SECTION 1: CARDIOLOGY

CHAPTER 2: HYPERTENSION

Q.1. A 47-year-old male with diabetes presents as a new patient to your clinic. He does not recall any abnormal blood pressure readings. You find his blood pressure to be 138/86 on two readings during this visit. You should

A. Start HCTZ 12.5 mg every day

B. Provide lifestyle counseling and start HCTZ 12.5 mg every day

C. Provide lifestyle counseling and recheck blood pressure within a few months

D. Do nothing now and recheck blood pressure within one year

E. Do nothing now and recheck blood pressure within a few months

Answer: C. Although drug therapy is indicated for diabetics with high normal blood pressure (i.e., 130–139/85–89), it is first necessary to establish the diagnosis of hypertension, which requires elevated readings on at least two office visits, not just two readings during one office visit. Lifestyle counseling, however, should begin immediately.

Q.2. A 48-year-old woman presents to the emergency room with headache and a blood pressure of 192/104. She has a long history of hypertension, for which she has been treated in the past with benazepril, hydrochlorothiazide, and metoprolol. She does not have a history of coronary artery disease. After careful interviewing, you determine that she stopped taking her antihypertensive medications approximately two months ago because she was feeling well and "did not want to be dependent on medications." She reports no other symptoms.

On examination, she appears comfortable and is fully alert and oriented. Funduscopic examination reveals arteriovenous crossing changes but no papilledema. The cardiac examination is notable for a fourth heart sound and a grade 2 systolic ejection murmur at the left lower sternal border. The chest x-ray shows a mildly increased cardiothoracic ratio and aortic calcifications. The electrocardiogram shows increased QRS voltage consistent with left ventricular hypertrophy. Urinalysis reveals 1□ proteinuria with no cells or casts. Blood urea nitrogen, creatinine, and

electrolytes are all within normal limits. Head CT is unremarkable. Appropriate management of this patient would include

A. Admission to the intensive care unit and administration of intravenous nitroprusside

B. Admission to the intensive care unit and administration of intravenous esmolol

C. Admission to the hospital ward and resumption of her usual medications

D. Administration of short-acting nifedipine 30 mg po, observation in the emergency room for six hours, and resumption of her usual medications

E. Resumption of her usual medications and follow-up in the outpatient clinic within one week

Answer: E. Although this patient presents with stage 2 hypertension and evidence of end-organ damage (i.e., proteinuria and left ventricular hypertrophy), she has no evidence of acutely progressive organ damage. Additionally, there is a good explanation for her hypertension: nonadherence. She should respond well to resumption of her usual medications. The primary focus of management of this patient should be maintaining adherence to her medication regimen. The use of short-acting nifedipine to lower her blood pressure rapidly does not decrease her risk of acute complications and may, in fact, be hazardous.

Q.3. A 72-year-old white female, previously well controlled on a once-daily combination pill containing atenolol 50 mg and hydrochlorothiazide 25 mg, presents with a rise in her blood pressure to 170/110. You add 5 mg of lisinopril, and her creatinine rises from 1.1 to 1.9. What do you suspect?

A. Nonadherence

B. Hypertensive nephrosclerosis

C. Hyperaldosteronism

D. Atherosclerotic renal artery stenosis

E. Pheochromocytoma

Answer: D. The recurrence of hypertension in a previously well-controlled patient should prompt the clinician to consider nonadherence to the medication, as well as a secondary cause of hypertension. The decline in renal function after addition of an angiotensin-converting enzyme inhibitor, however, is most suggestive of bilateral renal artery stenosis.

Q.4. A 47-year-old male with type 2 diabetes returns for follow-up. You find his blood pressure to be 138/72 in the left arm and 142/74 in the right arm. One month ago, his blood pressures were 136/68 in the left arm and 140/72 in the right, and on the visit before that the readings were 138/70 in the left arm and 142/68 in the right arm. He has attempted to modify his diet and exercise. Urinalysis shows microalbuminuria. You recommend

A. Start lisinopril 5 mg po every day

B. Start amlodipine 5 mg po every day

C. Start hydrochlorothiazide 12.5 mg every day

D. Continue lifestyle modification and recheck blood pressure in two months

E. Do nothing now and recheck blood pressure in two months

Answer: A. The diagnosis of stage 1 hypertension is established in this patient. The presence of diabetes places him at high risk of complications from hypertension and warrants the initiation of drug therapy. Although hydrochlorothiazide is a very reasonable option in most patients with hypertension, the use of an angiotensin-converting enzyme inhibitor is more appropriate in this patient because it has been shown to decrease the incidence of diabetic nephropathy in patients with microalbuminuria.

Q.5. A 42-year-old obese male returns for follow-up. His last visit with you was three years ago, and since that time his weight has increased by 15 kg, such that his BMI is now 32. He reports feeling tired during the day, and has increased his coffee consumption to four cups per day and his tobacco use to one pack of cigarettes per day. His blood pressure has increased from 136/86 at last visit to 152/90 today. He states that he has not drunk coffee or smoked in the last six hours. Which of the following is most likely to be contributing to his elevated blood pressure at this visit?

A. Type 2 diabetes

B. Excessive licorice consumption

C. Obstructive sleep apnea

D. Increased coffee intake

E. Tobacco use

Answer: C. Type 2 diabetes is an important comorbidity in patients with hypertension, but not a cause of hypertension. Excessive licorice intake is a very rare cause of hypertension. Obstructive sleep apnea is a common identifiable cause of hypertension. Coffee and tobacco use can raise blood pressure acutely, but do not increase the risk of development of hypertension.

Q.6. A 67-year-old woman is brought to the emergency room by her son. He states that she has been "acting strangely" for the last day or so. According to her records, her usual antihypertensive regimen consists of lisinopril/HCTZ 20/25 mg po every day, nifedipine extended release 90 mg po every day, and atenolol 50 mg every day. Her son indicates that she ran out of her medication a week ago. On examination, the patient is confused, somnolent, and complaining of headache. Her blood pressure is 230/114 bilaterally. Funduscopic examination shows arteriolar narrowing and indistinct optic disc margins. The lung examination reveals no rales; the cardiac examination is significant for an S4 gallop and a grade 2 midsystolic ejection murmur. The abdomen is soft and nontender, with no bruits. No peripheral edema is present. Appropriate management would include each of the following *except*

A. Administration of clonidine 0.3 mg po every six hours

B. Admission to the intensive care unit

C. CT imaging of the brain

D. Measurement of serum creatinine, sodium, and potassium

E. Placement of an arterial line

Answer: A. This patient is presenting with signs and symptoms of hypertensive encephalopathy, a hypertensive emergency. Appropriate initial management includes admission to ICU, placement of an arterial line to monitor BP, and administration of intravenous agents to lower BP. A noncontrast head CT is appropriate to exclude other causes of altered mental status, including intracerebral hemorrhage. Administration of oral agents may result in unpredicable rates of BP lowering and is not recommended.

Q.7. A 37-year-old man presents to the outpatient clinic for a routine health maintenance examination. His height is 180 cm and his weight is 102 kg. BP in both

arms is 148/86. He reports no chest pain, dyspnea, abdominal pain, or headache. He is asked to return in one month for follow-up, and at that time his BP is 146/90. Laboratory studies performed at the previous visit showed no abnormalities in the serum glucose, electrolytes, and creatinine, normal urinalysis, and normal resting electrocardiogram. The patient states that he wishes to avoid taking medication if possible. Currently, he smokes 10 cigarettes per day, drinks three cups of coffee per day, consumes one glass of wine per day, and exercises infrequently. Which of the following is *most* likely to result in significant improvement in his blood pressure?

A. Discontinuation of all alcohol use

B. Discontinuation of all tobacco use

C. Relaxation therapy and stress management techniques

D. Reduction of coffee intake to fewer than two cups per day

E. Loss of 5 kg through diet and exercise

Answer: E. Limitation of alcohol use to 1 ounce (of ethanol) or less in men, limitation of sodium intake to 2.4 gm, and weight loss of 10 pounds or more are established means of controlling BP. Relaxation therapy, discontinuation of tobacco, and discontinuation of caffeine have not been shown to consistently lower BP.

Q.8. A 49-year-old female with established hypertension returns to the clinic for follow-up. She has been monitoring her blood pressure at home using an automated device with an arm cuff. She states that she takes several measurements every morning, and provides you with a list of blood pressures. She asks you if you think her measurements are accurate. Which of the following is *not* a potential cause of inaccurate BP readings?

A. Use of a cuff that is smaller than recommended

B. Taking of two blood pressure measurements in succession in the same arm

C. Measurement of blood pressure in the right arm only

D. Measurement of blood pressure with the arm held in front of the body at shoulder height

E. Consumption of caffeine 15 minutes prior to measurement

Answer: B. Use of a cuff that is too small may falsely elevate BP readings. It is not necessary to wait more than about 15 seconds in between measurements, even in the same arm. BP should be measured in both arms and the higher of the two measurements used for management. The arm should be relaxed and at the level of the heart. Caffeine and tobacco should not be consumed in the 30 minutes prior to measurement.

Q.9. A 62-year-old man with a history of hypertension and type 2 diabetes mellitus presents to the emergency department with headache and confusion for the past 5 five hours. His son states that he ran out of his blood pressure medications last week. Prior to that, his blood pressure had been well-controlled on atenolol and nifedipine. In the emergency department, the patient's vital signs are blood pressure 210/120, pulse 96, respirations 14, and temperature is 97.8□□F. Physical examination is notable for a left ventricular heave and an S4 gallop. His lungs are clear. He is oriented to name but his neurologic examination is otherwise nonfocal. Initial labs reveal a hematocrit of 40.1% and a creatinine of 2.3 mg/dldL. Urinalysis shows 10 to 15 RBCs per high power field.

The most appropriate management is

A. Admission to the hospital and administration of intravenous nitroprusside with a goal of lowering blood pressure by 25% in the first two hours

B. Restart antihypertensive medications; if blood pressure falls ensure close follow-up the subsequent day in the office

C. Admission to the hospital and reinstitution of his outpatient medications as he has a hypertensive urgency

D. Admission to the hospital and administration of nitroglycerin with the goal of lowering his blood pressure to normal within the first 24 hours

E. Admission to the hospital and administration of intravenous enalaprilat, given that he is diabetic

Answer: A. This patient has a hypertensive emergency, as evidenced by a very high blood pressure and acute injury to target organs (e.g., brain, kidneys). Hypertensive emergency is differentiated from hypertensive urgency, which is not associated with acute target organ damage. Urgency may be treated as an outpatient with close follow-up within 24 hours. The appropriate management of

hypertensive emergency requires admission to the hospital and intravenous medication to lower blood pressure by roughly 25% in the first two hours. Care should be taken to avoid a precipitous decline in blood pressure to normal, which might result in cerebral watershed infarct (from impaired cerebrovascular autoregulation). A reasonable first-line choice is nitroprusside, as it is easily titrated and causes both arterial and venous dilation. Enalaprilat is more useful in emergencies associated with congestive heart failure and results in a more unpredictable fall in blood pressure. It would be less useful in this case.

Q.10. You have been treating a 75-year-old man for hypertension for the last 20 years. He frequently misses medication doses, and his blood pressure is rarely well controlled. In the office today, his blood pressure is 165/90. He states that he feels well. Which of the following would you expect on his physical exam?

A. Basilar crackles in the lung fields

B. S4 gallop and a left ventricular heave

C. S4 gallop and a right ventricular heave

D. S3 gallop and a left ventricular heave

E. Papilledema

Answer: B. This patient has long-standing, poorly controlled hypertension and will probably manifest evidence of chronic target organ damage. This probably includes an S4 gallop and a left ventricular heave (both associated with left ventricular hypertrophy). He shows no evidence of acute decompensation (hypertensive urgency or emergency). Therefore, he is unlikely to have papilledema or evidence of acute congestive heart failure (S3 gallop or pulmonary edema).

