

Common Disorders and Conditions Related to Phlebotomy

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OBJECTIVES

After studying this chapter, readers should be able to:

1. Describe the condition known as angina pectoris.
2. Explain major factors that cause myocardial infarction.
3. Describe primary hypertension.
4. Compare arteriosclerosis with atherosclerosis.
5. Distinguish among endocarditis, myocarditis, and pericarditis.
6. Explain the various types of anemias.
7. Compare polycythemia and leukemias.
8. Describe the various types of shock.
9. Explain the possible consequences of emboli.
10. Describe disseminated intravascular coagulation.

KEY TERMS

Abruptio placentae: A complication of pregnancy wherein the placental lining has separated from the uterus of the mother, causing late pregnancy bleeding, fetal heart rate effects, and potential fetal or maternal death.

Angina pectoris: Sharp pain usually felt in the chest or arm that occurs when the heart does not receive enough oxygen to support its workload.

Anoxia: Absence of oxygen supply to an organ or tissue.

Arrhythmia: An irregular heartbeat, which can range from mild to life-threatening; also called *dysrhythmia*.

Arthralgia: Joint pain.

Atherosclerosis: A form of arteriosclerosis characterized by deposits of cholesterol and other fats on the sides of the arteries.

Celiac disease: An autoimmune disorder of the small intestine that causes diarrhea, failure to thrive (in children), fatigue, and other effects upon multiple body systems; it is triggered by a reaction to wheat gluten.

Dysrhythmia: Also called *arrhythmia*, meaning “irregular heartbeat.”

KEY TERMS CONTINUED

Eclampsia: An acute, life-threatening complication of pregnancy wherein the mother may experience tonic-clonic seizures and coma.

Gastrectomy: Partial or complete surgical removal of the stomach.

Graves' disease: An autoimmune condition caused by overactive thyroid (hyperthyroidism), causing “bulging” eyes, bone damage, and central or peripheral nervous system symptoms.

Hemarthrosis: Blood accumulation or hemorrhage in a joint.

Hematopoietic stem cells: Stem cells that develop into all the different types of blood cells.

Hemochromatosis: Iron overload caused by either repeated transfusions or a genetic disorder.

Hemoglobin S: An inherited type of abnormal adult hemoglobin, which mostly affects African Americans, causing sickle-cell anemia.

Hemophilia A: The most common form of hemophilia; it is an inherited condition primarily affecting males wherein coagulation is much more prolonged than normal.

Hypertrophied: Enlarged, due to an increase in cell size.

Hypoplasia: Lack of development of a tissue or organ.

Hypoplastic anemia: Aplastic anemia; actually a variety of related anemias that result from destruction of or injury to stem cells in the bone marrow or its matrix.

Ischemia: A temporary reduction of blood supply to an organ or tissue due to obstruction of a blood vessel.

Lymph: Part of the interstitial fluid, which is referred to as *lymph* when it enters a lymph capillary; it picks up and carries bacteria to the lymph nodes to be destroyed.

Lymphoblasts: Immature cells that form lymphocytes; in acute lymphoblastic leukemia, lymphoblasts proliferate uncontrollably and are found in large numbers in the peripheral blood.

Mastectomy: Partial or complete removal of one or both breasts.

Megaloblastic anemia: An anemia that results from inhibition of DNA synthesis in red blood cell production; it is characterized by megaloblasts in the bone marrow.

Myocardial infarction: A heart attack; sudden death of cells in the heart muscle caused by an abrupt interruption of blood flow (and lack of oxygen) to part of the heart.

Myxedema: A type of cutaneous and dermal edema secondary to hypothyroidism and Graves' disease.

NSAID: Nonsteroidal anti-inflammatory drug; common examples include aspirin and ibuprofen.

Pancytopenia: A combination of anemia, leukopenia (decreased white blood cells), and thrombocytopenia (decreased platelets).

Proliferation: Growth and reproduction of cells.

Reed-Sternberg cells: Cells usually derived from B lymphocytes that are much larger than surrounding cells and are found via light microscopy in cases of Hodgkin's disease and certain other disorders.

Respiratory acidosis: A condition in which decreased respiration increases blood carbon dioxide and decreases pH.

Sepsis: The presence of pathogenic bacteria in tissue.

Thalassemia: An inherited autosomal recessive blood disorder in which hemoglobin chains are not synthesized normally, leading to anemia.

Thrombus: A blood clot that forms in the cardiovascular system.

Ventricular asystole: The absence of contraction of the ventricles.

Ventricular fibrillation: Abnormal discharge of electrical nerve impulses that cause the heart to stop beating.

Introduction

Common disorders and conditions that are related to phlebotomy include cardiovascular disorders such as coronary artery disease, myocardial infarction, and hypertension as well as blood vessel disorders and blood disorders. Heart attack (myocardial infarction) is the leading cause of death in the United States. Hypertension is a major cause of cardiac disease, renal failure, and stroke. Atherosclerosis (hardening of the arteries) causes most myocardial and cerebral infarctions. Anemias are defined as conditions of reduced blood cells or hemoglobin as well as the reduced ability to carry oxygen to the cells. Leukemias are malignant neoplasms of the bone marrow, spleen, and lymph nodes. Diseases of the lymphatic system include lymphedema, lymphangitis, and various lymphomas.

Cardiovascular Disorders

Cardiovascular disease is described as any abnormal condition characterized by heart or blood vessel dysfunction.

Cardiovascular disease is the leading cause of death in the United States.

