

CHAPTER Nursing Care 35 of Clients with Peripheral Vascular Disorders

LEARNING OUTCOMES

- Describe the etiology, pathophysiology, and manifestations of common peripheral vascular and lymphatic disorders.
- Compare and contrast the manifestations and effects of disorders affecting large and small vessels, arteries and veins.
- Explain risk factors for and measures to prevent peripheral vascular disorders and their complications.
- Explain the nursing implications for medications and other interdisciplinary treatments used for clients with peripheral vascular disorders.
- Describe preoperative and postoperative nursing care of clients having vascular surgery.

CLINICAL COMPETENCIES

- Assess clients with peripheral vascular disorders, using data to select and prioritize appropriate nursing diagnoses and identify desired outcomes of care.
- Identify the effects of peripheral vascular disorders on the functional health status of assigned clients.
- Use research and an evidence-based plan to provide individualized care for clients with peripheral vascular disorders.
- Collaborate with the interdisciplinary care team in planning and providing care for clients with peripheral vascular disorders.
- Safely and knowledgeably administer medications and prescribed treatments for clients with peripheral vascular disorders.
- Provide client and family teaching to promote, maintain, and restore health in clients with common peripheral vascular disorders.

MEDIA LINK



Resources for this chapter can be found on the Prentice Hall Nursing MediaLink DVD-ROM accompanying this textbook, and on the Companion Website at <http://www.prenhall.com/lemone>



KEY TERMS

aneurysm, 1170
atherosclerosis, 1176
blood pressure, 1154
chronic venous insufficiency, 1194
deep venous thrombosis (DVT), 1186
diastolic blood pressure, 1154
dissection, 1172
embolism, 1184
hypertension, 1154
intermittent claudication, 1172

lymphedema, 1199
mean arterial pressure (MAP), 1154
peripheral vascular disease (PVD), 1176
primary hypertension, 1155
pulse pressure, 1154
Raynaud's disease/phenomenon, 1182
secondary hypertension, 1167
systolic blood pressure, 1154

thromboangiitis obliterans, 1180
thromboembolus, 1184
thrombus, 1184
varicose veins, 1195
vasoconstriction, 1176
vasodilation, 1176
venous thrombosis, 1186

The major processes that interfere with peripheral blood flow and that of lymphatic fluid include constriction, obstruction, inflammation, and vasospasm. These conditions lead to disorders of blood pressure regulation, peripheral artery function, aortic structure, venous circulation, and lymphatic circulation.

A holistic approach is important when caring for clients with disorders of the peripheral vascular and lymphatic systems. The focus of care is on teaching long-term care measures, pain relief, improving peripheral blood and lymphatic circulation, preventing tissue damage, and promoting healing. The prescribed treatment may have emotional, social, and economic effects on the client and family.

DISORDERS OF BLOOD PRESSURE REGULATION

Blood flows through the circulatory system from areas of higher pressure to areas of lower pressure. The amount of pressure in any portion of the vascular system is affected by a number of factors, including blood volume, vascular resistance, and cardiac output. The **blood pressure** is the tension or pressure exerted by blood against arterial walls. A certain amount of pressure within the system is necessary to maintain open vessels, capillary perfusion, and oxygenation of all body tissues. Excess pressure, however, has harmful effects, increasing the workload of the heart, altering the structure of the vessels, and affecting sensitive body tissues such as the kidneys, eyes, and central nervous system (CNS).

This section focuses on **hypertension**, or excess pressure in the arterial portion of systemic circulation. Excessively low blood pressure, *hypotension*, is discussed in the shock section of Chapter 11 ∞. Altered pulmonary vascular pressures are discussed in Chapter 39 ∞.

Physiology Review

Blood flow through the circulatory system requires *sufficient blood volume* to fill the blood vessels and *pressure differences* within the system that allow blood to move forward. The arterial, or supply, side of the circulation has relatively high pressures created by the thick elastic walls of the arteries and arterioles. The venous, or return, side of the system, on the other hand, is a low-pressure system of thin-walled, distensible veins. Blood flows through the capillaries linking these two systems from the higher pressure arterial side to the lower pressure venous side.

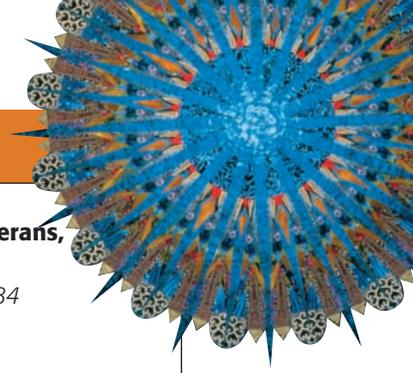
The arterial blood pressure is created by the ejection of blood from the heart during systole (*cardiac output* or *CO*) and the tension, or resistance to blood flow, created by the elastic

arterial walls (*systemic vascular resistance* or *SVR*). The blood pressure rises as the heart contracts during systole, ejecting its blood. This pressure wave, or the **systolic blood pressure**, is felt as the peripheral pulse and heard as the Korotkoff's sounds during blood pressure measurement. In healthy adults the average systolic pressure is less than 120 mmHg. During diastole, or cardiac relaxation and filling, elastic arterial walls maintain a minimum pressure, the **diastolic blood pressure**, to maintain blood flow through the capillary beds. The average diastolic pressure in a healthy adult is less than 80 mmHg. The difference between the systolic and diastolic pressure, normally about 40 mmHg, is known as the **pulse pressure**. The **mean arterial pressure (MAP)** is the average pressure in the arterial circulation throughout the cardiac cycle. It can be calculated using the formula $[\text{systolic BP} + 2(\text{diastolic BP})] / 3$.

PRACTICE ALERT

- Cardiac output and systemic (or peripheral) vascular resistance are the primary factors that determine blood pressure.
- A decrease in cardiac output (e.g., due to hemorrhage) or decreased peripheral vascular resistance (e.g., systemic vasodilation) cause the blood pressure to fall.
- Increased cardiac output (e.g., during exercise) or increased peripheral vascular resistance (e.g., vasoconstriction due to drug administration) cause the blood pressure to rise.

Cardiac output is determined by the blood volume and the ability of the ventricles to fill and effectively pump that blood. A number of factors contribute to systemic vascular resistance, including vessel length, blood viscosity, and vessel diameter and distensibility (compliance). While vessel length and blood



viscosity remain relatively constant, vessel diameter and compliance are subject to normal regulatory activities and disease.

The arterioles normally determine the SVR as their diameter changes in response to a variety of stimuli:

- **Sympathetic nervous system (SNS) stimulation.** Baroreceptors in the aortic arch and carotid sinus signal the SNS via the cardiovascular control center in the medulla when the MAP changes. A drop in MAP stimulates the SNS, increasing the heart rate and cardiac output, and constricting arterioles (except in skeletal muscle). As a result, BP rises. A rise in MAP has the opposite effect, decreasing the heart rate and cardiac output, and causing arteriolar vasodilation.
- **Circulating epinephrine and norepinephrine** from the adrenal cortex (e.g., the fight-or-flight response) have the same effect as SNS stimulation.
- **Renin–angiotensin–aldosterone system** responds to renal perfusion. A drop in renal perfusion stimulates renin release. Renin converts angiotensinogen to angiotensin I, which is subsequently converted to angiotensin II in the lungs by angiotensin-converting enzyme (ACE). Angiotensin II is a potent vasoconstrictor. It also promotes sodium and water retention both directly and by stimulating the adrenal medulla to release aldosterone. Both SVR and CO increase, raising BP.
- **Atrial natriuretic peptide (ANP) and brain natriuretic peptide (BNP)** are released from atrial cells in response to stretching by excess blood volume. These hormones promote vasodilation and sodium and water excretion, lowering BP.
- **Adrenomedullin** is a peptide synthesized and released by endothelial and smooth muscle cells in blood vessels. It is a potent vasodilator.

- **Vasopressin or antidiuretic hormone** (from the posterior pituitary gland) promotes water retention and vasoconstriction, raising BP.

- **Local factors** such as inflammatory mediators and various metabolites can promote vasodilation, affecting BP.

In addition to the preceding, the primary factor affecting vessel compliance is the extent of arteriosclerosis (hardening of the arteries) and atherosclerosis (plaque accumulation). Figure 35–1 ■ summarizes the interrelationships of major factors regulating blood pressure.

FAST FACTS

- Sympathetic nervous system stimulation, epinephrine and norepinephrine, and the hormones angiotensin II and vasopressin (antidiuretic hormone or ADH) are *vasoconstrictors*, increasing the blood pressure.
- Parasympathetic nervous system stimulation and the hormones ANP, BNP, and adrenomedullin are *vasodilators*, decreasing the blood pressure.
- The hormones aldosterone and ADH promote sodium and water retention, increasing the blood pressure.

THE CLIENT WITH PRIMARY HYPERTENSION

Primary hypertension, also known as *essential hypertension*, is a persistently elevated systemic blood pressure. About 50 to 65 million people in the United States have hypertension (American Heart Association [AHA], 2005; National Heart, Lung, and Blood Institute [NHLBI], 2004b). More than 90% of these have primary hypertension, which has no identified cause.

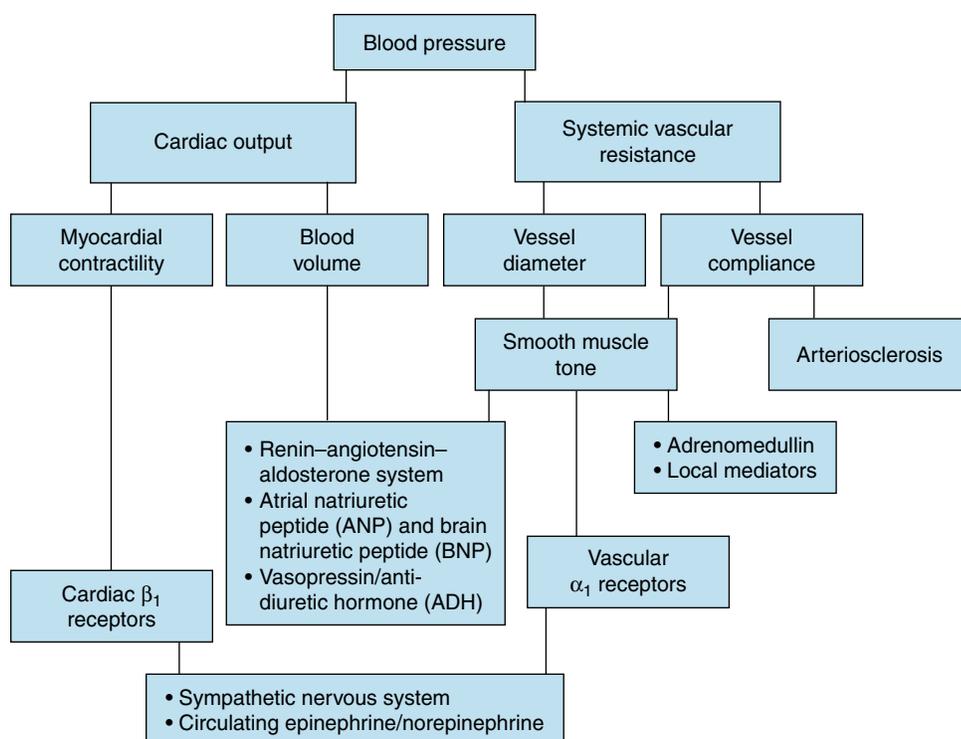


Figure 35–1 ■ Factors affecting blood pressure.

Hypertension is defined as systolic blood pressure of 140 mmHg or higher, or diastolic pressure of 90 mmHg or higher, based on the average of three or more readings taken on separate occasions (NHLBI, 2004b). Exceptions include clients being treated for hypertension and an initial reading of a systolic pressure of 210 mmHg or higher and/or a diastolic blood pressure of 120 mmHg or higher. Table 35–1 identifies classifications of blood pressure for adults age 18 and older as defined by the Joint National Committee.

Hypertension is an important public health issue: While it rarely causes symptoms or noticeably limits the client’s functional health, hypertension is a major risk factor for coronary heart disease, heart failure, stroke, and renal failure. Hypertension and its consequences are not unique to the United States. The World Health Organization identifies blood pressure above optimal levels (a systolic BP > 115 mmHg) as responsible for 62% of cerebrovascular disease and 49% of ischemic heart disease worldwide (NHLBI, 2004b).

While the identification and treatment of hypertension in the United States has improved significantly in the past 25 years, approximately 30% of hypertensive adults remain unaware of their condition. Although 59% of hypertensive adults are being treated for the disorder, effective blood pressure control is achieved in only about 34% (NHLBI, 2004b).

Incidence and Risk Factors

Hypertension primarily affects middle-aged and older adults: More than 50% of people ages 60 to 69 and about 75% of those age 70 and older are hypertensive (NHLBI, 2004b). An age-related increase in the systolic blood pressure is the primary factor leading to the high incidence of hypertension in older adults. Unlike the diastolic blood pressure, which tends to rise until approximately age 50, then level off, the systolic blood pressure continues to rise with aging (NHLBI, 2004b).

The prevalence of hypertension is significantly higher in blacks than in whites and Hispanics. Nearly 40% of black adults are hypertensive, whereas less than 30% of adult white and Hispanic people are affected. In whites and Hispanics,

more males than females are hypertensive; in blacks, more women than men are affected (NHLBI, 2004a). Essential hypertension affects people of all income groups, having great financial effects because of its effects on other body systems.

FAST FACTS

- Almost one-third of the adult population in the United States has hypertension.
- The prevalence of hypertension is highest in African American females and lowest in people of Asian ancestry.
- The prevalence of hypertension is higher among people who live in the southeastern United States.
- Up until age 55, more men than women are affected by hypertension; after that it affects more women than men.
- Hypertension increases the risk of stroke to about four times that of people with normal blood pressure, and the risk for heart failure by two to three times that of people with normal blood pressure (AHA, 2005).

A number of risk factors have been identified for primary hypertension (Box 35–1). Genetics plays a role, as do environmental factors.

- **Family history.** Studies show a genetic link in about 30% of people with primary hypertension (Kasper et al., 2005). Genes involved in the renin–angiotensin–aldosterone system and others that affect vascular tone, salt and water transportation in the kidney, obesity, and insulin resistance are likely involved in the development of hypertension, although no consistent genetic linkages have been found.
- **Age.** The incidence of hypertension rises with increasing age. Aging affects baroreceptors involved in blood pressure regulation as well as arterial compliance. As the arteries become less compliant, pressure within the vessels increases. This is often most apparent as a gradual increase in the systolic pressure with aging. See the Nursing Care of the Older Adult box on page 1157.
- **Race.** Essential hypertension is more common and more severe in blacks than in people of other ethnic backgrounds (see the accompanying Focus on Cultural Diversity box). It also tends to develop at an earlier age, and is associated with more cardiovascular and renal damage. More African Americans with hypertension have low renin levels and altered re-

TABLE 35–1 Classification of Blood Pressure for Adults^a

CATEGORY	SYSTOLIC (mmHG)		DIASTOLIC (mmHG)
Normal	<120	and	<80
Prehypertension	120–139	or	80–89
Hypertension ^b			
Stage 1	140–159	or	90–99
Stage 2	≥160	or	≥100

^aWhen systolic and diastolic blood pressures fall into different categories, the higher category is used to classify blood pressure status.
^bBased on the average of two or more readings taken at each of two or more visits after an initial screening.
 Source: Adapted from *The Seventh Report of the Joint National Committee on Prevention, Detection, Education, and Treatment of High Blood Pressure*, NIH Publication No. 04-5250 by NHLBI, 2004b, Bethesda, MD: National Institutes of Health. Retrieved from <http://www.nhlbi.nih.gov/guidelines/hypertension>.

BOX 35–1 Factors Contributing to Hypertension

- Modifiable Factors**
- High sodium intake
 - Low potassium, calcium, and magnesium intake
 - Obesity
 - Excess alcohol consumption
 - Insulin resistance
- Nonmodifiable Factors**
- Genetic factors
 - Family history
 - Age
 - Race

NURSING CARE OF THE OLDER ADULT Hypertension

Controlling high blood pressure is as important in the older adult as in younger adults. In the United States, the lifetime risk of hypertension is about 90% in men and women who live to age 80 to 85 (NHLBI, 2004b). Systolic hypertension is common, as is an elevated pulse pressure (systolic BP minus diastolic BP), indicating decreased compliance of large arteries. Despite this fact, less than two-thirds of people over age 80 who have high blood pressure are being treated and only 38% of men and 23% of women undergoing treatment had blood pressures that met established targets (NHLBI, 2005).

The Framingham Heart Study shows that cardiovascular deaths are two to five times more common in older adults with isolated systolic hypertension than in people with normal blood pressures. Stroke also is more common in older adults with sys-

tolic hypertension. These findings appear to relate to changes in blood vessels associated with aging: decreased compliance and decreased baroreceptor sensitivity. Decreased compliance impairs the ability of the vessels to expand and contract with varying amounts of blood, increasing peripheral vascular resistance and decreasing renal blood flow.

To obtain accurate blood pressure readings for older clients, slightly different procedures may be required. Palpation of the artery during cuff inflation is recommended to prevent inaccurate systolic readings due to an auscultatory gap, present in many older adults. The reflexes that maintain blood pressure during position changes diminish with aging. Allow the older client to sit upright or stand for 2 to 5 minutes before evaluating the blood pressure for true orthostatic readings.

nal excretion of sodium at normal blood pressure levels. This genetic tendency to conserve salt may have developed as an adaptation to working in a warm environment, when salt and water conservation are beneficial (Porth, 2005).

- **Mineral intake.** High sodium intake often is associated with fluid retention. Hypertension related to sodium intake involves a number of different physiologic mechanisms, including the renin–angiotensin–aldosterone system, nitric oxide, catecholamines, endothelin, and ANP (Copstead & Banasik, 2005). Low potassium, calcium, and magnesium intakes also contribute to hypertension by unknown mechanisms. The ratio of sodium to potassium intake appears to play a role, possibly through the effects of increased potassium intake on sodium excretion. Potassium also promotes vasodilation by reducing responses to catecholamines and angiotensin II. Calcium also has a vasodilator effect. While magnesium has been shown to reduce the blood pressure, the mechanism of action is unclear.
- **Obesity.** Central obesity (fat cell deposits in the abdomen), determined by an increased waist-to-hip ratio, has a stronger correlation with hypertension than body mass index or skin-fold thickness. Although a clear correlation exists between obesity and hypertension, the relationship may be one of com-

mon cause: Genetic factors appear to play a role in the common triad of obesity, hypertension, and insulin resistance.

- **Insulin resistance.** Insulin resistance with resulting hyperinsulinemia is linked with hypertension by its effects of excess circulating insulin on the sympathetic nervous system, vascular smooth muscle, renal regulation of sodium and water, and ion transport across cell membranes. Insulin resistance may be a genetic or an acquired trait. Although it is more commonly seen in obese individuals, insulin resistance also has been found in people of normal weight.
- **Excess alcohol consumption.** Regular consumption of three or more drinks a day increases the risk of hypertension. Decreasing or discontinuing alcohol consumption reduces the blood pressure, particularly systolic readings. Lifestyle factors associated with excessive alcohol intake (obesity and lack of exercise) may contribute to hypertension as well.
- **Stress.** Physical and emotional stress cause transient elevations of blood pressure, but the role of stress in primary hypertension is less clear. Blood pressure normally fluctuates throughout the day, increasing with activity, discomfort, or emotional responses such as anger. Frequent or continued stress may cause vascular smooth muscle hypertrophy or affect central integrative pathways of the brain (Porth, 2005).

FOCUS ON CULTURAL DIVERSITY Hypertension in African Americans

- The prevalence of hypertension among African Americans living in the United States is among the highest in the world: in African American adults, 41.8% of males and 45.4% of females are hypertensive.
 - African Americans with the highest risk for hypertension tend to be:
 - Middle aged or older
 - Less educated
 - Overweight or obese
 - Physically inactive
 - Affected by diabetes (AHA, 2005).

Pathophysiology

Primary hypertension is thought to develop from complex interactions among factors that regulate cardiac output and systemic vascular resistance. These interactions may include:

- Excess sympathetic nervous system with overstimulation of α - and β -adrenergic receptors, resulting in vasoconstriction and increased cardiac output.
- Altered function of the renin–angiotensin–aldosterone system and its responsiveness to factors such as sodium intake and overall fluid volume. The renin–angiotensin–aldosterone system affects vasomotor tone and salt and water excretion. Chronically high levels of angiotensin II lead to arteriolar remodeling, which permanently increases SVR. In approximately 20% of people with primary hypertension, renin levels are lower

than normal. Increased sodium intake increases the blood pressure in these clients. Low plasma renin levels are more commonly seen in African Americans than in whites. Another 15% of clients with hypertension have higher than normal plasma renin levels. For these clients, salt intake has less of an effect on blood pressure (Kasper et al., 2005). Most people with hypertension have normal levels of renin activity.

- Other chemical mediators of vasomotor tone and blood volume such as atrial natriuretic peptide also play a role by affecting vasomotor tone and sodium and water excretion. Vascular endothelium itself produces hormones (*endothelins*) that also affect vasomotor tone. Endothelin-1 is a potent vasoconstrictor (Copstead & Banasik, 2005).
- The interaction between insulin resistance, hyperinsulinemia, and endothelial function may be a primary cause of hypertension. Excess insulin has several effects that potentially contribute to hypertension: (1) sodium retention by the kidneys, (2) increased SNS activity, (3) hypertrophy of vascular smooth muscle, and (4) changes in ion transport across cell membranes (Kasper et al., 2005).

The result is sustained increases in blood volume and peripheral resistance. The cardiovascular system adapts to increased blood volume by increasing cardiac output. Autoregulatory mechanisms in the systemic arteries react to the increased volume, causing vasoconstriction. The increased systemic vascular resistance causes hypertension.

It appears unlikely that one single cause and pathologic process will be found to account for essential hypertension. Increasingly, evidence points to hypertension as a diverse group of pathophysiologic mechanisms resulting in the common manifestation of elevated blood pressure.

Manifestations

The early stages of primary hypertension typically are asymptomatic, marked only by elevated blood pressure. Blood pressure elevations are initially transient but eventually become permanent. When symptoms do appear, they are usually vague. Headache, usually in the back of the head and neck, may be present on awakening, subsiding during the day. Other symptoms result from target organ damage, and may include nocturia, confusion, nausea and vomiting, and visual disturbances. Examination of the retina of the eye may reveal narrowed arterioles, hemorrhages, exudates, and *papilledema* (swelling of the optic nerve).

Complications

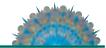
Sustained hypertension affects the cardiovascular, neurologic, and renal systems. The rate of atherosclerosis accelerates, increasing the risk for coronary heart disease and stroke. The workload of the left ventricle increases, leading to ventricular hypertrophy, which then increases the risk for coronary heart disease, dysrhythmias, and heart failure. The diastolic blood pressure is a significant cardiovascular risk factor until age 50; the systolic pressure then becomes the more important factor contributing to cardiovascular risk (NHLBI, 2004b). Most deaths due to hypertension result from coronary heart

disease and acute myocardial infarction or heart failure (Kasper et al., 2005).

Accelerated atherosclerosis associated with hypertension increases the risk for cerebral infarction (stroke). Increased pressure in the cerebral vessels can lead to development of microaneurysms and an increased risk for cerebral hemorrhage. *Hypertensive encephalopathy*, a syndrome characterized by extremely high blood pressure, altered level of consciousness, increased intracranial pressure, papilledema, and seizures, may develop. Its etiology is unclear.

Hypertension also can lead to nephrosclerosis and renal insufficiency. Proteinuria and microscopic hematuria develop, as well as signs of chronic renal failure. Blacks experience hypertensive kidney disease more frequently than whites. Renal failure causes about 10% of deaths attributed to hypertension (Kasper et al., 2005).

INTERDISCIPLINARY CARE



Hypertension management focuses on reducing the blood pressure to less than 140 mmHg systolic and 90 mmHg diastolic. The ultimate goal of hypertension management is to reduce cardiovascular and renal morbidity and mortality. The risk of cardiovascular complications (coronary heart disease, heart failure, stroke) decreases when the average blood pressure is less than 140/90; when the client also has diabetes or renal disease, the treatment goal is a blood pressure of less than 130/80. It now is recognized that most people with hypertension will require a combination of two or more drugs along with lifestyle changes to achieve recommended blood pressure levels (NHLBI, 2004b). Although there is no cure for hypertension, it can be controlled. Figure 35–2 ■ shows the recommended algorithm for hypertension management.

Diagnosis

The client with hypertension is evaluated for the presence of identifiable causes of hypertension, cardiovascular risk factors, and the presence or absence of target organ damage (heart, brain, kidneys, peripheral vascular systems, and retina of the eye). Before treatment is started, the following diagnostic tests are performed:

- Electrocardiogram (ECG)
- Urinalysis
- Blood glucose
- Hematocrit
- Serum potassium, creatinine, and calcium
- Cholesterol and lipoprotein profile, including HDL, LDL, and triglycerides.

Additional tests that may be done include urinary albumin excretion, evaluation of the glomerular filtration rate (such as the creatinine clearance), and tests for emerging cardiovascular risk factors such as C-reactive protein and homocystine levels.