Q.11. A 60-year-old man comes to your office for a routine visit. He has had hypertension for 10 years that has been under excellent control on a □-blocker. He also has truncal obesity and hypercholesterolemia. He last saw you 6 months ago. Today, his blood pressure is significantly higher than usual at 185/95. He denies symptoms of chest pain or dyspnea. He feels well. His physical exam is unremarkable. You draw routine labs and find the following:

Sodium = 139 mEq/L Hematocrit = 40.2%

Potassium = 3.1 mEq/L Creatinine = 1.1 mg/dL

Serum bicarbonate = 19 mEq/L Urinalysis is negative for protein

Which of the following is most likely to provide a diagnosis?

A. MRA of the renal arteries

B. Plasma aldosterone and renin levels

C. 24-hour urinary free cortisol

D. MRI of the pituitary gland

E. Captopril radionuclide scan

Answer: B. This patient has worsening blood pressure control but is otherwise asymptomatic. Given his hypokalemia and mild metabolic acidosis, hyperaldosteronism must be considered. A good initial screening test would be a plasma aldosterone to renin ratio, which should be greater than 20 in hyperaldosteronism. An MRA of the renal arteries would be more useful in diagnosing renovascular atherosclerosis, as would a captopril radionuclide scan (although the latter is used much less often as it has poorer sensitivity and specificity than MRA). A 24-hour urinary free cortisol is a good screen for hypercortisolism. An MRI of the pituitary would not be a good initial test—a biochemical diagnosis should be established first.

Q.12. Which of the following scenarios illustrates the *most* appropriate first-line selection of antihypertensive agent in the hypertensive patient described?

A. A 72- year-old man with gout is prescribed a diuretic

B. A 35- year-old woman, pregnant with her first child, is prescribed lisinopril

C. A 32- year-old with chronic migraines is prescribed metoprolol

D. A 76- year-old woman with a history of femoral artery bypass surgery is prescribed atenolol

E. A 42- year- old woman with newly diagnosed Graves'' disease is prescribed a diuretic

Answer: C. Most experts agree that first-line antihypertensive therapy should usually consist of a diuretic or □-blocker. There are certain compelling indications,

however, to choose a different agent. Use of a □-blocker in a patient with chronic migraines may serve to both control blood pressure and also prevent migraines. Likewise, there are relative contraindications to some agents. A diuretic can increase uric acid levels and thus worsen gout. Lisinopril is contraindicated in pregnancy. □-blockers can worsen peripheral vascular disease and should be avoided in a patient with a history of femoral bypass. Finally, a young woman with newly diagnosed Graves' disease may be better served by a □-blocker (rather than a diuretic) to control both blood pressure and heart rate.

CHAPTER 3: LIPID DISORDERS

Q.1. A 55-year-old man with well-controlled hypertension is found to have an LDL cholesterol of 145. He pursues diet therapy for six months with no improvement. You recommend

A. Referral to an endocrinologist

B. An additional four months of stricter dietary therapy to ensure an adequate trial

C. Beginning drug therapy with a fibrate

D. Beginning drug therapy with a statin

E. Beginning both a fibrate and a statin

Answer: D. The patient has two risk factors for CHD: age greater than 45 years and hypertension. Therefore, his LDL goal is less than 130. Referral to an endocrinologist is not yet necessary. Six months of diet therapy is adequate to assess effectiveness and/or compliance. Fibrates are more effective in lowering triglycerides than LDL levels. Gemfibrozil probably should not be used in combination with statins due to the increased risk of rhabdomyolysis. Beginning statin therapy is correct.

Q.2. A 45-year-old woman undergoes routine cholesterol screening in your office. She is found to have a reasonable LDL of 140 mg/dL. You advise her that which of the following, if consumed in higher than average amounts, is *most* likely to lead to a more atherogenic lipid profile?

A. Polyunsaturated fats

B. Monounsaturated fats

C. Coconut oil

D. Omega-3 fatty acids

Answer: C. Coconut oil, palm oil, and butter are rich in certain saturated fatty acids that tend to elevate cholesterol levels. Dietary saturated fatty acids range in length from 8 to 18 carbon atoms; they vary in their ability to raise cholesterol. Polyunsaturated and monounsaturated fats have more of a beneficial effect on lipids. Omega-3 fatty acids tend to lower triglycerides.

Q.3. A 58-year-old man with a strong family history of coronary heart disease (CHD) is interested in lowering his risk. You check a fasting lipid profile and find the following:

LDL 150

VLDL405

HDL 22

You recommend drug therapy. Which of the following will have the least favorable effect on his triglyceride level and HDL?

A. Cholestyramine

B. Gemfibrozil

C. Lovastatin

D. Nicotinic acid

Answer: A. Bile acid sequestrants tend to raise triglycerides and have only a modest effect on HDL. The rest of the lipid lowering medications lower triglycerides and raise HDL to varying degrees.

Q.4. Metabolic syndrome is characterized by all of the following *except*:

A. Abdominal obesity

B. Fasting glucose >100

C. Increased Lp(a)

D. Small, dense LDL particles

Answer: C. To make a diagnosis of metabolic syndrome, one must have three or more of the following five factors: abdominal obesity, low HDL, elevated triglycerides, elevated blood pressure, or elevated fasting glucose. Small, dense LDL particles are part of the syndrome but their measurement is not required for diagnosis. Increased Lp(a) is a risk factor for coronary heart disease but it is not part of metabolic syndrome.

Q.5. The pattern of atherogenic dyslipidemia is frequently encountered in patients with diabetes and metabolic syndrome. Which is *not* true of this dyslipidemia?

A. Patients often have rapid progression to coronary heart disease

B. Statins effectively reduce the preponderance of small, dense LDL particles

C. Patients often have marked elevation in LDL

D. Hemostatic function is prothrombogenic

Answer: C. Patients with the atherogenic profile have normal or modest increases in LDL. The total number of particles is increased, however, with a B-type pattern (small, dense, highly atherogenic). Statins reduce these LDL particles, as well as modestly raising HDL and lowering triglyceride. These patients often have impaired fibrinolysis and endothelial dysfunction, leading to a prothrombogenic state. The end result is an accelerated progression to CHD.

Q.6. A 48-year-old male patient is found to have an HDL of 38 mg/dL. Which of the following is *not* true?

A. Weight-bearing exercise can be beneficial in raising HDL

B. HDL <40 is a powerful predictor of cardiac risk, more so than elevated LDL or total cholesterol

C. Smoking tends not to affect HDL levels as much as other lipid parameters

D. Nicotinic acid raises HDL more effectively than statins

Answer: C. Low HDL (<40) is a powerful predictor of cardiac risk. Options to raise HDL include weight-bearing exercise and estrogen replacement in postmenopausal women. Regarding pharmacotherapy, nicotinic acid is most effective. Smoking has a detrimental effect on all lipid parameters.

Q.7. A 60-year-old man with hypertension and continued tobacco use visits your office for a physical. Initial labs reveal a total cholesterol of 340, LDL of 210, and HDL of 35. What would you recommend to lower his cholesterol?

A. Start diet therapy

B. Start diet therapy and an exercise program

C. Start diet therapy, an exercise program, and a statin

D. Repeat the labs to confirm the cholesterol measurement and then start diet therapy

E. Repeat the labs to confirm the cholesterol measurement and then start medication

Answer: C. This man is at extremely high risk of CHD, given his numerous risk factors: male, age over 45 years, hypertension, and active smoking. Compounding these factors is the markedly elevated LDL level. The most aggressive therapy, including diet, exercise, and medication (such as a statin), should be pursued without delay. There is no reason to repeat the measurement.

Q.8. A 35-year-old man comes to your office for a physical prior to running a marathon. He feels well except for some occasional numbness on the plantar surface of his feet. On physical examination, you note an unusual orange hue to his tonsils. Routine lab work is notable for a low HDL of 10 mg/dL but normal triglycerides and LDL. What is his most likely diagnosis?

A. Lecithin-cholesterol acetyltransferase (LCAT) deficiency

B. Familial dysbetalipoproteinemia

C. Fish-eye disease

D. Tangier disease

Answer: D. The clinical findings of orange tonsils and extremely low HDL suggest the diagnosis of Tangier disease, an inherited disease associated with increased HDL catabolism. His foot numbness may be an early manifestation of peripheral neuropathy that can also be seen with Tangier disease. LCAT deficiency is also associated with low HDL but orange tonsils are not characteristic. Fish-eye disease is

a mild form of LCAT deficiency. Familial dysbetalipoproteinemia is associated with increased VLDL (triglycerides).

Q.9. A 48-year-old woman presents for a follow-up visit for hypertension. Her blood pressure is still 145/90 despite adherence to diuretic therapy. From her last physical, you notice that she has significant abdominal obesity (waist circumference of 37 inches) and evidence of insulin resistance (fasting glucose of 138 mg/dL). Her triglyceride level was 300 mg/dL. Which of the following would you expect?

A. Large LDL particles

B. An elevated serum aldosterone level

C. An elevated serum estrogen level

D. An HDL less than 50 mg/dL

E. A normal C-reactive protein level

Answer: D. This patient most likely has metabolic syndrome, as evidenced by her abdominal obesity, hypertension, insulin resistance, and elevated triglyceride levels. She meets criteria for diagnosis. A low HDL (<50 mg/dL in women and <40 mg/dL in men) is also often associated with this disorder. LDL particles are usually small rather than large. Patients also may have elevated proinflammatory markers, such as C-reactive protein. Elevated aldosterone and estrogen levels are not a described component of metabolic syndrome.

Q.10. A 36-year-old woman visits you for an employment physical. She has not seen a physician in years, but feels well. She has no cardiac risk factors. Her initial fasting lipid profile reveals a total cholesterol (TC) of 240 mg/dL, HDL of 50 mg/dL, LDL of 90 mg/dL, and triglycerides (TG) of 400 mg/dL. In managing her lipid abnormalities, all of the following would be important to do *except*:

A. Ask her about alcohol consumption

B. Check thyroid function tests

C. Check fasting serum glucose

D. Ask her about combination oral contraceptive use

E. Ask her about use of the progestin-only mini-pill.

Answer: E. This patient has an isolated hypertriglyceridemia but an otherwise normal lipid profile. She could certainly have a familial or idiopathic lipid disorder. However, other diseases, including alcoholism, diabetes, obesity, hypothyroidism, and chronic renal insufficiency, can be associated with high TG. Answers A, B, and C attempt to rule out these other causes. Medications, such as estrogens (found in combined oral contraceptives), high-dose diuretics, and nonselective □-blockers can also be associated with high TG. Progestin (the main component of the mini-pill) is more associated with low HDL rather than high TG.

Q.11. In which of the following patients is the goal LDL cholesterol *not* less than 100 mg/dL?

A. A 60-year-old man who underwent percutaneous coronary intervention last month

B. A 72-year-old woman with a fasting glucose of 206 mg/dL

C. A 63-year-old man with hypertension, tobacco use, and a low HDL

D. A 74-year-old man who underwent an abdominal aortic aneurysm repair three months ago

E. A 76-year-old woman with a history of femoral artery bypass surgery last year.

Answer: C. The goal for LDL cholesterol is less than 100 mg/dL in all patients with known coronary heart disease of "coronary heart disease equivalents," such as diabetes, peripheral vascular disease, abdominal aortic aneurysms, and carotid artery disease. The patient in answer A clearly has a history of coronary heart disease. The patient in answer B has diabetes, and the patients in answers D and E have evidence of peripheral vascular disease. They all should strive for an LDL below 100 mg/dL. The patient in choice C has more than two cardiac risk factors, but no coronary heart disease or "equivalents." His goal LDL is below 130 mg/dL

CHAPTER 4: CORONARY ARTERY DISEASE

Q.1. A 70-year-old man with hypertension comes to see you and describes six months of stable exertional angina. Despite the symptoms, he has remained active.