Coronary Artery Disease

Coronary artery disease is an abnormal condition that may affect the arteries of the heart and produce varying pathologic effects, primarily reduced flow of oxygen and nutrients to the myocardium. **Atherosclerosis** is the most common type of coronary artery disease (see **Figure 7–1**). Angina pectoris is the classic symptom of coronary artery disease; it results from myocardial ischemia.

Angina Pectoris

Angina pectoris is a sudden outburst of chest pain frequently caused by myocardial **anoxia** as a result of atherosclerosis or coronary artery spasm.

Angina pectoris attacks are often related to emotional stress, eating, exertion, and exposure to intense cold. Complications of angina pectoris include arrhythmias, myocardial infarction, and ischemic cardiomyopathy.

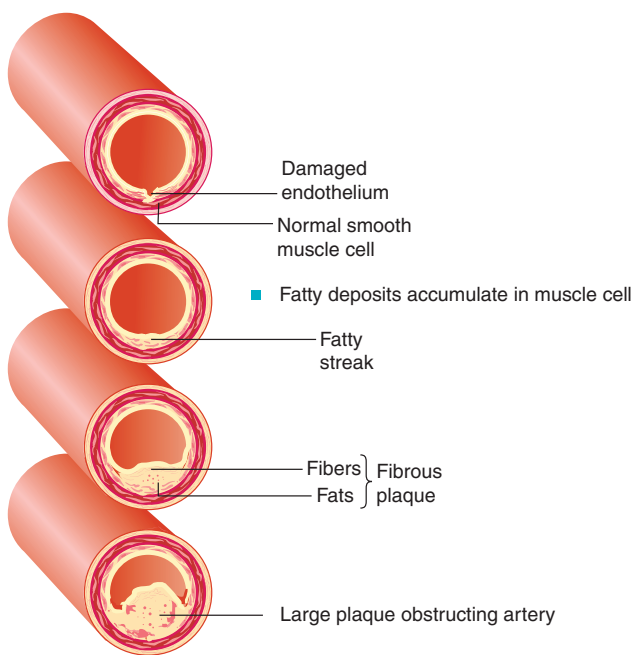


Figure 7-1 Development of a deposition of fat-containing substances that form plaque and lead to arterial occlusion

Myocardial Infarction

When coronary blood flow is interrupted for extended periods, necrosis (tissue death) of part of the cardiac muscle occurs. Necrosis results in **myocardial infarction** (see **Figure 7-2**). When the coronary arteries are obstructed, this may result in atherosclerosis, a spasm, or a **thrombus**. Myocardial infarction (MI) is also called *heart attack*.

Heart attack is the leading cause of death in the United States. When treatment is delayed, mortality is high. Nearly one-half of sudden myocardial infarction deaths occur before the patient can be hospitalized, usually within 1 h of the onset of symptoms. Risk factors for myocardial infarction include the following:

- Family history of MI
- Aging
- Gender
- Hypertension
- Elevated total cholesterol
- Obesity
- Lifestyle
- Smoking
- Stress or *type A personality*
- Drug use (especially cocaine and amphetamines)

Cardiac Arrhythmias

A **dysrhythmia** (an **arrhythmia**) is a disturbance of heart rhythm caused

by abnormal electrical conduction or automaticity. Normally, the sinoatrial (SA) node generates heart rhythms that travel through the heart's conduction system. This causes the atrial and ventricular myocardium to contract and relax at a regular rate. This rate maintains circulation during various levels of physical activity. Arrhythmias range from mild and asymptomatic such as sinus arrhythmia to catastrophic ventricular fibrillation (which requires immediate resuscitation).

Common causes of arrhythmias include the following:

- Congenital defects
- Drug toxicity
- Electrolyte imbalances
- Myocardial infarction or **ischemia**
- Organic heart disease
- Degeneration of the conductive tissue
- Connective tissue disorders
- Cellular hypoxia
- Hypertrophy of the heart muscle
- Acid–base imbalances
- Emotional stress

Hypertension

Hypertension is an elevation in either systolic or diastolic blood pressure. It occurs as either essential (primary) hypertension or secondary hypertension. Primary hypertension is the most common type and is of unknown cause. Secondary hypertension results from renal disease or other identifiable causes. Malignant hypertension is a severe form of hypertension that may be either primary or secondary. Hypertension is a major cause of cardiac disease, renal failure, and stroke.

