: B

Rationale: See page 17. NYHA class II describes symptoms with prolonged or moderate exertion. Class I describes patients that are nearly asymptomatic, class III describes patients with symptoms during mild activities such as walking across the room, and class IV describes patients with constant symptoms even at rest.

10.
MC
A 45-year-old man with a history of tobacco use and hypertension presents to the Emergency Department with shortness of breath. He complains of increased cough and sputum production, as well as chest pressure. On examination, he is afebrile and has bilateral expiratory wheezes. On examination of his lower extremities, he has 1+ pitting edema bilaterally. A diagnosis of COPD with acute exacerbation is suspected, but there is also concern for heart failure given his risk factors. Which of the following may be helpful in differentiating these conditions in the Emergency Department?

A. B-type natriuretic peptide (BNP)
B. Pulmonary function testing (PFTs)
C. Trial of furosemide
D. ECG
E. Procalcitonin

Correct Answer: A

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Rationale: See pages 18 and 19. Both COPD and heart failure can present with shortness of breath and wheeze. Typically, wheezing is thought to indicate COPD or asthma, but pulmonary edema can also produce wheezing (“all that wheezes is not asthma”). In patients where the diagnosis is unclear, an elevated BNP may indicate volume overload and heart failure, and is typically not elevated in COPD alone. PFTs are an outpatient test and are typically not performed in the hospital. A trial of furosemide should not be given unless the diagnosis is known, and an ECG could be normal in either condition. Procalcitonin is helpful in differentiating between viral and bacterial respiratory infections, which is not a consideration in this case.

11.
MC
A man is diagnosed with heart failure and has an ejection fraction of 25%. He is started on appropriate therapy with a β-blocker and an ACE inhibitor, and on repeat echocardiogram 6 months later his ejection fraction is 50%. Which of the following is the most appropriate next step?

A. Stop the treatments now that his ejection fraction has normalized
B. Continue the β-blocker but stop the ACE inhibitor
C. Continue both medications for another 6 months, and if the ejection fraction stays normalized then stop both
D. Continue both medications indefinitely
E. Add on spironolactone

Correct Answer: D

Rationale: Patients with HFrEF may have an improvement in their ejection fraction after starting appropriate medical therapy, but this therapy should be continued indefinitely even if the ejection fraction normalizes.

12.
MC

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A 56-year-old Caucasian woman was diagnosed with HFrEF 6 months ago and had been placed on furosemide, carvedilol, and lisinopril. Repeat echocardiogram shows an ejection fraction of 30%. Which of the following medications would be appropriate at this time?

A. Spironolactone
B. Sacubitril--valsartan
C. Hydralazine and isosorbide dinitrate
D. A and B
E. A, B, and C

Correct Answer: D

Rationale: See pages 19 and 20. Spironolactone is indicated for patients with an ejection fraction <35%. Sacubitril--valsartan is a combination neprilysin inhibitor and angiotensin receptor blocker and was shown to reduce mortality in the PARADIGM-HF trial. It should be started after lisinopril is stopped. Hydralazine and a nitrate reduced mortality in African American patients, but this patient is Caucasian.

13.
MC
A 69-year-old woman with HFrEF has had multiple hospitalizations for acute decompensated heart failure over the past 6 months. She is currently taking metoprolol succinate, sacubitril--valsartan, spironolactone, furosemide, atorvastatin, aspirin, and famotidine. On examination, she appears euvolemic and her blood pressure is 104/60 mm Hg and heart rate is 82 bpm. She is on maximum dose metoprolol succinate. Which of the following agents is indicated to reduce hospitalizations in this patient?

A. Lisinopril
B. Diltiazem
C. Carvedilol
D. Digoxin
E. Ivabradine

Correct Answer: E

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Rationale: See pages 19 and 20. Ivabradine has been shown to reduce hospitalizations in HFrEF patients who are on a maximally tolerated β-blocker and have a resting heart rate >70.

14.
MC
A 48-year-old man with a history of hypertension, hyperlipidemia, and tobacco use presents with shortness of breath. On examination, he has bibasilar crackles and his extremities are warm. Labs are significant for an elevated creatinine of 2.3 mg/dL and a BNP of 480 pg/mL. An ECG shows sinus rhythm without ST elevations. A chest x-ray shows bilateral pulmonary edema. Which of the following is an appropriate therapy in this patient?

A. Noninvasive positive pressure ventilation
B. Oral furosemide
C. Benazepril
D. Ultrafiltration
E. Clopidogrel

Correct Answer: A

Rationale: See page 21. Noninvasive positive pressure ventilation, such as BiPAP, improves oxygenation while reducing preload (increased intrathoracic pressure). Furosemide should be given intravenously, and likely would have poor oral bioavailability in the setting of volume overload and gut edema. ACE inhibitors should be avoided in the setting of acute kidney injury. Ultrafiltration will reduce intravascular volume but has no benefit over IV diuretic therapy. Clopidogrel can be given in ACS, but this patient has no evidence of ACS.