His resting ECG is normal. You order an ETT. He exercises 8 minutes on a Bruce protocol and reaches 100% of his maximal predicted heart rate. He develops his usual anginal symptoms at peak exercise, and the ECG shows only nonspecific changes. What do you do next?

A. Stress thallium test

B. Dobutamine echocardiogram

C. Refer for cardiac catheterization

D. Medical therapy

E. No intervention required

Answer: D. This patient has chronic stable angina. The fact that he has had stable symptoms, has remained active, and has a baseline normal ECG are all good prognostic signs. In a 70-year-old male who has coronary risk factors and a typical history of exertional angina, the pretest probability of CAD is high. The reason for ordering the stress test is not to determine whether or not he has CAD, but rather to assess his risk of MI and death (a negative test in a patient like this does not rule out CAD but does suggest that his risk for future events is low). The patient reaches 100% of his functional capacity and has anginal symptoms but has no ischemic ECG changes. For a low-risk patient like this one, who is on no medical therapy, the most appropriate next step is to begin medical therapy to reduce his symptoms (e.g., nitrates, □-blockers) and to reduce mortality and incidence of MI (ASA, lipid-lowering drugs). Further stress testing (answers A and B) will unlikely change case management, and stable patients determined to be at low risk should not be sent for catheterization (answer C) until they have failed medical therapy.

Q.2. You elect to treat the patient in the previous question medically. He returns a year later and reports that he is now getting chest pain more often and with less activity. You have been treating him with aspirin, a □-blocker, and a statin for his cholesterol. On examination, HR is 55 and BP is 120/80. Lab results show LDL cholesterol of 95 mg/dL. You repeat his stress test, and this time he develops chest pain and 2 to 3 mm ST depressions in II, III, aVF, and V4 through V6 at 4 minutes into exercise. What should you do next?

A. Prescribe a long-acting calcium blocker

B. Increase his β-blocker

C. Refer for cardiac catheterization

D. Admit to the hospital, start heparin, and consult cardiology for catheterization

E. Leave things alone because he has been stable for a long time

Answer: C. This patient with chronic angina is now failing medical therapy. Despite good control of his HR, BP, and cholesterol, he is now experiencing chest pain more easily and with less activity. His ETT is worrying in that it is positive early (<6 minutes) and there are deep ST depressions without much exercise. These findings suggest possible high-risk coronary anatomy (e.g., triple-vessel disease), which puts him at higher risk for future cardiac events and death. The reason to refer for catheterization is that you suspect high-risk anatomy that should be revascularized to relieve symptoms and improve survival. Because he is stable, his catheterization can be scheduled electively, and he does not need to be admitted urgently (answer D). There is also no need for intravenous heparin (answer D) in someone with stable exertional angina. Increasing his β-blocker (answer B) is probably unwise because his HR is already 55. Long-acting calcium blockers (answer A) are second-line agents for chronic stable angina and could be added, but catheterization is still warranted given his high-risk ETT and escalating symptoms.

Q.3. Which of the following statements about an unstable plaque is false?

A. An unstable plaque typically has a fibrous cap that covers a lipid-rich layer

B. The plaques most likely to rupture are the ones that cause the most severe stenoses seen at the time of catheterization

C. A lipid-rich plaque causing a 50% stenosis is more likely to rupture than a calcified and fibrotic plaque causing a 90% stenosis

D. Most deaths from MI are associated with plaque rupture

Answer: B. The extent of luminal narrowing at catheterization is often *not* predictive of which plaque will subsequently rupture. Usually, it is the smaller, lipid-rich, non–flow-limiting plaques that are most likely to rupture (answer C). The larger fibrotic plaques tend to be more stable. Answers A and D are both true statements.

Q.4. Which of the following statements is false with respect to STEMI versus NSTEMI?

A. There is a greater chance of finding an occlusive thrombus in a STEMI

B. Patients with NSTEMI have a more developed coronary collateral network

C. A person with a STEMI is more likely to have single vessel disease than a person with a NSTEMI

D. In the absence of PCI, GP IIB-IIIA inhibitors are not indicated for STEMI

E. The thrombus in a STEMI is more platelet rich than is the thrombus of a NSTEMI

Answer: E. All of the statements are true, except answer E. The thrombus of a STEMI tends to be richer in fibrin, whereas the thrombus of a NSTEMI is richer in platelets. This may be one important reason why thrombolytics are efficacious for STEMI, while GP IIB-IIIA inhibitors work better for NSTEMI. One should also remember that GP IIB-IIIA inhibitors are indicated for unstable angina and NSTEMI. In STEMI, unless PCI is performed, GP IIB-IIIA inhibitors are not indicated.

Q.5. A 62-year-old man presents to the emergency department with intermittent substernal chest tightness for the last two days. The pain radiates to the left jaw, occurs with exertion, and is relieved by rest. The longest episode was two minutes. He is admitted to the hospital and rules ruled out for a myocardial infarction. A subsequent stress test is positive. He undergoes cardiac catheterization, which reveals a 90% lesion in the right coronary artery and otherwise insignificant disease. All of the following anti-platelet agents are reasonable to use at the time of his percutaneous angioplasty except

A. Aspirin

B. Abciximab

C. Eftifibitide

D. Ticlopidine

E. Clopidogrel

Answer: D. Unless a patient has an aspirin allergy, aspirin is always used with a percutaneous coronary intervention (PCI). Abciximab and eftifibitide are two GP IIB-

IIIA inhibitors that have been shown to reduce ischemic events and improve survival when given during angioplasty procedures and are now frequently used in the catheterization lab. Ticlopidine and clopidogrel are anti-platelet agents that inhibit ADP- mediated platelet activation. These agents help decrease stent thrombosis. Because of associated neutropenia, ticlopidine is now used infrequently and has been essentially replaced by clopidogrel.

Q.6. A 60-year-old man presents with an acute anterior MI. He receives tPA in the emergency room one hour after onset of symptoms with rapid resolution of pain and ST elevations. He is admitted to the coronary care unit feeling well, pain free, and with stable blood pressure and pulse. Which intervention is least appropriate next?

A. Urgent cardiac catheterization with possible percutaneous coronary intervention

B. ACE inhibitor

C. Heparin

D. □- -blocker

E. Daily aspirin

Answer: A. This question emphasizes the point that there are no data to support that stable patients who rapidly reperfuse with thrombolytic therapy and have no manifestations of ischemia derive any mortality benefit from cardiac catheterization for PCI. Aspirin, heparin, ACE inhibitors, and □-blockers are all indicated in an acute ST elevation MI.

Q.7. A 70-year-old man is admitted to the coronary care unit with an acute infero-posterior myocardial infarction (MI). He is treated with tPA and initially does well. On day three, however, he suddenly becomes hypotensive, and you are called to see him. On examination, he is lying flat in bed with a pulse of 80, respiratory rate of 14, and systolic blood pressure of 80 mm Hg. He has an elevated jugular venous pressure (JVP), clear lungs, a new pansystolic murmur, and a palpable thrill. Which of the following is correct?

A. The triad of clear lungs, elevated JVP, and hypotension following a posterior MI suggests a right ventricular infarction, and he should receive fluids.

B. Sudden hypotension with elevated JVP in a patient who has been lying in bed for several days suggests a pulmonary embolism; the new systolic murmur is likely tricuspid regurgitation in the setting of sudden increase in pulmonary pressure

C. This presentation is consistent with rupture of the ventricular septum and cardiac surgery is necessary.

D. This presentation is consistent with rupture of a papillary muscle, and cardiac surgery is necessary.

E. This presentation is consistent with post-MI pericarditis (Dressler's syndrome) and prednisone should be administered.

Answer: C. A new systolic murmur following an acute MI could represent several things, and the differential diagnosis is outlined by the various answers given as choices. Hypotension, right ventricular (RV) failure, a new systolic murmur, and a palpable thrill are all most consistent with rupture of the ventricular septum. This typically occurs several days following the infarct. Answer A is incorrect because RV infarcts do not cause sudden hypotension several days after initial presentation. They also do not cause a palpable thrill. Answer B is wrong because a pulmonary embolism that causes hypotension would also be expected to cause tachycardia and tachypnea and would not cause a thrill. Answer D is incorrect because acute papillary muscle rupture causing severe mitral regurgitation would result in pulmonary edema, and the patient would not have clear lungs or be able to lie flat. Answer E is also wrong because Dressler's syndrome is usually associated with fever and a rub, not a thrill and hypotension.

Q.8. Match the problem with its hemodynamics:*

1. Papillary muscle rupture

2. RV infarct

3. Rupture of the ventricular septum

4. Tamponade

A. RA = 21 mm Hg, RV = 60/22 mm Hg, PCWP = 20 mm Hg, CI = 1.7 l/min/m^2, PA O_2 sat = 70%

B. RA = 15 mm Hg, RV = 60/30 mm Hg, PCWP = 6 mm Hg, CI = 1.7 l/min/m^2, PA O_2 sat =7 0%

C. RA = 12 mm Hg, RV = 60/30 mm Hg, PCWP = 10 mm Hg, CI = 1.7 l/min/m^2, PA O_2 sat = 95%

D. RA = 12 mm Hg, RV = 50/20 mm Hg, PCWP = 40 mm Hg, CI = 1.6 l/min/m^2, PA O_2 sat = 75%

*CI, cardiac index; PA O_2 sat, pulmonary artery oxygen saturation; PCWP, pulmonary capillary wedge pressure; RA, right atrial pressure; and RV, right ventricular pressure.

Answer: 1:D, 2:B, 3:C, 4:A.

Papillary muscle rupture is answer D. With the acute mitral regurgitation, there is a huge increase in left atrial pressure (which is reflected in the high PCWP). Some of the oxygenated blood from the LV may even jet back into the pulmonary artery giving the slightly higher O_2 sat. RV infarct is answer B because, with an RV infarct, the right-sided pressures are high while left-sided (wedge) pressures remain low. Rupture of the septum is answer C**,** which reveals high right-sided pressures, fairly normal wedge pressure, and the increased pulmonary artery O_2 saturation (oxygen-rich blood moves from the left side of the heart to the right). Tamponade is answer A because there is equalization of right- and left-sided diastolic pressures.

Q.9. A 22-year-old man with no significant past history presents to the emergency room complaining of intense, left-sided chest pain radiating to his left arm. He admits to smoking crack cocaine about two hours ago. His pain has now been present for over an hour. His physical examination reveals a pale, diaphoretic man. His blood pressure is 155/90. His pulse is 110 bpm. Pulmonary and cardiac exams are only notable for tachycardia. His EKG reveals 2 mm ST elevation in the inferior leads. The troponin level is elevated. All of the following are appropriate treatment measures for this patient *except*

A. Oxygen

B. Lorazepam

C. Propranolol

D. Nitroglycerin

E. Aspirin

Answer: C. This patient presents with evidence of a cocaine-induced myocardial infarction. Chest pain can occur minutes to hours after cocaine use. It is thought to cause myocardial ischemia by increasing myocardial oxygen demand, causing vasoconstriction, and/or accelerating thrombosis. All of the answers listed except for propranolol are appropriate therapies for cocaine-induced infarction. Since

cocaine-induced vasoconstriction is primarily caused by stimulation of □-adrenergic receptors, beta-blockade may actually potentiate the vasoconstrictor response. Benzodiazepines can serve to reduce the heart rate and systemic arterial pressure. In animal studies, they have been shown to attenuate cocaine's effect on the heart.