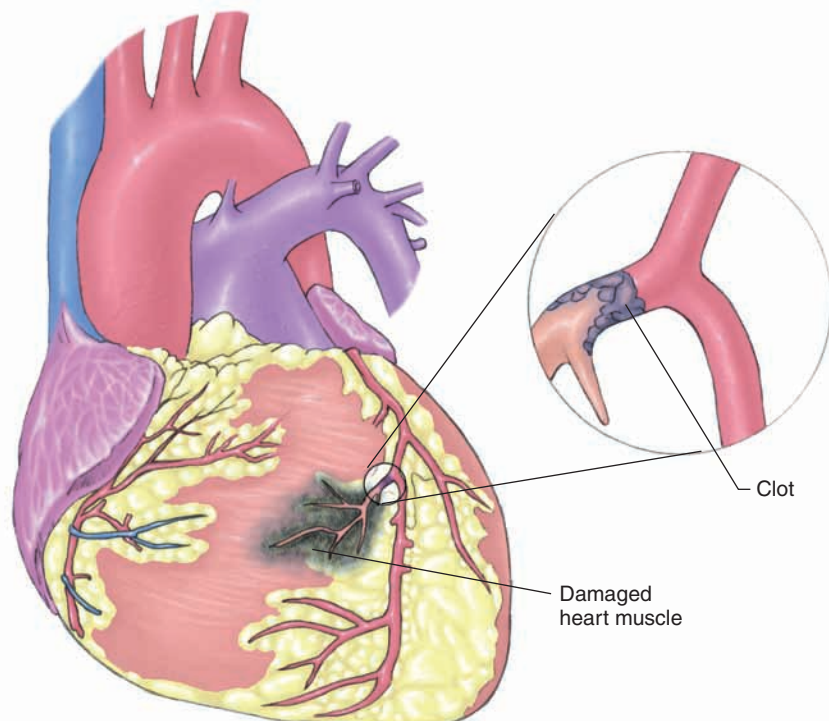


Figure 7-2 Damage caused by myocardial infarction.

Risks for hypertension increase with age. Hypertension is more prevalent in the black population than in the white population. It is also more prevalent in people with less education and lower income. During young and middle adulthood, men have a higher incidence of hypertension, but thereafter, women have a higher incidence.

Risk factors for essential hypertension include the following:

- The aging process
- Family history
- Obesity
- High intake of sodium
- High intake of saturated fat
- Sleep apnea
- Stress
- Excessive alcohol consumption
- Sedentary lifestyle
- Diabetes mellitus
- Tobacco use

Cardiomyopathy

Cardiomyopathy is a term that generally applies to a disease of the heart muscle fibers. It is the second most common direct cause of sudden death (after coronary artery disease). The most common type of cardiomyopathy is the dilated form. Men and blacks have the greatest risk for dilated cardiomyopathy. Other risk factors include coronary artery disease, hypertension, pregnancy, viral infections, and the use of alcohol or illegal drugs. Hypertrophic cardiomyopathy is different in that it is caused by a genetic abnormality.

Carditis

Carditis is defined as inflammation of the heart and its surrounding structures. The several types of carditis include pericarditis, myocarditis, and endocarditis. Common causes of the various forms of carditis include viral infections, bacterial infections, fungal infections, immune conditions, myocardial infarction, trauma, uremia, cancers, certain medications, radiation, and other causes.

Heart Failure

Heart failure is the inability of the heart muscle to contract with enough force to properly circulate the blood throughout the body. Dysfunction of the left ventricle is the most common cause of heart failure. However, the right ventricle may also be dysfunctional, especially in pulmonary disease (right ventricular failure). The most common form of heart failure is congestive heart failure. It is called this because of the collection of fluid (congestion) in the lungs and extremities.

Cardiac Arrest

Cardiac arrest is a sudden cessation of cardiac output and effective circulation. It is usually precipitated by **ventricular fibrillation** or **ventricular asystole**. When cardiac arrest occurs, the delivery of oxygen and removal of carbon dioxide cease. Tissue cell metabolism becomes anaerobic, and metabolic acidosis and **respiratory acidosis** occur. Immediate initiation of cardiopulmonary resuscitation (CPR) is required. Cardiac arrest is also called *cardiopulmonary arrest*.

Pulmonary Edema

Pulmonary edema involves fluid that shifts into the extravascular spaces of the lungs. Pulmonary circulation becomes overloaded with excessive blood volume. It causes dyspnea; coughing; orthopnea; raised cardiac and respiratory rates; and bloody, frothy sputum. Blood pressure may be reduced, and the skin feels cold and clammy. Symptoms often occur after a patient goes to bed. Pulmonary edema is caused by left-sided heart failure, mitral valve disease, pulmonary embolus, arrhythmias, renal failure, or systemic hypertension. Other causes include drug overdose, exposure to high altitudes, and head trauma.

Rheumatic Fever

Rheumatic fever affects the joints and cardiac tissue, and it is a systemic inflammatory and autoimmune disease. It follows a sore throat that is caused by group-A beta-hemolytic streptococcus. This usually occurs in children, resulting in fever and polyarthritis. The joints most affected include the knees, ankles, and fingers. Other symptoms include carditis, cardiac murmurs, cardiomegaly, and congestive heart failure. Symptoms occur within 5 weeks after the upper respiratory tract infection. Prompt assessment is required. Rheumatic fever develops as antibodies against the bacteria cross-react with normal tissues. The body attacks its own cells to initiate an inflammatory reaction, which migrates to the endocardium and heart valves.

Valvular Heart Disease

Valvular heart disease can affect all heart valves, and it may be acquired or congenital. If insufficient, the valves do not close completely, and blood is forced back into the previous chamber as the heart contracts. This increases the heart's workload. Stenosis occurs when the cusps of the valves harden, preventing complete opening. Diagnosis of valvular heart disease requires electrocardiogram, echocardiogram, cardiac catheterization, and radiographic chest studies. Treatment involves digitalis or quinidine, to treat arrhythmias, and prophylactic antibiotics.

Mitral Valve Prolapse

Mitral valve prolapse is defined as one or both cusps of the mitral valve protruding back into the left atrium when the ventricles contract. It is usually a benign condition, with patients being asymptomatic. When symptoms do exist, they include dyspnea, chest pain, fatigue, dizziness, and syncope. It affects all age groups and often results in severe anxiety. Mitral valve prolapse is usually diagnosed during a routine physical examination, although a physician should evaluate any reports of chest pain promptly.