15.
MC
Which of the following β-blockers have been shown to reduce mortality in patients with HFrEF?

A. Atenolol
B. Propranolol
C. Bisoprolol

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D. Metoprolol tartrate
E. Sotalol

Correct Answer: C

Rationale: See page 21. The three β-blockers proven to reduce mortality in randomized trials are carvedilol, metoprolol succinate, and bisoprolol. The others (including metoprolol tartrate, which is the short-acting version of metoprolol), have not been shown to reduce mortality and thus should not be used in place of the trial-proven β-blockers.

16.
MC
A 52-year-old woman is diagnosed with heart failure and started on carvedilol and lisinopril. She returns 3 months later complaining of cough. Which of the following is another possible adverse effect of the responsible medication?

A. Hypokalemia
B. Renal insufficiency
C. Hypertension
D. Sexual dysfunction
E. Lower extremity edema

Correct Answer: B

Rationale: See page 21. Common adverse effects of ACE inhibitors include cough, hyperkalemia, hypotension, a decrease in GFR, and anemia. Some degree of creatinine elevation is acceptable (up to 30% increase from baseline), otherwise the ACE inhibitor should be stopped. Sexual dysfunction is an adverse effect of β-blockers, however β-blockers are not associated with chronic cough. Lower extremity edema is an adverse effect of dihydropyridine calcium channel blockers (e.g., amlodipine).

17.
MC
A 38-year-old woman presents to the clinic complaining of the sensation that her heart is "skipping a beat." She states that this has occurred a couple times in the last week, during

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which she has been stressed at work and drinking more coffee than usual. She denies any chest pain or lightheadedness, and has no history of syncope. An ECG in the office is normal. Which of the following is the most appropriate next step?

A. 48-hour Holter monitor
B. Implantable cardiac monitor
C. Ischemic evaluation
D. Echocardiogram
E. Reassurance

Correct Answer: E

Rationale: See page 22. The patient may be having premature ventricular contractions (PVCs), which fits her story of being stressed and drinking more caffeine. PVCs are generally benign, and do not require further workup unless they are increasing in frequency and/or becoming symptomatic. Reassurance is appropriate at this time.

18.
MC
An 83-year-old woman presents to the office with fatigue. She has a long history of poorly-controlled hypertension. On examination, her blood pressure is 164/94 mm Hg, and her heart rate is irregular and 122 bpm. Which of the following is the next step in diagnosing the cause of this patient's fatigue?

A. Reassurance with no further testing necessary
B. ECG
C. Echocardiogram
D. Treadmill stress test
E. Coronary angiography

Correct Answer: B

Rationale: See page 23. This patient likely has atrial fibrillation, which can present with fatigue and dyspnea. The clues include her history of hypertension (common predisposing

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condition) and her fast, irregular heart rate. An ECG will show an irregularly irregular rhythm without clear P waves.

19.
MC
A 62-year-old man presents to the Emergency Department with chest pain, lightheadedness, and palpitations. He appears uncomfortable on examination, with a heart rate of 140 bpm and a blood pressure of 112/60 mm Hg. An ECG shows an irregularly irregular rhythm without P waves. After placing the patient on telemetry, what should be done next?

A. Immediate cardioversion
B. Amiodarone
C. Oral diltiazem
D. IV metoprolol
E. IV adenosine

Correct Answer: D

Rationale: See page 23. This patient is presenting with atrial fibrillation with rapid ventricular response. As long as the patient is hemodynamically stable, they should be given an IV agent to control the heart rate. IV β-blockers such as metoprolol are generally preferred, and calcium channel blockers should be avoided in patients with heart failure. Once the rate is improved with IV therapy, an oral therapy should be given for longer-term rate control.

20.
MC
An 82-year-old man with a history of hypertension and diabetes presents with palpitations and is found to be in atrial fibrillation. The patient's chronic medical conditions are well controlled and he lives with his wife. Over the past year, he has had two mechanical falls at home that did not require hospitalization. He denies any history of GI bleeding. What is the most appropriate anticoagulation strategy for this patient?

A. Start anticoagulation with warfarin or a direct oral anticoagulant (DOAC)
B. Start anticoagulation with warfarin only

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C. Start aspirin 81 mg daily
D. Start aspirin 325 mg daily
E. Do not start anticoagulation due to the patient's risk of intracerebral hemorrhage (ICH) with falls at home

Correct Answer: A

Rationale: See page 24. This patient's risk of stroke can be calculated with the CHA_2DS_2-VASc score. His score is 4, thus his stroke risk is 4% per year. Anticoagulation is always a risk--benefit discussion with each patient but is generally indicated for scores above 1. Warfarin or a DOAC would both be reasonable choices since there's no indication of renal impairment or valvular disease requiring use of warfarin only. Mechanical falls at home are not a contraindication for starting anticoagulation, and the risk of ICH with any fall is typically very low and thus does not outweigh the benefit of anticoagulation for reducing stroke risk.