CHAPTER 5: ARRHYTHMIAS

Q.1. A 43-year-old man undergoes laparoscopic cholecystectomy. On postoperative day 1, he develops atrial fibrillation at a rate of 150 bpm. He has no history of atrial fibrillation in the past. He is asymptomatic, and his echocardiogram shows normal left ventricular function with no valvular pathology. His left atrial size is 4.2 cm. He has no contraindications to anticoagulation and is considered to be at a low risk for bleeding. You are asked to see the patient. You recommend

A. Transesophageal echocardiogram and cardioversion with periprocedure heparin therapy

B. Rate control with IV diltiazem and heparin therapy now, followed by four weeks of coumadin therapy if he does not convert to sinus rhythm at the time of discharge

C. Cardioversion within 24 hours without periprocedure heparin

D. Cardioversion within 24 hours with periprocedure heparin

E. All of the above except A are possible treatment strategies

Answer: E. There are multiple possible strategies for control of atrial fibrillation in this situation. One could argue that the patient has postoperative atrial fibrillation, which is adrenergically mediated and, with appropriate rate control and time, he will probably convert back to sinus rhythm on his own (Answer B). Cardioversion could also be elected, although use of periprocedure heparin is controversial. The duration of atrial fibrillation is documented to be less than 24 hours, and the patient is low risk for embolization (given his age and lack of other risk factors). Thus, foregoing periprocedure heparin is reasonable (Answer C). Alternatively, there is a theoretical risk of cardioversion leading to atrial stunning and, since the patient is low risk for bleeding, heparin and coumadin should be used in the short run (Answer D). Given

the brief duration of atrial fibrillation, a trans-esophageal echocardiogram to rule out thrombus is not warranted (Answer A).

Q.2. A 65-year-old man with a history of hypertension presents to your office with palpitations and fatigue. He says that the palpitations have been occurring for over two weeks. Office ECG shows atrial fibrillation at a rate of 115 bpm. Echocardiogram reveals a left atrial size of 4.1 cm, mild left ventricular hypertrophy, and normal ejection fraction. As all of his other past ECGs revealed normal sinus rhythm, and you are pretty convinced that his atrial fibrillation is new. You discuss possible TEE and cardioversion with the patient. However, the patient refuses TEE as he is afraid of the probe. His options include

A. Rate control with oral medications

B. Rhythm control with oral sotalol

C. Coumadin pretreatment for at least 3 three weeks followed by cardioversion

D. A and C

E. All of the above

Answer: D. Given the fact that this patient's symptoms have been ongoing for at least two weeks, he would be at high risk for stroke if he received cardioversion without coumadin pretreatment or transesophageal echocardiogram to rule out left atrial thrombus. Rhythm control with oral medications carries the same risk. Therefore, starting an oral load of sotalol without anticoagulation or a TEE would be contraindicated.

Q.3. A 24-year-old woman has monthly episodes of a racing heart. The palpitations start abruptly, are regular at over 200 bpm, and typically end abruptly after 15 to 20 minutes. She can occasionally make the episode resolve with a Valsalva maneuver. She has never had an ECG during an episode, but has come to the emergency room on several occasions just afterwards, where the ECG always shows normal sinus rhythm at 70 to 90 bpm. She was recently married and would like to become pregnant but is concerned about the palpitations. What would be the appropriate management?

A. Educate the patient that she is having panic attacks and teach her to breathe into a paper bag when the episodes occur

B. Prescribe a Holter monitor to assess her rhythm over 24 hours

C. Prescribe an event recorder so she can document her rhythm with the next episode

D. Start her on a β-blocker with instructions to return if symptoms recur

E. Refer her for electrophysiology (EP) study and catheter ablation

Answer: E. This patient has a classic history for paroxysmal supraventricular tachycardia (PSVT), not panic attacks. She can be cured with catheter ablation, whether or not the diagnosis is AV node re-entrant tachycardia (AVNRT) or an accessory pathway mediated tachycardia. A Holter monitor is unlikely to catch an episode because the Holter captures only 24 hours. An event recorder is more likely to provide a noninvasive diagnosis but will only confirm what is clear from the patient's history and will delay therapy. Medication may suppress the arrhythmia but is undesirable if the patient wishes to become pregnant.

Q.4. A 70-year-old man has exertional chest pain without shortness of breath, dizziness, or syncope. He undergoes elective catheterization and angioplasty. He is then hospitalized overnight and, while asleep, has a 7-second sinus pause noted on cardiac monitor. Appropriate management would be

A. Insertion of temporary pacing wire and further observation on cardiac monitor

B. Atropine 1 mg IV followed by insertion of temporary pacing wire if pauses recur

C. Atropine 1 mg IV and arrange permanent pacemaker implantation in morning

D. Atropine 1 mg IV and arrange EP study in morning

E. Continue discharge planning

Answer: E. Asymptomatic sinus pauses are common and usually do not require treatment. There is no upper limit on the length of an asymptomatic sinus pause that is allowed before a pacemaker is indicated. If the patient reported syncopal or near-syncopal spells, then the pause would be viewed in an entirely different context and a pacemaker would be indicated.

Q.5. A 14-year-old girl has syncope while standing in line at a store. She feels sweaty and nauseated and notes palpitations immediately before passing out. Afterwards, she feels tired for hours. She claims this has never happened before. What would be appropriate management be?

A. Provide reassurance and advise her to drink plenty of fluids

B. Arrange for tilt table testing to rule out vasodepressor syncope

C. Arrange for electrophysiology study to rule out arrhythmic etiology of syncope

D. Initiate treatment for vasodepressor syncope with fludrocortisone 0.1 mg by mouth daily

E. Prescribe an event recorder so she can record the ECG tracing if syncope recurs

Answer: A. Fainting because of vasodepressor syncope is common, particularly in adolescent girls. Unless syncope is frequent, it does not compel a workup with tilt table testing or event recorder monitoring. Likewise, it does not require empiric treatment with medication.

Q.6. A 70-year-old woman has not seen a doctor in over five years. She is asymptomatic but comes in for a check-up at her daughter's urging. She claims she had rheumatic fever as a child. On examination, her cardiac rhythm is irregular, and she has a holosystolic murmur. An ECG shows atrial fibrillation with a ventricular response that averages 80 bpm. An echocardiogram reveals normal left ventricular size and function, a dilated left atrium of 6 cm in diameter, and a calcified rheumatic mitral valve with moderate regurgitation. What would be appropriate management at this time?

A. Arrange for a transesophageal echocardiogram and subsequent cardioversion if no left atrial thrombus is present

B. Start warfarin and arrange for outpatient cardioversion in 1 month

C. Start warfarin and tell the patient she will need anticoagulation for the rest of her life

D. Start warfarin and amiodarone and plan to arrange outpatient cardioversion in one month if chemical conversion does not occur by then

E. Refer for AV node ablation and ventricular pacemaker implantation, after which warfarin will be initiated

Answer: C. This patient is at high risk for thromboembolism and stroke because of a rheumatic mitral valve and left atrial enlargement. Therefore, lifelong anticoagulation with warfarin is mandatory. Her left atrium is severely dilated because of longstanding mitral regurgitation, and she has probably been in atrial fibrillation for years. Cardioversion will likely be futile in this case. Even if successful, it would be of no clear benefit because she is asymptomatic from a cardiac standpoint. Also, there is an extremely high likelihood that the atrial fibrillation would recur (again without symptoms and escaping medical detection). Thus, she would need to remain on permanent warfarin therapy anyway.

Q.7. A 60-year-old woman had an anterior myocardial infarction three months ago. Her left ventricular ejection fraction is 30% with anterior akinesis. She has done well and is currently asymptomatic with no pedal edema, dyspnea on exertion, or orthopnea. Her medications are low-dose atenolol, enalapril, and aspirin. Her cardiologist orders a Holter monitor, which shows normal sinus rhythm with occasional PVCs and brief runs of nonsustained ventricular tachycardia (VT). Appropriate management would be

A. Double atenolol dose

B. Discontinue atenolol, and start amiodarone

C. Refer for automatic implantable cardioverter/defibrillator (AICD) implantation

D. Refer for electrophysiology (EP) study, and if sustained VT is inducible, then AICD implantation

E. No change in management

Answer: D. In patients with unnsustained ventricular tachycardia in the setting of poor LV function from a prior myocardial infarction, an EP study can identify those at highest risk for sudden death. These patients have improved survival with AICD implantation. While increasing atenolol is not a "wrong" answer, it is not the best option. Amiodarone would also not be a first-line choice, as AICD therapy is superior. Doing nothing is not acceptable, as she is at risk of sudden death.

Q.8. A 50-year-old man collapses while crossing the street. CPR is administered and the paramedics arrive to find him in ventricular fibrillation (VF). He is defibrillated and intubated at the scene, and rapidly extubated once he arrives at the hospital emergency department. An ECG now shows sinus rhythm with LBBB and a bedside echocardiogram shows he has a dilated cardiomyopathy with an ejection fraction of 30%. Later in his hospital stay, a cardiac catheterization shows no flow-limiting coronary disease. He has no prior history of syncope, heart failure symptoms, or coronary artery disease. Appropriate management would include

A. Lidocaine drip with plan for electrophysiology (EP) study

B. Refer for automatic implantable cardioverter/defibrillator (AICD) implantation

C. Initiate amiodarone load to be followed by daily dose of 400 mg every day

D. Start β-blocker and arrange for EP study

E. No antiarrhythmic therapy necessary

Answer: B. Given this patient's cardiomyopathy of unknown etiology (coronary artery disease is ruled out by a clean catheterization), low ejection fraction, and presentation with "sudden death," he is at high risk for a recurrent malignant arrhythmia. Treatment is necessary. An AICD confers a greater survival advantage than amiodarone (or other medications). An EP study is not useful for stratifying arrhythmic risk in patients with nonischemic cardiomyopathy.

Q.9. A 75-year-old man has syncope lasting only seconds. He came to the hospital because he lacerated his forehead when he collapsed, but otherwise feels fine. He claims this has never happened before. His only medication is a β-blocker, which he takes for hypertension. His ECG shows sinus rhythm at 60 bpm with RBBB and left posterior fascicular block. An echocardiogram shows normal ventricular size and function. He is admitted for observation, and three-blocked P waves are observed. The PR interval appears constant on all other beats. He remains asymptomatic in the hospital. Appropriate management would be

A. Prescribe an event monitor that he should wear for one month to capture any symptomatic episodes

B. Discontinue the β-blocker and initiate ACE inhibitor for his hypertension, monitor for another 24 hours, and discharge to home unless more blocked P waves are observed

C. Refer for electrophysiology (EP) study

D. Refer for pacemaker implantation

E. Discharge to home after 24 hours of monitoring, with instructions to contact his physician if syncope recurs

Answer: D. This patient has syncope and Mobitz II second degree AV block. A pacemaker is strongly indicated. He is symptomatic (syncope), so no further documentation of symptoms with a Holter monitor is necessary. Changing his medications is unlikely to help, and discharging him for observation is not appropriate. An EP study is not required to make this diagnosis.

Q.10. Which of the following statements about antiarrhythmic medications is true?

A. Class II agents are calcium channel blockers and work by decreasing AV node conduction

B. Amiodarone can lead to hepatotoxicity, thyroid abnormalities, and nephrotoxicity

C. Torsades de pointes secondary to long QT syndrome is best managed with class II agents

D. Flecainide has been linked to drug-induced lupus

E. Class III agents, such as quinidine and lidocaine, predominantly work by blocking sodium channels.

Answer: C. Of the statements listed, answer C is correct. Torsades de pointes secondary to long QT syndrome is best managed with class II agents (β-blockers). Answer A is wrong because class II agents are beta-blockers, not calcium channel blockers (class IV agents). Amiodarone can lead to hepatotoxicity, hypo- and hyperthyroidism, pulmonary toxicity, and peripheral neuropathy. Nephrotoxicity is not commonly described. Procainamide, not flecainide, has been linked to drug-induced lupus. Quinidine and lidocaine are class I agents (not class III) and work by blocking sodium channels. Class III agents, such as amiodarone and sotalol, act by prolonging the action potential duration.