Shock

Shock is defined as cardiovascular system collapse. It includes fluid shifts and vasodilation along with inefficient cardiac output. The organs and tissues experience inadequate perfusion, and the patient appears pale, cold, and clammy. The pulse is rapid (tachycardia), weak, and thready, and there is rapid breathing as well as an altered level of consciousness. Drops in blood pressure may cause anxiety, irritability, and

restlessness. Other symptoms include dizziness, extreme thirst, profuse sweating, and then dilation of the pupils, shaking, and trembling. Shock is a true medical emergency.

Shock may be caused by anaphylaxis, hemorrhage, respiratory distress, **sepsis**, heart failure, neurologic failure, emotional catastrophe, or severe metabolic insult. The vital organs eventually do not receive enough oxygen and nutrients to sustain life. Rapid blood loss or fluid loss, with hypovolemia, precipitates shock. Another cause of shock is failure of the heart to pump adequately.

Types of shock include the following:

- **Cardiogenic**—decreased cardiac output with tissue hypoxia in the presence of adequate intravascular volume; it is caused by heart failure (usually after myocardial infarction)
- **Hypovolemic**—develops when intravascular volume has decreased by approximately 15%; it is caused by hemorrhage, burns, or loss of interstitial fluid
- **Neurogenic**—widespread vasodilation due to parasympathetic overstimulation or sympathetic understimulation; it is caused by spinal cord or medulla trauma, depressants, anesthetics, pain, or severe emotional stress
- **Anaphylactic**—results from a widespread hypersensitivity reaction (anaphylaxis); often caused by allergies and poisons—it may lead to death quickly if untreated
- **Septic**—part of the systemic inflammatory response syndrome; it begins with an infection that progresses to bacteremia and sepsis, resulting in multiple organ dysfunction syndrome

Blood Vessel Disorders

The vascular system contains the arteries, arterioles, capillaries, venules, and veins. These vessels supply the tissues with oxygen and nutrients, which are carried in the blood. This system also moves carbon dioxide and waste products to the appropriate organs for excretion. The arteries carry oxygenated blood away from the heart, and in general, the veins carry deoxygenated blood back to the heart. The capillaries are the point of exchange at the cellular level. Blood vessel disorders include atherosclerosis, arteriosclerosis, emboli, aneurysms, phlebitis, thrombophlebitis, and varicose veins.

Atherosclerosis

Atherosclerosis is defined as a form of arteriosclerosis characterized by deposits of cholesterol and other fats on the sides of blood arteries (see Figure 7-1). Atherosclerosis causes most myocardial and cerebral infarctions. Risk factors include heredity, a sedentary lifestyle, a diet high in fats and cholesterol, smoking cigarettes, hypertension, diabetes mellitus, and obesity. Infarction becomes more likely as plaque forms and thickens the arterial walls. Blood tests will indicate elevated cholesterol, triglyceride, and lipid levels, and hypertension is usually noted. Treatment consists of changes in diet and exercise as well as stopping smoking. Drug therapies are quite varied, including hyperlipidemic agents and those that inhibit cholesterol absorption in the intestine.

Arteriosclerosis

Arteriosclerosis is actually a group of diseases characterized by the hardening of the arteries. The most common form of arteriosclerosis is atherosclerosis. Some types of arteriosclerosis involve the destruction of muscle and elastic fibers as well as deposits of calcium. Arteriosclerosis occurs when the walls of the arterioles thicken, and a loss of elasticity and contractility occurs.

Emboli

Emboli are (usually) blood clots that lodge in blood vessels to inhibit blood flow. Symptoms vary, but usually include severe pain in the area of the embolus. If an embolus lodges in an extremity, paleness, numbness, or coldness may develop. If nausea, vomiting, fainting, or shock occurs, the patient is in an emergency state. Emboli may also be composed of air bubbles, clumps of bacteria, globules of fat, or pieces of tissue. Venous thrombosis in the deep veins of the legs is most common. When a portion of a thrombus breaks loose, it travels through the veins until it lodges in a narrow vessel, such as a vessel in the lungs. Thrombi can form in the heart because of cardiac arrhythmias. This can result in a myocardial infarction, or the thrombus can travel to the brain, which results in a stroke.

Aneurysms

Aneurysms are defined as abnormal dilations of blood vessels located in distinctly limited areas (see Figure 7-3). Symptoms vary with location, and abdominal aortic aneurysm is the most common type. Aneurysms are often caused by a buildup of atherosclerotic plaque that weakens vessel walls. If the aneurysm is abdominal, a “bruit” sound is heard on auscultation.

Phlebitis

Phlebitis is defined as inflammation of a vein. It occurs usually in the lower legs, but it can affect any veins in the body. Pain and tenderness in the affected area develop first, followed by intensifying discomfort, swelling, redness, and warmth. Phlebitis can develop into thrombophlebitis. Although the exact cause is unknown, it is possible that venous stasis, blood disorders, obesity, injury to a vein during phlebotomy, and surgery may be related.

Thrombophlebitis

Thrombophlebitis results from phlebitis, with a thrombus forming on the vessel wall. It interferes with blood flow and causes edema, pain, swelling, heaviness, warmth in the affected area, and chills and fever. It is also influenced by venous stasis, blood disorders that cause hypercoagulability, and injury to the venous wall. The tunica intima is affected, allowing the formation of clots. Often, there will be gross edema in one leg, with tenderness to the touch. Thrombophlebitis is confirmed with radiographic venography and ultrasonography. It requires immediate treatment, with immobilization of the affected part. Heparin is given to prevent enlargement of the clot, and antibiotics are used to prevent infection. Surgery may be used to ligate the affected vessel so that collateral circulation can develop. Prevention of deep vein thrombosis during immobilization or reduced physical activity is essential.