Lifestyle Modifications

Lifestyle modifications are recommended for all clients whose blood pressure falls within the prehypertension range (120–139/80–89) and everyone with intermittent or sustained

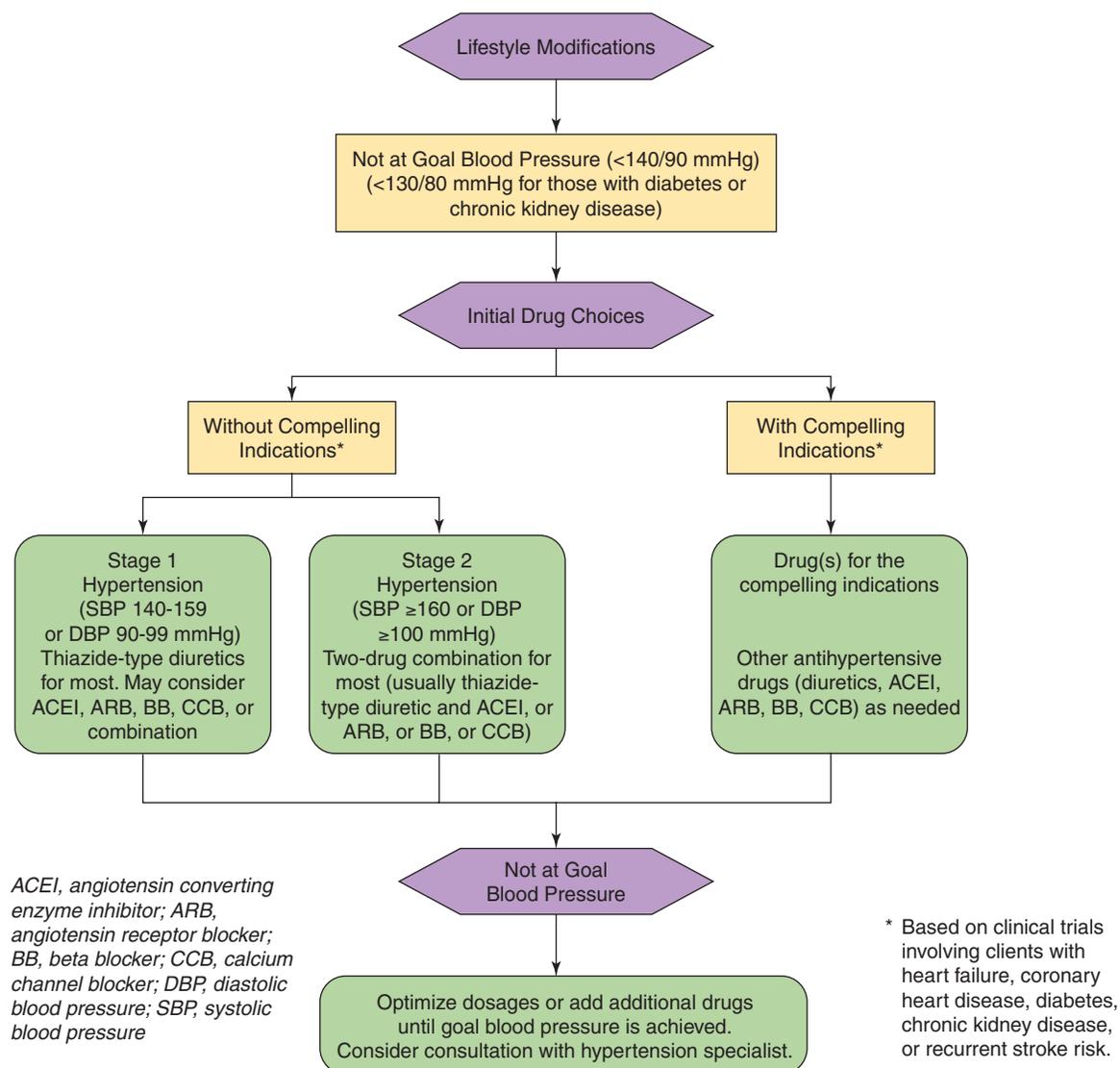


Figure 35–2 ■ Algorithm for treating hypertension.

Source: Adapted from *The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure* (2004b). National Heart, Lung, and Blood Institute, Bethesda, MD: National Institutes of Health.

hypertension. These modifications include weight loss, dietary changes, restricted alcohol use and cigarette smoking, increased physical activity, and stress reduction (Box 35–2).

BOX 35–2 Lifestyle Modifications for Hypertension

- Maintain normal body weight; lose weight if overweight.
- Dietary modifications:
 - Eat a diet rich in fruits, vegetables, and low-fat dairy products.
 - Reduce sodium intake.
 - Reduce intake of cholesterol, total and saturated fat.
- Limit alcohol intake to no more than 1 oz of ethanol (1/2 oz for women and lighter weight people) per day.
- Engage in aerobic exercise for 30 minutes most days of the week (5 to 6).
- Stop smoking.
- Use stress management techniques such as relaxation therapy.

DIET Dietary approaches to managing hypertension focus on reducing sodium intake, maintaining adequate potassium and calcium intakes, and reducing total and saturated fat intake. A mild to moderate sodium restriction (no added salt) lowers blood pressure and potentiates the effect of antihypertensive drugs for most hypertensive clients. The DASH (Dietary Approaches to Stop Hypertension) diet has proven beneficial effects in lowering blood pressure. This diet (Box 35–3) focuses on whole foods rather than individual nutrients. It is rich in fruits and vegetables (up to 10 servings per day), and low in total and saturated fats.

Weight loss is recommended for clients who are obese. Loss of as little as 10 pounds (4.5 kg) reduces blood pressure in many people (NHLBI, 2004b). A balanced diet such as the DASH diet is recommended for weight loss.

PHYSICAL ACTIVITY Regular exercise (such as walking, cycling, jogging, or swimming) reduces blood pressure and contributes to weight loss, stress reduction, and feelings of overall

MEDICATION ADMINISTRATION Antihypertensive Drugs

ALPHA-ADRENERGIC BLOCKERS
Doxazosin (Cardura)
Prazosin (Minipress)
Terazosin (Hytrin)

Alpha-adrenergic blocking agents block alpha-receptors in vascular smooth muscle, decreasing vasomotor tone and vasoconstriction. They also reduce serum levels of low-density lipoproteins (LDL) and very low-density lipoproteins (VLDL). However, vasodilation may cause orthostatic hypotension and reflex stimulation of the heart, resulting in tachycardia and palpitations. A beta-blocker may be ordered to minimize this effect.

Nursing Responsibilities

- Give the first dose at bedtime to minimize risk of fainting (called “first-dose syncope”). If the first dose is given in the daytime (or if the dose is increased), instruct to remain in bed for 3 to 4 hours.
- Assess blood pressure and apical pulse before each dose and as indicated thereafter.

Health Education for the Client and Family

- There is a risk of fainting after taking the first dose of this drug. Take the drug at bedtime to reduce this risk, and do not drive or engage in other hazardous activities for 12 to 24 hours after the first dose.
- This drug may cause dizziness or light-headedness. Change positions slowly, and sit down if you become dizzy or light-headed.
- Notify your primary care provider if you develop nasal congestion or impotence while taking this drug.
- Notify your primary care provider before discontinuing this medication.

ANGIOTENSIN-CONVERTING ENZYME (ACE) INHIBITORS
Benazepril (Lotensin)
Captopril (Capoten)
Enalapril (Vasotec)
Fosinopril (Monopril)
Lisinopril (Prinivil, Zestril)
Moexipril (Univasc)
Perindopril (Aceon)
Quinapril (Accupril)
Ramipril (Altace)
Trandolapril (Mavik)
ANGIOTENSIN II RECEPTOR BLOCKERS (ARBs)
Candesartan (Atacand)
Eprosartan (Teveten)
Irbesartan (Avapro)
Losartan (Cozaar)
Olmesartan (Benicar)
Telmisartan (Micardis)
Valsartan (Diovan)

The ACE inhibitors lower blood pressure by preventing conversion of angiotensin I to angiotensin II. This in turn prevents vasoconstriction and sodium and water retention. ARBs have the same effect, but they act by blocking the effect of angiotensin II on receptors. Both ACE inhibitors and ARBs are less effective in black clients and are contraindicated in pregnancy (Lehne, 2004). Their primary adverse effects are persistent cough, first-dose hypotension, and hyperkalemia.

Nursing Responsibilities

- Assess blood pressure and WBC before giving the first dose. Monitor blood pressure for 2 hours after the first dose and regularly thereafter.
- Administer PO 1 hour before meals; tablets may be crushed.
- Report changes in WBC or differential, hyperkalemia, or changes in BUN or serum creatinine to the primary care provider.

- Do not administer to clients with renal artery stenosis or who are pregnant.
- Immediately report and treat manifestations of angioedema (giant wheals and edema of the tongue, glottis, and pharynx). Initiate resuscitation measures as needed. Discontinue drug immediately and do not use in the future.

Health Education for the Client and Family

- Report peripheral edema, signs of infection, or difficulty breathing to your primary care provider.
- Change position (lying to sitting and sitting to standing) slowly to prevent dizziness; sit down if dizziness or light-headedness develops.
- Do not take a potassium supplement or use a potassium-based salt substitute while taking this drug unless prescribed by your physician.
- Notify your physician if you become pregnant while taking this drug. Although it is safe early in pregnancy, taking the drug during the second and third trimesters may harm the fetus.

BETA-ADRENERGIC BLOCKING AGENTS
Acebutolol (Sectral)
Atenolol (Tenormin)
Betaxolol (Kerlone)
Bisoprolol (Zebeta)
Metoprolol tartrate (Lopressor)
Combined with an alpha-blocker:
Carvedilol (Coreg)
Nadolol (Corgard)
Penbutolol (Levotal)
Pindolol (Visken)
Propranolol (Inderal)
Timolol (Blocadren)
Labetalol (Normodyne)

Beta-adrenergic blockers are commonly used to control hypertension. Beta-blockers reduce blood pressure by preventing beta-receptor stimulation in the heart, thereby decreasing heart rate and cardiac output. Beta-blockers also interfere with renin release by the kidneys, decreasing the effects of angiotensin and aldosterone. Potential adverse effects of beta-blockers include bronchospasm, fatigue, sleep disturbances, nightmares, bradycardia, heart block, worsening of heart failure, gastrointestinal disturbances, impotence, and increased triglyceride levels.

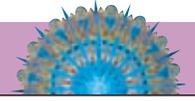
Nursing Responsibilities

- Before giving initial dose, assess for contraindications to beta-blockers such as asthma, chronic lung disease, bradycardia, or heart block.
- Assess blood pressure and apical pulse before giving; notify primary care provider if vital signs are outside established parameters.
- Report adverse effects such as bradycardia, decreased cardiac output (fatigue, dyspnea with exertion, hypotension, decreased level of consciousness), heart failure, heart block, bronchoconstriction (wheezing, dyspnea), or altered blood glucose levels (in diabetic clients).
- Carefully monitor responses of the older client.

Health Education for the Client and Family

- Monitor blood pressure and pulse daily as instructed.
- Change position (lying to sitting and sitting to standing) slowly to prevent dizziness and possible falls.
- Report effects such as fatigue, lethargy, and impotence to your primary care provider.
- Notify your physician if you become short of breath or develop a cough or swelling of your extremities.

(continued)



MEDICATION ADMINISTRATION Antihypertensive Drugs (continued)

- If you have diabetes, check blood glucose levels more frequently because hypoglycemia may develop with few symptoms.
- Talk to your primary care provider before taking any over-the-counter medications.
- Carry an adequate supply of the drug when traveling. Do not stop taking this drug without notifying your primary care provider.

CALCIUM CHANNEL BLOCKERS

Amlodipine (Norvasc)	Nicardipine (Cardene)
Diltiazem (Cardizem)	Nifedipine (Procardia)
Felodipine (Plendil)	Nisoldipine (Sular)
Isradipine (DynaCirc)	Verapamil (Isoptin)

Calcium channel blockers inhibit the flow of calcium ions across the cell membrane of vascular tissue and cardiac cells. In doing so, they relax arterial smooth muscle, lowering peripheral resistance through vasodilation. Calcium channel blockers can cause reflex tachycardia, and some (e.g., verapamil and diltiazem) may impair cardiac function, worsening heart failure.

Nursing Responsibilities

- Assess blood pressure, apical pulse, and liver and renal function tests prior to giving these drugs.
- Calcium channel blockers may be given orally or intravenously.
- Do not administer verapamil or diltiazem to clients with severe hypotension, sinus, or atrioventricular blocks. Administer with caution to clients also taking digoxin or a beta-blocker.
- Periodically monitor blood pressure and apical pulse during therapy. Promptly report signs of bradycardia, AV block, or heart failure to the physician.

Health Education for the Client and Family

- Take blood pressure and pulse daily as taught. Notify your physician if your pulse is less than 60 bpm or your blood pressure is not within the specified range.
- This drug may cause constipation. Drink six to eight glasses of water each day, and increase fiber in diet.
- Report shortness of breath, weight gain, or swelling in feet or ankles to your primary care provider.

CENTRALLY ACTING SYMPATHOLYTICS

Clonidine (Catapres)	Methyldopa (Aldomet)
Guanfacine (Tenex)	Reserpine (generic)

The centrally acting sympatholytics stimulate the α_2 -receptors in the CNS to suppress sympathetic outflow to the heart and blood vessels. A fall in cardiac output and vasodilation result, reducing blood pressure. Dry mouth and sedation are common adverse effects. Severe reflex hypertension may occur if abruptly discontinued. Clonidine is contraindicated during pregnancy; methyldopa is contraindicated for clients with active liver disease.

Nursing Responsibilities

- Assess for contraindications to therapy. Obtain baseline blood pressure, CBC, Coombs' test, and liver function studies.
- Administer oral doses at bedtime to minimize effects of sedation.
- Methyldopa may be given intravenously for hypertensive emergencies.

- Apply transdermal clonidine patch to dry, hairless area of intact skin on the chest or upper arm. Assess for rash, which indicates allergy, at area of application.
- Promptly report changes in laboratory values to the physician. Discontinue methyldopa if manifestations of liver dysfunction develop.

Health Education for the Client and Family

- Relieve dry mouth by sipping water or chewing sugarless gum.
- Take with meals if gastric upset or nausea develop.
- Change position (lying to sitting and sitting to standing) slowly to prevent dizziness and possible falls.
- Do not suddenly discontinue medication or skip doses; this could cause serious hypertension.
- Report mental depression or decreased mental acuity to your healthcare provider.
- Side effects (such as dry mouth, nausea, and dizziness) tend to diminish over time.
- Do not drive a car if the medications cause drowsiness.

VASODILATORS

Hydralazine (Apresoline)	Minoxidil (Loniten)
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Vasodilators reduce blood pressure by relaxing vascular smooth muscle (especially in the arterioles), and decreasing peripheral vascular resistance. These drugs are often prescribed in combination with a diuretic or beta-blocker, because they can cause reflex tachycardia and fluid retention. Because these drugs can have significant toxic effects, they are not routinely used to manage chronic hypertension.

Nursing Responsibilities

- Hydralazine may be given orally or intravenously; minoxidil is given orally.
- Assess blood pressure and pulse before giving the drug and monitor during therapy as indicated. Report tachycardia or hypotension to the physician.
- Report peripheral edema and manifestations of volume overload and heart failure.
- Immediately report muffled heart sounds or paradoxical pulse because pericardial effusion and possible cardiac tamponade may develop during minoxidil therapy.
- Discontinue hydralazine and report manifestations of a systemic lupus erythematosus (SLE) like syndrome: muscle or joint pain, fever, or symptoms of nephritis or pericarditis.

Health Education for the Client and Family

- Change position (lying to sitting and sitting to standing) slowly to prevent dizziness and possible falls.
- Report muscle, joint aches, and fever to your healthcare provider.
- Headache, palpitations, and rapid pulse may develop but should abate in about 10 days.
- Do not discontinue the medication without talking to your healthcare provider.
- Minoxidil may cause excessive hair growth. Contact your physician if this becomes troublesome.

are widely used. In major clinical studies, treatment with a single diuretic controlled blood pressure in about 50% of the clients and reduced hypertension-linked morbidity and mortality related to coronary heart disease. Diuretics control hypertension primarily by preventing tubular reabsorption of sodium, thus promoting sodium and water excretion and reducing blood volume. Thiazide diuretics also reduce systemic vascular resistance through an unknown mechanism. Diuretics are particularly effective in blacks and in clients who are obese, older, or who have increased plasma volume or low renin activity. The adverse effects of diuretics generally are dose related. In addition to hypokalemia, diuretics may affect serum levels of glucose, triglycerides, uric acid, LDLs, and insulin. More information about diuretics can be found in Chapters 10 and 29 ∞.

Clients with heart failure, coronary heart disease (CHD), or diabetes may initially be treated with a beta-blocker. These drugs lower blood pressure, apparently by reducing peripheral vascular resistance. They may also reduce the amount of renin released by the kidneys by blocking beta₁-receptors in the kidney. Beta-blockers reduce the risk of complications such as heart failure and stroke. They are, however, relatively contraindicated for clients with asthma or chronic obstructive pulmonary disease, because they promote bronchial constriction.

ACE inhibitors and ARBs also are commonly used in initial treatment of hypertension, particularly for clients who are diabetic or who have heart failure, a history of myocardial infarction (MI), or chronic kidney disease. ACE inhibitors block formation of angiotensin II by inhibiting the action of angiotensin-converting enzyme. Angiotensin II is a potent vasoconstrictor that also stimulates aldosterone release from the adrenal gland; blocking its action prevents vasoconstriction and sodium and water retention resulting from aldosterone release. ARBs have a very similar effect, although their action is to block angiotensin II receptors, thus preventing its vasoconstrictive and volume expansion effects.

Several drug classes work through their ability to promote vasodilation and reduce peripheral vascular resistance. Alpha-blockers such as prazosin and terazosin block stimulation of alpha₁-receptors on arterioles and veins, preventing vasoconstriction. Because of their ability to dilate both arterioles and veins, alpha-blockers can cause significant orthostatic hypotension, particularly following the initial dose. Calcium channel blockers promote dilation of arterioles, the primary regulators of peripheral vascular resistance. These drugs can cause reflex tachycardia. Some calcium channel blockers, verapamil and diltiazem in particular, also suppress heart function, reducing stroke volume and cardiac output. Reflex tachycardia is minimal with these calcium channel blockers. Direct-acting vasodilators such as hydralazine and minoxidil also directly affect the arterioles, reducing peripheral vascular resistance. These drugs have little effect on veins, so the risk of orthostatic hypotension is minimal. They are, however, associated with reflex tachycardia and fluid retention, so rarely are administered as in single-drug treatment regimens.

Other factors considered in selecting drugs for treating hypertension include demographic characteristics of the client, concurrent conditions, quality of life, cost, and possible interac-

tions among prescribed drugs. In general, diuretics and calcium channel blockers are more effective for treating hypertension in blacks than beta-blockers or ACE inhibitors. Beta-blockers are preferred to treat hypertension with concurrent coronary heart disease and angina, but are contraindicated for clients who have asthma or depression. Beta-blockers also reduce exercise tolerance and may adversely affect lifestyle for some clients.

DRUG REGIMENS Treatment usually is initiated using a single antihypertensive drug at a low dose. Unless otherwise indicated, a diuretic is recommended as the initial drug of choice. The dose is slowly increased until optimal blood pressure control is achieved. If the drug does not effectively lower the blood pressure or has troubling side effects, a different drug from another class of antihypertensive medications is substituted. If, on the other hand, the drug is tolerated well but has not lowered blood pressure to the desired level, a second drug from another class may be added to the treatment regimen.

Treatment of clients with stage 2 hypertension generally is more aggressive to minimize the risk of MI, heart failure, or stroke. When the average blood pressure is greater than 200/120, immediate therapy, and possible hospitalization, is vital.

After a year of effective hypertension control, an effort may be made to reduce the dosage and number of drugs. This is known as step-down therapy. It is more successful in clients who have made lifestyle modifications. Careful blood pressure monitoring is necessary during and after step-down therapy, because the blood pressure often rises again to hypertensive levels.

Complementary Therapies

Behavioral and mind-body therapies may be helpful for some clients in lowering blood pressure (see the Nursing Research box on page 1164). The blood pressure increases in response to physiologic and psychologic stress and anxiety. Mind-body therapies such as yoga and t'ai chi, meditation, and guided imagery are designed to modify both physiologic and cognitive aspects of the stress response. In a study of older African American men and women with moderate hypertension, transcendental meditation was shown to reduce the blood pressure. Eastern exercises such as yoga and t'ai chi, which often combine imagery, meditation, and physical exercise, have been shown to reduce sympathetic nervous system activity, blood pressure, and heart and respiratory rates (Spencer & Jacobs, 2003). A nursing research study of hypertensive clients in Thailand demonstrated the effectiveness of yoga to reduce blood pressure, heart rate, and body mass index (McCaffrey et al., 2005).



NURSING CARE

Health Promotion

Health promotion teaching and activities focus on the modifiable risk factors for hypertension. Advise all clients (as well as children and adolescents) to stop or never start smoking. Discuss the risks of obesity, excess alcohol intake, and a sedentary lifestyle with clients. Encourage all clients to eat a diet rich in fruits and vegetables and low in total and saturated fat. Discuss the potential benefits of following the DASH diet or a similar



NURSING RESEARCH

Evidence-Based Practice: The Client with Primary Hypertension

Standard therapies for hypertension include lifestyle changes and medications. Clients often are advised to reduce stress levels in their lives, but rarely are provided with the tools to do so. A study by Yucha and colleagues (2005) sought to identify those clients who were most likely to benefit (reduced blood pressure in both clinic and ambulatory settings) from biofeedback-assisted relaxation training. Participants, all of whom had stage 1 or 2 hypertension, received 8 weeks of relaxation training with biofeedback provided by measurements of finger temperature, muscle tension, and respiratory sinus arrhythmia. The most benefit (greatest reduction in BP) occurred in participants who were not taking antihypertensive medication, had lower starting finger temperatures, had less daytime blood pressure variation, and who had a more external health locus of control.

IMPLICATIONS FOR NURSING

Predicting which clients would benefit from biofeedback-assisted relaxation training to lower blood pressure could potentially reduce the risk that these clients will go on to develop stage 1 or 2 hypertension. While biofeedback-assisted relaxation training is expensive and may not be covered by insurance, its benefits in reducing the overall costs of treating hypertension and its potential consequences are significant.

Nurses are in a position to identify clients with prehypertension through blood pressure screening. It is very appropriate to suggest mind–body therapies such as relaxation training with biofeedback to these clients, most of whom do not require medication.

CRITICAL THINKING IN CLIENT CARE

1. This study found that clients who were not taking antihypertensive medications were more likely to benefit from training in biofeedback-assisted relaxation. Think about the different ways in which antihypertensive medications work. Why do you think more benefit was seen in those clients who were not taking drugs?
2. Another finding of the study showed more benefit in clients with a more external health locus of control. Compare characteristics of clients with an internal health locus of control and those with an external health locus. What differences in these clients might account for this finding?
3. While you are discussing lifestyle modifications and the use of mind–body therapies with a client with prehypertension, he tells you that he thinks all this is nonsense. How would you respond?

eating plan. Advise all clients to remain active and engage in aerobic exercise 5 or more days a week. Discuss the stress-reducing benefits of exercise.

Offer blood pressure screening, and refer clients for follow-up as indicated (Table 35–2).

Assessment

Focused assessment of the client with hypertension includes:

- **Health history:** Complaints of morning headache, cervical pain; cardiovascular or central nervous system manifestations; history of hypertension, renal disease, diabetes; family history of high blood pressure, heart failure, or kidney disease; current medications.
- **Physical examination:** Vital signs including blood pressure in both arms, apical and peripheral pulses; ophthalmologic exam of retinal fundus as appropriate.
- **Diagnostic tests:** Serum electrolytes, glucose, and creatinine; cholesterol and lipoprotein profile; urinalysis.

Nursing Diagnoses and Interventions

All clients with primary hypertension and their families need significant teaching to manage this chronic condition. Health maintenance is a high-priority problem. Depending on the stage of hypertension and concurrent illnesses, other appropriate nursing diagnoses may include *Imbalanced Nutrition, Fluid Volume Excess*, and *Risk for Noncompliance*.

Ineffective Health Maintenance

Unhealthy lifestyle and behaviors can contribute to health problems such as hypertension. When hypertension has been identified, knowledge of the disease and its management is vital for the client. Willingness to take responsibility for hypertension management is central to effective blood pressure control. Adopting healthy lifestyle changes enhances drug therapy; in some cases, the need for medications may be eliminated or reduced. Because hypertension is often an asymptomatic disease and many antihypertensive drugs have unpleasant side effects, it

TABLE 35–2 Recommended Blood Pressure Follow-Up

CATEGORY	BLOOD PRESSURE (mmHG)	RECOMMENDED FOLLOW-UP
Normal	<120/80	Recheck in 2 years.
Prehypertension	120–139/80–89	Recheck in 1 year.
Stage 1 hypertension	140–159/90–99	Confirm within 2 months.
Stage 2 hypertension	≥160/≥100	Evaluate or refer to care provider within 1 month; for higher pressures (e.g., ≥180/≥110), evaluate or refer to care provider immediately or within 1 week as indicated.

is vital that the client understand the chronic progressive nature of the disease and its long-term consequences.

- Assist with identifying current behaviors that contribute to hypertension. *The client must first identify contributory behaviors before he or she can change them. Using knowledge of hypertension risk factors, the nurse can help identify behaviors and factors contributing to hypertension that can be changed. Including the family in this process is important to reduce potential sabotage of the client's efforts to adopt healthier behaviors.*
- Assist in developing a realistic health maintenance plan. *Preparing a health maintenance plan for the client does little to encourage personal responsibility for health. However, nurses can guide clients in developing realistic goals and expectations for the treatment plan and modifying risk factors such as smoking, exercise, diet, and stress.*
- Help the client and family identify strengths and weaknesses in maintaining health. *Discussing areas of the health maintenance plan that are working well and those that present difficulties can help to identify necessary changes in the plan and additional strategies for implementing it.*

Risk for Noncompliance

Noncompliance, or failure to follow the identified treatment plan, is a continuing risk for any client with a chronic disease. Recommended lifestyle changes such as diet, exercise, restricted alcohol intake, stress reduction, and smoking cessation often are difficult to maintain on a continuing basis. In addition, prescribed medications may have undesirable effects whereas hypertension itself often has no symptoms or noticeable effects.