CHAPTER 6: HEART FAILURE

Q.1. A 72-year-old woman presents to your office with dyspnea and peripheral edema. On examination, her BP is 180/70 mm Hg and her pulse is 100 bpm. She has elevated jugular venous pressure, peripheral edema of the ankles, and a fourth heart sound. All of the following would be reasonable to obtain in the near future *except*

A. ECG and chest x-ray

B. Serum electrolytes, complete blood count, and a urinalysis

C. 24-hour Holter monitor

D. Echocardiogram

Answer: C. In general, a Holter would not be considered a part of the initial workup of heart failure. If the patient complained of syncope or palpitations, a Holter would be indicated. All of the other tests are reasonable.

Q.2. You would expect all of the following to be elevated in the plasma of the 72-year-old female patient in the previous question *except*

A. Norepinephrine

B. Thyroxine

C. Angiotensin II

D. Atrial natriuretic peptide

E. Endothelin

Answer: B. A, C, D, and E are all elevated in heart failure as part of "neurohormonal activation." Thyroxine is generally not increased unless the patient has a cardiomyopathy due to hyperthyroidism (which is rare).

Q.3. An 18-year-old high school student has a syncopal episode while playing basketball. He is brought to the nearest emergency room, where it is learned that an older brother had experienced a similar event three years ago. Which of the following is the physical examination most likely to reveal?

A. A rapid carotid upstroke

B. A delayed carotid upstroke

C. An outflow murmur that increases with the Valsalva maneuver

D. B and C

E. A and C

Answer: E. Sudden death in a young man during competitive athletics is a classic presentation for hypertrophic cardiomyopathy. It is, in fact, the most common cause of sudden death in young athletes, and syncope can be an early warning sign. The patient's family history further suggests this diagnosis. Patients with hypertrophic cardiomyopathy may have a dynamic ventricular outflow obstruction associated with a murmur. The murmur is augmented by maneuvers that decrease preload (Valsava) or decrease afterload (amyl nitrite, vasodilators). In contrast to patients with aortic stenosis, patients with hypertrophic cardiomyopathy have a strong carotid upstroke.

Q.4. A 65-year-old man presents with class III symptoms of heart failure and a known ischemic cardiomyopathy with prior myocardial infarctions. His EF is 18%. His ECG shows a QRS duration of 110 ms. Appropriate therapy for this man would include all of the following *except*

A. Lisinopril and carvedilol

B. Furosemide

C. Digoxin

D. An internal cardioverter-defibrillator (ICD)

E. A biventricular pacing ICD

Answer: E. ACE inhibitors (lisinopril) and β-blockers (carvedilol) prolong life in patients with HF. This patient has evidence of fluid overload—thus, adding furosemide is appropriate. Furthermore, he would benefit from ICD placement given his low EF and class III symptoms. The patient does not need biventricular pacing because his QRS duration is not greater than 120 ms. The key here is actually not the QRS duration but the presence of ventricular dyssynchrony that comes with prolongation of the QRS duration.

Q.5. You are asked to see a 32-year-old man with obstructive hypertrophic cardiomyopathy and a resting left ventricular gradient of 30 mm Hg. He feels well on propranolol. There is no family history of sudden death, and the patient denies palpitations and syncope. As you go to see him, you remind yourself to tell him all of the following *except*

A. To follow prophylactic antibiotic recommendations prior to dental work

B. To make sure his first-degree relatives are screened with an echocardiogram and an ECG

C. To get an ICD

D. To avoid competitive athletics and dehydration

Answer: C. This man does not need an ICD as he has no history of sudden death or syncope and no familial history of the same. We are not told about other risk factors for sudden death, such as nonsustained ventricular tachycardia, massive hypertrophy, or a high-risk genotype. All the other things are commonly recommended to patients with obstructive hypertrophic cardiomyopathy.

Q.6. Your new patient today presents with classic findings of right-sided heart failure. She is 55 years old and had an episode of viral pericarditis 10 years ago. This is her only cardiac history. Her echocardiogram shows normal LV size and function, as well as normal valves. No Doppler study was performed. Her ECG shows atrial fibrillation and low voltage QRS. While waiting for the chest film, you consider restrictive cardiomyopathy and constrictive pericarditis as possibilities. To differentiate between the two entities, you would think about ordering all of the following tests *except*

A. Echocardiography with Doppler study

B. Cardiac catheterization with simultaneous measurement of right and left heart pressures

C. Cardiac MRI or CT scan

D. Nuclear ventriculography

Answer: D. The presentation should make you strongly consider constrictive pericarditis given the prior history of viral pericarditis and the current right-sided heart failure. If a thickened pericardium was seen on CT scan or MRI, especially if

calcified, one would be suspicious of constrictive pericarditis. Echocardiography alone may show a thickened pericardium but often does not, even in the presence of constrictive pericarditis. The addition of Doppler studies, particularly looking at mitral and tricuspid valve inflow velocity in response to respiration, may be diagnostic. Similarly, certain patterns seen during simultaneous measurement of both right and left heart pressures with cardiac catheterization, especially in response to respiration, may be diagnostic. One should not miss constrictive pericarditis because pericardial stripping is curative. Nuclear ventriculography is unlikely to be helpful.

Q.7. A 65-year-old man with long-standing hypertension presents to your office for the first time in two years with new pedal edema over the last three months. He denies shortness of breath and chest pain. He was supposed to be on medication for his blood pressure, but ran out of it a year ago. You find his blood pressure in the office to be 165/95. His lungs are clear, but he has 2+ pitting edema at the ankles bilaterally. You order an echocardiogram that reveals hypertrophic left ventricular walls with "E to A reversal" and an ejection fraction of 70%. All of the following medications would be appropriate *except*

A. Lisinopril

B. Atenolol

C. Verapamil

D. Furosemide

E. Digoxin

Answer: E. This patient with long-standing hypertension has now developed hypertensive cardiomyopathy. The pathophysiology is primarily that of diastolic dysfunction. □-blockers (atenolol) and certain calcium channel blockers (verapamil, diltiazem) are useful because they are myocardial relaxants. ACE inhibitors (lisinopril) are beneficial for their remodeling effects and diuretics (furosemide) are good for volume control. Digoxin would be inappropriate, as it enhances myocardial contractility (which is undesirable).

Q.8. A 48-year-old man suffers a large myocardial infarction, leaving him with congestive heart failure and an ejection fraction of 35%. Which of the following therapies has *not* been shown to decrease his subsequent mortality?

A. □-Bblocker

B. Digoxin

C. Angiotensin-converting enzyme inhibitor

D. Aspirin

E. Statin

Answer: B. Digoxin has been shown to decrease recurrent episodes of CHF and to decrease readmission rates to hospitals. Unlike the others, it has not been proven to decrease mortality.

Q.9. A 62-year-old man with chronic congestive heart failure (CHF) due to coronary artery disease has been on a stable medical regimen of lisinopril, aspirin, and furosemide for years. He has been extremely compliant with medications and office visits. He closely monitors his weight daily. In addition to his CHF, he has hypertension, diabetes, and gout. Last month, he suffered a gout flare-up that is being treated with indomethacin. Over the last three weeks he has noticed a gradual decline in exercise tolerance, a weight gain of five pounds, and worsening pedal edema. What is the most appropriate course of action?

A. Perform cardiac catheterization to rule out coronary ischemia

B. Increase the diuretic

C. Check a white blood cell count and urinalysis to rule out infection

D. Discontinue the indomethacin

E. Counsel him regarding better compliance with a low- salt diet

Answer: D. This patient presents with mild symptoms of worsening CHF. It is important to know which factors can lead to such deterioration. In this patient, the most likely cause is the addition of a nonsteroidal anti-inflammatory agent (indomethacin) to his regimen. Such drugs can worsen symptoms of CHF in an otherwise stable patient. It should be discontinued. The other choices are plausible and should be considered in a patient with worsening CHF. In this patient, however,

these are less likely. He does not have chest tightness or other symptoms of ischemia, nor does he have fever, dysuria, or other infectious symptoms. He has a long history of excellent compliance, so noncompliance now seems unlikely. Increasing the diuretic is reasonable, but discontinuing the indomethacin should be done first because of the temporal relationship between the institution of the drug and the onset of the patient's symptoms.

Q.10. A 35-year-old woman presents with five months of worsening shortness of breath on exertion and leg swelling. She has no prior history of medical problems. Physical examination reveals a blood pressure of 135/85, crackles over both lung bases, an S3 gallop, and normal carotid upstrokes. Her ECG shows Mobitz II second-degree heart block. Echocardiographic findings include an ejection fraction of 55%, mild enlargement of all four chambers, thickened left and right ventricular walls, and "E to A" reversal. Which of the following is the most likely diagnosis?

A. Hypertensive cardiomyopathy

B. Cardiac amyloidosis

C. Cardiac sarcoidosis

D. Constrictive pericarditis

E. Viral myocarditis

Answer: C. This patient presents with symptoms and signs of congestive heart failure (CHF), including dyspnea on exertion, pedal edema, S3 gallop, and pulmonary edema. Her echocardiogram suggests diastolic dysfunction with thickened ventricular walls and good systolic function. Viral myocarditis is unlikely, as it usually presents with systolic dysfunction, and constrictive pericarditis should appear as a thickened pericardium on echocardiogram. Hypertension, amyloidosis, and sarcoidosis can all lead to diastolic dysfunction with CHF. Hypertensive cardiomyopathy, however, is unlikely in this patient who lacks a history of hypertension and is normotensive on examination. She is the wrong age group for amyloidosis and has no other features to suggest this. Her most likely diagnosis, given her symptoms, diastolic dysfunction, and heart block on ECG, is sarcoidosis.

CHAPTER 7: VALVULAR HEART DISEASE

Q.1. Which of the following parameters is *not* helpful in determining the need for surgery in severe chronic aortic regurgitation?

A. Decreasing exercise tolerance

B. Left ventricular end systolic diameter

C. Severity of pulmonary hypertension

D. Left ventricular end diastolic diameter

E. Left ventricular ejection fraction

Answer: C. Indications for aortic valve replacement in patients with severe chronic aortic regurgitation include onset of symptoms, worsening exercise tolerance, declining ejection fraction, and severe LV dilatation. Unlike mitral valvular disorders, pulmonary hypertension is not usually a prominent feature of chronic aortic regurgitation except in the late stages when the decompensated ventricle leads to congestive heart failure.

Q.2. A 75-year-old man is diagnosed with aortic stenosis. What is the most likely etiology of his valvular disorder?

A. Degenerative calcific valve

B. Bicuspid aortic valve

C. Infective endocarditis

D. Rheumatic heart disease

E. Subvalvular aortic ridge

Answer: A. Degenerative calcific aortic disease is the most common cause of aortic stenosis in individuals over the age of 70 years. Patients with congenital bicuspid aortic valves usually present under the age of 65 years. Similarly, patients with rheumatic aortic stenosis and subvalvular stenosis usually present with clinical symptoms earlier than the 8th decade. Infective endocarditis does not usually lead to severe aortic stenosis.

Q.3. A 19-year-old, healthy woman is referred to you for evaluation of a murmur that was noted during a mandatory examination for her university's athletic program. She was a star basketball player in high school. She has no prior medical history. She does not smoke, drink, use illicit drugs, or take anorectic agents. Her family history is only significant for the sudden death of an older brother in his mid-twenties while away in the Peace Corps. She is 6''1, 165 pounds, and her physical examination is notable only for a diastolic decrescendo murmur heard best at the left sternal border. Which of the following is the most likely cause of her murmur?