Figure 7-3 Large arteriosclerotic aneurysm extending from renal arteries (above) to iliac arteries (below)

Varicose Veins

Varicose veins usually occur in the lower legs and appear swollen, tortuous, and knotted. They usually develop gradually, causing leg fatigue and then a continuous dull ache. Eventually, the veins become harder and thicker, with pain worsening. They are easily diagnosed by their appearance. Although the cause is not clearly identified, absent or defective valves in the veins are suspected. When the patient has adequate exercise, the blood in the legs moves normally. When the patient is standing or sitting for extended periods, gravity causes the blood to be pushed downward, causing pressure on the valves. When advanced, varicosities cause skin around the affected vessels to become brownish. Treatment involves frequent rest with the legs raised, exercise, submergence in warm water, and wearing support stockings. Surgery may be indicated if these treatments are not adequate.

Blood Disorders

The common blood disorders include anemias, leukemias, lymphatic diseases, transfusion incompatibility reaction, and clotting disorders.

Anemias

Anemias are defined as conditions of reduced red blood cells or hemoglobin as well as the reduced ability to carry oxygen to the cells. Types of anemias include iron deficiency, folic acid deficiency, pernicious, aplastic, sickle cell, hemorrhagic, and hemolytic. Most anemic patients are pale and fatigued. Progressive symptoms include dyspnea, tachycardia, and the pounding of the heart, which a physician should promptly assess. Various causes include hemorrhage, heavy menstrual flow, the insufficient intake of iron, the insufficient intake of folic acid, oversized immature RBCs, autoimmune conditions, damaged stem cells, and exposure to certain cytotoxic agents. Diagnosis shows reduced numbers of RBCs, hemoglobin, and hematocrit. Treatment is based on the etiology of the anemia.

Iron Deficiency Anemia

Iron deficiency anemia is a disorder of oxygen transport. Hemoglobin synthesis is deficient in this disease, which affects between 10 and 30% of adults in the United States. It is the most common type of anemia, and IT occurs in all ages. Replacement therapy usually reverses the condition. Possible causes of iron deficiency anemia include the following:

- Inadequate dietary intake of iron
- Blood loss (due to drugs, heavy menses, hemorrhaging, peptic ulcers, etc.)
- Iron malabsorption (from chronic diarrhea, gastrectomy, **celiac disease**, etc.)
- Various types of hemoglobinuria (the presence of free hemoglobin in the urine)
- Pregnancy (wherein iron is carried from the mother to the fetus)
- Mechanical red blood cell trauma (due to prosthetic heart valves or vena cava filters)

Folic Acid Deficiency Anemia

Folic acid deficiency anemia is a slowly progressing form of **megaloblastic anemia**. It is very common, usually occurring in infants, adolescents, pregnant or lactating women, alcoholics, elderly people, and patients with malignancies or intestinal diseases. It is caused by the following:

- Alcohol abuse, which suppresses the metabolic effects of folate
- Poor diet
- Impaired absorption due to intestinal dysfunction or diseases
- Overcooking of food, destroying much of the contained folic acid
- Prolonged drug therapy (including anticonvulsants and estrogens)
- Increased need for folic acid (during pregnancy, increased periods of growth throughout life, and in patients with skin diseases or neoplastic diseases)

Pernicious Anemia

Pernicious anemia is the most common form of megaloblastic anemia. It is mainly caused by malabsorption of vitamin B₁₂. It usually affects people between the ages of 50 and 60, and incidence increases with age. It is a fatal condition if not

treated. When treated properly, its signs and symptoms subside, although certain neurologic deficits may be permanent. Possible causes of pernicious anemia include the following:

- Genetic predisposition
- Thyroiditis, **myxedema**, or **Graves' disease**
- Partial **gastrectomy**
- Lack of adequate dietary consumption of vitamin B₁₂ (usually in the elderly)

Aplastic Anemia

Aplastic anemia is also called **hypoplastic anemia**. These terms actually describe a variety of related anemias. Aplastic anemia results from the destruction of or injury to stem cells in the bone marrow or its matrix. It causes **pancytopenia** and bone marrow **hypoplasia**. Pancytopenia actually results from the decreased functioning of hypoplastic fatty bone marrow. Aplastic anemia usually results in fatal bleeding or infection, with the death rate for severe cases being between 80 and 90% of patients. Possible causes of aplastic anemia include the following:

- Drugs (antibiotics, anticonvulsants) or toxic agents
- Radiation (nearly one-half of all cases are related to radiation exposure)
- Severe disease (especially hepatitis)
- Preleukemic and neoplastic infiltration of bone marrow
- Congenital (idiopathic) causes

Sickle-Cell Anemia

Sickle-cell anemia is a congenital condition caused by defective hemoglobin molecules. The sickle-cell trait results from mutations of the **hemoglobin S** gene. The disease is initially asymptomatic. However, about 50% of patients die by their early twenties from this condition. Very few will live to middle age. Sickle-cell anemia mainly affects people of African or Mediterranean descent. It is also commonly seen in Puerto Rico, India, the Middle East, and Turkey.