- Inquire about reasons for noncompliance with recommended treatment plan. Listen openly and without judging. *Non-threatening discussion of factors contributing to noncompliance validates the client's self-esteem and partnership in the treatment plan.*

PRACTICE ALERT

Assess factors contributing to noncompliance, such as adverse drug effects. Suggest measures to manage adverse effects or, if indicated, contact the primary care provider about possible alternative drugs. Some adverse effects of antihypertensive drugs, such as gastric upset, light-headedness, or nocturia, may be easily managed by changing the timing of the drug dose. Others, such as fatigue, decreased exercise tolerance, or impotence may interfere with lifestyle and life roles to the extent that the client finds them intolerable.

- Evaluate knowledge of hypertension, its long-term effects, and treatment. Provide additional information and reinforce teaching as needed. *Knowledge increases the sense of control, which also increases the likelihood of compliance with treatment.*
- Assist to develop realistic short-term goals for lifestyle changes. *Attempting to lose weight, exercise daily, stop smoking, and dramatically change the diet all at the same time may be overwhelming, leading to a sense of failure. Smaller, gradual changes are more easily incorporated into lifestyle and daily activities, improving compliance.*

PRACTICE ALERT

Work with the client to develop mutual outcomes for the treatment plan. Discuss measures to improve compliance. The client has absolute control over compliance with the treatment plan. Demonstrating respect and involving the client in decision making and planning can improve compliance.

- Help the client identify cues and develop reminders (e.g., written notes, a medication box filled weekly) to assist with maintaining a schedule for exercise and medications. *Cues and other devices provide helpful reminders of activities and schedules until they are incorporated into habits.*
- Reassure the client that relapse into old habits and behaviors is common. Encourage avoiding feelings of guilt associated with relapse, and use the circumstance to renew efforts to comply with treatment. *Guilt and feelings of failure can lead to further noncompliance unless the event is used to identify reasons for noncompliance and ways to prevent it from recurring in the future.*

Imbalanced Nutrition: More than Body Requirements

The relationship between obesity, excess alcohol intake, and hypertension is well documented. Hypertension is particularly associated with central obesity, identified by waist circumference greater than hip circumference. Although weight loss is difficult and takes commitment to changing eating and exercise habits, it is possible for most clients to achieve.

- Assess usual daily food intake, and discuss possible contributing factors to excess weight, such as sedentary lifestyle, or using food as a reward or stress reliever. Inquire about diversionary activities, exercise patterns, and previous weight reduction efforts (e.g., participation in weight reduction programs or using fad or crash diets). *Assessment data provide clues about contributing factors to obesity, the client's knowledge base about the relationship between eating and exercise habits and weight, and safe weight loss strategies. This provides direction for further teaching and for developing a realistic weight reduction plan.*
- Mutually determine with the client a realistic target weight (e.g., loss of 10% of current body weight over a 6-month period). Regularly monitor weight. Encourage a system of non-food rewards for achieving small, incremental goals. *Setting weight loss goals helps formalize the process and provides motivation for continued progress. Developing realistic goals may be difficult; unrealistic goals, however, set the client up for failure. Continuous incremental weight loss provides reassurance that it can be achieved and promotes permanent weight reduction.*
- Refer to a dietitian for information about low-fat, low-calorie foods and eating plans. Focus on changing eating habits as opposed to "following a diet." *Focusing on changing eating habits promotes the sense that low-fat, low-calorie eating patterns should become a part of lifestyle rather than a short-term measure to be endured until the weight loss goal is achieved.*

- Recommend participating in an approved weight loss program such as Weight Watchers, Overeaters Anonymous, or Take off Pounds Sensibly (TOPS). *Organized weight loss programs provide structure for a balanced weight reduction program, as well as mutual support from others trying to lose weight.*

Excess Fluid Volume

Excess fluid volume often contributes to hypertension by increasing the cardiac output. A number of factors associated with hypertension can cause excess fluid volume, including sodium retention and disruption of the renin–angiotensin–aldosterone system. In addition, some antihypertensive drugs, such as calcium channel blockers and vasodilators, can contribute to excess fluid in the interstitial spaces and peripheral edema.

PRACTICE ALERT

Monitor blood pressure and other vital signs as indicated: every 1 to 2 hours or more frequently during acute hypertensive states; once a week or more frequently during initial treatment in the community. Vital signs are an indicator of fluid balance and the effectiveness of treatment. An elevated blood pressure, pulse, and respiratory rate may indicate fluid retention, whereas orthostatic hypotension and tachycardia may indicate fluid volume deficit.

- Monitor intake and output, and weigh daily (if in an acute or long-term care facility) or weekly (in the community). *Rapid weight changes (over days) more accurately reflect fluid balance than intake and output records. One liter of fluid weighs 1 kg (2.2 lb). Weight changes and intake and output records help monitor the effects of therapy.*
- Monitor for peripheral edema (sacral edema in the bedridden client). *Drugs such as vasodilators can cause fluid accumulation in interstitial tissues, leading to peripheral or dependent edema. Adding a diuretic to the treatment plan may be necessary.*
- Refer to a dietitian for teaching about a restricted sodium diet. Discuss the relationship between sodium intake and fluid retention. Provide opportunities to choose low-sodium foods from simulated menus. Support efforts, and reassure that lifestyle changes such as consuming less sodium take time. *Knowledge provides the power to take control of sodium intake. Patience and perseverance are needed to succeed; positive reinforcement of efforts to change long-standing dietary patterns is important.*

PRACTICE ALERT

Monitor laboratory values, such as blood urea nitrogen (BUN), urine specific gravity, creatinine, electrolytes, and hematocrit and hemoglobin. Hypertension can alter renal perfusion and function, leading to fluid retention and altered laboratory values. Changes in BUN and creatinine indicate impaired renal function, whereas changes in hematocrit and hemoglobin often reflect changes in fluid volume.

- Discuss the importance of adhering to treatment plans such as dietary restrictions and medication schedules. *Understanding the rationale for treatment measures promotes the client's sense of control and encourages compliance with the treatment regimen.*

Using NANDA, NIC, and NOC

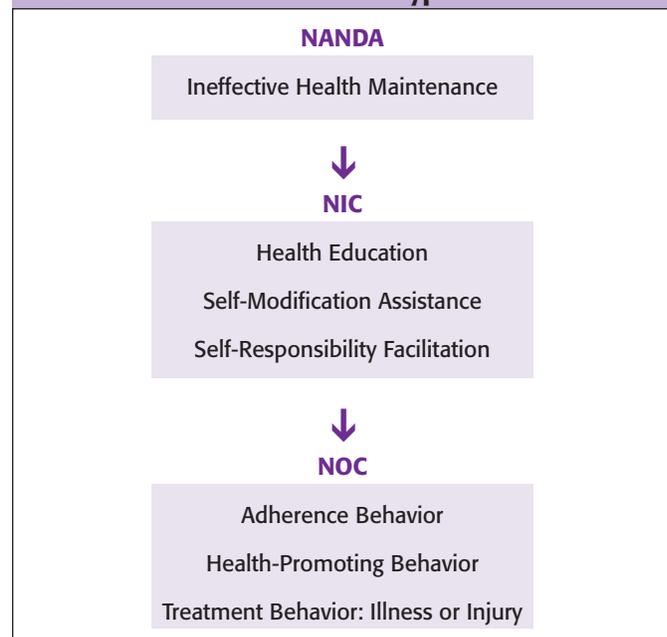
See Chart 35–1 for linkages between NANDA nursing diagnoses, nursing interventions, and nursing outcomes for the client with hypertension.

Community-Based Care

Effective control of hypertension requires the client to not only participate in the plan of care, but also to take an active role in managing the disease. Treatment is managed in community settings, with regular visits to a clinic or office to monitor blood pressure and effects of treatment measures. Include the following topics when teaching the client and family about hypertension:

- Specific lifestyle changes recommended for the client and suggestions for implementing them. For example:
 - Increase activity gradually. Develop a realistic exercise program that is enjoyable and fits into lifestyle. Identify an exercise buddy for additional motivation. Activity and exercise, through a gradual conditioning of muscles and blood vessels, lower blood pressure by reducing peripheral vascular resistance. As the heart becomes conditioned and pumps more efficiently, kidney perfusion improves and intravascular volume falls, further reducing blood pressure. Exercise also reduces stress and contributes to weight loss and maintenance. Aerobic exercise, such as walking, jogging, swimming, and cycling, are appropriate; isometric activities (such as weight lifting) should be avoided without physician approval.

NANDA, NIC, AND NOC LINKAGES CHART 35–1 The Client with Hypertension



Data from NANDA's *Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA International (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bulechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC)* (3rd ed.) by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.

- Adopt healthy eating patterns, following a low-fat, low-cholesterol, moderate sodium diet that also is rich in fruits and vegetables and includes at least two servings of low-fat milk or milk products daily. Do not give up if you slip into old eating habits on occasion; use such occasions to identify ways to avoid future lapses.
- Stop smoking. Participating in organized smoking cessation programs or using aids such as nicotine patches can help.
- Use alcohol in moderation if at all, consuming no more than 1.5 oz of hard liquor, 5 to 10 oz of wine, or 12 to 20 oz of beer per day.
- Use stress-reducing techniques such as meditation, relaxation, deep breathing, and exercise to manage stress. Anger and hostility intensify vasoconstriction; channeling these emotions into more positive responses such as using a change process to modify factors that provoke these emotions can reduce their harmful effects on blood pressure.
- Prescribed medications, their intended effect, dose and timing, interactions, and possible adverse effects. Discuss effects that should be reported to the physician, and those that can be managed by the client or that will diminish over time.
- The importance of monitoring blood pressure and regular visits to the primary care provider or hypertension clinic to monitor treatment. During follow-up visits, assess the blood pressure and specific laboratory work (such as serum creatinine, BUN, and/or serum electrolytes) to evaluate the disease and the effects of antihypertensive medications.

Refer the client to community blood pressure clinics, and to home health services as needed for regular follow-up and reinforcement of teaching. Refer to a dietitian or to an organized weight loss program as indicated for further teaching and weight loss support. The Nursing Care Plan on page 1168 provides additional information about community-based care for the client with high blood pressure.

THE CLIENT WITH SECONDARY HYPERTENSION

Secondary hypertension is elevated blood pressure resulting from an identifiable underlying process. It accounts for only 5% to 10% of identified cases of hypertension. Kidney disease is the most common identifiable cause of high blood pressure in both adults and children (Copstead & Banasik, 2005). Other common identifiable causes of hypertension in adults include renovascular disease (reduced blood flow to the kidneys), disorders of the adrenal cortex, pheochromocytoma, coarctation of the aorta, and sleep apnea. The pathophysiology of selected causes of high blood pressure are summarized here:

- **Kidney disease.** Any disease that affects renal blood flow (e.g., renal artery stenosis) or renal function (e.g., glomerulonephritis, renal failure) can lead to hypertension. Disruption of the blood supply stimulates the renin–angiotensin–aldosterone system, with resulting vasoconstriction and sodium and water retention. Altered kidney function affects the elimination of water and electrolytes, leading to hypertension.
- **Coarctation of the aorta.** Coarctation of the aorta is narrowing of the aorta, usually just distal to the subclavian arteries.

Reduced renal and peripheral blood flow stimulates the renin–angiotensin–aldosterone system and local vasoconstrictive responses, raising the blood pressure. A marked difference between pressures in the upper and lower extremities is common, with weak pulses and poor capillary refill in the lower extremities.

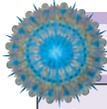
- **Endocrine disorders.** Adrenal gland disorders such as Cushing’s syndrome and primary aldosteronism can cause hypertension. A rare tumor of the adrenal medulla, *pheochromocytoma*, causes persistent or intermittent hypertension. Other endocrine disorders such as hyperthyroidism and pituitary disorders also can lead to hypertension.
- **Neurologic disorders.** Increased intracranial pressure causes an elevated blood pressure as the body attempts to maintain cerebral blood flow. Disorders that interfere with autonomic nervous system regulation (such as high spinal cord injury) may allow the sympathetic nervous system to predominate, increasing systemic vascular resistance and blood pressure.
- **Drug use.** Estrogen and oral contraceptive use may lead to hypertension, possibly by prompting sodium and water retention and affecting the renin–angiotensin–aldosterone system. Stimulant drugs, such as cocaine and methamphetamines, increase systemic vascular resistance and cardiac output, resulting in hypertension.
- **Pregnancy.** About 10% of all pregnant women are hypertensive. Hypertension may predate pregnancy or occur as a direct response to the pregnancy. The mechanism of pregnancy-induced hypertension (PIH) is unclear. It is a significant cause of maternal and fetal morbidity and mortality and requires careful perinatal management.

The pattern of secondary hypertension varies, depending on its cause. Pheochromocytoma may cause attacks of hypertension that last for minutes to hours, accompanied by anxiety, palpitations, diaphoresis, pallor, and nausea and vomiting. Primary aldosteronism may cause hypertension, weakness, paresthesias, polyuria, and nocturia (see Chapter 18 ∞). Symptoms of kidney disease accompany hypertension when a renal disorder is the cause.

The following diagnostic tests may be ordered to differentiate primary from secondary hypertension:

- **Renal function studies and urinalysis** to identify renal causes of hypertension. Elevated serum creatinine and BUN, reduced creatinine clearance, and hematuria, proteinuria, and casts often indicate kidney disease.
- **Serum potassium** is decreased in hyperaldosteronism.
- **Blood chemistries**, including serum electrolytes, glucose, and lipid studies, are done to detect abnormalities indicative of endocrine or cardiovascular disease.
- **Intravenous pyelography (IVP), renal ultrasonography, renal arteriography,** and **CT or MRI** may be done when secondary hypertension is suspected.

Interdisciplinary and nursing care for the client with secondary hypertension is the same as that for primary hypertension, discussed in the previous section. In addition, the underlying process is treated. See chapters covering specific disorders for more information about treatment measures.



NURSING CARE PLAN A Client with Hypertension

Margaret Spezia is a married, 49-year-old Italian American with eight children whose ages range from 3 to 18 years. For the past 2 months, Mrs. Spezia has had frequent morning headaches, and occasional dizziness and blurred vision. At her annual physical examination 1 month ago, her blood pressure was 168/104 and 156/94. She was instructed to reduce her fat and cholesterol intake, to avoid using salt at the table, and to start walking for 30 to 45 minutes daily. Mrs. Spezia returns to the clinic for follow-up.

ASSESSMENT

While escorting Mrs. Spezia to the exam room and obtaining her weight, blood pressure, and history, Lisa Christos, RN, notices that Mrs. Spezia seems restless and upset. Ms. Christos says, "You look upset about something. Is everything OK?" Mrs. Spezia responds, "Well, my head is throbbing, and I'm sort of dizzy. I think I'm just overdoing it and not getting enough rest. You know, raising eight children is a lot of work and expense. I just started working part time so we wouldn't get behind in our bills. I thought the extra money might relieve some of my stress, but I'm not so sure that's really happening. I'm not getting any better and I'm worried that I'll lose my job or become disabled and that my husband won't be able to manage the children by himself. I really need to go home, but first, I want to get rid of this awful headache. Would you please get me a couple of aspirin or something?"

Mrs. Spezia's history shows a steady weight gain during the past 18 years. She has no known family history of hypertension. Physical findings include height 63 inches (160 cm), weight 225 lb (102 kg), T 99°F (37.2°C), P 100 regular, R 16, BP 180/115 (lying), 170/110 (sitting), 165/105 (standing), average 10-point difference in readings between right and left arm (lower on left). Skin cool and dry, capillary refill 4 seconds right hand, 3 seconds left hand. Mrs. Spezia's total serum cholesterol is 245 mg/dL (normal <200 mg/dL). All other blood and urine studies are within normal limits. Based on analysis of the data, Mrs. Spezia is started on enalapril 5 mg and hydrochlorothiazide 12.5 mg in a combination drug (Vaseretic), and placed on a low-fat, low-cholesterol, no-added-salt diet.

DIAGNOSES

- *Fatigue* related to effects of hypertension and stresses of daily life
- *Imbalanced Nutrition: More than Body Requirements* related to excessive food intake
- *Ineffective Health Maintenance* related to inability to modify lifestyle
- *Deficient Knowledge* related to effects of prescribed treatment

EXPECTED OUTCOMES

- Reduce blood pressure readings to less than 150 systolic and 90 diastolic by return visit next week.
- Incorporate low-sodium and low-fat foods from a list provided into her diet.

- Develop a plan for regular exercise.
- Verbalize understanding of the effects of prescribed drug, dietary restrictions, exercise, and follow-up visits to help control hypertension.

PLANNING AND IMPLEMENTATION

- Teach to take own blood pressure daily and record it, bringing the record to scheduled clinic visits.
- Teach name, dose, action, and side effects of her antihypertensive medication.
- Instruct to walk for 15 minutes each day this week, and to investigate swimming classes at the local pool.
- Discuss strategies for achieving a realistic weight loss goal.
- Refer for a dietary consultation for further teaching about fat and sodium restrictions.
- Discuss stress-reducing techniques, helping identify possible choices.

EVALUATION

Mrs. Spezia returns to the clinic 1 week later. Her average blood pressure is now 148/88 mmHg. She has lost 1.5 lb, and states that her oldest daughter has suggested that they join a weight reduction program together. Mrs. Spezia is walking for an average of 20 minutes at a local mall each day. She verbalizes an understanding of her medication, and is taking it in the morning and before dinner each day. She met with the dietitian and discussed ways to reduce the sodium and fat in her diet. The dietitian provided a list of low-fat, low-sodium foods and recommended cookbooks to help Mrs. Spezia modify her cooking. Mrs. Spezia tells Ms. Christos, "I just can't believe how much better I feel already. My headaches are gone, and I've actually lost some weight—and I feel motivated to keep going. If I had only known how much better I could feel! I don't expect I'll ever go back to my old habits again; it's just not worth it!"

CRITICAL THINKING IN THE NURSING PROCESS

1. Identify the factors that contributed to Mrs. Spezia's hypertension. Which were modifiable and which were not?
2. What is the rationale for reducing sodium and fat in Mrs. Spezia's diet?
3. Suppose your hypertensive client is homeless and has no source of income. How could you help ensure your client would follow the treatment plan? What would you do if the client did not follow it?
4. Discuss the role of stress in hypertension. What factors in Mrs. Spezia's life contribute to her stress level?
5. Develop a plan of care for the nursing diagnosis *Low Self-Esteem* related to obesity.

See Evaluating Your Response in Appendix C.

THE CLIENT WITH HYPERTENSIVE CRISIS

Some clients with hypertension may, for reasons not clearly understood, develop rapid, significant elevations in systolic and/or diastolic pressures. In a *hypertensive emergency* (or *malignant hypertension*), the systolic pressure is greater than 180 mmHg

and the diastolic pressure higher than 120 mmHg. Immediate treatment (within 1 hour) is vital to prevent cardiac, renal, and vascular damage, and reduce morbidity and mortality. Intense cerebral artery spasms help protect the brain from excess pressure; however, cerebral edema often develops. Prolonged severe hypertension damages walls of the arterioles and renal blood

vessels, and may lead to intravascular coagulation and acute renal failure.

Clients presenting with a hypertensive emergency may have manifestations such as headache, confusion, swelling of the optic nerve (papilledema), blurred vision, restlessness, and motor and sensory deficits. Manifestations of hypertensive emergencies are listed in the accompanying box.

Most hypertensive emergencies occur when clients suddenly stop taking their medications or their hypertension is poorly controlled. Younger clients (30 to 50 years old), African American men, pregnant women with preeclampsia, and people with collagen and/or renal disease also are at higher risk for a hypertensive emergency (Porth, 2005).

The goal of care in hypertensive emergencies is to reduce the blood pressure by no more than 25% within minutes to 1 hour, then toward 160/100 within 2 to 6 hours. It is important to avoid rapid or excessive blood pressure decreases that may lead to renal, cerebral, or cardiac ischemia (NHLBI, 2004b). Blood pressure is monitored frequently (every 5 to 30 minutes)



MANIFESTATIONS of Hypertensive Emergencies

- Rapid onset
- Blurred vision, papilledema
- Systolic pressure > 180 mmHg
- Diastolic pressure > 120 mmHg
- Headache
- Confusion
- Motor and sensory deficits

during a hypertensive emergency. The BUN, serum creatinine, calcium, and total protein levels are carefully monitored to help determine the prognosis for recovery. Drug treatment for malignant hypertension includes parenteral administration of a rapidly acting antihypertensive, such as the potent vasodilator sodium nitroprusside (Nipride). Other medications that may be used are outlined in Table 35–3. Management also focuses on

TABLE 35–3 Intravenous Drugs Used to Treat Hypertensive Emergencies

CLASS/DRUG	ONSET	DURATION	NURSING IMPLICATIONS
Vasodilator			
Sodium nitroprusside (Nipride)	seconds	1 to 2 min	<ul style="list-style-type: none"> ■ Effective, easy to titrate ■ May cause nausea, vomiting, muscle twitching, sweating ■ Use with caution in increased intracranial pressure
Nitroglycerin	2 to 5 min	5 to 10 min	<ul style="list-style-type: none"> ■ Used when coronary ischemia accompanies hypertension ■ May cause headache, vomiting ■ Tolerance may develop with prolonged use
Diazoxide (Hyperstat)	1 to 2 min	4 to 24 h	<ul style="list-style-type: none"> ■ Avoided in clients with coronary artery disease ■ Used with beta-blockers and diuretics ■ Painful if it enters tissues
Fenoldopam (Corlopam)	<5 min	30 min	<ul style="list-style-type: none"> ■ Use with caution in clients with glaucoma ■ May cause tachycardia, headache, nausea, flushing ■ Do not use concurrently with beta-blockers ■ Monitor for heart failure, ischemic heart disease
Hydralazine (Apresoline)	10 to 30 min	2 to 6 h	<ul style="list-style-type: none"> ■ May be used for hypertension associated with eclampsia ■ Avoided in clients with CHD ■ May cause tachycardia, flushing, headache, vomiting, angina
Calcium Channel Blocker			
Nicardipine (Cardene)	5 to 10 min	15 to 30 min; up to 4 h	<ul style="list-style-type: none"> ■ Use with caution in CHD ■ Avoid in clients with heart failure ■ May cause tachycardia, headache, flushing, local phlebitis
ACE Inhibitor			
Enalaprilat (Vasotec)	15 to 30 min	6 to 12 h	<ul style="list-style-type: none"> ■ Monitor for hypotension ■ Used in acute left heart failure ■ Avoid in acute myocardial infarction
Adrenergic Blockers			
Labetalol (Trandate)	5 to 10 min	3 to 6 h	<ul style="list-style-type: none"> ■ Avoid in clients with acute heart failure and asthma ■ May cause nausea, vomiting, dizziness ■ Monitor for dyspnea, wheezing, heart block, orthostatic hypotension
Esmolol (Brevibloc)	1 to 2 min	10 to 30 min	<ul style="list-style-type: none"> ■ Avoided in clients with heart failure and asthma ■ May cause nausea ■ Monitor for hypotension, dyspnea, wheezing, heart failure, first-degree heart block
Phentolamine (Regitine)	1 to 2 min	10 to 30 min	<ul style="list-style-type: none"> ■ May cause tachycardia, flushing, headache

treating any underlying or coexisting heart, kidney, and CNS disorders.

Nursing care for the client with a hypertensive emergency focuses on continuous monitoring of the blood pressure and titrating drugs (administered by intravenous bolus or infusion) as ordered to achieve desired blood pressure. Avoiding excessive or very rapid blood pressure reductions is as important as achieving

the desired blood pressure readings. Reassure the client and family of the rapid effect of prescribed drugs. Provide psychologic and emotional support as needed. Maintain an attitude of confidence that the treatment will achieve the desired effect. Following resolution of the hypertensive crisis, review causes of the crisis. Teach the client and family measures to effectively manage hypertension and prevent future hypertensive emergencies.

DISORDERS OF THE AORTA AND ITS BRANCHES

The aorta and its branches may be affected by occlusions, aneurysms, and inflammations. These disorders may be chronic or acute and life threatening (e.g., a thoracic dissection). This section focuses on aneurysms of the aorta and its branches.

THE CLIENT WITH AN ANEURYSM

An **aneurysm** is an abnormal dilation of a blood vessel, commonly at a site of a weakness or tear in the vessel wall. Aneurysms commonly affect the aorta and peripheral arteries, because of the high pressure in these vessels. An aneurysm also may develop in the ventricular wall, usually affecting the left ventricle. Most arterial aneurysms are caused by arteriosclerosis or atherosclerosis; trauma also may lead to aneurysm formation.

Arterial aneurysms are most common in men over age 50, most of whom are asymptomatic at the time of diagnosis. Hypertension is a major contributing factor in the development of some types of aortic aneurysms.

FAST FACTS

- The incidence of aortic aneurysm is an estimated 5.9 per 100,000 persons per year.
- Aortic dissection affects an estimated 5 to 30 per 1 million people per year.
- Although aortic aneurysm and aortic dissection can occur concurrently, this is rare (Wung & Aouizerat, 2004).