A. Rheumatic heart disease

B. Inherited autosomal dominant single gene disorder

C. Congenital valvular abnormality

D. Traumatic injury to the aortic valve

E. Inherited chromosomal defect

Answer: B. The description of the murmur suggests the murmur of aortic regurgitation. This young woman with tall stature most likely has Marfan syndrome, an autosomal dominant genetic disorder that affects connective tissues. Ascending aortic root dilatation is one of the cardiac manifestations of Marfan syndrome, and it may lead to aortic regurgitation. The dilated aorta may also dissect or rupture. This may be a possible explanation for the sudden death of her brother, who may also have had unrecognized Marfan.

Q.4. A 31-year-old woman who just moved to town comes in for a routine clinic visit. She has no medical problems and, on review of systems, notes occasional self-limited episodes of palpitations. These do not concern her. On physical examination, she has a midsystolic click followed by a blowing apical murmur. Which of the following statements regarding dynamic auscultatory findings in this individual is *false*?

A. The click will occur earlier in systole with prompt squatting

B. The murmur will occur later in systole with isometric exercise (handgrip)

C. The click will occur earlier in systole with amyl nitrite inhalation

D. The murmur will occur earlier in systole during the strain phase of the Valsalva maneuver

Answer: A. Prompt squatting leads to a transient increase in venous return, which moves the click later in systole. Such an increase in preload increases ventricular size and results in prolapse of the valve later in the cycle (and with a later murmur). Likewise, isometric exercise (handgrip) moves the click earlier in systole (i.e., increases afterload primarily but also increases preload to some degree). Administration of amyl nitrite causes systemic vasodilatation and a decline in preload, which moves the click earlier in systole. Similarly, during the strain phase of the Valsalva maneuver, decreased filling of the left ventricle moves the click earlier in systole.

Q.5. A 65-year-old man with a history of rheumatic fever as a child underwent a root canal four weeks ago. Two weeks ago, he presented to the emergency department with fever, myalgias, and fatigue. Admission creatinine was 1.8 with microscopic hematuria. An echocardiogram revealed mitral valve vegetation, and he was started on intravenous antibiotics for presumed endocarditis. Blood cultures subsequently grow *Stetococcus viridans*. He responds well, with resolution of his fever and return of his creatinine to normal. However, on the day of discharge, you are called urgently to his room because of sudden shortness of breath. His examination is notable for labored breathing, a blood pressure of 90/55, crackles in the bases of the lungs, and II/VI systolic murmur. An ECG is notable for sinus tachycardia at 110 bpm but no ischemic changes. What is the best course of action?

A. Urgent echocardiogram followed by intra-aortic balloon pump insertion

B. Urgent echocardiogram and surgical consultation

C. Urgent Swan-Ganz catheter with pulmonary capillary wedge measurement

D. Urgent transesophageal echocardiogram

E. Fluid challenge, repeat blood cultures, and addition of vancomycin treatment

Answer: B. This patient has been treated for infective encarditis involving the mitral valve. While he has had a microbiologic response, the inflammation to the valve has resulted in acute regurgitation (despite initial clinical improvement). He now has acute shortness of breath, hypotension, and pulmonary edema. He requires urgent echocardiography to confirm regurgitation, followed by emergent surgery. Neither a transesophageal echocardiography nor a Swan-Ganz catheter is necessary for confirmation or diagnosis. An intra-aortic balloon pump would be temporizing

only and could potentially worsen the situation. The picture is that of acutely worsening mitral valve function, not sepsis, thus and a mechanical solution is required.

Q.6. A 31-year-old woman is 28 weeks pregnant with her first child. She is relatively healthy and has had an uneventful pregnancy. Her obstetrician asked her to call you because she has had increasing difficulty breathing at night. In fact she is now using three pillows and occasionally wakes up gasping for air. In your office she appears dyspneic when speaking in full sentences. Her blood pressure is 95/65 and her pulse is 118. Lung examination is notable for crackles at both bases. Cardiac exam reveals a loud S1, and an extra sound in diastole. ECG shows deep inverted P waves in V1 and a rightward QRS axis. She has 1+ pitting edema in the lower extremities. Which of the following is true?

A. She should be started on heparin and sent for immediate venous ultrasound and a V-Q scan

B. She probably has peripartum cardiomyopathy and should be delivered immediately since the fetus is already viable

C. The likely diagnosis is mitral stenosis, and she should respond to furosemide and β-blockers

D. Urgent right-heart catheterization is the most definitive way to distinguish the main diagnostic possibilities

E. Her preecclampsia has exhausted left ventricular afterload reserve, and the prognosis is grim; the obstetrician should be advised to arrange immediate delivery regardless of fetal viability.

Answer: C. The history and findings point to left heart dysfunction. Although breathlessness in a pregnant woman should always raise the suspicion of pulmonary embolism, this would not be a likely diagnosis here (edema is bilateral, etc.). Peripartum cardiomyopathy is not the most likely diagnosis; even if it does prove correct, the timing of delivery would depend on careful analysis of risk to mother and fetus. Mitral stenosis is more likely than cardiomyopathy, given the ECG suggestion of long-standing left atrial hypertrophy and the rightward axis (these changes would likely not be found in peripartum cardiomyopathy of fairly recent onset). The two likely possibilities can be distinguished much better by echocardiography than by

right heart catheterization, since either will lead to increased right heart pressures. This is not the picture of preecclampsia as she is not hypertensive.

Q.7. A 65-year-old man with known coronary artery disease and a previous history of myocardial infarction presents to the emergency department with sudden onset of severe shortness of breath. He had experienced intermittent chest tightness over the last few days. In the emergency department, he is apprehensive, cool, clammy, and diaphoretic. His blood pressure is 90/50 mm Hg. A bedside echocardiogram reveals the presence of wide-open mitral regurgitation. Which of the following interventions is *not* indicated?

A. Insertion of an intra-aortic balloon pump

B. Cardiac catheterization

C. Insertion of an arterial line

D. Transesophageal echocardiography

E. Parenteral nitroprusside

Answer: D. This patient has acute severe mitral regurgitation, likely due to myocardial ischemia affecting the papillary muscles. Initiation of afterload reduction with nitroprusside, insertion of an arterial line for hemodynamic monitoring, and/or placement of an intra-aortic balloon pump for hemodynamic support, are all justifiable temporizing measures while awaiting the needed cardiac catheterization. There is no need for transesophageal echocardiography since the transthoracic echocardiogram yielded the necessary information.

Q.8. A 35-year-old woman presents with the complaint of progressive dyspnea on exertion of several months' duration. She has a history of rheumatic fever as a child, but has otherwise done well. Her physical examination is notable for an opening snap in diastole followed by a rumbling apical murmur. Which of the following statements regarding auscultatory findings in this woman is *false*?

A. The murmur is usually heard best in the left lateral recumbent position

B. The time interval between S2 and the opening snap is variable during atrial fibrillation

C. P2 component of the second heart sound may be prominent

D. The murmur decreases in intensity with amyl nitrite inhalation

E. The strain phase of the Valsalva maneuver will decrease the intensity of the murmur

Answer: D. The murmur of rheumatic mitral stenosis (MS) is heard best in the left lateral decubitus position. The variable R-R cycle length in atrial fibrillation leads to a variable time interval between S2 and the opening snap. A prominent P2 component of S2 is a common auscultatory finding in pulmonary hypertension, which is also found in patients with mitral stenosis. Amyl nitrite administration causes systemic vasodilation with a decrease in afterload. This results in an increase in flow across the valve and thus an increase in the intensity of the murmur. Conversely, the Valsalva maneuver causes a decrease in venous return and a decrease in preload. This leads to a decrease in the intensity of the MS murmur.

Q.9. A 54-year-old man with a long-standing history of hypertension presents to the emergency department with the sudden onset of tearing pain in his mid-back. He appears dyspneic. Vital signs show a blood pressure of 90/65, respirations of 24, and heart rate of 110. He has crackles in one third of the lung fields bilaterally. Cardiac exam reveals an early decrescendo diastolic murmur at the left sternal border. CT reveals a false lumen and thrombus in the ascending aorta. Which of the following statements is true?

A. Emergent surgery will most likely be required

B. One could expect to hear "pistol shot" sounds when auscultating over the femoral artery

C. Aortic regurgitation is unlikely as his pulse pressure is not widened

D. Gentle compression of the nail bed should result in capillary pulsation

E. An intra-aortic balloon pump should be inserted urgently to treat hypotension and stabilize until surgery

Answer: A. This patient has *acute* aortic regurgitation (AR) secondary to a proximal aortic dissection. Emergent surgery will most likely be required in such a severe case associated with acute heart failure. One would not expect to hear pistol shot sounds over the femoral artery (Traube's sign) or see capillary pulsation with gentle nail-bed compression (Quincke's sign), as these are predominantly found in *long-standing* aortic regurgitation (not acute decompensation). Likewise, a widened pulse pressure

is often found in chronic AR but not in acute AR. Intra-aortic balloon pump is contraindicated as a temporizing measure. It inflates during diastole, which serves to worsen the AR.

Q.10. A 67-year-old woman presents complaining of dysphagia to solids and weight loss. She has a history of a cervical esophageal web that was corrected with surgery 10 years ago. A barium swallow is done, revealing narrowing in the midesophagus. A biopsy of the area done during EGD reveals squamous cell carcinoma. All of the following are risk factors for the development of this cancer *except*

A. Gastroesophageal reflux

B. Smoking

C. Lye ingestion

D. Alcohol

E. Plummer-Vinson syndrome

Answer: A. Gastroesophageal reflux disease results in Barrett's esophagus and an increased risk of adenocarcinoma of the esophagus. All of the other conditions are associated with squamous cell carcinoma. Plummer-Vinson syndrome is characterized by iron-deficiency anemia and a cervical web. It is usually seen in women and associated with an increased risk of squamous cell carcinoma.

CHAPTER 8: PERICARDIAL DISEASE

Q.1. A 58-year-old man, treated a year ago for melanoma, presents to the emergency department with light-headedness and shortness of breath for the last two days. Physical examination is notable for a blood pressure of 85/50. He has very distant heart sounds and pedal edema. A chest x-ray reveals an enlarged cardiac silhouette. Which of the following is most likely true of his physical examination?

A. He most likely has clear lungs and decreased jugular venous pressure

B. He probably has an increase in jugular venous pressure with inspiration

C. He most likely has a greater than 10 mm Hg drop in his systolic blood pressure with inspiration

D. He is likely to have a pericardial knock

Answer: C. This patient most likely has a pericardial effusion given his symptoms, decreased heart sounds, and enlarged cardiac silhouette. Another clue is his history of melanoma—a tumor that can spread to the pericardium. More urgently, he probably has cardiac tamponade because his blood pressure is quite low, and he is light-headed and dyspneic. Therefore, the most likely physical finding is a pulsus

paradoxus (Answer C). Answer A is incorrect because one would expect his jugular venous pressure to be elevated in tamponade (part of Beck's triad). Answers B (Kussmaul's sign) and D (pericardial knock) are more likely to be seen in constrictive pericarditis than tamponade.

Q.2. A 55-year-old woman presents to your office with a history of constant, substernal chest pain for three days. It is worse with inspiration. She denies sick contacts and otherwise feels well. Her only medications are a statin for hypercholesterolemia and aspirin and procainamide for a history of atrial fibrillation. On physical examination, she has no rashes but has a subtle friction rub. What is the most appropriate next step?

A. Obtain serologies for an ANA and double-stranded DNA to evaluate for possible lupus erythematosus

B. Admit to the hospital, begin heparin and nitrates, and check serial cardiac biomarkers to rule out myocardial infarction

C. Admit to the hospital and begin intravenous diltiazem for probable recurrence of her atrial fibrillation

D. Discontinue procainamide and order an echocardiogram

Answer: D. This patient presents with acute pericarditis as evidenced by her symptoms and her friction rub on examination. A clue to the etiology is that one of her medications is procainamide (known to cause pericarditis). Her procainamide should be discontinued, and an echocardiogram should be obtained. Whereas it is certainly reasonable to obtain lupus serologies (Answer A), this is not the most immediate next step. One should avoid heparin in a patient with suspected pericarditis (Answer B) so as to prevent bleeding into the pericardium. Finally, a recurrence of her atrial fibrillation (Answer C) is unlikely because she has no symptoms or physical findings to suggest this.