Hemorrhagic Anemia

A hemorrhage is a loss of a large amount of blood in a short period, either externally or internally. Hemorrhaging may occur in arteries, veins, or capillaries. An untreated hemorrhage may result in anemia. This is referred to as *hemorrhagic anemia*. Hemoglobin levels are lowered severely due to rapid, massive hemorrhage. Most commonly, hemorrhagic anemia is seen after car accidents, major surgery, gunshot or stab wounds, and other severe forms of tissue damage. Surgery to repair the bleeding tissues or organs is usually indicated, as are blood transfusions. If prompt treatment is not given, the patient goes into shock, which leads to coma and death.

Hemolytic Anemia

Hemolytic anemia is a disorder characterized by the chronic premature destruction of red blood cells. Anemia may be minimal or absent and may reflect the ability of bone marrow to increase red blood cell production. The process of the destruction of red blood cells is called *hemolysis*. The condition may be associated with an infectious disease, certain inherited red blood cell disorders, or neoplastic diseases. Hemolytic

anemia occurs when the bone marrow cannot produce more red blood cells than are being destroyed. Hemolytic anemias are seen in disorders such as malaria and **thalassemia**. These may be due to protein abnormalities or differences.

Polycythemia

Polycythemia is an abnormal increase in the number of erythrocytes in the blood. It may be primary or secondary to pulmonary disease, heart disease, or prolonged exposure to high altitudes. It may also be idiopathic. Symptoms include headaches, dyspnea, irritability, mental sluggishness, dizziness, syncope, night sweats, and weight loss. Diagnosis is made via blood tests, spleen enlargement, and total RBC mass evaluation. Periodic phlebotomy is used to reduce blood volume, as are myelosuppressive drugs and radiation.

Hemochromatosis

Hemochromatosis is defined as an iron overload that may be caused by either repeated transfusions or a genetic condition. When related to heredity, the disorder causes the small intestine to absorb excessive iron. Symptoms include **arthralgia**, decreased libido, and fatigue, followed by cirrhosis of the liver, diabetes, excessive melanin-related skin pigmentation, and heart failure. The excess iron is stored in muscles and organs such as the liver, pancreas, and heart. Liver damage may result in liver carcinoma. Symptoms usually develop in the fifth or sixth decade of life, with clinical signs being more prevalent in males.

Leukemias

Leukemias are malignant neoplasms of the bone marrow, spleen, and lymph nodes. They produce an abnormal proliferation of certain lymphoid or myeloid cells, causing reduced production and function of normal blood cells. They are classified by the proliferating cell type and degree of differentiation of the neoplastic cells. Leukemias may be acute or chronic. Common types of leukemias include acute lymphocytic leukemia, chronic lymphocytic leukemia, acute myelogenous leukemia, and chronic myelogenous leukemia.

Acute Lymphocytic Leukemia

Acute lymphocytic leukemia causes an overproduction of immature lymphoid cells (**lymphoblasts**) in the lymph nodes and bone marrow. Common signs and symptoms include bone pain, sore throat, fatigue, night sweats, weakness, and weight loss. Prompt assessment by a physician is required. This type of leukemia usually affects children and people over age 65. It is the most common childhood leukemia.

Chronic Lymphocytic Leukemia

Chronic lymphocytic leukemia is a neoplasm that usually affects the B lymphocytes. It progresses slowly, resulting in mature-appearing but hypofunctional lymphocytes. There are often no symptoms prior to the disease being revealed in a complete blood count. When symptoms develop, they usually include fever, night sweats, extreme fatigue, a noticeable swelling of lymph nodes, and weight loss. Prompt assessment by a physician is required. There are five stages of chronic lymphocytic leukemia:

- Stage 0—low risk—lymphocytosis exists
- Stage I—intermediate risk—lymphocytosis plus enlarged lymph nodes
- Stage II—intermediate risk—lymphocytosis plus an enlarged liver or spleen, with or without lymphadenopathy
- Stage III—high risk—lymphocytosis plus anemia
- Stage IV—high risk—lymphocytosis plus thrombocytopenia

Acute Myelogenous Leukemia

Acute myelogenous leukemia is a rapidly progressive neoplasm of myeloid-related cells. In this condition, leukemic cells accumulate in the bone marrow, peripheral blood, and other tissues. It is also known as *acute myeloid, granulocytic, or myelocytic* leukemia. Rapidly accumulating myeloblasts lead to pancytopenia and anemia. This type of leukemia is the most common adult leukemia and represents about 20% of childhood leukemias.

Chronic Myelogenous Leukemia

Chronic myelogenous leukemia is a slowly progressing neoplasm arising in early progenitor cells or **hematopoietic stem cells**. It results in excessive mature-appearing but hypofunctional neutrophils. Most cases are genetic in origin, identified because of the *Philadelphia chromosome*. This type of leukemia accounts for 15 to 20% of adult leukemias. Nearly one-half of patients are asymptomatic at diagnosis. It is usually diagnosed because of leukocytosis or thrombocytosis found during routine blood tests. The disease usually occurs in adults over the age of 40. The only chance for a complete cure is bone marrow transplantation.

Lymphatic Diseases

Diseases of the lymphatic system include lymphedema, lymphangitis, and various lymphomas.