Pathophysiology and Manifestations

Aneurysms form due to weakness of the arterial wall. The major structural proteins of the aorta are collagen and elastin. Collagen provides tensile strength of the vessel, preventing excessive dilation. Elastin allows vessel recoil, during which the vessel returns to its original size following systole. This recoil provides continued propulsion of the bolus of blood expelled from the ventricle. Elastin is a primary component of internal elastic lamina, which separates the intimal and medial layers of the aorta, and of the media, the smooth muscle layer of the aorta. Destruction of elastin can lead to abnormal dilation of the vessel; collagen destruction can allow the vessel to rupture (Wung & Aouizerat, 2004).

True aneurysms are caused by slow weakening of the arterial wall due to the long-term, eroding effects of atherosclerosis and hypertension. True aneurysms affect all three layers of the vessel wall, and most are fusiform and circumferential. *Fusiform aneurysms* are spindle shaped and taper at both ends. *Circumferential aneurysms* involve the entire diameter

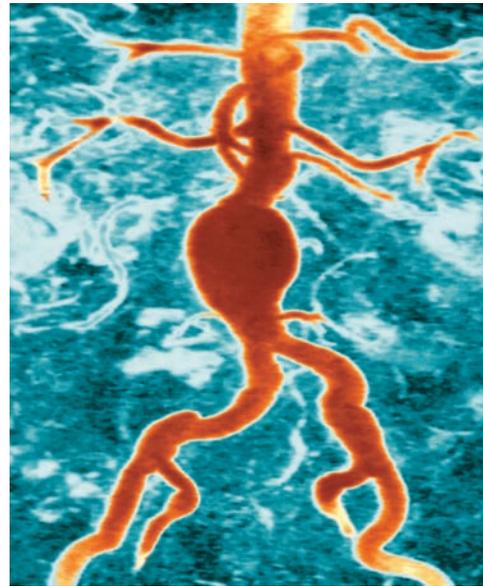


Figure 35–4 ■ A magnetic resonance angiogram (MRA) showing a circumferential aneurysm of the lower abdominal aorta.

Source: Zephyr, Photo Researchers, Inc.

of the vessel (Figure 35–4 ■). They generally grow slowly but progressively. Their length and diameter vary considerably among clients. A large fusiform aneurysm may affect most of the ascending aorta as well as a large portion of the abdominal aorta.

False aneurysms, also known as traumatic aneurysms, are caused by a traumatic break in the vessel wall rather than weakening of the vessel. They often are *saccular*, shaped like small outpouchings (sacs) on a portion of the vessel wall (Figure 35–5 ■). A *berry aneurysm* is a type of saccular aneurysm. They are often small (less than 2 cm in diameter), caused by congenital weakness in the tunica media of the artery. Berry aneurysms are commonly found in the circle of Willis in the brain.

Dissecting aneurysms are unique, developing when a break or tear in the tunica intima and media allows blood to invade or *dissect* the layers of the vessel wall. The blood usually is contained by the adventitia, forming a saccular or longitudinal aneurysm).

Aneurysms affect different segments of the aorta and its branches. Their manifestations generally are due to pressure of the aneurysm on adjacent structures. Table 35–4 summarizes the manifestations and complications of various types of aortic aneurysms.



Figure 35-5 ■ An angiogram showing a sacular (berry) aneurysm in the carotid artery of a 50-year-old man.

Source: Simon Fraser/RNC, Newcastle, Photo Researchers, Inc.

Thoracic Aortic Aneurysms

Thoracic aortic aneurysms account for about 10% of aortic aneurysms, with an annual incidence of about 6 per 100,000 people (Klein, 2005). See Figure 35-6 ■. They usually result from weakening of the aortic wall by arteriosclerosis and hypertension (Tierney et al., 2005). Other causes include trauma, coarctation of the aorta, tertiary syphilis, fungal infections, and Marfan syndrome. The syphilis spirochete can invade and weaken aortic smooth muscle, causing an aneurysm to develop as long as 20 years after the primary infection. Marfan syndrome fragments elastic fibers of the aortic media, weakening the vessel wall. The box on page 1172 discusses genetic links associated with thoracic aortic aneurysms.

Thoracic aneurysms frequently are asymptomatic. When present, manifestations are caused by the effects of the aneurysm on blood flow (e.g., to the coronary arteries and

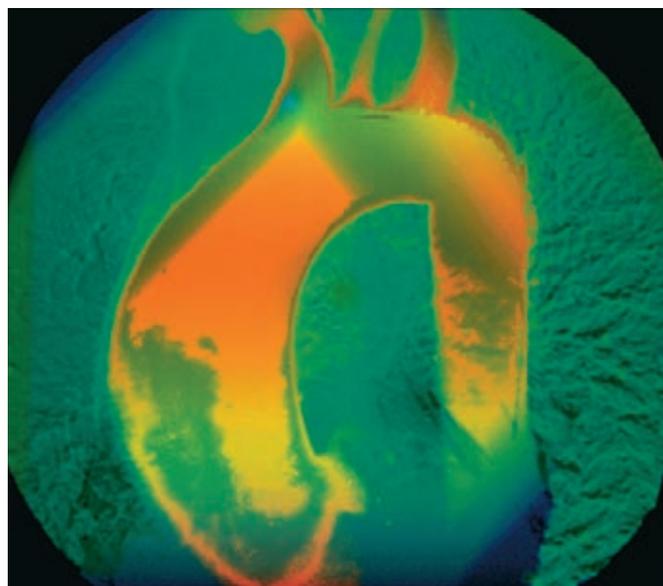


Figure 35-6 ■ An angiogram showing a large aneurysm of the ascending aorta and aortic arch.

great vessels of the head and upper body) and pressure placed by distended aorta on surrounding structures. Consequently, manifestations vary by the location, size, and growth rate of the aneurysm. Substernal, neck, or back pain may occur. Pressure on the trachea, esophagus, laryngeal nerve, or superior vena cava may cause dyspnea, stridor, cough, difficult or painful swallowing, hoarseness, edema of the face and neck, and distended neck veins.

Aneurysms of the ascending aorta typically cause angina due to disruption of blood flow into the coronary arteries. Heart failure may develop as a result of disruption of the aortic valve and

TABLE 35-4 Manifestations and Complications of Aortic Aneurysms

TYPE OR LOCATION	MANIFESTATIONS	COMPLICATIONS
Thoracic	<ul style="list-style-type: none"> ■ May be asymptomatic ■ Back, neck, or substernal pain ■ Dyspnea, stridor, or brassy cough if pressing on trachea ■ Hoarseness and dysphagia if pressing on esophagus or laryngeal nerve ■ Edema of the face and neck ■ Distended neck veins 	<ul style="list-style-type: none"> ■ Rupture and hemorrhage
Abdominal	<ul style="list-style-type: none"> ■ Pulsating abdominal mass ■ Aortic calcification noted on x-ray ■ Mild to severe midabdominal or lumbar back pain ■ Cool, cyanotic extremities if iliac arteries are involved ■ Claudication (ischemic pain with exercise, relieved by rest) 	<ul style="list-style-type: none"> ■ Peripheral emboli to lower extremities ■ Rupture and hemorrhage
Aortic dissection	<ul style="list-style-type: none"> ■ Abrupt, severe, ripping or tearing pain in area of aneurysm ■ Mild or marked hypertension early ■ Weak or absent pulses and blood pressure in upper extremities ■ Syncope 	<ul style="list-style-type: none"> ■ Hemorrhage ■ Renal failure ■ MI, heart failure, cardiac tamponade ■ Sepsis ■ Weakness or paralysis of lower extremities



GENETIC CONSIDERATIONS

Thoracic Aortic Aneurysms

About 20% of clients with aortic aneurysms have a family history of the disorder.

A condition known as *cystic medial necrosis* is prevalent in clients with Marfan syndrome and Ehlers-Danlos syndrome, inherited disorders involving connective tissues. In cystic medial necrosis, collagen and elastic fibers of the tunica media of the aorta degenerate. This loss of collagen and elastic tissues weakens the wall of the proximal aorta, leading to circumferential dilation of the ascending aorta and development of a fusiform aneurysm. In many other clients with thoracic aortic aneurysm (up to 20%), genetic syndromes affecting collagen and elastin are not recognized, but a strong family history of the disorder is present (Wung & Aouizerat, 2004).

regurgitation of blood back into the left ventricle. Aneurysms of the aortic arch often cause dysphagia, dyspnea, hoarseness, confusion, and dizziness (due to disrupted cerebral blood flow). Thrombi that form within a thoracic aneurysm can embolize, causing a stroke, renal or mesenteric ischemia, or ischemia of the lower extremities (Klein, 2005). Aneurysms of the thoracic aorta tend to enlarge progressively and may rupture, causing death.

Abdominal Aortic Aneurysms

Abdominal aortic aneurysms are associated with arteriosclerosis and hypertension. Increasing age and smoking are believed to contribute as well. Most abdominal aortic aneurysms are found in adults over age 70. The vast majority (over 90%) develop below the renal arteries, usually where the abdominal aorta branches to form the iliac arteries (see Figure 35–4).

Most abdominal aneurysms are asymptomatic, but a pulsating mass in the mid and upper abdomen and a bruit over the mass are found on exam. When pain is present, it may be constant or intermittent, usually felt in the midabdominal region or lower back. Its intensity may range from mild discomfort to severe pain. Pain intensity often correlates with the size and severity of the aneurysm. Severe pain may indicate impending rupture.

Sluggish blood flow within the aneurysm may cause thrombi (blood clots) to form. These can become emboli (circulating clots), traveling to the lower extremities and occluding peripheral arteries. The aneurysm may also rupture, with hemorrhage and hypovolemic shock. The risk of rupture increases as the size of the aneurysm increases; 20% to 40% of aneurysms more than 5 cm in diameter rupture. After acute rupture, the mortality rate is greater than 50%, even when emergency surgery is performed (Kasper et al., 2005).

Popliteal and Femoral Aneurysms

Most popliteal and femoral aneurysms are due to arteriosclerosis. They are often bilateral and usually affect men.

Popliteal aneurysms may be asymptomatic (Figure 35–7 ■). Manifestations, if any, are due to decreased blood flow to the lower extremity and include **intermittent claudication** (cramping or pain in the leg muscles brought on by exercise and relieved by rest), rest pain, and numbness. A pulsating mass may be palpable in the popliteal fossa (behind the knee). Thrombo-

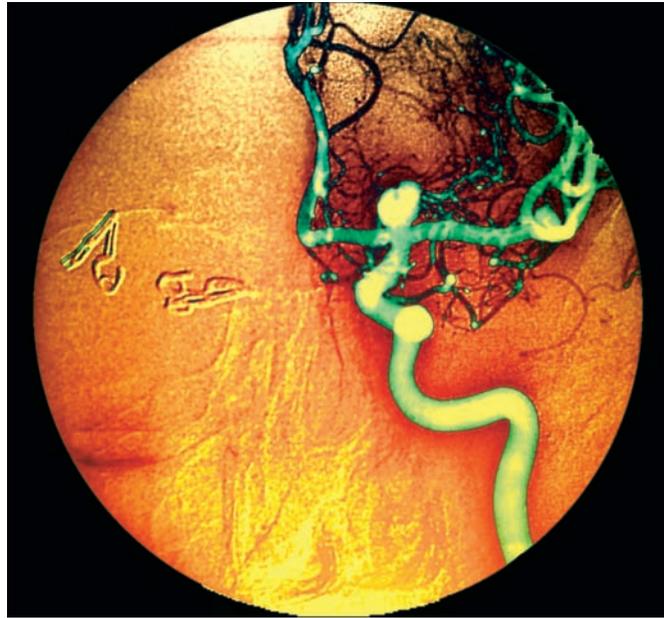


Figure 35–7 ■ An angiogram showing several popliteal aneurysms.
Source: Zephyr, Photo Researchers, Inc.

sis and embolism are complications; gangrene may result, often necessitating amputation.

A *femoral aneurysm* usually is detected as a pulsating mass in the femoral area. The manifestations are similar to those of popliteal aneurysms, resulting from impaired blood flow. Femoral aneurysms may rupture.

Aortic Dissections

Dissection is a life-threatening emergency caused by a tear in the intima of the aorta with hemorrhage into the media. The hemorrhage dissects or splits the vessel wall, forming a blood-filled channel between its layers. Dissection can occur anywhere along the aorta. *Type A dissection* (also called *proximal dissection*) affects the ascending aorta; *type B dissection* (*distal dissection*) is limited to the descending aorta.

Hypertension is a major predisposing factor for aortic dissection, accounting for 70% of aortic dissections. Cystic medial necrosis (see the Genetic Considerations box above) also is a major risk factor. Other risk factors include male gender, advancing age, pregnancy, congenital defects of the aortic valve, coarctation of the aorta, and inflammatory aortitis (Kasper et al., 2005).

Dissection of the thoracic aortic walls progresses along the length of the vessel, moving both proximally and distally. As the aneurysm expands, pressure may prevent the aortic valve from closing or may occlude the branches of the aorta. Descending aortic dissection may extend into the renal, iliac, or femoral arteries.

The primary symptom of an aortic dissection is sudden, excruciating pain. The pain, often described as a ripping or tearing sensation, is usually over the area of dissection. Thoracic dissections cause chest or back pain. Other symptoms may include syncope, dyspnea, and weakness. The blood pressure may initially be increased, but rapidly falls and is often inaudi-

ble as the dissection occludes blood flow. Peripheral pulses are absent for the same reason.

Complications develop if major arteries are affected. Obstruction of the carotid artery causes neurologic symptoms such as weakness or paralysis. The myocardium, kidneys, or bowel may become ischemic or infarct if blood flow to the coronary arteries, renal arteries, or mesenteric artery is affected. Acute aortic regurgitation may develop with dissection of the ascending aorta. With treatment, the long-term prognosis is generally good, although the in-hospital mortality rate following surgery is 15% to 20% (Kasper et al., 2005).

INTERDISCIPLINARY CARE



Most aneurysms are asymptomatic, detected through a routine physical examination. Treatment depends on the size of the aneurysm. Small, asymptomatic aneurysms may not be treated or are medically managed; large aneurysms (>5 cm) at risk for rupture require surgery.

Diagnosis

Diagnostic studies done to establish the diagnosis and determine the size and location of the aneurysm may include:

- *Chest x-ray* to visualize thoracic aortic aneurysms.
- *Abdominal ultrasonography* to diagnose abdominal aortic aneurysms.
- *Transesophageal echocardiography* to identify the specific location and extent of a thoracic aneurysm and to visualize a dissecting aneurysm.
- *Contrast-enhanced CT or MRI* allows precise measurements of aneurysm size.
- *Angiography* uses contrast solution injected into the aorta or involved vessel to visualize the precise size and location of the aneurysm.

Medications

Thoracic aortic aneurysms may be treated with long-term beta-blocker therapy and additional antihypertensive drugs as needed to control heart rate and blood pressure.

Clients with aortic dissection are initially treated with intravenous beta-blockers such as propranolol (Inderal), metoprolol (Lopressor), or esmolol (Brevibloc) to reduce the heart rate to about 60 bpm. Sodium nitroprusside (Nipride) infusion is started concurrently to reduce the systolic pressure to 120 mmHg or less. Calcium channel blockers (verapamil and diltiazem) also may be used. Direct vasodilators such as diazoxide (Hyperstat) and hydralazine (Apresoline) are avoided because they may actually worsen the dissection (Kasper et al., 2005). Constant monitoring of vital signs, hemodynamic pressures (via Swan-Ganz catheter; see Chapter 32  for more information about hemodynamic pressure monitoring), and urine output are vital to ensure adequate perfusion of vital organs.

Following surgical correction of an aneurysm, anticoagulant therapy may be initiated. Heparin therapy is used initially, with conversion to oral anticoagulation prior to discharge. Many clients are maintained indefinitely on anticoagulant therapy; others may use lifelong, low-dose aspirin therapy to reduce the risk of clot formation.

Surgery

Operative repair of aortic aneurysms is indicated when the aneurysm is symptomatic or expanding rapidly. Thoracic aneurysms more than 6 cm in diameter are surgically repaired; asymptomatic abdominal aneurysms greater than 5 cm in diameter may be repaired, depending on the client's operative risk factors. Type A dissections are repaired as soon as feasible; type B dissections may be surgically repaired, depending on the extent of involvement and risk for rupture (Kasper et al., 2005).

Endovascular stent grafts (EVSgs) are increasingly being used to treat abdominal and thoracic aortic aneurysms. The use of EVSG to treat aortic dissections is in investigational stages. The stent, which consists of a metal sheath covered with polyester fabric or a woven polyester tube, usually is placed percutaneously via the femoral artery. Fluoroscopy is used to guide its placement. Both straight and bifurcated grafts are available. Endovascular stent placement results in a shorter hospital stay and lower treatment cost. EVSG is associated with fewer pulmonary, renal, and cardiovascular complications than open surgical aneurysm repair (Jones, 2005). This option generally is preferred for clients who have a high surgical risk. The most common complication of endovascular aneurysm repair is persistent perfusion of the aneurysm (*endoleak*) caused by an ineffective seal at the proximal or distal end of the graft (Way & Doherty, 2003). Regular follow-up with abdominal CT scans is necessary to detect this complication, which can develop at any time postoperatively. Because stent grafts are handcrafted to fit the individual, repeated CT scans with contrast media are required preoperatively, increasing the risk for kidney damage and renal failure. On rare occasions, the graft may be malpositioned or may migrate from the desired location (Jones, 2005).

An open surgical procedure in which the aneurysm is excised and replaced with a synthetic fabric graft is the standard treatment for expanding abdominal aortic aneurysms (Figure 35-8 ■). Although the aneurysm walls may be excised, they usually are left intact and used to cover the graft. Surgical repair of thoracic aneurysms is similar but more complex due to major vessels exiting at the aortic arch. Cardiopulmonary bypass is required if the ascending aorta is involved. The aortic valve also may be replaced during surgery. See the box on page 1174 for nursing care of the client having surgery of the aorta.



NURSING CARE

Assessment

Focused assessment for the client with a suspected aortic aneurysm includes:

- *Health history*: Complaints of chest, back, or abdominal pain; extremity weakness; shortness of breath, cough, difficult or painful swallowing, hoarseness; history of hypertension, coronary heart disease, heart failure, or peripheral vascular disease.
- *Physical examination*: Vital signs including blood pressure in upper and lower extremities; peripheral pulses; skin color

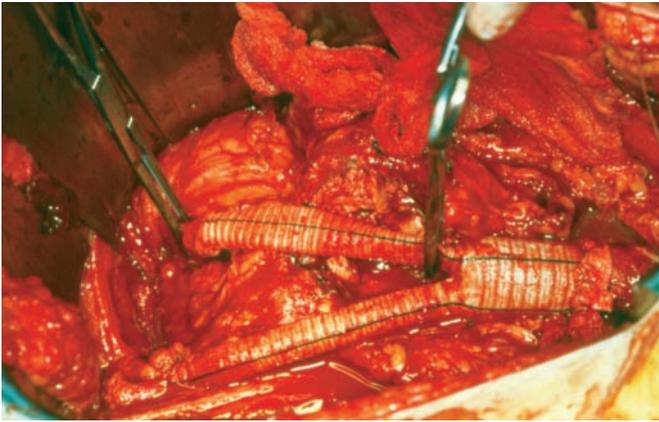


Figure 35-8 ■ Repair of an abdominal aortic aneurysm. The aorta is exposed and clamped between the renal and iliac arteries. Atherosclerotic plaque and thrombotic material are removed. A synthetic graft is used to replace the aneurysm. The aneurysm walls are then sutured around the graft.

Source: Stevie Grand, Photo Researchers, Inc.

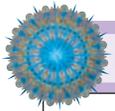
and temperature; neck veins; abdominal exam including gentle palpation for masses and auscultation for bruits; neurologic exam including level of consciousness (LOC), sensation, and movement of extremities.

Nursing Diagnoses and Interventions

Nursing care for clients with an aneurysm of the aorta or its branches focuses on monitoring and maintaining tissue perfusion, relieving pain, and reducing anxiety. Nursing care usually is acute, precipitated by a complication or surgical repair of the aneurysm.

Risk for Ineffective Tissue Perfusion

Clients with aortic aneurysms are at risk for impaired tissue perfusion due to aneurysm rupture with resulting hemorrhage and lack of blood flow to tissues distal to the rupture. In addition, thrombi often form within the aneurysm and may become emboli, obstructing distal arterial blood flow.



NURSING CARE OF THE CLIENT HAVING Surgery of the Aorta

PREOPERATIVE CARE

- As time permits, provide routine preoperative care and teaching as outlined in Chapter 4 ∞. *Clients having vascular surgery have similar preoperative nursing care needs to other clients having major abdominal or thoracic surgery. If emergent surgery is required, time for preoperative care and teaching may be limited.*
- Implement measures to reduce fear and anxiety:
 - a. Orient to the intensive care unit, if appropriate.
 - b. Describe and explain the reason for all equipment and tubes, such as cardiac monitors, ventilators, nasogastric tubes, urinary catheters, intravenous lines and fluids, and intra-arterial lines.
 - c. Explain what to expect following surgery (sights, sounds, frequency of taking vital signs, dressings, pain relief measures, communication strategies).
 - d. Allow time for questions and expression of fears and concerns.

These explanations provide a sense of control for the client and family.

- Monitor for and implement care to reduce the risk of aneurysm rupture (see the following section). *Clients with a rapidly expanding or symptomatic aneurysm are at risk for rupture prior to surgical repair.*

POSTOPERATIVE CARE

- Provide routine postoperative care and specific measures as ordered by the physician. *Clients undergoing aneurysm repair require nursing care similar to that provided to all clients with major thoracic or abdominal surgery, in addition to specific measures related to vascular surgery.*
- Maintain fluid replacement and blood or volume expanders as ordered. Promptly report changes in vital signs, level of consciousness, and urine output. *Hypovolemic shock may develop due to blood loss during surgery, third spacing, inadequate fluid replacement, and/or hemorrhage if graft separation or leakage occurs.*

PRACTICE ALERT

Monitor for and report manifestations of graft leakage:

- a. Ecchymoses of the scrotum, perineum, or penis; a new or expanding hematoma
- b. Increased abdominal girth
- c. Weak or absent peripheral pulses; tachycardia; hypotension
- d. Decreased motor function or sensation in the extremities
- e. Fall in hemoglobin and hematocrit
- f. Increasing abdominal, pelvic, back, or groin pain
- g. Decreasing urinary output (less than 30 mL/h)
- h. Decreasing CVP, pulmonary artery pressure, or pulmonary artery wedge pressure.

These manifestations may signal graft leakage and possible hemorrhage. Pain may be due to pressure from an expanding hematoma or bowel ischemia. Decreased renal perfusion causes the glomerular filtration rate and urine output to fall.

- Report manifestations of lower extremity embolism: pain and numbness in lower extremities, decreasing pulses, and pale, cool, or cyanotic skin. *Pulses may be absent for 4 to 12 hours postoperatively due to vasospasm; however, absent pulses with pain, changes in sensation, and a pale, cool extremity are indicative of arterial occlusion.*
- Report manifestations of bowel ischemia or gangrene: abdominal pain and distention, occult or fresh blood in stools, and diarrhea. *Bowel ischemia may result from an embolism or occur as a complication of surgery.*
- Report manifestations of impaired renal function: urine output less than 30 mL/h, fixed specific gravity, increasing BUN and serum creatinine levels. *Hypovolemia or clamping of the aorta during surgery may impair renal perfusion, leading to acute renal failure.*
- Report manifestations of spinal cord ischemia: lower extremity weakness or paraplegia. *Impaired spinal cord perfusion may lead to ischemia and impaired function.*

PRACTICE ALERT

Immediately report manifestations of impending rupture, expansion, or dissection of the aneurysm: increased pain; discrepancy between upper and lower extremity blood pressures and peripheral pulses; increased mass size; change in LOC or motor or sensory function; laboratory results. Rapid expansion may indicate increased risk for rupture, with resulting hemorrhage, shock, and possible death. Elective or planned surgery may rapidly become emergency surgery to prevent complications.

- Implement interventions to reduce the risk of aneurysm rupture:
 - a. Maintain bed rest with legs flat.
 - b. Maintain a calm environment, implementing measures to reduce psychologic stress.
 - c. Prevent straining during defecation and instruct to avoid holding the breath while moving.
 - d. Administer beta-blockers and antihypertensives as prescribed.

Activity, stress, and the Valsalva maneuver increase blood pressure, increasing the risk of rupture. Elevating or crossing the legs restricts peripheral blood flow and increases pressure in the aorta or iliac arteries. Beta-blockers and antihypertensives often are ordered to reduce pressure in the dilated vessel.

PRACTICE ALERT

Report manifestations of arterial thrombosis or embolism: absent peripheral pulses; a pale or cyanotic, cool extremity; severe, diffuse abdominal pain with guarding; or increased groin, lumbar, or lower extremity pain. Sluggish blood flow within the aneurysm often causes thrombi to form. These thrombi can break loose, becoming emboli that can occlude peripheral arteries or arteries to the kidneys or mesentery. Arterial occlusion may necessitate emergency surgery to restore blood flow and prevent tissue infarct or gangrene.

- Continuously monitor cardiac rhythm. Report complaints of chest pain or changes in ECG tracing. Administer oxygen as indicated. *Aortic dissection and repair place the client at significant risk for MI, a major cause of postoperative mortality and morbidity (Kasper et al., 2005). Rapid identification and treatment of this complication can reduce the risk of death or long-term adverse effects of MI.*

PRACTICE ALERT

Immediately report changes in mental status or symptoms of peripheral neurologic impairment (weakness, paresthesias, paralysis). The expanding aneurysm or dissection can affect carotid and cerebral blood flow or spinal cord perfusion, leading to neurologic symptoms. Immediate restoration of blood flow is vital to prevent permanent neurologic deficits.