Q.3. A 46-year-old woman presents to the emergency department with eight hours of chest pain. The pain is constant, severe, and midsternal in location. She notes that it is worse when she lies down. She denies exposure to sick friends or relatives. Past history is notable for tobacco use, borderline hypertension, and elevated cholesterol. Her father died of a myocardial infarction at age 67 years. Examination is notable for a heart rate of 104, and a blood pressure of 125/80 in both arms. Her lungs are clear. On cardiac examination, she has a prominent friction rub with two out of three components present. The remainder of the examination is unremarkable. Which of the following ECG abnormalities does *not* suggest pericarditis in the absence of an effusion?

A. Sinus tachycardia

B. Electrical alternans

C. PR segment depression

D. Concave upward ST segment elevation

E. PR segment elevation in lead aVR

Answer: B. This patient presents with acute pericarditis. Electrical alternans is found with an effusion and is thought to be a result of "swinging of the heart in a collection of pericardial fluid." This patient does not have an effusion. Answers A, C, D, and E may represent ECG manifestations of acute pericarditis even without an effusion.

Q.4. The patient in the preceding question is diagnosed with acute pericarditis and treated successfully with nonsteroidal anti-inflammatory agents. Over the next five years, she has recurrent episodes of pericarditis, each treated with indomethacin. She now presents with the gradual onset of lower extremity edema over six months. She has vague symptoms of exertional dyspnea and abdominal bloating but doesn't feel acutely ill. When you see her in the office, she has obvious edema and distended neck veins although her lung fields are clear. Her voltage on ECG is not significantly different from her baseline, and an office echocardiogram suggests normal left ventricular function and no significant effusion. Which of the following findings would you expect to see during right heart catheterization?

A. Right atrial pressure tracing with a steep Y descent

B. Increased cardiac output

C. Left ventricular end diastolic pressure of 25 mm Hg and a right ventricular end diastolic pressure of 10 mm Hg

D. Right atrial pressure of 3 mm Hg

Answer: A. This patient with recurrent pericarditis has probably progressed to constrictive pericarditis. The new onset of symptoms of right-sided heart failure supports this diagnosis. On right heart catheterization, one would expect to see a steep Y descent (Answer A). Answer B is incorrect because constrictive pericarditis is associated with reduced ventricular filling, which leads to a decrease in cardiac output. Constrictive pericarditis results in equalization of diastolic pressures in all chambers; thus Answer C is incorrect. Finally, one should also see an elevation of diastolic pressures in constrictive pericarditis. A right atrial pressure of 3 mm Hg (Answer D) is not elevated.

Q.5. A 56-year-old man with type 2 diabetes mellitus and end-stage renal disease is admitted frequently to the hospital for emergent dialysis due to nonadherence with

outpatient dialysis sessions. He has also been admitted twice for uremic pericarditis that was successfully treated with nonsteroidal anti-inflammatory agents and dialysis. He now presents to your office with fatigue, pedal edema, and abdominal fullness, which has been increasing over the last one to two months. His exam is notable for a blood pressure of 145/90 mm Hg, a heart rate of 105 bpm, clear lungs, and a pericardial knock. Lab studies include the following:

Na 142

K 5.1

Chloride 108

HCO3 19

BUN 77

Creatinine 4.9

An ECG shows sinus tachycardia with nonspecific T-wave changes. Which of the following is a true statement regarding his condition?

A. One should avoid beta-blockers for blood pressure control at this point

B. A right heart catheterization is likely to show a blunted "Y" descent

C. Pericardiocentesis would be a useful treatment modality

D. An echocardiogram will likely show a decreased ejection fraction from silent ischemia

Answer: A. This patient has constrictive pericarditis as evidenced by the insidious onset and clinical findings of right heart failure, clear lungs, and a pericardial knock. The underlying etiology is probably due to long-standing uremia and recurrent uremic pericarditis. His sinus tachycardia is a compensatory mechanism and is required for maintaining adequate blood pressure. Beta-blocker therapy that would slow the heart rate should be avoided until definitive therapy (i.e., pericardial stripping) can be accomplished. A right heart catheterization is likely to show prominent "X" and "Y" descents ("M" or "W" configuration), not a blunted "Y" descent (Answer B). In constrictive pericarditis, there is usually very little fluid in the pericaridal space, thus pericardiocentesis as a therapeutic treatment is not often useful (Answer C). Finally, there is no indication that an echocardiogram would show a decreased ejection fraction; the patient's clinical presentation is not consistent with cardiac ischemia or infarction (Answer D).

Q.6. All of the following patients with acute pericarditis should be hospitalized for management *except*

A. A 65-year-old man with end-stage renal disease on warfarin for chronic atrial fibrillation with new onset acute uremic pericarditis.

B. A 55–year-old man with acute pericarditis and a CPK of 2100.

C. A 28-year-old woman with chest pain, malar rash, symmetrical polyarthritis, and an echocardiogram that reveals a moderate pericardial effusion.

D. A 33-year-old man with chest pain, three broken ribs by chest x-ray, and a pericardial effusion by echocardiogram in the setting of a motor vehicle accident.

Answer: C. Not all patients with acute pericarditis require admission to the hospital. Most cases—particularly those due to viral or idiopathic etiologies—are self-limited and can be managed as an outpatient with nonsteroidal anti-inflammatory agents. Answer C describes a patient with probably lupus pericarditis who has no contraindication to a trial of outpatient management. Patients on anticoagulants (Answer A) should be admitted in case of large pericardial bleed and acute tamponade. Other patients who are candidates for hospitalization include patients with evidence of myocardial injury as evidenced by an elevated CPK (Answer B), and patients with pericarditis in the setting of trauma (Answer D). These patients are at higher risk for complications and potentially bad outcomes.

Q.7. A 36-year-old man developed acute viral pericarditis one month ago. Other than mild chest pain, he was relatively asymptomatic and was being treated with nonsteroidal anti-inflammatory medication as an outpatient. He now presents to the emergency department with a new onset of dizziness and dyspnea. His blood pressure is 90/50. He has distant heart sounds and an elevated jugular venous pressure. Which of the following statements is *false*?

A. An echocardiogram is unlikely to reveal a thickened pericardium

B. Right heart catheterization will likely show equalization of diastolic pressures

C. He is likely to demonstrate Kussmaul’s sign

D. His ECG is likely to show reduced voltage or electrical alternans.

E. He is likely to have a pulsus paradoxus.

Answer: C. This patient, who has a history of acute pericarditis, now presents with physical findings suggestive of cardiac tamponade (elevated jugular venous pressure, distant heart sounds, and hypotension). Tamponade can complicate up to 15% of cases of acute pericarditis. He is unlikely to have Kussmaul’s sign (increase

in jugular venous pressure with inspiration), as this is usually seen in constrictive pericarditis. The other choices are true. A thickened pericardium is more often found in constrictive pericarditis rather than tamponade. He is likely to have a pulsus paradoxus on physical exam, low voltage on his ECG, and equalization of diastolic pressures by right heart catheterization.

Q.8. A 32-year-old woman with a history of Hodgkin's disease treated with mantle radiation to the chest develops acute pericarditis. It is difficult to treat and frequently recurs. Two years later, she presents with symptoms of right heart failure. Physical exam reveals elevated jugular venous pressure, pedal edema, and a pericardial knock. Which of the following regarding her condition is false?

A. The right atrial waveform will show prominent X and Y descents

B. Treatment will require a pericardiotomy

C. ECG will probably show nonspecific findings

D. Treatment should start with nonsteroidal anti-inflammatory medication

E. Right heart catheterization may show a "square root sign"

Answer: D. This woman most likely has constrictive pericarditis, due to recurrent bouts of acute pericarditis (possibly related to her radiation). Evidence of right-sided heart failure (elevated jugular venous pressure and pedal edema) as well as the pericardial knock support this diagnosis. In chronic, constrictive pericarditis, one can frequently see prominent X and Y descents in the right atrial waveform and may see a "square root" sign on right heart catheterization. The ECG is usually nonspecific (unlike acute pericarditis). Treatment for symptomatic patients almost always requires a pericardiotomy. Nonsteroidal anti-inflammatory medications are not effective.

CHAPTER 9: ELECTROCARDIOGRAM REVIEW

Q.1. A 48-year-old businessman comes to your office complaining of moderate chest discomfort, shortness of breath, and diaphoresis. These symptoms started suddenly about two hours previously when the patient left a business meeting and walked down the hall to his office. They have persisted without much change. He is generally healthy but is overweight. He denies smoking, hypertension, hypercholesterolemia, or diabetes mellitus. Of note, he returned two days ago from a business trip to

Japan. He is normotensive, and his physical examination is unrevealing. You obtain an ECG in your office (Fig. 9Q-2). What is the most likely diagnosis?

A. Pericarditis

B. Pulmonary embolism

C. Acute myocardial infarction

D. Costochondritis

E. Pleuritis

Answer: B. The tracing shows sinus tachycardia and flat T waves in II and inverted T waves in III, aVF, and V3–V6. These changes are nonspecific but would raise the question of inferior and anterior non-Q wave infarction. In this clinical setting, when the ECG suggests both inferior and anterior myocardial disease, one should consider pulmonary embolism. This patient had a large pulmonary embolism by V/Q scan.

Q.2. A 32-year-old man is found unresponsive in an alley just outside the hospital. He is brought into the emergency room, and an ECG is performed (Fig. 9Q-3). What is the patient's most likely diagnosis?

A. Hypocalcemia

B. Acute myocardial infarction

C. Hypothermia

D. Hyperkalemia

Answer: C. The ECG shows sinus bradycardia and prominent Osborn waves (positive deflection off the declining shoulder of the R wave), perhaps best seen in leads V4–V6. Osborn waves are suggestive of hypothermia, and the patient's temperature at the time of this ECG was 84° F.

Q.3. A 50-year-old woman complains of intermittent episodes of palpitations lasting up to 10 minutes at a time. During one episode that fortuitously began in your office, you obtain a rhythm strip (Fig. 9Q-4). What is this patient's rhythm?

A. Paroxysmal atrial tachycardia

B. Paroxysmal atrial fibrillation

C. Paroxysmal atrial flutter

D. Multifocal atrial tachycardia

E. Intermittent sinus tachycardia

Answer: A. The ECG, which is a rhythm strip, shows a rapid, regular tachycardia at a rate of about 230 bpm. The QRS complexes are narrow, indicating a supraventricular focus. This rhythm is paroxysmal atrial tachycardia. Actual fibrillation (B) would not be regular, and atrial flutter (C) and sinus tachycardia (E) are usually not this fast. Three P wave morphologies are not demonstrated, making answer D incorrect.

Q.4. Fifteen minutes later, the patient in the preceding question is no longer complaining of palpitations and has a regular rhythm at a rate of 74 beats per minute. A 12-lead ECG is obtained (Fig. 9Q-5). What is the patient's most likely diagnosis?

A. Hyperthyroidism

B. Hyperkalemia

C. Pheochromocytoma

D. Wolff-Parkinson-White syndrome

E. Pulmonary hypertension

Answer: D. The second ECG, which is a 12-lead recording, shows normal sinus rhythm at a rate of about 75 bpm and prominent delta waves in I, V5, and V6. These delta waves are "slurred upstrokes" to the QRS and indicate pre-excitation of the ventricles from an accessory pathway. The PR interval is also short, indicating early initiation of ventricular depolarization. The presence of delta waves, particularly along with a short PR interval, is diagnostic of Wolff-Parkinson-White syndrome.