Lymphedema

Lymphedema is an abnormal collection of **lymph** (usually in the extremities) that results in a painless swelling. It is usually due to an obstruction, but may also be caused by inflammation or the removal of lymph channels. Congenital lymphedema (Milroy's disease) is a hereditary condition characterized by chronic lymphatic obstruction. Secondary lymphedema may follow the surgical removal of lymph channels in **mastectomy**, the obstruction of lymph drainage caused by malignant tumors, or adult filarial parasite infestation of lymph vessels. Lymphedema is most common in the lower limbs. It can also occur in the arms, face, trunk, and external genitalia. Lymphedema may be primary or secondary. There is no cure for lymphedema, but lymph drainage from the extremities can be improved if the patient sleeps with the foot of his or her bed elevated 4 to 8 in. Other helpful measures include the wearing of elastic stockings and regular moderate exercise. Surgery may be performed to remove **hypertrophied** lymph channels and disfiguring tissue.

Lymphangitis

Lymphangitis is an inflammation of the lymph vessels that may be caused by an acute streptococcal infection in one of

the extremities. It is characterized by fine red streaks that extend from the infected area to the axilla or groin. Other symptoms include chills, fever, headache, and myalgia. Risk factors include chronic steroid use, diabetes mellitus, long-term placement of a peripheral venous catheter, immunocompromise, bites (from insects, animals, or humans), and any skin trauma.

Lymphomas

Lymphomas are neoplasms of the lymphatic tissue that originate in the lymphatic system. They are usually malignant, but in rare cases may be benign. A lymphoma normally appears initially as a single, painless, enlarged lymph node, usually in the neck. Signs and symptoms progress to include fever, weakness, anemia, and weight loss. The disease may spread to the liver, bones, spleen, and gastrointestinal tract. Lymphomas are usually categorized as Hodgkin's or non-Hodgkin's lymphoma. Hodgkin disease is caused by clonal **proliferation** of transformed B lymphocytes. The presence of **Reed-Sternberg cells** on a pathologic examination is all that is needed to confirm diagnosis of this disease (see **Figure 7-4**). The disease spreads first to continuous lymphoid tissue and then to nonlymphoid tissue.

Transfusion Incompatibility Reaction

It is extremely important that blood components to be transfused be compatible with the individual receiving the transfusion. The correct individual must be identified prior to the transfusion process. Transfusion incompatibility reaction occurs when a transfused blood product has antibodies to the recipient's red blood cells, or when the recipient has antibodies to the donated blood's red blood cells. Individuals must be carefully monitored for a transfusion reaction. The hypersensitivity reaction can range from mild to fatal. Therefore, vital signs should be checked every 5 min during the procedure, and signs and symptoms such as chills, fever, facial flushing, tachycardia, cold or clammy skin, and itching should also be checked. More intensive symptoms may lead to circulatory collapse. This type of reaction produces hemolysis or agglutination of blood cells. Any further transfusion must be quickly stopped, and antihistamines are indicated.

Clotting Disorders

Clotting disorders include hemophilia and disseminated intravascular coagulation. Hemophilia results from a deficiency of

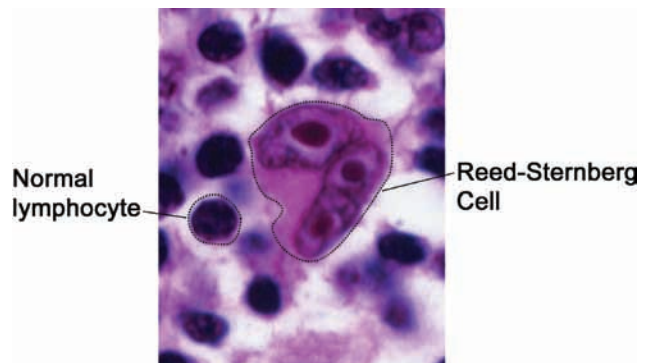


Figure 7-4 Reed-Sternberg cells

clotting factors, and it is a hereditarily linked disorder. It affects male children and is signified by prolonged bleeding after injury, easy bruising, hematomas, and excessive nosebleeds.

Hemophilia

Hemophilia is a group of hereditary bleeding disorders characterized by a deficiency of one of the factors necessary for blood coagulation. The two most common forms of the disorder are hemophilia A and hemophilia B. **Hemophilia A** is also known as *classic hemophilia*. It is the result of a deficiency or absence of antihemophilic factor VIII. Hemophilia B (Christmas disease) represents a deficiency of plasma thromboplastin component. The greater the deficiency, the more severe the disorder will manifest. Patients with hemophilia experience a greater than normal loss of blood during dental procedures, epistaxis, hematoma, and **hemarthrosis**. Severe nonsurgical internal hemorrhage and hematuria are less common.

The primary treatment for hemophilia is the replacement of deficient factors with recombinant factor products or plasma. Treatment may be prophylactic, or to stop bleeding episodes. Acetaminophen or codeine is used to control pain. Both aspirin and **NSAID** use, as well as intramuscular injections, should be avoided because they may precipitate bleeding. When hemophiliacs need surgery or dental work, extreme care must be exercised. Gene transfer therapy is being experimented with to develop methods of replacing the absent gene.