Risk for Injury

Potent antihypertensive drugs often are given intravenously to reduce the pressure on an expanding or dissecting aneurysm. Continuous monitoring of infusions and hemodynamic param-

eters such as arterial pressure, pulmonary pressures, and cardiac output is vital to ensure that adequate tissue perfusion is maintained during infusions of these potent drugs.

PRACTICE ALERT

Use an infusion control device for all drug infusions. These devices prevent accidental or inadvertent changes in the rate of the infusion and dose of the drug.

- Continuously monitor arterial pressure and hemodynamic parameters as indicated. Promptly report results outside the specified parameters to the physician. *Many of the drugs used are effective within minutes. Responses vary among individuals, particularly in the older adult, necessitating continuous monitoring.*
- Monitor urine output hourly. Report output less than 30 mL/h. *The kidneys are very sensitive to reduced perfusion pressure; inadequate renal blood flow can lead to acute renal failure.*

Anxiety

Clients with aortic aneurysms often are highly anxious because of the urgent nature of the disorder. The nurse must manage the anxiety levels of both the client and family members to effectively address physiologic care needs. Stress reduction also is necessary to help maintain the blood pressure within desired limits.

- Explain all procedures and treatments, using simple and understandable terms. *Simplified explanations are necessary when anxiety levels interfere with learning and understanding.*
- Respond to all questions honestly, using a calm, empathetic, but matter-of-fact manner. *Honesty with the client and family promotes trust and provides reassurance that the true nature of the situation is not being “hidden” from them.*
- Provide care in a calm, efficient manner. *Using a calm manner even during preparations for emergency surgery reassures the client and family that although the situation is critical, the staff is prepared to handle things effectively.*
- Spend as much time as possible with the client. Allow supportive family members to remain with the client when possible. *The presence of a health professional and supportive family member reassures the client that he or she is not alone in facing this crisis.*

Community-Based Care

Topics to discuss when preparing clients and their families for home care or care in a community-based setting depend on the treatment plan. Discuss the following topics when surgical repair is not immediately planned and the aneurysm will be monitored:

- Measures to control hypertension, including lifestyle and prescribed drugs
- The benefits of smoking cessation
- Manifestations of increasing aneurysm size or complications to report to the physician.

Following surgery, discuss the following topics in preparing the client and family for home care:

- Wound care and preventing infection; manifestations of impaired healing or infection to be reported
- Prescribed antihypertensive and anticoagulant medications and their expected and unintended effects

- The importance of adequate rest and nutrition for healing
- Measures to prevent constipation and straining at stool (such as increasing fluid and fiber in the diet)
- The importance of avoiding prolonged sitting, lifting heavy objects, engaging in strenuous exercise, and having sexual intercourse until approved by the physician (usually 6 to 12 weeks)

- Signs and symptoms of complications to report to the physician.

Provide referrals to a home health agency or community health service as necessary. Referrals are especially important for older adults and their caregivers, who may require additional assistance with the complex care needs.

DISORDERS OF THE PERIPHERAL ARTERIES

Disorders that impair peripheral arterial blood flow may be *acute* (e.g., arterial thrombosis) or *chronic* (e.g., peripheral arteriosclerosis). Chronic occlusive disorders may be due to structural defects of the arterial walls or spasm of affected arteries. Impaired peripheral arterial circulation limits the availability of oxygen and nutrients to the tissues, and can have significant adverse effects. This section focuses on acute and chronic disorders affecting peripheral arteries. The nurse's role in caring for clients with peripheral arterial disorders focuses on maintaining tissue perfusion and educating the client and family about the disorder and its management.

Physiology Review

Peripheral arteries are the part of the systemic circulation that delivers oxygen and nutrients to the skin and the extremities. Arterial walls have three layers: the intima, which includes the endothelium and a layer of connective tissue and the basement membrane; the media, composed of smooth muscle and elastic fibers; and the adventitia, a thin layer of connective tissue that contains collagen and elastic fibers. The smooth muscle of peripheral arteries controls blood flow as it contracts and relaxes. Contraction narrows the vessel lumen (**vasoconstriction**), whereas smooth muscle relaxation expands the vessel (**vasodilation**). Peripheral arteries become progressively smaller; arterioles are less than 0.5 mm in diameter and are composed primarily of smooth muscle. The arterioles control blood flow through the capillary beds where gas, nutrient, and waste product exchange occurs. Capillary walls are very thin, consisting of a single layer of endothelial cells surrounded by a thin basement membrane.

Blood flows from an area of higher pressure to an area of lower pressure. *Resistance* opposes blood flow. Resistance is created by friction of the blood itself, although the primary determinants of vascular resistance are the diameter and length of the blood vessel. See the physiology review section earlier in this chapter under “Disorders of Blood Pressure Regulation” for more information about factors that determine vessel resistance.

THE CLIENT WITH PERIPHERAL VASCULAR DISEASE

Arteriosclerosis is the most common chronic arterial disorder, characterized by thickening, loss of elasticity, and calcification of arterial walls. **Atherosclerosis** is a form of arteriosclerosis in which deposits of fat and fibrin obstruct and harden the arteries. In the peripheral circulation, these pathologic changes impair the blood supply to peripheral tissues, particularly the lower extremities. This is known as **peripheral vascular disease (PVD)** or peripheral artery disease (PAD).

Incidence and Risk Factors

PVD usually affects people in their 60s and 70s; men are more often affected than women. Deaths attributed to peripheral arterial disease are about the same for black and white males, but are higher among black women than white women (NHLBI, 2004a).

Risk factors for PVD are similar to those for atherosclerosis and CHD (see Chapter 30 ∞). Diabetes mellitus, hypercholesterolemia, hypertension, cigarette smoking, and high homocystine levels are risk factors for PVD (Kasper et al., 2005).

FAST FACTS

- PVD is a common manifestation of atherosclerosis, particularly in older men.
- PVD interferes with arterial blood flow to the lower extremities, increasing the risk for neuropathy and paresthesias, ulcers that do not heal, necrosis, gangrene, and amputation.
- Regular daily exercise is a primary intervention for all types of peripheral arterial disease to promote development of collateral circulation and maintain tissue perfusion.

Pathophysiology

The pathophysiology of atherosclerosis is detailed in Chapter 31 ∞. Atherosclerotic lesions involve both the intima and the media of the involved arteries. Lesions typically develop in large and midsize arteries, particularly the abdominal aorta and iliac arteries (30% of symptomatic clients), the femoral and popliteal arteries (80% to 90% of clients), and more distal arteries (40% to 50% of clients) (Kasper et al., 2005). Arteriosclerosis in the abdominal aorta leads to the development of aneurysms as plaque erodes the vessel wall.

Plaque tends to form at arterial bifurcations. The vessel lumen is progressively obstructed, decreasing blood flow to the lower extremities. Tissue hypoxia or anoxia results. With gradual obstruction of the vessel, collateral circulation often develops. However, it is usually not adequate to supply tissue needs, especially when metabolic demand increases (e.g., during exercise). Manifestations typically develop only when the vessel is occluded by 60% or more.

Manifestations and Complications

Pain is the primary symptom of peripheral atherosclerosis. **Intermittent claudication**, a cramping or aching pain in the calves of the legs, the thighs, and the buttocks that occurs with a predictable level of activity, is characteristic of PVD. The pain is often accompanied by weakness and is relieved by rest.

Rest pain, in contrast, occurs during periods of inactivity. It is often described as a burning sensation in the lower legs. Rest pain increases when the legs are elevated and decreases when the legs are dependent (e.g., hanging over the side of the bed). The legs also may feel cold or numb along with the pain. Sensation is diminished and the muscles may atrophy.

Peripheral pulses may be decreased or absent. A bruit may be heard over large affected arteries, such as the femoral artery and the abdominal aorta. The legs are pale when elevated, but often are dark red (*dependent rubor*) when dependent. The skin often is thin, shiny, and hairless, with discolored areas. Toenails may be thickened. Areas of skin breakdown and ulceration may be evident. Edema may develop with severe PVD. See the box below for manifestations of peripheral atherosclerosis.

Complications of peripheral atherosclerosis include gangrene and extremity amputation, rupture of abdominal aortic aneurysms, and possible infection and sepsis.

INTERDISCIPLINARY CARE



Management of peripheral vascular disease focuses on slowing the atherosclerotic process and maintaining tissue perfusion.

Diagnosis

Although PVD often can be diagnosed by the history and physical examination, diagnostic tests may be ordered to evaluate its extent. Noninvasive studies often are sufficient.

- *Segmental pressure measurements* use sphygmomanometer cuffs and a Doppler device to compare blood pressures between the upper and lower extremities (normally similar) and within different segments of the affected extremity. In PVD, the BP may be lower in the legs than in the arms.
- *Stress testing* using a treadmill provides functional assessment of limitations. In PVD, pressure at the ankle may decline even further with exercise, confirming the diagnosis. Evaluation for coronary heart disease may be done simultaneously during exercise testing (Kasper et al., 2005).
- *Doppler ultrasound* uses sound waves reflected off moving red blood cells within a vessel to evaluate blood flow. The impulses may be translated into an audible signal or a graphic waveform. With significant PVD, the waveform becomes progressively flatter as the transducer is moved distally along the affected vessel. Segmental pressures may be used to locate the site of obstruction.



MANIFESTATIONS of Peripheral Atherosclerosis

- Intermittent claudication
- Rest pain
- Paresthesias (numbness, decreased sensation)
- Diminished or absent peripheral pulses
- Pallor with extremity elevation, dependent rubor when dependent
- Thin, shiny, hairless skin; thickened toenails
- Areas of discoloration or skin breakdown

- *Duplex Doppler ultrasound* combines the audible or graphic Doppler ultrasound with ultrasound imaging to identify arterial or venous abnormalities. Ultrasonic imaging provides views of the affected vessel while Doppler ultrasound evaluates blood flow. *Color-flow Doppler ultrasound (CDU)* provides color images of the vessel and blood flow.
- *Transcutaneous oximetry* evaluates oxygenation of tissues.
- *Angiography* or *magnetic resonance angiography* is done before revascularization procedures to locate and evaluate the extent of arterial obstruction. For angiography, a contrast medium is injected and vessels are visualized using fluoroscopy and x-rays. MRA does not require injection of a contrast medium and may replace angiography.

See Chapter 33  for more information on diagnostic testing for PVD.

Medications

Drug treatment of peripheral atherosclerosis is less effective than with coronary heart disease. Medications to inhibit platelet aggregation, such as aspirin or clopidogrel (Plavix), are ordered to reduce the risk of arterial thrombosis. Cilostazol (Pletal), a platelet inhibitor with vasodilator properties, improves claudication. Pentoxifylline (Trental) decreases blood viscosity and increases red blood cell flexibility, increasing blood flow to the microcirculation and tissues of the extremities. Parenteral vasodilator prostaglandins may be given on a long-term basis to decrease pain and facilitate healing in clients with severe limb ischemia (Kasper et al., 2005).

Treatments

Smoking cessation is vital. Nicotine not only promotes atherosclerosis, but also causes vasospasm, further reducing blood flow to the extremities.

Meticulous foot care is vital to prevent ulceration and infection (Box 35-4). Elastic support hose, which reduce circulation to the skin, are avoided. Elevating the head of the bed on blocks may help relieve rest pain. Regular, progressively strenuous exercise, such as 30 to 45 minutes of walking daily, is important. The client is taught to rest at the onset of claudication, resuming activity when the pain resolves.

Other measures to slow the process of atherosclerosis, such as controlling diabetes and hypertension, lowering cholesterol levels, and weight loss, also are recommended (see Chapter 30 ). See the box on page 1178 for care of the older adult.

Revascularization

Revascularization may be performed if symptoms are progressive, severe, or disabling. Other indications for surgery include symptoms that significantly interfere with activities of daily living (ADLs), rest pain, and pregangrenous or gangrenous lesions. Either nonsurgical revascularization procedures or surgery may be performed.

Nonsurgical procedures include percutaneous transluminal angioplasty (PTA), stent placement, or atherectomy. Techniques may include balloon angioplasty to dilate the narrowed lumen, mechanical atherectomy to remove plaque, or laser or thermal angioplasty to vaporize the occluding material. In either case, a stent typically is placed at the time of PTA to maintain vessel

BOX 35–4 Foot Care for the Client with Peripheral Atherosclerosis

1. Keep legs and feet clean, dry, and comfortable.
 - Wash legs and feet daily in warm water, using mild soap.
 - Pat dry using a soft towel; be sure to dry between the toes.
 - Apply moisturizing cream to prevent drying.
 - Use powder on the feet and between the toes.
 - Buy shoes in the afternoon (when feet are largest); never buy shoes that are uncomfortable. Be sure toes have adequate room.
 - Wear a clean pair of cotton socks each day.
2. Prevent accidents and injuries to the feet.
 - Always wear shoes or slippers when getting out of bed.
 - Walk on level ground and avoid crowds, if possible.
 - Do not go barefoot.
3. Improve blood supply to the legs and feet.
 - Inspect legs and feet daily; use a mirror to examine backs of legs and bottoms of feet.
 - Have a professional foot care provider trim toenails and care for corns, calluses, ingrown toenails, or athlete's foot.
 - Always check the temperature of the water before stepping into the tub.
 - Do not get the legs or tops of the feet sunburned.
 - Report leg or foot problems (increased pain, cuts, bruises, blistering, redness, or open areas) to your healthcare provider.

patency. Iliac and femoral-popliteal PTA initially reestablish good blood flow and relieve symptoms in more than 80% of clients. While the 3-year success rate is lower, stent placement improves the duration of symptom relief (Kasper et al., 2005). See Chapter 31  for more information about revascularization procedures.

Surgical options include endarterectomy to remove occlusive plaque from the artery and bypass grafts. Knitted Dacron bypass grafts are commonly used. Both immediate and long-term graft patency is better with bypass grafting than with non-surgical revascularization procedures, but the risk for operative complications such as myocardial infarction, stroke, infection, and peripheral embolization is higher (Kasper et al., 2005). Nursing care for the client having revascularization surgery is similar to that provided for clients having an aortic aneurysm repair (see the box on page 1174).

Complementary Therapies

Complementary therapies for peripheral vascular disease include interventions to improve circulation and to reduce stress. A number of complementary therapies may improve peripheral circulation, including aromatherapy with rosemary or vetiver; biofeedback; healing or therapeutic touch and massage;

herbals such as ginkgo, garlic, cayenne, hawthorn, and bilberry; and exercise including yoga. Aromatherapy and yoga also may reduce stress, as can breathing exercises, meditation, and counseling. In addition, complementary therapies to reduce atherosclerosis and lower cholesterol levels may slow the progress of PVD. Measures such as a very low-fat or vegetarian diet, including antioxidant nutrients or using vitamin C, vitamin E, or garlic supplements, and traditional Chinese medicine may be useful.



NURSING CARE

Health Promotion

Discuss healthy lifestyle habits with community and religious groups, schoolchildren (grades K through 12), and through the print media to reduce the incidence and slow the progression of atherosclerosis.

Strongly encourage all clients to avoid smoking in the first place, and to stop all forms of tobacco use. Discuss the adverse effects of smoking and the benefits of quitting. Provide information about dietary recommendations to maintain a healthy weight and optimal cholesterol levels. Discuss the benefits and importance of regular exercise. Finally, encourage clients with cardiovascular risk factors to undergo regular screening for hypertension, diabetes, and hyperlipidemia.

Assessment

Focused assessment related to peripheral atherosclerosis includes the following:

- **Health history:** Complaints of pain, its relationship to exercise or rest, timing, associated symptoms, and relief measures; history of coronary heart disease, peripheral vascular disease, hyperlipidemia, hypertension, or diabetes; current medications; smoking history; usual diet and activity patterns.
- **Physical examination:** Vital signs; strength and equality of peripheral pulses of all extremities; capillary refill; skin color, temperature, hair distribution, presence of any discolorations or lesions; movement and sensation of lower extremities.

NURSING CARE OF THE OLDER ADULT

Peripheral Vascular Disease

With aging, blood vessels thicken and become less compliant. These changes reduce oxygen delivery to the tissues and impair carbon dioxide and waste product removal from the tissues. When normal effects of aging combine with an increased risk of atherosclerosis, the risk of peripheral vascular disease is high.

The older adult with peripheral vascular disease requires the same care and teaching as other clients. However, visual deficits and osteoarthritis may make foot care more difficult. Long-standing smoking habits are difficult to break. Mobility may be impaired by arthritis or the effects of neurologic disorders. The client who lives alone may resist walking. Periodic visits by a community or home health nurse may be helpful, as may be encouraging the client to join a support group for stopping smoking, changing eating habits, and taking part in regular activity.

Nursing Diagnoses and Interventions

Impaired tissue perfusion is an obvious problem in peripheral atherosclerosis. Acute and chronic pain may interfere with ADLs, and ambulation may be limited. The possibility of losing a lower extremity is frightening.

Ineffective Tissue Perfusion: Peripheral

Impaired blood flow to the lower extremities affects gas, nutrient, and waste product exchange between the capillaries and cells. Oxygen and nutrient deprivation impairs cell function and tissue integrity, causing pain and impaired healing. Pain develops with exercise and when extremities are elevated.

- Assess peripheral pulses, pain, color, temperature, and capillary refill every 4 hours and as needed. Use a Doppler device if pulses are not palpable. Mark pulse locations with an indelible marker. *Assessment data provide a baseline for evaluating the effectiveness of interventions and identifies changes in arterial blood flow.*
- Position with extremities dependent. *Gravity promotes arterial flow to the dependent extremity, increasing tissue perfusion and relieving pain.*

PRACTICE ALERT

Instruct to avoid smoking. If necessary, obtain an order for a nicotine patch or gum from the physician. Nicotine is a potent vasoconstrictor that further impairs arterial blood flow. Smoking cessation is a vital component of care. Nicotine patches and gum contain less nicotine than cigarettes, and can help reduce the stress of smoking cessation.

- Discuss the benefits of regular exercise. *Exercise promotes development of collateral circulation to ischemic tissues and slows the process of atherosclerosis.*
- Use a foot cradle and lightweight blankets, socks, and slippers to keep extremities warm. Avoid electric heating pads or hot water bottles. *Keeping extremities warm conserves heat, prevents vasospasm, and promotes arterial flow. External heating devices are avoided to reduce the risk of burns in the client with impaired sensation. The foot cradle protects tissues from compression by linens.*
- Encourage frequent position changes. Instruct to avoid crossing legs or using a pillow under the knees. *Position changes promote blood flow and reduce damage caused by pressure. Leg crossing and excessive flexion of the hip or knee joints can compress partially obstructed arteries and impair blood flow to distal tissues.*

Pain

Impaired blood flow results in tissue ischemia. Metabolism shifts from an efficient aerobic process to an anaerobic process. Lactic acid and metabolic waste products accumulate in tissues, causing pain. Severe and cramping pain generally occurs with exercise early in the disease. Rest initially produces relief, similar to the process of angina (see Chapter 31 ∞). As the disease progresses, pain develops with less exercise and often occurs even at rest. Rest pain disrupts sleep, the sense of well-being, and has significant disruptive effects on life roles.

- Assess pain at least every 4 hours, using a standard pain scale. *Pain is a subjective experience. Using a standard pain scale allows evaluation of treatment measures in relieving pain and restoring blood flow.*
- Keep extremities warm. *Cooling leads to vasoconstriction, increasing pain. Warming the extremities promotes vasodilation and improves arterial flow, reducing pain.*
- Teach pain relief and stress reduction techniques such as relaxation, meditation, and guided imagery. *Pain increases stress. The stress response leads to vasoconstriction, increasing pain. Stress reduction techniques, when combined with other measures to promote blood flow, can help reduce pain.*

Impaired Skin Integrity

Clients with PVD are at risk for impaired skin integrity as a result of oxygen and nutrient deprivation. Chronic tissue ischemia leads to dry, scaly, and atrophied skin. Pruritus can lead to scratching; minor injuries may go unnoticed due to impaired sensation. Impaired tissue healing can lead to ulceration, infection, and potential gangrene.

PRACTICE ALERT

Assess and document skin condition at least every 8 hours or with each home visit; more frequently as indicated. Tissue ischemia increases the risk for damage, even with minor trauma such as pressure from poorly fitting shoes or bed linens. Frequent inspection and documentation of skin condition is vital to identify early indicators of impaired skin integrity and reduce the risk of complications such as infection.

- Provide meticulous daily skin care, keeping the skin clean and dry. Apply a moisturizing cream to dry or scaly areas. *Intact skin is the body's first defense against bacterial invasion. Ischemic tissues of the injured extremity provide an excellent medium for microorganism growth. Clean, dry, supple skin decreases the risk of breakdown.*
- Apply a bed cradle. *The bed cradle suspends bed linens over the legs, preventing them from placing pressure on extremities and injured tissues. Minimizing pressure on the tissues promotes capillary blood flow.*
- Provide an egg-crate mattress, flotation pad, sheepskin, or heel protectors. *Ischemic tissues may be damaged by minor trauma such as that created by the shearing forces of skin against bed linens.*

Activity Intolerance

Pain and impaired perfusion of peripheral tissues may limit the client's ability to engage in desired activities, even impairing self-care.

- Assist with care activities as needed. *Severe claudication or rest pain may limit activities. Muscle atrophy of affected extremities is common, leading to fatigue and weakness.*
- Unless contraindicated, encourage gradual increases in duration and intensity of exercise. Teach to rest with extremities dependent when claudication develops, resuming activity after pain has abated. *Gradual increases in the duration and intensity of exercise promote development of collateral circulation,*

improve exercise tolerance, provide a sense of well-being, and support self-esteem.

- Provide diversional activities during periods of prescribed bed rest. Encourage relaxation techniques to reduce muscle tension. *Diversional activities help prevent boredom and stress associated with enforced rest. Relaxation techniques reduce vasoconstriction induced by stress, improving peripheral circulation.*
- Encourage frequent position changes and active range-of-motion exercises. Encourage self-care to the extent possible. *Position changes relieve pressure on tissues, improving capillary circulation and reducing tissue ischemia. Range-of-motion exercises help prevent muscle atrophy and joint contractures. Self-care supports self-esteem.*

Using NANDA, NIC, and NOC

Chart 35–2 shows links between NANDA nursing diagnoses, NIC, and NOC for the client with peripheral vascular disease.

Community-Based Care

Discuss the following topics when preparing the client and family for home and community-based care. See the accompanying Nursing Care Plan for additional community-based nursing interventions.

- Smoking cessation strategies and ways to avoid second-hand smoke

- Prescribed medications and anticoagulants, their purpose, doses, desired and adverse effects
- Signs of excess bleeding to report to the physician
- Skin surveillance and foot care (see Box 35–4)
- Recommended diet and exercise
- Weight loss strategies if appropriate.

If revascularization or surgery has been performed, include the following topics as appropriate:

- Incision care
- Manifestations of complications (e.g., infection, graft leakage, or thrombosis) to be reported to the physician
- Activity limitations.

Provide referrals to home health services, physical or occupational therapy, and home maintenance assistance services as indicated. Consider resources such as Meals-on-Wheels for clients who are severely limited by their disease.

THE CLIENT WITH THROMBOANGIITIS OBLITERANS

Thromboangiitis obliterans (also called *Buerger's disease*) is an occlusive vascular disease in which small and midsize peripheral arteries become inflamed and spastic, causing clots to form. This disease may affect either the upper or lower extremities; it often affects a leg or foot. Its exact etiology is unknown.

Incidence and Risk Factors

Thromboangiitis obliterans primarily affects men under age 40 who smoke. Cigarette smoking is the single most significant cause of the disease. The disease is more prevalent in Asians and people of Eastern European descent. The incidence of HLA-B5 and 2A9 antigens is higher in people with thromboangiitis obliterans, suggesting a genetic link.

Pathophysiology and Course

Inflammatory cells infiltrate the wall of small and midsize arteries in the feet and possibly the hands. This inflammatory process is accompanied by thrombus formation and vasospasms of arterial segments that impair blood flow. Adjacent veins and nerves also may be affected. As the disease progresses, affected vessels become scarred and fibrotic.

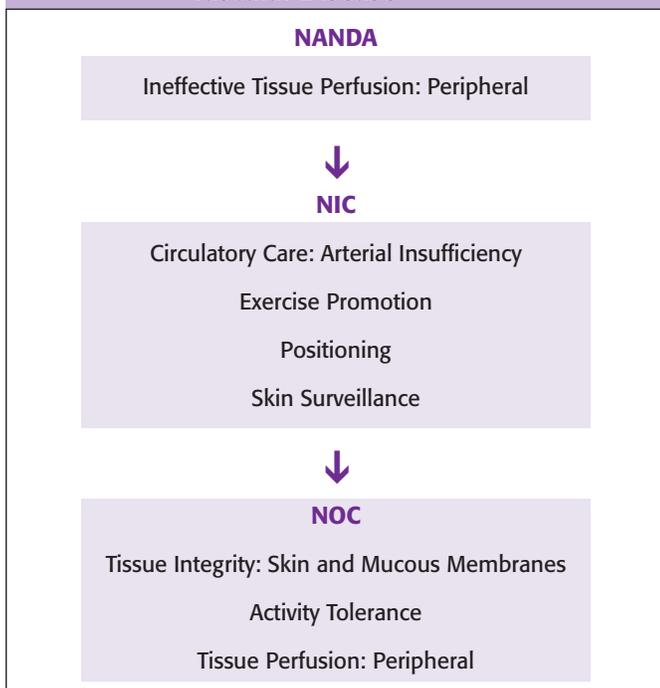
The course of the disease is intermittent with dramatic exacerbations and marked remissions. The disease may remain dormant for periods of weeks, months, or years. As the disease progresses, collateral vessels are more extensively involved. Consequently, subsequent episodes are more intense and prolonged. Prolonged periods of tissue hypoxia increase the risk for tissue ulceration and gangrene.