Q.5. A 64-year-old woman with known renal failure on thrice-weekly dialysis comes to your office feeling poorly. She has missed her last two dialysis sessions because she had a sore throat and cold symptoms. You check her pulse and find it to be

slightly rapid. Her blood pressure is about her usual at 145/88. You obtain an ECG (Fig. 9Q-6). What is the most likely diagnosis?

A. Ventricular tachycardia

B. Right bundle branch block

C. Hyperkalemia

D. Wolff-Parkinson-White syndrome

E. Left bundle branch block

Answer: C. The ECG shows a wide complex tachycardia with an almost "sinusoidal" appearance in some leads. The rate is just over 100 bpm, so ventricular tachycardia could be considered. The clinical history of end-stage renal disease and lack of recent dialysis, however, is more suspicious for hyperkalemia. The patient's serum potassium was 8.4 mEq/L. There are no delta waves suggesting Wolff-Parkinson-White syndrome.

Q.6. A 54-year-old physician colleague is racing you up five flights of steps to get to a conference. At the end of the fifth flight, he complains of a "twinge" of chest discomfort and is light-headed. The heart station is on the same floor, and you promptly obtain an ECG on your associate (Fig. 9Q-7). What is the most likely diagnosis?

A. Anterolateral infarction

B. Idiopathic hypertrophic subaortic stenosis

C. Left ventricular hypertrophy

D. Inferolateral ischemia

Answer: D. The tracing shows voltage criteria for LVH and nonspecific ST segment depression and biphasic T waves in II, III, avF, and V4–V6. Although this would be compatible with LVH with strain, the clinical scenario is worrisome for possible myocardial ischemia. The inferolateral changes could be compatible with inferolateral myocardial ischemia (the correct diagnosis in this patient).

Q.7. An 82-year-old man presents for routine follow up. He has a history of hypertension, which was treated with HCTZ and atenolol, and first-degree block on

an ECG one year ago with a PR interval of 0.32 seconds. He runs five days per week, three miles per run, with rare episodes of his legs feeling weak. He may stop for a moment, but then resumes his run without problems. His blood pressure was 180/68, pulse 30 and regular. His ECG is shown (Fig. 9Q-8). What is the diagnosis?

A. First-degree AV block

B. Second-degree AV block

C. Third-degree AV block

D. Trifascicular block

E. Complete heart block

Answer: B. Half of the P waves are followed by a prolonged PR interval and a narrow QRS. The PR interval of the conducted beats is fairly constant at about 0.32 seconds. Because there are some P waves not followed by QRSs, it cannot be first-degree AV block. The PR interval is constant for the conducted QRSs; therefore, the tracing is not consistent with third-degree heart block (which is the same as "complete heart block"). Because there is no bundle branch block or complete heart block, it cannot be trifascicular block. Therefore, this is second-degree AV block with 2:1 block. With this tracing, it is impossible to distiguish Mobitz I from Mobitz II. With the history of the previous first-degree AV block, however, it is probably Mobitz I. As the ventricular response was only 30 bpm and did not improve with stopping the beta-blocker, he was treated with a permanent pacemaker.

Q.8. A 63-year-old woman was visited by two policemen at her home, who informed her that her husband had been killed in an automobile accident earlier that day. She was emotionally devastated, despite efforts at consolation by the policemen, neighbors, and her pastor. Two hours after hearing the news, she developed chest pain and shortness of breath and was rushed to the hospital. An ECG initially showed nonspecific T-wave changes, but another tracing an hour later is shown (Fig. 9Q-9). What is the diagnosis?

A. Subendocardial infarction

B. Massive stroke

C. "Stress cardiomyopathy" or "broken heart syndrome"

D. Acute pericarditis

Answer: C. The broad diffuse T-wave changes are compatible with a massive stroke, but this is not consistent with the history. Acute pericarditis evolves from ST elevation to T-wave inversions, but not in two hours. The neurohumoral changes of severe emotional distress can cause the physiologic and electrocardiographic changes described. Fortunately, with aggressive supportive care, it is usually reversible within 2 to 4 weeks.

Q.9. Which of the following statements is *false* regarding ECG interpretation?

A. The QT interval is directly proportional to the heart rate; therefore, using a corrected QT is preferred

B. Obesity can be associated with low voltage

C. First-degree AV block is diagnosed by the length of the PR interval

D. Hyperkalemia can be associated with a wide QRS complex

E. Mobitz I second-degree heart block rarely requires intervention

Answer: A. The QT interval is inversely proportional to the heart rate (not directly proportional). Regardless, the corrected QT should be used. The remaining statements are true.

Q.10. Which of the following patients will most likely need permanent pacemaker placement?

A. A 63-year-old woman with atrial fibrillation and frequent episodes associated with a rapid ventricular response; she thus undergoes pulmonary vein ablation

B. A 62-year-old man with a long history of tobacco use admitted for treatment of community-acquired pneumonia and found to have multifocal atrial tachycardia

C. A 45-year-old woman undergoing preoperative evaluation for a hysterectomy and found to have Mobitz I second-degree block on an ECG

D. A 64-year-old man with a history of myocardial infarction three years ago who presents with dizziness and a heart rate of 45; his ECG shows Mobitz II

E. A. 72-year-old man who presents with an inferior myocardial infarction and a heart rate in the 40s who is taken to the cath lab and revascularized

Answer: D. The 64–year-old man with known structural heart disease (prior MI), has Mobitz II block on ECG, and is symptomatic. He will most likely require pacemaker placement, as his block is likely recur and cause future symptoms. Pulmonary vein ablation for atrial fibrillation does not usually require pacemaker, unlike ablation of the AV node. Multifocal atrial tachycardia, frequently seen in patients with underlying lung disease and acute hypoxemia, is usually self-limited. Mobitz I second-degree block is considered a benign rhythm that is rarely associated with symptoms and rarely requires any definitive therapy. Bradycardia in the setting of an acute inferior myocardial infarction (the right coronary artery supplies the sinus and AV nodes), is also often self-limited once the acute ischemia is treated (by revascularization in this case).

Q.11. A 36-year-old athletic man presents to the emergency room with the sudden onset of severe palpitations 45 minutes ago. He feels somewhat light-headed, but denies dyspnea or chest pain. He has no chronic medical conditions. He runs five miles every day and has never experienced such palpitations while running. In the emergency room, his vitals signs show a blood pressure of 110/75 and a heart rate of 160 beats per minute. His ECG is shown (Fig. 9Q-10). Which of the following is *not* true regarding his condition?

A. It may terminate with carotid sinus massage

B. Catheter ablation will result in a cure in over 95% of patients

C. The underlying mechanism is probably increased automaticity

D. Intravenous adenosine is highly effective at slowing rate

E. There is usually a 1:1 relationship of the P wave to the QRS complex

Answer: C. The patient's history of the sudden onset of palpitations, together with his young age, lack of cardiac history, heart rate between 150 to 150 beats per minute, and ECG findings point to the diagnosis of AV node reentrant tachycardia (AVNRT). AVNRT usually terminates with vagal maneuvers, such as carotid sinus massage or Valsalva. Adenosine is also highly effective. AVNRT may recur, however, and catheter ablation offers a cure for over 95% of patients. On ECG, one sees a regular rhythm at a rate of 150 to 250 beats per minute and a 1:1 relationship of the P wave to the QRS complex. The false statement is C. The underlying mechanism behind AVNRT is thought to be a reentrant pathway within the AV node.

Q.12. Which of the following is true regarding reading and interpretation of an ECG?

A. The corrected QT interval (QTc) is adjusted for respiratory rate

B. Pseudonormalization of the T waves may suggest underlying ischemia

C. One of the criteria that can be used for diagnosis of left ventricular hypertrophy is an R in aVL that is taller than 15 mm

D. Left ventricular "strain" may manifest as mild, upsloping ST segments

E. Pathologic Q waves (indicating a prior myocardial infarction) must be at least two small boxes wide and one small box deep (at normal paper speed of 25 mm/sec)

Answer: B. Pseudonormalization of the T waves may be indicative of underlying ischemia. The QTc is adjusted for heart rate, not respiratory rate. A common criteria used for the diagnosis of left ventricular hypertrophy is an R in aVL greater than 11 mm (not 15 mm). Left ventricular strain can be seen as mild downward-sloping ST segments. Finally, pathologic Q waves must be only one box high (not two) and one box deep.

Q.13. A 68-year-old man is seen in the emergency department for syncope. His wife reports that she was cooking in the kitchen when she heard a "thump" and found him on the living room floor. He recalls feeling very light-headed but remembers nothing more. Upon further questioning, he recalls feeling dizzy on several occasions over the last three months. He has a history of hypertension that is managed with metoprolol and a remote history of a myocardial infarction 10 years ago. He has since been quite well and exercises on a daily basis. In the emergency room, he has a blood pressure of 95/55 and a heart rate of 40 beats per minute. He still feels light-headed but is no longer worried about passing out. An ECG is obtained (Fig. 9Q-11). What is the most important initial step in managing this patient?

A. Administer dobutamine

B. Discontinue the metoprolol

C. Admit for monitoring with cardiac telemetry

D. Place a temporary pacer

E. Administer isoproterenol

Answer: D. This patient's ECG shows third-degree heart block. He is clearly symptomatic with frank syncope. In the emergency department, he is still not stable as his blood pressure is very low and he remains light-headed. Urgent treatment is required, and a temporary pacer is the *most important* initial step. The pacer will be more effective and less toxic than dobutamine in raising his blood pressure. It is very reasonable to discontinue his metoprolol (☐-blockers can worsen heart block) and admit for cardiac telemetry, but these are not the most important initial steps. While atropine may be appropriate to try for third-degree heart block, isoproterenol is not typically used as first-line therapy.

Q.14. A 62-year-old man develops palpitations and feels extremely light-headed at a baseball game. The paramedics arrive and find his heart rate to be 145 beats per minute. A rhythm strip is obtained in the ambulance (Fig. 9Q-12). On arrival in the emergency department, he is still symptomatic. A complete history, physical exam, and 12-lead ECG are performed. Which of the following would *not* be supportive of a ventricular origin of his tachycardia (as opposed to a supraventricular origin with aberrancy)?

A. Regularity of the R-R interval

B. A history of a myocardial infarction two years ago

C. Voltage greater than 12 mm in the precordial leads

D. If left bundle branch morphology, a QRS width greater than 0.16 seconds

E. The presence of atrioventricular dissociation

Answer: C. This patient has near-syncope and a wide-complex tachycardia on his rhythm strip. When treating such a patient, it is helpful to distinguish between a ventricular origin of the dysrhythmia (ventricular tachycardia) and a supraventricular origin (supraventricular tachycardia with aberrancy). Many different criteria have been proposed. Answers A, B, D, and E are all suggestive of a ventricular origin. Increased voltage is *not* suggestive of one versus the other.

Q.15. Which of the following patients is least likely to have a left bundle branch block on ECG?

A. A 40-year-old woman with bilateral hilar adenopathy and an S4 on cardiac examination

B. A 55-year-old man with chronic hypertension and hyperlipidemia who develops new onset chest pressure radiating to the jaw and lasting one hour

C. A 79-year-old woman with degenerative conduction disease

D. A 44-year-old man with hepatomegaly, cardiomegaly, and a ferritin of 2300 mg/mL

E. A 65-year-old woman who underwent hip replacement two days ago and now has acute onset of shortness of breath and pleuritic chest pain

Answer: E. The key to the question is to recognize each patient's underlying condition and then to determine if it can be associated with a left bundle branch block on ECG. The patient in A has sarcoidosis with cardiac involvement; the patient in B has an acute myocardial infarction; the patient in C has degenerative conduction disease; and the patient in D has hemachromatosis and cardiac involvement. All of these conditions can be associated with a left bundle branch block. The patient in E has a pulmonary embolism in the postoperative setting. She is more likely to have a right bundle branch block (not left).