Disseminated Intravascular Coagulation

Disseminated intravascular coagulation occurs as a complication of diseases and conditions that accelerate clotting. When clotting accelerates, it causes occlusion of small blood vessels and organ necrosis. Clotting in the microcirculation usually affects the lungs, kidneys, extremities, and brain. Disseminated intravascular coagulation is caused by the following:

- Infection (gram-negative septicemia, gram-positive septicemia, or from viruses, fungi, rickettsiae, or protozoans)
- Neoplastic disease (including acute leukemia, aplastic anemia, and metastatic carcinoma)
- Necrotic disorders (including brain tissue destruction, extensive trauma or burns, hepatic necrosis, and transplant rejection)
- Obstetric complications (including **abruptio placentae**, *amniotic fluid embolism*, retained dead fetus, **eclampsia**, and septic abortion)
- Other conditions (including heatstroke, poisonous snakebite, cirrhosis, fat embolism, incompatible blood transfusion, cardiac arrest, shock, severe venous thrombosis, and surgery requiring cardiopulmonary bypass)

Summary

Common disorders related to phlebotomy include those that affect the cardiovascular system, including the blood and blood vessels. Atherosclerosis is the most common type of coronary artery disease. Necrosis of heart tissue results in myocardial infarction. When the coronary arteries are

obstructed, this may result in atherosclerosis, a spasm, or a thrombus. A dysrhythmia (arrhythmia) is a disturbance of heart rhythm caused by abnormal electrical conduction or automaticity. Cardiac arrest is a sudden cessation of cardiac output and effective circulation, which is usually precipitated by ventricular fibrillation or ventricular asystole. Common vascular disorders include phlebitis, thrombophlebitis, and varicose veins.

Shock may be caused by anaphylaxis, hemorrhage, respiratory distress, sepsis, heart failure, neurologic failure, emotional catastrophe, or severe metabolic insult. There are many types of anemia, some of which have high fatality rates. Aplastic anemia usually results in fatal bleeding or infection, with the death rate for severe cases being between 80 and 90% of patients. Acute myelogenous leukemia is the most common adult leukemia, while acute lymphocytic leukemia is the most common childhood leukemia.

CRITICAL THINKING

A woman who has been pregnant for 32 weeks has been complaining of weakness, tiredness, and lack of appetite. Her physician orders blood tests to see if she has any type of anemia. The results confirm this.

1. What is the most common type of anemia during pregnancy once iron deficiency anemia is ruled out?
2. Under what form of anemia is this type classified?

WEBSITES

<http://digestive.niddk.nih.gov/ddiseases/pubs/hemochromatosis>

<http://www.americanheart.org/presenter.jhtml?identifier=4440>

http://www.heartfailure.org/eng_site/hf.asp

<http://www.labtestsonline.org/understanding/conditions/anemia.html>

<http://www.mayoclinic.com/health/high-blood-pressure/DS00100>

http://www.medicinenet.com/heart_attack/article.htm

<http://www.merckmanuals.com/professional/sec07.html>

<http://www.nlm.nih.gov/medlineplus/bloodandblooddisorders.html>

<http://www.nlm.nih.gov/medlineplus/ency/article/001124.htm>

<http://www.oncologychannel.com/leukemias/index.shtml>

http://www.wrongdiagnosis.com/medical/blood_vessel_disorder.htm

REVIEW QUESTIONS

Multiple Choice

1. An area of dead cells due to lack of oxygen is called
 - A. ischemia
 - B. infarction
 - C. atresia
 - D. gangrene

2. The most common type of anemia in the United States is
 - A. sickle cell
 - B. pernicious
 - C. folic acid deficiency
 - D. iron deficiency
3. Thrombophlebitis occurs most commonly in the
 - A. lower legs
 - B. lower arms
 - C. lower abdomen
 - D. lungs
4. When the heart is pumping inadequately to meet the needs of the body, the condition is called
 - A. cor pulmonale
 - B. heart failure
 - C. arrhythmia
 - D. myocardial infarction
5. Which of the following is a sign of shock?
 - A. bradycardia
 - B. tachycardia
 - C. bradypnea
 - D. hypertension
6. In which of the following types of anemia may you find hemoglobin S?
 - A. hemolytic
 - B. aplastic
 - C. sickle cell
 - D. megaloblastic
7. Stasis of blood flow from immobility, injury to a vessel, or predisposition to clot formation increases the risk of
 - A. pulmonary embolism
 - B. emphysema
 - C. pneumothorax
 - D. chronic obstructive pulmonary disease
8. What is the most common type of coronary artery disease?
 - A. dysrhythmia
 - B. atherosclerosis
 - C. anoxia
 - D. pancytopenia
9. Aneurysms are often caused by
 - A. buildup of atherosclerotic plaque that weakens vessel walls
 - B. an inflammation of a vein
 - C. various cardiac arrhythmias
 - D. complication of syphilis
10. The presence of Reed-Sternberg cells can confirm diagnosis of
 - A. chronic lymphocytic leukemia
 - B. acute myelogenous leukemia
 - C. Hodgkin's disease
 - D. hemophilia
11. Which of the following is a major cause of cardiac disease, renal failure, and stroke?
 - A. emphysema
 - B. heart failure
 - C. hypertension
 - D. asthma
12. Which of the following does not cause disseminated intravascular coagulation?
 - A. neoplastic diseases such as acute leukemia and metastatic carcinoma
 - B. abruptio placentae and septic abortion
 - C. severe dehydration and low potassium in the blood
 - D. brain tissue destruction and hepatic necrosis
13. Which of the following cardiovascular disorders is the leading cause of death in the United States?
 - A. myocardial infarction
 - B. hypertension
 - C. stroke
 - D. angina pectoris
14. Thrombophlebitis results from
 - A. inflammation of veins
 - B. inflammation of the sac enclosing the heart
 - C. hypertension
 - D. myocardial infarction
15. The diagnosis of anemia indicates that the patient is experiencing a reduction in
 - A. platelets
 - B. leukocytes
 - C. antibodies or albumin
 - D. red blood cells or hemoglobin