Manifestations and Complications

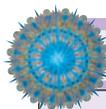
Pain in the affected extremities is the primary manifestation of thromboangiitis obliterans. Both claudication, cramping pain in calves and feet or the forearms and hands, and rest pain in

NANDA, NIC, AND NOC LINKAGES

CHART 35–2 The Client with Peripheral Vascular Disease



Data from *NANDA's Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA International (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bulechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC)* (3rd ed.) by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.



NURSING CARE PLAN A Client with Peripheral Vascular Disease

William Duffy, age 69, is retired. His wife convinces him to see his primary care provider for increasing leg pain with walking and other exercise.

ASSESSMENT

Katie Kotson, RN, obtains Mr. Duffy's history before he sees his physician. He states that he can only walk about a block before the pain in his calves gets so bad that he has to stop and rest. As a result, he has been less and less active, spending most of his time the past few months watching sports on television. He denies rest pain. He was diagnosed with type 2 diabetes about 15 years ago, which he manages with daily glyburide (DiaBeta), an oral hypoglycemic. He also has stable angina, for which he takes atenolol (Tenormin) and an occasional nitroglycerin tablet. His alcohol intake is moderate, averaging one to two beers per day, and he smokes about a pack of cigarettes per day. He states he tried to quit smoking after developing angina, but "after nearly 50 years of smoking, I think that's impossible!"

Physical exam findings include height 68 inches (173 cm), weight 235 lb (107 kg), BP 168/78, P 66, R 16, T 97.6°F (36.5°C); upper extremities warm and pink, normal hair distribution, pulses strong and equal; lower extremities below knees cool and ruddy when dependent, pale to pink when elevated, skin shiny, scant hair; posterior tibial pulses weak bilaterally; weak pedal pulse on R, unable to palpate on L; 1+ to 2+ edema both feet and ankles.

The physician finds that Mr. Duffy's systolic blood pressure in his legs is an average of 28 mmHg lower than in his arms. He makes the diagnosis of peripheral atherosclerosis, and schedules Mr. Duffy for an exercise stress test with ankle pressure measurements before and after exercise and a color-flow Doppler ultrasound. Mr. Duffy is to return in 3 weeks after these studies have been completed.

DIAGNOSES

- *Activity Intolerance* related to poor blood flow to lower extremities
- *Ineffective Health Maintenance* related to smoking and lack of information about disease management
- *Risk for Impaired Skin Integrity* related to ischemic tissues of legs and feet
- *Risk for Peripheral Neurovascular Dysfunction* related to impaired peripheral blood flow to lower extremities

EXPECTED OUTCOMES

- Walk for at least 15 minutes three to four times per day, gradually increasing his pace and duration of exercise.
- Relate the benefits of smoking cessation.
- Identify strategies to improve chances for success in stopping smoking.
- Meet with dietitian before next visit to discuss dietary measures to promote weight loss and slow atherosclerosis.

- Verbalize an understanding of appropriate foot care measures.
- Identify measures to prevent inadvertent injury of feet and legs.

PLANNING AND IMPLEMENTATION

- Teach about peripheral atherosclerosis and its relationship to Mr. Duffy's symptoms.
- With Mr. and Mrs. Duffy, plan strategies to start and maintain a program of regular exercise.
- Instruct to warm up slowly, and to stop exercise and rest for 3 minutes (or until pain is relieved) when claudication develops, then resume exercising.
- Discuss the effects of smoking on blood vessels.
- Help Mr. Duffy identify smoking cessation strategies such as support groups, clinics, and nicotine patches.
- Schedule an appointment with the dietitian to develop a low-calorie, low-fat, and low-cholesterol ADA diet that includes preferred foods and considers usual eating patterns.
- Reinforce and supplement previous foot care teaching.
- Discuss effects of impaired circulation on sensation in feet and legs and measures to prevent injury.

EVALUATION

When Mr. Duffy returns to the office 3 weeks later, his diagnosis has been confirmed by the diagnostic studies. The physician decides to continue conservative therapy, now prescribing atorvastatin (Lipitor) to lower Mr. Duffy's serum cholesterol level, and cilostazol (Pletal) to reduce the risk of thrombosis and improve symptoms of claudication. Mr. Duffy also asks his physician for a prescription for nicotine patches, saying he is ready to quit smoking, but thinks he needs help to be successful. Mr. and Mrs. Duffy tell Miss Kotson that they are walking before every meal and really enjoying being outside more. They plan to walk in the local shopping mall when the weather gets worse. Mrs. Duffy has bought an American Heart Association cookbook, and is carefully planning their meals. Both Mr. and Mrs. Duffy have lost 5 lb since the previous visit. Mr. Duffy's skin on his legs and feet remains intact, and he identifies the measures he is using to protect his lower extremities from injury.

CRITICAL THINKING IN THE NURSING PROCESS

1. What additional lifestyle changes related to peripheral atherosclerosis might be appropriate to suggest to Mr. Duffy at this time? Why?
2. Explain the relationship between physical exercise and pain in the client with peripheral atherosclerosis. Compare this relationship to that between exercise and angina.
3. Mr. Duffy uses a beta-blocker, atenolol, to prevent angina. Why is this drug not effective in preventing claudication?
4. Develop a nursing care plan for the nursing diagnosis *Imbalanced Nutrition: More than Body Requirements*.
See Evaluating Your Response in Appendix C.

the fingers and toes may occur. Sensation is diminished. Eventually, the skin becomes thin and shiny and the nails are thickened and malformed. On examination, the involved digits and/or extremities are pale, cyanotic, or ruddy, and cool or cold to touch. Distal pulses (e.g., the dorsalis pedis, posterior tibial,

ulnar, or radial) are either difficult to locate or absent, even with a Doppler device.

Painful ulcers and gangrene may develop in the fingers and toes as a result of severely impaired blood flow. Amputation may be necessary to remove necrotic tissue.

INTERDISCIPLINARY CARE



Thromboangiitis obliterans usually is diagnosed by the history and physical examination. Doppler studies may be used to locate and determine the extent of the disease. Angiography and magnetic resonance imaging may also be used to evaluate the extent of the disease, but usually are unnecessary.

The one most important component in managing this disease is smoking cessation. While stopping smoking does not cure the disease, it may slow its extension to other vessels. With continued smoking, attacks become increasingly intense and last much longer, significantly increasing the risk for ulcerations and gangrene.

Additional conservative measures are used to prevent vasoconstriction, improve peripheral blood flow, and prevent complications of chronic ischemia. These measures include keeping extremities warm, managing stress, keeping affected extremities in a dependent position, preventing injury to affected tissues, and regular exercise. Walking for 20 or more minutes several times a day is recommended.

There are no specific drugs for thromboangiitis obliterans. A calcium channel blocker such as diltiazem (Cardizem) or verapamil (Isoptin), or pentoxifylline (Trental), which decreases blood viscosity and increases red blood cell flexibility to improve peripheral blood flow, may provide some symptom relief.

Surgical approaches for thromboangiitis obliterans include sympathectomy or arterial bypass graft. Sympathectomy interrupts sympathetic nervous system input to affected vessels, reducing vasoconstriction and spasm. Arterial bypass grafts may be useful when larger vessels are affected by the disease. Amputation of an affected digit or extremity may be necessary if gangrene develops (see Chapter 41  for more information about amputation). Only portions of digits or of limbs (e.g., below the knee) are usually amputated, to preserve as much healthy tissue as possible.

The prognosis for thromboangiitis obliterans depends significantly on the client's ability and willingness to stop smoking. With smoking cessation and good foot care, the prognosis for saving the extremities is good, even though no cure is available.



NURSING CARE

Health promotion activities to prevent thromboangiitis obliterans focus on preventing smoking, especially in high-risk populations. Nursing assessment and care for clients with this disease are similar to those provided for clients with other arterial occlusive diseases. Nursing care focuses on promoting arterial circulation and preventing prolonged tissue hypoxia. Because inflammatory, spastic episodes may be unpredictable, care focuses on smoking cessation and relieving acute manifestations. In addition, postsurgical care is necessary if surgery has been performed. See the nursing care section for peripheral atherosclerosis as well as nursing care of the postsurgical client (Chapter 4 ) and following amputation (Chapter 41 )

Community-Based Care

Discuss the following topics when preparing clients with thromboangiitis obliterans and their families for home or community-based care:

- Absolute necessity of smoking cessation
- Foot care
- Protecting affected extremities from injury
- Purpose, dose, desired and adverse effects, interactions, and any precautions associated with prescribed medications
- Signs and symptoms to report to the physician.

THE CLIENT WITH RAYNAUD'S DISEASE

Raynaud's disease and **phenomenon** are characterized by episodes of intense vasospasm in the small arteries and arterioles of the fingers and sometimes the toes (Porth, 2005). Raynaud's disease and phenomenon differ only in terms of cause. Raynaud's disease has no identifiable cause; Raynaud's phenomenon occurs secondarily to another disease (such as collagen vascular diseases such as scleroderma and rheumatoid arthritis), other known causes of vasospasm, or long-term exposure to cold or machinery (McCance & Huether, 2006; Porth, 2005).

Raynaud's disease primarily affects young women between the ages of 20 and 40. Genetic predisposition may play a role in its development, although the actual cause is unknown. Table 35-5 compares thromboangiitis obliterans and Raynaud's disease.

Pathophysiology and Manifestations

Raynaud's disease and phenomenon are characterized by spasms of the small arteries in the digits. The arterial spasms limit arterial blood flow to the fingers and possibly the toes. Initial attacks may involve only the tips of one or two fingers; with disease progression, the entire finger and all fingers may be affected.

The manifestations of Raynaud's occur intermittently when spasms develop. Raynaud's disease has been called the "blue-white-red disease," because affected digits initially turn blue as blood flow is reduced due to vasospasm, then white as circulation is more severely limited, and finally very red as the fingers are warmed and the spasm resolves (Figure 35-9 ). Sensory changes may occur during attacks, including numbness, stiffness, decreased sensation, and aching pain.

The attacks tend to become more frequent and prolonged over time. With repeated attacks (and resultant decrease in oxygenation), the fingertips thicken and the nails become brittle. Ulceration and gangrene are serious complications that rarely occur.

INTERDISCIPLINARY CARE



Raynaud's disease and phenomenon are primarily diagnosed by the history and physical examination. There are no specific diagnostic tests for these disorders.

Vasodilators may be prescribed to provide symptomatic relief. Low doses of a sustained release calcium channel blocker

TABLE 35–5 Comparison of Raynaud’s Disease and Thromboangiitis Obliterans

TOPIC	RAYNAUD’S DISEASE	THROMBOANGIITIS OBLITERANS
Etiology	<ul style="list-style-type: none"> ■ Unknown ■ Possible genetic predisposition 	<ul style="list-style-type: none"> ■ Cigarette smoking most probable single cause ■ Possible autoimmune response
Incidence/course of the disease	<ul style="list-style-type: none"> ■ Onset commonly between 15 and 45 years of age ■ Usually affects young women ■ Becomes progressively worse over time 	<ul style="list-style-type: none"> ■ Occurs predominantly in men under age 40 ■ More common in Asians and people of European heritage ■ Intermittent course with exacerbations and remissions ■ Increased severity and duration of attacks over time
Triggering stimuli	<ul style="list-style-type: none"> ■ Emotional stress ■ Exposure to cold 	<ul style="list-style-type: none"> ■ Cigarette smoking
Assessment findings	<ul style="list-style-type: none"> ■ Usually affects hands, sometimes toes ■ Pain becomes more severe and prolonged as disease progresses ■ “Blue-white-red” changes in color of hands with accompanying changes in skin temperature 	<ul style="list-style-type: none"> ■ Claudication and pain ■ Numbness or diminished sensation ■ Cool, pale, or cyanotic skin ■ Shiny, thin skin and white, malformed nails in affected extremities ■ Distal pulses difficult to find or absent ■ Trophic changes to nail beds ■ Ulceration and gangrene in later stages ■ Small, red, tender vascular cords in affected extremities
Management	<ul style="list-style-type: none"> ■ Avoid unnecessary cold exposure ■ Emphasize smoking cessation ■ Medications such as calcium channel or alpha-adrenergic blockers as indicated ■ Teach stress management 	<ul style="list-style-type: none"> ■ Stop smoking (crucial) ■ Regular exercise ■ Protect extremities from cold injury ■ Teach stress management

such as nifedipine (Procardia) or diltiazem (Cardizem) may be prescribed. The alpha-adrenergic blocker prazosin (Minipress) also may reduce the frequency and severity of attacks. Transdermal nitroglycerin (or longer acting oral nitrates) helps some clients by decreasing the amount of time necessary for the hands to return to normal following an attack (Tierney et al., 2005).

Conservative measures are a mainstay of treatment. Clients are instructed to keep their hands warm, wearing gloves when outside in cold weather and kitchen gloves when handling cold items (for instance, when preparing and serving cold foods and cleaning the refrigerator). Measures to avoid injury to the hands

are taught. Sometimes attacks can be stopped by swinging the arms back and forth, increasing perfusion pressure in the small arteries by centrifugal force.

Smoking cessation is important. Stress reduction measures such as exercise, relaxation techniques, massage therapy, hobbies, aroma therapy, and counseling are taught or suggested. Additional lifestyle habits that contribute to vascular health are encouraged, such as reducing dietary fat, increasing activity level, and maintaining normal body weight.



NURSING CARE

Nursing care for the client with Raynaud’s disease or phenomenon is primarily educative and supportive. Protecting the hands and feet from exposure to cold and trauma is the major teaching topic. Nursing diagnoses and interventions previously outlined for peripheral atherosclerosis also are appropriate for clients with Raynaud’s.

Community-Based Care

Reassure clients with Raynaud’s phenomenon that most people with the disorder experience only mild, infrequent episodes. Discuss the following topics in preparing the client for managing the disorder:

- Dress warmly, keeping the trunk and hands warm.
- Avoid unnecessary exposure to cold.
- Stop smoking or do not start.
- The use, purpose, desired and potential adverse effects of prescribed medications, if any.



Figure 35–9 ■ Hands of a client with Raynaud’s phenomenon. Note cyanosis of fingers on the right hand and the left thumb and the extreme pallor of the other digits of the left hand.

Source: Bart’s Medical Library, Phototake NYC.

THE CLIENT WITH ACUTE ARTERIAL OCCLUSION

A peripheral artery may be acutely occluded by development of a thrombus (blood clot) or by an embolism. Blood flow to tissues supplied by the artery is impaired, resulting in acute tissue ischemia and a risk for necrosis and gangrene.

Pathophysiology

Arterial Thrombosis

A **thrombus** is a blood clot that adheres to the vessel wall. Thrombi tend to develop in areas where intravascular factors stimulate coagulation (e.g., where a vessel lumen is partially obstructed and its wall is damaged and roughened by atherosclerosis). Other disorders, such as infection or inflammation of the vessel wall or pooling of blood (e.g., in an aneurysm) also can prompt coagulation and thrombus formation (McCance & Huether, 2006). A developing thrombus can occlude arterial blood flow through the vessel, leading to ischemia of tissues supplied by that artery. The extent of ischemia depends on the size of the affected artery and the degree of collateral circulation. In gradual processes of arterial occlusion such as atherosclerosis, collateral vessels often develop to compensate for impaired arterial flow. The extent of collateral circulation affects the degree of tissue ischemia distal to the thrombus.

Arterial Embolism

An **embolism** is sudden obstruction of a blood vessel by debris. A thrombus can break loose from the arterial wall to become a **thromboembolus**. Other substances also can become emboli: atherosclerotic plaque, masses of bacteria, cancer cells, amniotic fluid, bone marrow fat, and foreign objects such as air bubbles or broken intravenous catheters. Regardless of cause, an embolus eventually lodges in a vessel that is too small to allow it to pass.

Arterial emboli often originate in the left side of the heart. They are associated with myocardial infarction, valvular heart disease, left-sided heart failure, atrial fibrillation, or infectious heart diseases. Emboli from the left heart often enter the carotid arteries and become trapped in the cerebral circulation, causing neurologic deficits (see Chapter 43 ∞). Thromboemboli that develop in the aorta or peripheral arterial circulation tend to lodge in areas where the arterial lumen is narrowed by atherosclerotic plaque and at arterial bifurcations.

Manifestations

The manifestations of arterial thrombosis and embolism are those of tissue ischemia. Ischemic tissues are painful, pale, and cool or cold. Distal pulses are absent. Paresthesias (numbness and tingling) develop in the extremity. Cyanosis and mottling are common. Paralysis and muscle spasms may develop in the affected extremity. A line of demarcation between normal and ischemic tissue may be seen, particularly with embolism. Tissue below the line is cool or cold, and pale, cyanotic, or mottled. See the Manifestations box that follows.

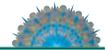
Arterial occlusion can result in permanent vessel and limb damage. Complete arterial occlusion leads to tissue necrosis and gangrene unless blood flow is promptly restored.



MANIFESTATIONS of Acute Arterial Occlusion

- Pain
- Pallor or mottling
- Paresthesias (numbness and tingling)
- Cool or cold skin
- Pulselessness distal to the blockage
- Possible paralysis, weakness, or muscle spasms
- Possible line of demarcation; with pallor, cyanosis, and cooler skin distal to the blockage (especially with arterial embolism)

INTERDISCIPLINARY CARE



Acute arterial occlusions may require emergency treatment to preserve the limb if the obstructed vessel is large or collateral circulation is minimal. If the limb is not in jeopardy, more conservative management may be initiated.

Diagnosis

The diagnosis of acute arterial occlusion often is apparent by the signs and symptoms. *Arteriography* is used to confirm the diagnosis, locate the occlusion, and determine its extent.

Medications

Anticoagulation with intravenous heparin is initiated to prevent further clot propagation and recurrent embolism. Anticoagulation is continued with oral anticoagulants after discharge. See the section on venous thrombosis later in this chapter for more information about anticoagulant therapy.

Arterial thrombosis may be treated with intra-arterial fibrinolytic therapy using streptokinase, urokinase, or tissue plasminogen activator (t-PA) (see Chapter 31 ∞). Lysis of the thrombus or embolus is achieved in 50% to 80% of the cases (Tierney et al., 2005). Local intra-arterial injection of the fibrinolytic drug allows use of lower doses and reduces the bleeding risk associated with fibrinolytic drugs.

Surgery

Immediate *embolectomy* (within 4 to 6 hours) is the treatment of choice for acute arterial occlusion by an embolus to prevent tissue necrosis and gangrene. When the involved vessel is in an extremity, local anesthesia and a special balloon-tipped catheter known as a Fogarty catheter may be used for high surgical risk clients (Tierney et al., 2005). An embolus in the mesenteric circulation necessitates emergency laparotomy. The risk of complications and limb loss increases significantly if surgery is delayed by 12 or more hours. Potential major complications include compartment syndrome (see Chapter 41 ∞), acute respiratory distress syndrome (Chapter 39 ∞), or acute renal failure (Chapter 28 ∞).

Arterial thrombosis also may be treated surgically, although the required surgery may be more extensive due to the length of the vessel involved. *Thromboendarterectomy* is done to remove the thrombus and plaque in the artery. An arterial graft may be required. Nursing care for clients who have undergone embolectomy or thrombus removal is discussed in the nursing care section that follows.



NURSING CARE

Assessment

Nursing assessment for the client with an acute arterial occlusion is highly focused due to the emergency nature of the problem.

- **Health history:** Complaints of pain, numbness, tingling, or weakness in the involved extremity; history of atherosclerotic vessel disease, heart disease, or recent invasive procedure (e.g., angiography, percutaneous revascularization procedure).
- **Physical examination:** Vital signs; peripheral pulses in both extremities; color, temperature, sensation, and movement of involved extremity; skin condition; presence of a line of demarcation.

Nursing Diagnoses and Interventions

Nursing care related to acute arterial occlusion focuses on protecting the affected extremity, managing anxiety, and reducing the risk of complications related to anticoagulant therapy.

Ineffective Tissue Perfusion: Peripheral

Protecting ischemic tissue from injury prior to surgery or medical thrombolysis is vital. Following surgery, there is a risk for thrombosis at the graft site or impaired perfusion due to edema of the surgical site.

PRACTICE ALERT

Monitor extremity perfusion, comparing affected and unaffected extremities. Assess peripheral pulses (using the Doppler stethoscope as needed), skin temperature and color, capillary refill, movement, and sensation every 1 to 4 hours. Promptly report changes or complaints of increased or unrelieved pain.

Propagation of a thrombus can further obstruct arterial flow, increasing tissue ischemia. Following surgery, arterial spasms may cause a cyanotic, pulseless extremity; normal color and pulses should return within 12 hours. A thrombus may form at the surgical site or within a graft, causing tissue ischemia with pain and other manifestations of arterial occlusion. Further measures to restore circulation may be necessary.

- Maintain intravenous fluids as ordered. *Adequate circulating blood volume is necessary to maintain cardiac output and tissue perfusion.*
- Protect the extremity, keeping it horizontal or lower than the heart. Use a cradle to keep bedclothes off the extremity and sheepskin or foam pad to protect it from hard or abrasive surfaces. Do not apply heat or cold. *Keeping the extremity lower than the heart promotes collateral blood flow. Ischemic tissue is easily damaged by minimal trauma such as shearing by bed linens, or heat or cold application.*
- Following surgery, avoid raising the knee gatch, placing pillows under the knees, or sitting with 90-degree hip flexion. *These activities may impair blood flow through the affected vessel.*

Anxiety

Clients with an acute arterial occlusion often are very anxious. The rapid and intense nature of preoperative activities can be overwhelming, increasing anxiety about the disorder and its out-

come. Manifestations of anxiety may include trembling, palpitations, restlessness, dry mouth, helplessness, inability to relax, irritability, forgetfulness, and lack of awareness of surroundings. Nursing measures focus on establishing trust and minimizing the effects of anxiety to decrease surgical risk and improve recovery.

- Spend as much time as possible with the client. Provide opportunities to verbalize anxiety; offer reassurance and support. Support adaptive coping mechanisms. *The presence of a caring nurse provides a safe environment for expressing fears and anxieties. Coping mechanisms reduce the immediate perceived threat and increase the ability to deal with the situational crisis.*
- Perform required measures in an expedient but calm manner. *Calm, confident performance of treatment measures reassures the client and family that appropriate care is being given to treat the problem at hand.*
- Assess anxiety level at least every 8 hours; more often as needed. Intervene as indicated to reduce anxiety. *Assessment helps determine the intensity of anxiety, the client's ability to control it, and directs interventions to reduce it.*
- Decrease sensory stimuli as much as possible. *Reducing environmental stimuli provides the client a degree of control over anxiety.*
- Speak slowly and clearly and avoid unnecessary interruptions when listening. Give concise directions, focusing on the present. Involve the client in simple tasks and decisions to the extent possible. *High levels of anxiety interfere with learning. Keeping interactions focused on the present situation directs the client's focus and provides reassurance that it is the most important focus of the nurse as well. Providing opportunities for self-care and decision making reinforces the client's importance and power to control the situation.*

Altered Protection

Fibrinolytic and/or anticoagulant therapy used to dissolve existing clots and prevent further clot formation increase the risk for bleeding. Close monitoring of physical status and laboratory data is vital, as are measures to reduce the risk for injury and bleeding.

PRACTICE ALERT

Assess for and report manifestations of impaired clotting, including excessive incisional bleeding; prolonged oozing from injection sites; bleeding gums, nosebleed, or hematuria; petechiae, bruising, or purpura. Anticoagulants and fibrinolytics interfere with the clotting cascade and may cause abnormal bleeding.

- Monitor activated partial thromboplastin time (aPTT) during heparin therapy and prothrombin time (PT) or International Normalized Ratio (INR) during oral anticoagulant therapy. Report values outside desired range. *The APTT, PT, and INR are prolonged by anticoagulant therapy. Values higher than the desired range may indicate an increased risk for bleeding; values below the target may indicate inadequate anticoagulation.*
- Protect from injury: Use side rails or other measures as needed to prevent falls; avoid parenteral injections and other invasive procedures as much as possible; hold firm pressure over injection and intravenous sites for 5 minutes and over

arterial punctures for 20 minutes; use a soft toothbrush or sponge for oral care; use an electric razor for shaving. *Minor trauma can lead to extensive bleeding, particularly in the client who has received a fibrinolytic drug.*

Community-Based Care

When preparing the client and family for home or community-based care related to an acute arterial occlusion, discuss the following topics as indicated:

- Care of the incision
- Manifestations of complications to be reported, including symptoms of infection or occlusion of the graft or artery

- Long-term anticoagulant therapy, including the reason, prescribed dose, follow-up laboratory testing and appointments, interactions with other drugs, and manifestations of excessive bleeding
- Any activity restrictions or dietary modifications
- Lifestyle modifications to slow atherosclerosis and control hypertension
- Measures to promote peripheral circulation and maintain tissue integrity (see the discussion of peripheral atherosclerosis earlier in the chapter).

Refer for home care services (nursing care, physical therapy, housekeeping services) as indicated.

DISORDERS OF VENOUS CIRCULATION

The two primary categories of venous system disorders are occlusive disorders and those related to ineffective venous blood flow. Impaired venous blood flow can lead to stasis and clotting, as well as tissue changes associated with venous congestion.