21.
MC
A 28-year-old woman presents to the Emergency Department with palpitations and lightheadedness. She has a known history of Wolff—Parkinson--White syndrome, and is not on any medical therapy. On examination, her blood pressure is 110/60 mm Hg and her heart rate is 138 bpm. An ECG shows atrial fibrillation with rapid ventricular response. Which of the following is the next step in management?

A. Adenosine
B. Metoprolol
C. Procainamide
D. Cardioversion
E. Radiofrequency catheter ablation

Correct Answer: C

Rationale: See page 28. For patients with an accessory conduction pathway (Wolff--Parkinson--White) who are in atrial fibrillation or atrial flutter, agents acting on the AV node (A and B) should be avoided since this just promotes impulses traveling down the accessory

pathway and increasing the ventricular rate. Antiarrhythmic therapy with procainamide should be used in this situation. Cardioversion would be appropriate if the patient was hemodynamically unstable. Radiofrequency catheter ablation is the eventual definitive treatment, however is not done emergently in a situation like this one.

22.
MC
A 68-year-old man presents to the hospital after a syncopal event. He complains of feeling lightheaded and having chest pain. He takes no medications at home. An ECG shows a ventricular rate of 30 bpm and complete AV dissociation. Which of the following is the definitive therapy for this patient?

A. Avoid all AV nodal blocking agents
B. Pacemaker implantation
C. Oral metoprolol
D. Atropine to be used as needed
E. Cardioversion

Correct Answer: B

Rationale: See page 33. This patient has third-degree AV block, as seen by complete AV dissociation on his ECG. This is an indication for pacemaker implantation, which is the definitive treatment in this case.

23.
MC
A 58-year-old man presents with progressive shortness of breath and leg swelling. He has not been to a doctor in many years, but states that he has been told that he has liver disease in the past. On examination, he is jaundiced with bibasilar crackles and lower extremity edema without evidence of ascites. His labs are significant for a creatinine of 0.9 mg/dL, a hemoglobin of 15 g/dL, a transferrin saturation of 80%, a hemoglobin A1c of 9.4%, and a BNP of 340 pg/mL. An ECG shows low voltages, and an echocardiogram shows thickened myocardium with a reduced ejection fraction. What is the most likely diagnosis?

A. Chagas disease

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B. Amyloidosis
C. Hemochromatosis
D. Ischemic cardiomyopathy
E. Hypertrophic cardiomyopathy

Correct Answer: C

Rationale: See page 34. This patient presents with an infiltrative/restrictive cardiomyopathy, as suggestive by the low voltages on ECG as well as thickened myocardium with a low ejection fraction. The elevated transferrin saturation, as well as other findings (liver disease and diabetes), make hemochromatosis the most likely diagnosis. Amyloidosis is also an infiltrative process but is not suggested by the history or labs.

24.
MC
A 65-year-old woman with a history of metastatic breast cancer presents with a history of shortness of breath and lightheadedness. In the Emergency Department, she is found to have a blood pressure of 68/34 mm Hg and a heart rate of 120 bpm. Her neck veins are distended on examination. An ECG shows sinus tachycardia with low voltages. A pulsus paradoxus is performed, and systolic pressure varies by 14 mm Hg. Which of the following is the correct diagnosis?

A. Pulmonary embolism
B. Congestive heart failure
C. Malignant pleural effusion
D. Atrial fibrillation with rapid ventricular response
E. Cardiac tamponade

Correct Answer: E

Rationale: See page 39. This patient presents with hypotension, low voltages on ECG, and an elevated pulsus paradoxus which are all suggestive of cardiac tamponade. The cause of the pericardial effusion in her case is likely related to her malignancy.

25.

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MC

A 60-year-old woman presents to her doctor for follow-up. She reports feeling well and denies any symptoms at this visit. On examination, she has a III/VI mid-systolic murmur at the right upper sternal border, radiating to her carotids. An echocardiogram shows aortic stenosis. Which of the following should be done next?

A. Periodic monitoring
B. Start carvedilol
C. Afterload reduction with hydralazine and a nitrate
D. Start furosemide
E. Surgical aortic valve replacement

Correct Answer: A

Rationale: See page 42. This patient has asymptomatic aortic stenosis, and thus no further treatment is necessary at this time. There are certain echocardiographic criteria for valve replacement, but in general patients do not undergo replacement unless they become symptomatic. As valvular disease progresses, medical therapy has little to no role, and it is a surgical issue.

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