Physiology Review

The venous system is a low-pressure system in comparison with the arterial circulation. Veins and venules are thin-walled, distensible vessels. While they contain smooth muscle that allows them to contract or expand, the media (muscle layer) of veins is significantly thinner than that of arteries. The low pressures in the venous system allow it to serve as a reservoir for blood. Stimulation by the sympathetic nervous system causes veins to contract, helping maintain vascular volume. The low-pressure venous system relies on skeletal muscle contractions and pressure changes in the abdomen and thorax to facilitate blood return to the heart. Unlike arteries, veins of the extremities contain valves to prevent retrograde blood flow.

THE CLIENT WITH VENOUS THROMBOSIS

Venous thrombosis (also known as *thrombophlebitis*) is a condition in which a blood clot (thrombus) forms on the wall of a vein, accompanied by inflammation of the vein wall and some degree of obstructed venous blood flow.

Venous thrombi are more common than arterial thrombi because of lower pressures and flow within the venous system (McCance & Huether, 2006). Thrombi can form in either superficial or deep veins. **Deep venous thrombosis (DVT)** is a common complication of hospitalization, surgery, and immobilization. Obstetric and orthopedic procedures carry a higher risk for venous thrombosis; it may develop in more than 50% of clients having orthopedic surgery, particularly surgeries involving the hip or knee (Kasper et al., 2005). Other significant risk factors for venous thrombosis include abdominal or thoracic surgery, certain cancers, trauma, pregnancy, and use of oral contraceptives or hormone replacement therapy. See Box 35–5.

BOX 35–5 Factors Associated with Venous Thrombosis

- Immobilization: myocardial infarction, heart failure, stroke, postoperative
- Surgery: orthopedic, thoracic, abdominal, genitourinary
- Cancer: pancreatic, lung, ovary, testes, urinary tract, breast, stomach
- Trauma: fractures of the spine, pelvis, femur, tibia; spinal cord injury
- Pregnancy and delivery
- Hormone therapy: oral contraceptives, hormone replacement therapy
- Coagulation disorders

FAST FACTS

- DVT is a common complication of surgery and immobility. It usually develops in the deep veins of the calf (80%).
- Venous stasis (sluggish blood flow), altered blood coagulation, and damage (e.g., inflammation) to blood vessels are precipitating factors for DVT.
- A thrombus or a portion of a thrombus may break loose, traveling through the venous system to the right side of the heart and into the pulmonary circulation, where it ultimately becomes lodged (pulmonary embolus).

Pathophysiology

Three pathologic factors, called *Virchow's triad*, are associated with thrombophlebitis: stasis of blood, vessel damage, and increased blood coagulability. Vessel trauma stimulates the clotting cascade. Platelets aggregate at the site, particularly when venous stasis is present. Platelets and fibrin form the initial clot. Red blood cells are trapped in the fibrin meshwork, and the thrombus propagates (grows) in the direction of blood flow. The inflammatory response is triggered, causing tenderness, swelling, and erythema in the area of the thrombus. Initially the thrombus floats within the vein. Pieces of the thrombus may break loose and travel through the circulation as emboli. Fibroblasts eventually invade the thrombus, scarring the vein

wall and destroying venous valves. Although patency of the vein may be restored, valve damage is permanent, affecting directional flow (Tierney et al., 2005).

Deep Venous Thrombosis

The deep veins of the legs, primarily in the calf, and the pelvis provide the most hospitable environment for venous thrombosis. Approximately 80% of deep vein thromboses begin in the deep veins of the calf, often propagating into the popliteal and femoral veins (Figure 35–10 ■) (Tierney et al., 2005). DVT usually is asymptomatic; in some clients, a pulmonary embolism may be the first indication.

MANIFESTATIONS When present, the manifestations of DVT are primarily due to the inflammatory process accompanying the thrombus. Calf pain, which may be described as tightness or a dull, aching pain in the affected extremity, particularly upon walking, is the most common symptom. Tenderness, swelling, warmth, and erythema may be noted along the course of involved veins. The affected extremity may be cyanotic and often is edematous. Rarely, a cord may be palpated over the affected vein. A positive Homan’s sign (pain in the calf when the foot is dorsiflexed) is an unreliable indicator of DVT. See the Manifestations box for a summary of the manifestations of deep and superficial venous thrombosis.

COMPLICATIONS The major complications of DVT are chronic venous insufficiency (see the next section of this

MANIFESTATIONS of Venous Thrombosis

Deep Venous Thrombosis

- Usually asymptomatic
- Dull, aching pain in affected extremity, especially when walking
- Possible tenderness, warmth, erythema along affected vein
- Cyanosis of affected extremity
- Edema of affected extremity

Superficial Venous Thrombosis

- Localized pain and tenderness over the affected vein
- Redness and warmth along the course of the vein
- Palpable cordlike structure along the affected vein
- Swelling and redness of surrounding tissue

chapter) and pulmonary embolism. Pulmonary embolism occurs when the clot fragments or breaks loose from the vein wall. As the clot travels, it moves through progressively larger veins and into the right side of the heart. From there it enters the pulmonary circulation, where it eventually occludes arterial flow to a portion of the lungs. The result is a mismatch between ventilation (air flow) and perfusion (blood flow) in a portion of the lungs. The effect on gas exchange depends on the size of the embolism and the vessel it

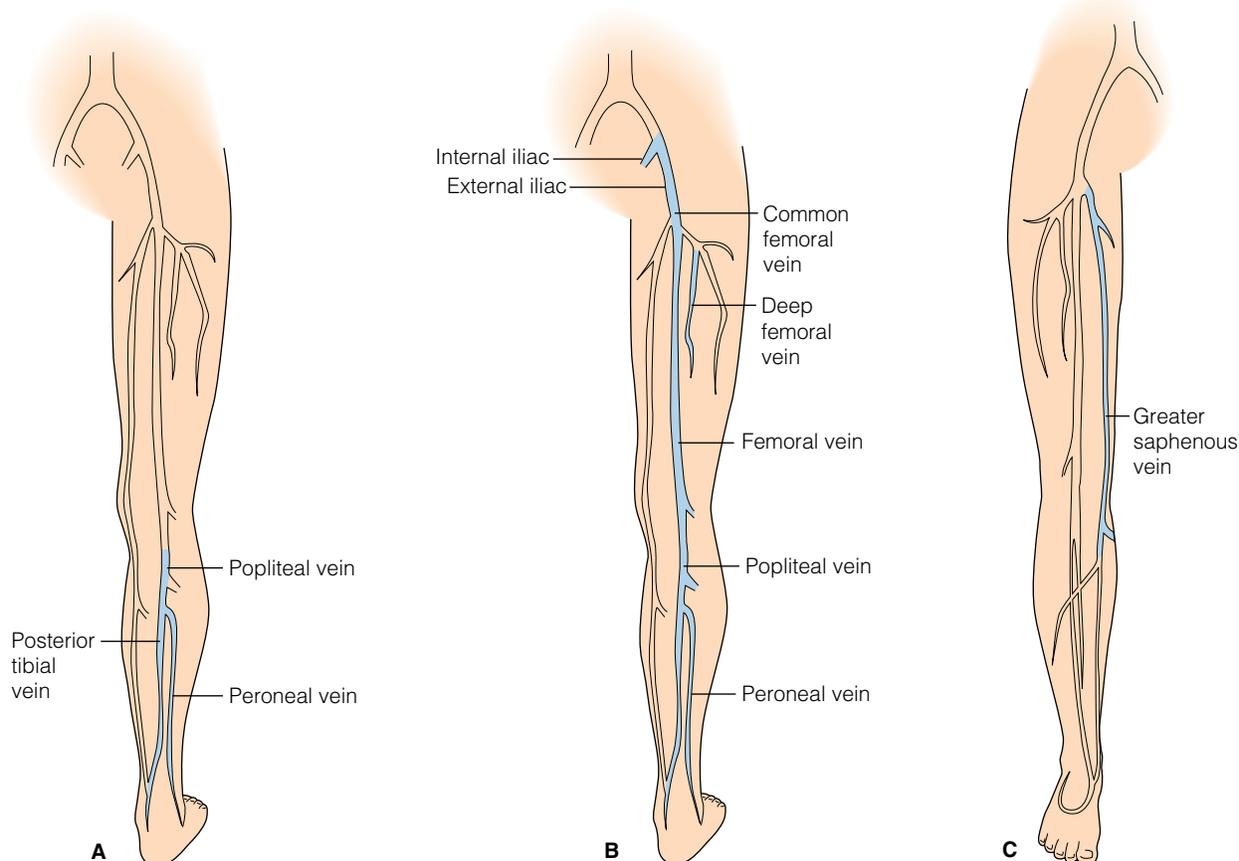


Figure 35–10 ■ Common locations of venous thrombosis. *A*, The most common sites of DVT. *B*, DVT extending from the calf to the iliac veins. *C*, Superficial venous thrombosis.

occludes. See Chapter 39  for more information about pulmonary emboli.

Superficial Venous Thrombosis

Venous catheters and infusions are the primary risk factors for superficial venous thrombosis. Superficial venous thrombosis also may develop in conjunction with thromboangiitis obliterans, varicose veins, or DVT. It may develop spontaneously in pregnant women or following delivery. In some cases, superficial venous thrombosis of the long saphenous vein is the earliest sign of an abdominal cancer such as pancreatic cancer (Tierney et al., 2005).

Superficial venous thrombosis is marked by pain and tenderness at the site of the thrombus. A reddened, warm, tender cord extending along the affected vein can be palpated. The area surrounding the vein may be swollen and red (see the Manifestations box).

INTERDISCIPLINARY CARE



It is important to differentiate venous thrombosis from other causes of extremity pain, such as cellulitis, muscle strain, contusion, and lymphedema. The history, physical examination, and diagnostic tests are used to establish the diagnosis. Treatment focuses on preventing further clotting or extension of the clot and addressing underlying causes.

Diagnosis

- *Duplex venous ultrasonography* is a noninvasive test used to visualize the vein and measure the velocity of blood flow in the veins. Although the clot often cannot be visualized directly, its presence can be inferred by an inability to compress the vein during the examination.
- *Plethysmography* is a noninvasive test that measures changes in blood flow through the veins. It is often used in conjunction with Doppler ultrasonography. Plethysmography is most valuable in diagnosing thromboses of larger or more superficial veins.
- *Magnetic resonance imaging (MRI)* is another noninvasive means of detecting DVT. It is particularly useful when thrombosis of the venae cavae or pelvic veins is suspected.
- *Ascending contrast venography* uses an injected contrast medium to assess the location and extent of venous thrombosis. Although invasive, expensive, and uncomfortable, contrast venography is the most accurate diagnostic tool for venous thrombosis. It is used when the results of less invasive tests leave the diagnosis unclear (Tierney et al., 2005).

Prophylaxis

Medications and other measures are used to prevent venous thrombosis when the risk is high. Low-molecular-weight (LMW) heparins prevent DVT in clients who are undergoing general or orthopedic surgery, experiencing acute medical illness, or on prolonged bed rest. Oral anticoagulation also may be used as a prophylactic measure in clients with fractures or who are undergoing orthopedic surgery.

Elevating the foot of the bed with the knees slightly flexed promotes venous return. Early mobilization and leg exercises

such as ankle flexion and extension assist venous flow by muscle compression. Intermittent pneumatic compression devices applied to the legs are effective to prevent DVT. They also are used when anticoagulation is contraindicated due to the increased risk for bleeding (Kasper et al., 2005). Elastic stockings are also used to prevent venous thrombosis in clients at risk.

Medications

Anticoagulants to prevent clot propagation and enable the body's own lytic system to dissolve the clot are the mainstay of treatment for venous thrombosis. Fibrinolytic drugs such as streptokinase or t-PA may accelerate the process of clot lysis and prevent damage to venous valves. There is, however, no evidence that fibrinolytic therapy is more effective in preventing pulmonary embolism in clients with existing DVT than anticoagulants (Kasper et al., 2005). It also significantly increases the risk for bleeding and hemorrhage.

Nonsteroidal anti-inflammatory agents (NSAIDs) such as indomethacin (Indocin) or naproxen (Naprosyn) may be ordered to reduce inflammation in the veins and provide symptomatic relief, particularly for clients with superficial venous thrombosis.

ANTICOAGULANTS Anticoagulants are given to prevent clot extension and reduce the risk of subsequent pulmonary embolism. See the Medication Administration box on pages 1189–1190 for the nursing implications for anticoagulant therapy.

Anticoagulation is initiated with unfractionated heparin or LMW heparin. Following an initial intravenous bolus of 7500 to 10,000 units of unfractionated heparin, a continuous heparin infusion of 1000 to 1500 international units per hour is started. The dosage is calculated to maintain the aPTT at approximately twice the control or normal value. An infusion pump is used to deliver the prescribed dosage. Frequent monitoring of the infusion is an important nursing responsibility. Subcutaneous heparin injections may be used as an alternative to intravenous infusion in some instances.

LMW heparins are increasingly used to prevent and treat venous thrombosis. They do not require the close laboratory monitoring of unfractionated heparins. LMW heparin is administered subcutaneously in fixed doses once or twice daily, allowing the option of outpatient treatment. LMW heparins have additional advantages, in that they are more effective and carry lower risks for bleeding and thrombocytopenia than conventional, unfractionated heparins.

Oral anticoagulation with warfarin may be initiated concurrently with heparin therapy. Overlapping heparin and warfarin therapy for 4 to 5 days is important because the full anticoagulant effect of warfarin is delayed, and it may actually promote clotting during the first few days of therapy (Tierney et al., 2005). Warfarin doses are adjusted to maintain the INR at 2.0 to 3.0 (Kasper et al., 2005).

Once this level is achieved, the heparin is discontinued and a maintenance dose of warfarin is prescribed to prevent recurrent thrombosis. Anticoagulation generally is continued for at least 3 months. When DVT is recurrent or risk factors such as altered coagulability or cancer are present, anticoagulant therapy may be prolonged. Regular follow-up is necessary to

MEDICATION ADMINISTRATION Anticoagulant Therapy

HEPARIN

Heparin interferes with the clotting cascade by inhibiting the effects of thrombin and preventing the conversion of fibrinogen to fibrin. This prevents the formation of a stable fibrin clot. At therapeutic levels, heparin prolongs the thrombin time, clotting time, and activated partial thromboplastin time. When given intravenously, its effect is immediate. Given subcutaneously, its onset of action is within 1 hour. When heparin is discontinued, clotting times return to normal within 2 to 6 hours (Spratto & Woods, 2003). *Heparin-induced thrombocytopenia (HIT)* is a potential complication of therapy with unfractionated heparin. See Chapter 34  for more information about HIT and nursing responsibilities in monitoring for this dangerous potential complication.

Nursing Responsibilities

- Assess for history of unexplained or active bleeding. Assess laboratory results for abnormal clotting profile or evidence of active bleeding.
- Give a test dose as indicated to clients with a history of multiple allergies or a history of asthma.
- Administer by deep subcutaneous injection; abdominal sites are preferred. Avoid injecting within 2 inches of the umbilicus. Rotate sites. Do not aspirate prior to injecting or massage after the injection.
- Intravenous solutions may be diluted with dextrose, normal saline, or Ringer's solution. Use an infusion pump.
- Keep protamine sulfate, a heparin antagonist, available to treat excessive bleeding.
- Monitor and report abnormal laboratory results and aPTT values outside the desired range.
- Promptly report evidence of bleeding such as hematemesis, hematuria, bleeding gums, or unexplained abdominal or back pain.

Health Education for the Client and Family

- Report unusual bleeding or excessive menstrual flow.
- Use an electric razor and a soft-bristle toothbrush; prevent injury by clearing pathways, using a night light, and other measures. Do not consume alcohol.
- Avoid contact sports while on anticoagulant therapy.
- Do not consume large amounts of food rich in vitamin K (yellow and dark green vegetables).
- Do not use aspirin or NSAIDs while on heparin therapy unless advised to do so by your physician.
- Wear a Medic-Alert tag and advise all healthcare providers (including dentists and podiatrists) of therapy.

LOW-MOLECULAR-WEIGHT HEPARINS
Ardeparin (Normiflo)
Dalteparin (Fragmin)
Enoxaparin (Lovenox)
Tinzaparin (Innohep)

LMW heparins are the most bioavailable fraction of heparin. They provide a more precise and predictable anticoagulant effect than unfractionated heparins. Like unfractionated heparin, LMW heparin prevents conversion of prothrombin to thrombin, liberation of thromboplastin from platelets, and formation of a stable clot. LMW heparins cannot be used interchangeably with each other or with

unfractionated heparin. Although the risk of heparin-induced thrombocytopenia is significantly lower with LMW heparin, clients who were previously treated with unfractionated heparin may develop HIT when treated with LMW heparin.

Nursing Responsibilities

- Assess for evidence of active bleeding, a history of bleeding disorders or thrombocytopenia, or sensitivity to heparin, sulfites, or pork products.
- Monitor for unusual or masked bleeding. PT and aPTT levels may be within normal levels even in the presence of hemorrhage.
- Administer by deep subcutaneous injection into abdominal wall, thigh, or buttocks. Rotate sites. Do not aspirate or massage.

Health Education for the Client and Family

- Subcutaneous self-administration technique, timing of doses, and site rotation. Do not rub site after administering to minimize bruising.
- Do not take aspirin, NSAIDs, or other over-the-counter drugs unless recommended by your physician.
- Promptly report excessive bruising or bleeding, chest pain, difficulty breathing, itching, rash, or swelling to your healthcare provider.
- Keep follow-up appointments as scheduled.

ORAL ANTICOAGULANT
Warfarin (Coumadin)

Warfarin interferes with synthesis of vitamin K–dependent clotting factors by the liver, leading to depletion of these factors. It has no effect on already circulating clotting factors or on existing clots. Warfarin inhibits extension of existing thrombi and the formation of new clots. Its action is cumulative and more prolonged than that of heparin.

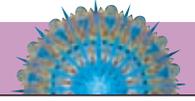
Nursing Responsibilities

- Assess laboratory results and history for evidence of abnormal bleeding.
- Multiple drugs affect the metabolism and protein binding of warfarin; note all medications and assess for interactions with warfarin.
- Do not give during pregnancy because warfarin may cause congenital malformations.
- Oral tablets may be crushed and given without regard to meals.
- Dilute intravenous warfarin with supplied diluent; administer within 4 hours by direct intravenous injection at a rate of 25 mg/min.
- Keep vitamin K available to reverse effects of warfarin in the event of excessive bleeding or hemorrhage.
- Monitor PT or INR; report values outside the desired range.

Health Education for the Client and Family

- If bleeding occurs (hematemesis, bright red or black tarry feces, hematuria, bleeding gums, excessive bruising, etc.), do not take your prescribed dose and notify your physician immediately. Report rash or manifestations of hepatitis (dark urine, malaise, yellow skin or sclera).
- Take your warfarin at the same time every day; do not change brands because their effects may differ.

(continued)



MEDICATION ADMINISTRATION Anticoagulant Therapy (continued)

- Menstrual bleeding may be slightly increased; contact your healthcare provider if it increases significantly. Use reliable birth control to prevent pregnancy while taking warfarin. Immediately contact your healthcare provider if you think you may be pregnant.
- Take precautions to prevent injury and bleeding: use a soft-bristle toothbrush and electric razor, wear shoes, and use a night light. Avoid participating in contact sports.
- Do not smoke, use alcohol, or take any over-the-counter drugs unless specifically recommended by your healthcare provider. Notify all healthcare providers, including dentists and podiatrists, of therapy. Wear a Medic-Alert tag.
- Obtain lab tests as scheduled and keep all scheduled follow-up appointments.

be sure prothrombin times (INR) remain within the desirable range for anticoagulation.

Treatments

Treatment of venous thrombosis also includes measures to relieve symptoms and reduce inflammation. With superficial venous thrombosis, applying warm, moist compresses over the affected vein, extremity rest, and anti-inflammatory agents usually provide relief of symptoms.

Bed rest may be ordered for deep venous thrombosis. The duration of bed rest typically is determined by the extent of leg edema. The legs are elevated 15 to 20 degrees, with the knees slightly flexed, above the level of the heart to promote venous return and discourage venous pooling. Elastic antiembolism stockings (TEDS) or pneumatic compression devices are also frequently ordered to stimulate the muscle-pumping mechanism that promotes the return of blood to the heart. When permitted, walking is encouraged while avoiding prolonged standing or sitting. Crossing the legs also is avoided, as are tight-fitting garments or stockings that bind.

Surgery

Venous thrombosis usually is effectively treated with conservative measures and anticoagulation. In some cases, however, surgery is required to remove the thrombus, prevent its extension into deep veins, or prevent the effects of embolization.

Venous thrombectomy is done when thrombi lodge in the femoral vein and their removal is necessary to prevent pulmonary embolism or gangrene. Successful thrombus removal rapidly improves venous circulation. The duration of this effect varies.

When venous thrombosis is recurrent and anticoagulant therapy is contraindicated, a filter may be inserted into the vena cava to capture emboli from the pelvis and lower extremities, preventing pulmonary embolism. Several different filters are available (Figure 35–11 ■). The Greenfield filter is widely used for its ability to trap emboli within its apex while maintaining patency of the vena cava. The filter can be inserted under fluoroscopy with local anesthesia. Mortality and morbidity associated with the filter are very low.

Extensive thrombosis of the saphenous vein may necessitate ligation and division of the saphenous vein where it joins the femoral vein to prevent clot extension into the deep venous system. A vein affected by septic venous thrombosis

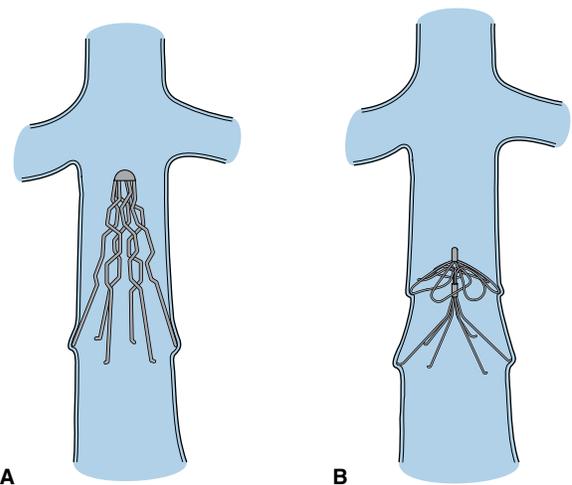


Figure 35–11 ■ Venal caval filters. A, Greenfield filter. B, Nitinol filter.

is excised to control the infection. Antibiotic therapy also is initiated.



NURSING CARE

Health Promotion

Prevention of venous thrombosis is an important component of nursing care for all at-risk clients. Position clients to promote venous blood flow from the lower extremities, with the feet elevated and the knees slightly bent. Avoid placing pillows under the knees and positions in which the hips and knees are sharply flexed. Use a recliner chair or footstool when sitting. Ambulate clients as soon as possible, and maintain a regular schedule of ambulation throughout the day. Teach ankle flexion and extension exercises, and frequently remind clients to perform them. Apply elastic hose and pneumatic compression devices when appropriate. Instruct clients to avoid crossing legs when in bed or sitting. Inquire about possible prophylactic heparin or warfarin therapy for clients undergoing orthopedic surgery or other high-risk procedures. Frequently assess intravenous sites. Change the site and catheter as dictated by agency protocol and if evidence of local inflammation is noted.

Assessment

Assess clients at risk for venous thrombosis for manifestations and risk factors.

- **Health history:** Complaints of leg or calf pain, its duration and characteristics, and the effect of walking on the pain; history of venous thrombosis or other clotting disorders; current medications.
- **Physical examination:** Inspect affected extremity for redness, edema; palpate for tenderness, warmth, cordlike structures; body temperature.
- **Diagnostic tests:** Clotting studies (aPTT, protime, INR).

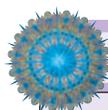
See the accompanying Nursing Care Plan for an example of an assessment of a client with deep venous thrombosis.

Nursing Diagnoses and Interventions

In addition to the preventive measures identified earlier, priority nursing diagnoses for the client with venous thrombosis relate to pain, maintenance of tissue perfusion and integrity, and the potential adverse effects of prescribed treatments.

Pain

The pain associated with venous thrombosis results from inflammation of the involved vein. It may be aggravated by use



NURSING CARE PLAN A Client with Deep Venous Thrombosis

Mrs. Opal Hipps, age 75, lives alone with her dog, Chester, in her family home in the suburbs. She retired from her job as a postal clerk 10 years ago and now spends a lot of time reading and watching television. Over the past week she has developed a vague aching pain in her right leg. She ignored the pain until last night when it developed into a much more severe pain in her right calf. She noticed that her right lower leg seemed larger than the left, and it was very tender to the touch. After seeing her physician and undergoing Doppler ultrasound studies, Mrs. Hipps is admitted to the hospital with the diagnosis of deep venous thrombosis in the right leg. She is placed on bed rest, and intravenous heparin. Michael Cookson, RN, is assigned to admit and care for Mrs. Hipps.

ASSESSMENT

Mr. Cookson notices that Mrs. Hipps was admitted 14 months ago for repair of a fractured femur. Mrs. Hipps says, "This business about a blood clot really has me worried." She also tells Mr. Cookson that she is worried about who will care for her dog while she is in the hospital. Physical findings include height 62 inches (157 cm), weight 149 lb (68 kg), T 99.2°F (37.3°C); vital signs within normal limits otherwise. Her left leg is warm and pink, with strong peripheral pulses and good capillary refill. Her right calf is dark red, very warm, and dry to touch. It is tender to palpation. The right femoral and popliteal pulses are strong, but the pedal and posterior tibial pulses are difficult to locate. The right calf diameter is 0.5 inch (1.27 cm) larger than the left.

DIAGNOSES

- **Pain** related to inflammatory response in affected vein
- **Anxiety** related to unexpected hospitalization and uncertainty about the seriousness of her illness
- **Ineffective Tissue Perfusion: Peripheral** related to decreased venous circulation in the right leg
- **Risk for Impaired Skin Integrity** related to pooling of venous blood in the right leg

EXPECTED OUTCOMES

- Verbalize relief of right leg pain by day of discharge.
- Verbalize reduced anxiety by the second day of her hospitalization.
- Demonstrate reduced right leg diameter by 0.25 inch (0.64 cm) by the fifth day of hospitalization.
- Maintain intact skin in the right foot throughout the hospital stay.

PLANNING AND IMPLEMENTATION

- Elevate legs, maintaining slight knee flexion, while in bed.
- Apply warm, moist compresses to right leg using a 2-hour-on, 2-hour-off schedule around the clock.
- Administer prescribed analgesics and evaluate effectiveness.
- Spend time with Mrs. Hipps to explain venous thrombosis and its treatment.
- Arrange for a friend or neighbor to care for Mrs. Hipps's dog.
- Apply antiembolism stockings as ordered; remove for 30 minutes every 8 hours.
- Monitor laboratory values to assess effect of anticoagulant therapy; report values outside desired range.
- Assist with progressive ambulation when allowed.
- Inspect legs and feet and record findings every 8 hours.

EVALUATION

Seven days after admission, the pain in Mrs. Hipps's right leg has subsided and the diameter of her right calf is equal to that of her left calf. Mrs. Hipps admits to Mr. Cookson that her fears really relate to a cousin who was hospitalized for a similar problem and had his leg amputated. After talking about her condition and the steps she can take to prevent its recurrence, she is much less anxious. Before discharge, Mr. Cookson reviews instructions for antiembolism stockings, daily walking, warfarin schedule, and scheduled follow-up appointment. Her neighbor, Kate, came to pick her up. As Mr. Cookson was helping Mrs. Hipps into the car, Kate handed her a small brown dog and said, "I took good care of Chester for you, but he's missed you." Mrs. Hipps smiled, and assured Mr. Cookson that she would call the number he provided if she had any questions.

CRITICAL THINKING IN THE NURSING PROCESS

1. Describe the pathophysiologic reasons for the pain in Mrs. Hipps's right leg.
2. How would you respond if Mrs. Hipps tells you she does not have the money to buy the prescribed anticoagulant when she goes home?
3. How would you change your teaching and discharge planning if Mrs. Hipps had difficulty caring for herself?
4. Design a plan of care for Mrs. Hipps for the nursing diagnosis *Activity Intolerance*.

See *Evaluating Your Response in Appendix C*.

of the involved extremity. Associated edema and swelling may contribute to discomfort. Measures to reduce the inflammation often help relieve the pain.

- Regularly assess pain location, characteristics, and level using a standardized pain scale. Report increasing pain or changes in its location or characteristics. *Tissue substances released during the inflammatory process can stimulate pain receptors. In addition, localized swelling presses on pain-sensitive structures in the area of the inflammation, contributing to discomfort. As inflammation and swelling are reduced, pain should abate. Continued or increasing pain may indicate extension of the thrombosis. Sudden chest pain may indicate a pulmonary embolism, necessitating immediate intervention.*
- Measure calf and thigh diameter of the affected extremity on admission and daily thereafter. Report increases promptly. *The inflammatory process causes vasodilation and increases vessel permeability, causing edema of the affected extremity. Baseline and subsequent measurements provide a measure of treatment effectiveness.*
- Apply warm, moist heat to affected extremity at least four times daily, using warm, moist compresses or an aqua-K pad. *Moist heat penetrates tissues to a greater depth. Warmth promotes vasodilation, allowing reabsorption of excess fluid into the circulation. Vasodilation also reduces resistance within the affected vessel, reducing pain. As edema subsides, pressure on surrounding tissues is relieved, thereby reducing pain.*
- Maintain bed rest as ordered. *Using leg muscles during walking exacerbates the inflammatory process and increases edema. This, in turn, increases venous compression and pain.*

Ineffective Tissue Perfusion: Peripheral

As thrombi develop, they occlude the lumen of the vein and obstruct blood flow. In addition, the accompanying inflammatory response may precipitate vessel spasms, further impairing arterial and venous blood flow and tissue perfusion. Impaired tissue perfusion, in turn, deprives tissues of nutrients and oxygen. As a result, distal tissues of the affected extremity are at risk for ulceration and infection.

PRACTICE ALERT

Assess peripheral pulses, skin integrity, capillary refill times, and color of extremities at least every 8 hours. Report changes promptly. Assessment of both extremities allows comparison of the affected and unaffected limbs. Weak or absent pulses, impaired capillary refill, or significant color changes in the affected extremity may indicate extension of the thrombus or a possible complication.

- Assess skin of the affected lower leg and foot at least every 8 hours; more often as indicated. *Frequent assessment is important to rapidly detect early signs of tissue breakdown and implementation of measures to protect vulnerable tissues. Early intervention allows healing and restoration of tissue integrity; allowed to continue, the process can lead to necrosis and potential gangrene.*

- Elevate extremities at all times, keeping knees slightly flexed and legs above the level of the heart. *Elevation of the extremities promotes venous return and reduces peripheral edema. Knee flexion promotes muscle relaxation.*

PRACTICE ALERT

Remove antiembolic stockings or pneumatic compression device for 30 to 60 minutes during daily hygiene. Antiembolic stockings (e.g., TED hose) and pneumatic compression devices exert pressure on the extremity and promote venous return. They can, however, impair perfusion of the dermis. Removing them periodically allows assessment of the underlying tissue and restores perfusion of the dermis, reducing the risk for skin breakdown. Their use may be continued following discharge to reduce the risk of recurrent venous thrombosis.

- Use mild soaps, solutions, and lotions to clean the affected leg and foot daily. Pat dry after washing, and apply a non-alcohol-based lotion or moisturizing cream. *Daily hygiene with nondrying soaps and solutions removes potential pathogens from the skin surface, and maintains skin integrity and the first line of defense against infection. Cautic or harsh soaps or solutions can dry and crack the skin. Dry, cracked skin permits bacteria and other microorganisms to enter and infect the tissue, potentially leading to ulceration and venous gangrene.*
- Use egg-crate mattress or sheepskins on the bed as needed. *Egg-crate mattresses and sheepskins distribute weight more evenly, preventing excess pressure on affected tissues.*
- Encourage frequent position changes, at least every 2 hours while awake. *Frequent position changes reduce pressure on bony prominences and edematous tissue, reducing the risk of tissue breakdown.*

Ineffective Protection

Anticoagulant therapy interferes with the body's normal clotting mechanisms, increasing the risk for bleeding and hemorrhage.

PRACTICE ALERT

Assess for and promptly report evidence of bleeding, such as petechiae, bruising, bleeding gums, obvious or occult blood in vomitus, stool, or urine, unexplained back or abdominal pain. Anticoagulants interfere with the ability to form a stable clot and prevent excessive bleeding. Even minor trauma such as toothbrushing or bumping into furniture can result in bleeding.

- Monitor laboratory results, including the INR (prothrombin time), aPTT, hemoglobin, and hematocrit as indicated. Report values outside the normal or desired range. *Coagulation studies are used to monitor the effect of anticoagulant medications. Values within the desired range prevent further clot development while carrying a low risk for bleeding and hemorrhage. A fall in the hemoglobin and hematocrit may indicate undetected bleeding.*

Impaired Physical Mobility

Although prolonged bed rest rarely is required, it is associated with many problems, including constipation, joint contrac-

tures, muscle atrophy, and boredom. Nursing care goals include maintaining joint range of motion, minimizing muscle atrophy, and reducing boredom.

- Encourage active range-of-motion (ROM) exercises at least every 8 hours. Provide passive range of motion as needed. *ROM exercises maintain joint mobility and prevent contractures. Active range of motion (performed by the client) also helps prevent muscle atrophy and preserve function. While passive ROM exercises do not prevent muscle atrophy, they do maintain joint mobility.*
- Encourage frequent position changes, deep breathing, and coughing. *Prolonged immobility can lead to impaired airway clearance and respiratory complications, such as atelectasis or pneumonia. Turning, coughing, and deep breathing facilitate expulsion of secretions from the respiratory tract, airway clearance, and alveolar ventilation.*
- Encourage increased fluid and dietary fiber intake. *Constipation is a frequent complication of immobility due to decreased gastrointestinal motility and loss of abdominal muscle strength. Increasing fluid and fiber intake helps maintain soft, easily expelled stools.*
- Assist with and encourage ambulation as allowed. *Ambulation promotes venous blood flow, helps maintain muscle tone and joint mobility, and increases the sense of well-being.*
- Encourage diversional activities such as reading, handiwork or other hobbies, television or video games, and socializing. *Boredom may lead to dozing and inertia, with little physical movement or mental stimulation, increasing the risk for complications of immobility.*

Risk for Ineffective Tissue Perfusion: Cardiopulmonary

A thrombus that forms in the deep veins of the legs or pelvis may break loose or fragment, becoming an embolism. Emboli that originate in the venous system usually become trapped in the pulmonary circulation (pulmonary embolism). Gas exchange in the affected area is impaired as blood flow ceases or is reduced to an area of the lungs that is well ventilated (see Chapter 38 ∞).

- Frequently assess respiratory status, including rate, depth, ease, and oxygen saturation levels. *A mismatch of ventilation and perfusion can significantly affect gas exchange, leading to rapid, shallow respirations, dyspnea and air hunger, and a fall in oxygen saturation levels.*

PRACTICE ALERT

Immediately report complaints of chest pain and shortness of breath, anxiety, or a sense of impending doom. The manifestations of pulmonary embolism are similar to those of myocardial infarction. Prompt intervention to restore pulmonary blood flow can reduce the risk of significant adverse effects.

- Initiate oxygen therapy, elevate the head of the bed, and reassure the client who is experiencing manifestations of pulmonary embolism. *Oxygen therapy and elevating the head of*

the bed promote ventilation and gas exchange in those alveoli that are well perfused, helping maintain tissue oxygenation. Reassurance helps reduce anxiety and slow the respiratory rate, promoting greater respiratory depth and alveolar ventilation.

Using NANDA, NIC, and NOC

Chart 35–3 illustrates linkages between nursing diagnoses, nursing interventions, and nursing outcomes for the client with deep venous thrombosis.

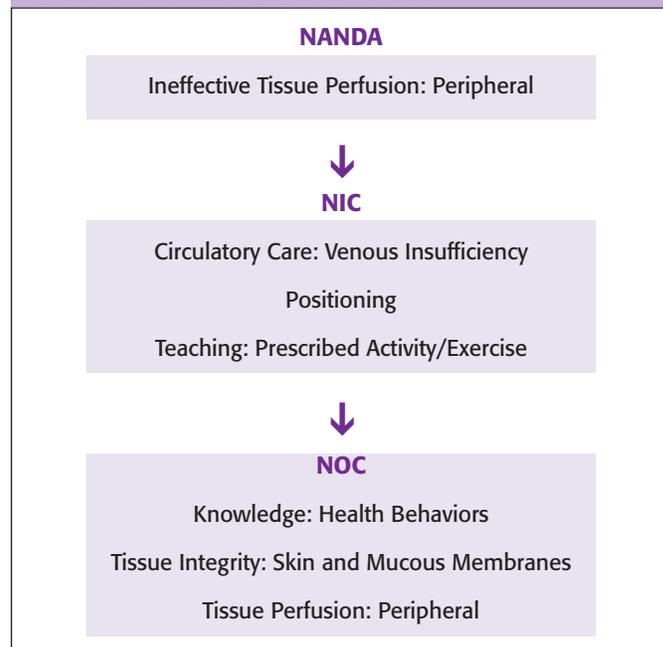
Community-Based Care

Treatment measures for venous thrombosis may be initiated and carried out on an outpatient basis or continued for an extended period of time following hospital discharge. Include the following topics when teaching for home care:

- Explanation of the disease process
- Treatment measures, including laboratory tests and their purposes, medications and adverse effects that should be reported
- Appropriate methods of heat application
- Prescribed activity restrictions
- Measures to prevent future episodes of venous thrombosis
- The importance of follow-up visits and laboratory tests as scheduled.

Refer clients for community nursing services for continued assessment and reinforcement of teaching. Provide referrals for assistance with ADLs and home maintenance services as indicated. Consider referral for physical therapy if needed.

NANDA, NIC, and NOC Linkages CHART 35–3 The Client with DVT



Data from *NANDA's Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA International (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bulechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC)* (3rd ed.) by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.

THE CLIENT WITH CHRONIC VENOUS INSUFFICIENCY

Chronic venous insufficiency is a disorder of inadequate venous return over a prolonged period. Deep venous thrombosis is the most frequent cause of chronic venous insufficiency. Other conditions, such as varicose veins or leg trauma, may contribute; in some instances, it develops without an identified precipitating cause (Kasper et al., 2005; Tierney et al., 2005).

Pathophysiology

Following DVT, large veins may remain occluded, increasing the pressure in other veins of the extremity. This increased pressure distends the veins, separating valve leaflets and impairing their ability to close. DVT also damages valve leaflets, causing them to thicken and contract. The result is impaired unidirectional blood flow and deep vein emptying (Porth, 2005).

When venous valves are incompetent, the muscle-pumping action produced during activity cannot propel blood back to the heart. Venous blood collects and stagnates in the lower leg (*venous stasis*). Venous pressures in the calf and lower leg increase, particularly during ambulation. This increased pressure impairs arterial circulation to the lower extremities as well. The body's ability to provide sufficient oxygen and nutrients to the cells and remove metabolic waste products diminishes. Eventually, there is so little oxygen and nutrients that cells begin to die. The skin atrophies, and subcutaneous fat deposits necrose. Breakdown of red blood cells in the congested tissues causes brown skin pigmentation (Porth, 2005). Venous stasis ulcers develop. Congested tissues impair the body's ability to increase the supply of oxygen, nutrients, and metabolic energy to heal the ulcer. As a result, the condition worsens and, over time, the ulcers enlarge. The congested venous circulation also prevents the blood from mounting effective inflammatory and immune responses, significantly increasing the risk for infection in the ulcerated tissue (McCance & Huether, 2006).

Manifestations

Manifestations of chronic venous insufficiency include lower leg edema, itching, and discomfort of the affected extremity that increase with prolonged standing. The extremity is cyanotic. Recurrent stasis ulcers develop (Figure 35–12 ■), usually forming just above the ankle, on the medial or anterior aspect of the leg. They heal poorly, forming scar tissue that breaks down easily. Tissue surrounding the ulcer is shiny, atrophic, and cyanotic, and there is a brownish pigmentation to the skin. Other skin changes may develop as well, such as eczema or stasis dermatitis. Necrosis and fibrosis of subcutaneous tissue causes the affected area of the leg to feel hard and somewhat leathery to the touch, but even the slightest trauma to the area can produce serious tissue breakdown. See the box on this page for the manifestations of chronic venous insufficiency. Table 35–6 compares venous and arterial ulcers.

INTERDISCIPLINARY CARE

Collaborative care for the client with venous insufficiency focuses on relieving symptoms, promoting adequate circulation, and healing and preventing tissue damage.



Figure 35–12 ■ Chronic venous insufficiency. Note the discoloration of the ankle and the stasis ulcer.

Source: Dr. P. Marazzi, Photo Researchers, Inc.

The history and physical examination often establish the diagnosis of chronic venous insufficiency. Because a history of DVT is a major risk factor, careful evaluation of the past medical history and questioning of the client is important. There are no specific diagnostic tests to confirm the diagnosis of chronic venous insufficiency.

Conservative management of venous insufficiency focuses on reducing edema and treating ulcerations. Prolonged standing or sitting is discouraged. Graduated compression hosiery is ordered for daytime use, and frequent elevation of the legs and feet during the day is recommended. At night, the legs and feet should be elevated above the level of the heart by raising the foot of the mattress.

Treatment of associated stasis dermatitis varies, based on the duration of the condition. Wet compresses of boric acid, buffered aluminum acetate (Burow's solution), or isotonic saline solution are applied to acute weeping dermatitis four times a day for 1-hour periods. Following the compress, a topical corticosteroid (such as 0.5% hydrocortisone cream) is applied. Bed rest is prescribed during the acute period. Stasis dermatitis that is subsiding or chronic may be treated with a topical corticosteroid, zinc oxide ointment, or a topical broad-spectrum antifungal cream such as clotrimazole (Lotrimin) cream or miconazole (Monistat) cream (Tierney et al., 2005).

Isotonic saline compresses or wet-to-dry dressings are applied to stasis ulcers to promote healing. A dilute topical an-



MANIFESTATIONS of Chronic Venous Insufficiency

- Lower extremity edema that worsens with standing
- Itching, dull leg discomfort or pain that increases with standing
- Thin, shiny, atrophic skin
- Cyanosis and brown skin pigmentation of lower leg and foot
- Possible weeping dermatitis
- Thick, fibrous (hard) subcutaneous tissue
- Recurrent ulcerations of medial or anterior ankle

TABLE 35–6 Comparison of Arterial and Venous Leg Ulcers

FACTOR	ARTERIAL ULCERS	VENOUS ULCERS
Location	Toes, feet, shin	Over medial or anterior ankle
Ulcer appearance	Deep, pale	Superficial, pink
Skin appearance	Normal to atrophic Pallor on elevation Rubor on dependency	Brown discoloration Stasis dermatitis Cyanosis on dependency
Skin temperature	Cool	Normal
Edema	Absent or mild	May be significant
Pain	Usually severe Intermittent claudication Rest pain	Usually mild Aching pain
Gangrene	May occur	Does not occur
Pulses	Decreased or absent	Normal

tibiotic solution also may be used (Kasper et al., 2005). The ulcer may be treated by using a semirigid boot applied to the foot and lower leg. This device may be made of Unna's paste or Gauzetex bandage. Bony prominences must be well padded. The boot must be changed every 1 to 2 weeks, depending on the amount of drainage from the ulcer. This device often allows ambulatory treatment.

A very large, chronic ulcer may require surgery. In this case, the incompetent veins are ligated, the ulcer is excised, and the area is covered with a skin graft (see Chapter 17 ∞).



NURSING CARE

Nursing care for the client with chronic venous insufficiency is primarily educative and supportive. Client teaching includes the following recommendations:

- Elevate the legs while resting and during sleep. See the box on page 1196 for a nursing research study that suggests the supine position for resting.
- Walk as much as possible, but avoid sitting or standing for long periods of time.
- When sitting, do not cross your legs or allow pressure on the back of the knees (such as sitting on the side of the bed).
- Do not wear anything that pinches your legs (such as knee-high hose, garters, or girdles).
- Wear elastic hose as prescribed. The elastic hose should be tighter over the feet than at the top of the leg. Be sure the tops of the elastic hose do not cut into your legs. Put on the hose after you have had your legs elevated.
- Keep the skin on your feet and legs clean, soft, and dry.
- Follow guidelines in Box 35–4 for care of the legs and feet.

The following nursing diagnoses may apply to the client with chronic venous insufficiency.

- *Disturbed Body Image* related to edema and stasis ulcers on lower leg
- *Ineffective Health Maintenance* related to lack of knowledge about disorder and prescribed treatments
- *Risk for Infection* related to ulcerations

- *Impaired Physical Mobility* related to pain and edema in lower legs
- *Impaired Skin Integrity* related to presence of stasis ulcers
- *Ineffective Tissue Perfusion: Peripheral* related to incompetent venous valves.

See other sections of this chapter for specific nursing interventions related to many of these diagnoses. See the box on page 1196 for nursing care for the older adult with chronic venous stasis.

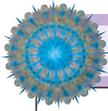
THE CLIENT WITH VARICOSE VEINS

Varicose veins are irregular, tortuous veins with incompetent valves. Varicosities may develop in any vein, and may be called by other names, such as hemorrhoids in the rectum and varices in the esophagus. Varicosities usually affect the veins of the lower extremities; the long saphenous vein is often affected, and they also may develop in the short saphenous vein.

Incidence and Risk Factors

Varicose veins affect about 2% of people in industrialized nations. They are more common in women over age 35. Studies also suggest that the increased risk for varicose veins in women may relate to venous stasis during pregnancy. Aging is a risk factor, possibly related to decreased exercise and other factors that contribute to venous stasis. People in occupations that involve prolonged standing (such as beauticians, salespeople, and nurses) also have an increased incidence of varicose veins. Race is a risk factor: Whites are more frequently affected than blacks. The majority of people with primary varicose veins (those affecting superficial veins) have a family history of the disorder, suggesting a genetic link (Porth, 2005).

Most varicosities occur in the deep veins of the legs. Contributing causes include obesity, venous thrombosis, congenital arteriovenous malformations, or sustained pressure on abdominal veins (as in pregnancy and/or the presence of abdominal tumors). The effects of gravity, produced by long periods of standing, are a major causative factor.



NURSING RESEARCH Evidence-Based Practice for the Client with Venous Leg Ulcers

Chronic leg ulcers due to venous insufficiency are a challenge to treat and heal. Oxygen is necessary for tissue repair and to prevent infection; however, peripheral perfusion to deliver oxygen to the tissues is impaired in clients with chronic venous insufficiency. Using measurements of transcutaneous tissue oxygen (TcPo₂), a group of nurse researchers evaluated the effects of four different positions and supplemental oxygen on a small group of subjects with venous ulcers (Wipke-Tevis et al., 2001). Not surprisingly, these researchers found lower extremity resting TcPo₂ levels in clients with venous ulcers than in healthy adults. Changes in position resulted in minimal TcPo₂ changes in tissue surrounding the ulcer. When supplemental oxygen was given, TcPo₂ levels were higher in the supine position than with the legs elevated, sitting, or standing. These results suggest that control of peripheral circulation and tissue oxygenation may be impaired in clients with venous ulcers.

IMPLICATIONS FOR NURSING

The results of this study support advising clients with chronic venous ulcers to stay off their feet and rest in bed as much as possible to promote healing of venous ulcers.

Remove compression stockings and devices while the client is in bed to promote perfusion of subcutaneous tissues and of the region surrounding the ulcer itself. Discuss the effects of position on peripheral tissue perfusion with clients, and encourage frequent rest periods during the day. Consider discussing the option of supplemental oxygen therapy for a client with delayed ulcer healing with the primary care provider.

CRITICAL THINKING IN CLIENT CARE

1. What is the usual response of blood vessels to changing positions from supine or sitting to standing? How does this compare with the results found here?
2. What is required for tissue healing? What measures can the nurse take to promote tissue healing in a client with impaired peripheral tissue perfusion?
3. How do the measures used to treat arterial and venous ulcers compare? Explain the rationale for differing treatment measures.

Pathophysiology

Varicose veins are classified as primary (with no involvement of deep veins) or secondary (caused by the obstruction of deep veins). In both cases, long-standing increased venous pressure stretches the vessel wall. This sustained stretching impairs the ability of the venous valves to close, causing them to become incompetent.

The erect position produces a twofold negative effect on the veins. When standing, the leg veins resemble vertical columns and must withstand the full force of venous blood pressure. Prolonged standing, the force of gravity, lack of leg exercise, and incompetent venous valves all weaken the muscle-pumping

mechanism, reducing venous blood return to the heart. As standing continues, the amount of blood pooled in the veins increases, further stretching the vessel wall. The venous valves become increasingly incompetent.

Manifestations

Although varicose veins may be asymptomatic, most cause manifestations such as severe aching leg pain, leg fatigue, leg heaviness, itching, or feelings of heat in the legs. The degree of valvular incompetence does not seem to correlate well with the extent of symptoms. The menstrual cycle tends to worsen symptoms, suggesting a possible correlation with hormonal factors in women. Assessment reveals obvious dilated, tortuous veins beneath the skin of the upper and lower leg. If varicose veins are long standing, the skin above the ankles may be thin and discolored, with a brown pigmentation. See the Manifestations box below.

Complications

Complications of varicose veins include venous insufficiency and stasis ulcers. Chronic stasis dermatitis may also develop. Superficial venous thrombosis may develop in varicose veins, especially during and after pregnancy, following surgery, and in clients on estrogen therapy (oral contraceptives or hormone replacement therapy).

NURSING CARE OF THE OLDER ADULT Chronic Venous Stasis

Disorders of venous stasis are common after the fifth decade of life. Aging affects vessels and tissues, increasing the risk for venous insufficiency and varicose veins. In addition, mobility frequently declines with aging, reducing the effect of the muscle pump in promoting venous return.

Regular exercise, walking in particular, is an important part of the treatment plan. Safety when walking is an important issue for older clients. Assess the client's mobility and stability during ambulation. If appropriate, suggest using a walker and quad-cane as needed. Assist older clients holding jobs that require prolonged standing to identify strategies to minimize standing and incorporate periods of activity into their work.

Following surgery or during treatment for stasis ulcers, older clients may need additional assistance with home care and maintenance. Initiate referral to social services as needed to arrange for home nursing care, meals, assistance with ADLs, and home maintenance services as indicated. In some instances, temporary placement in an extended care facility is necessary until the client and family can assume care.



MANIFESTATIONS of Varicose Veins

- Severe, aching pain in the leg
- Leg fatigue, heaviness
- Itching of the affected leg (stasis dermatitis)
- Feelings of warmth in the leg
- Visibly dilated veins
- Thin, discolored skin above the ankles
- Stasis ulcers

INTERDISCIPLINARY CARE



Varicose veins usually can be managed using conservative measures, although surgery may be required if symptoms are severe, when complications develop, or for cosmetic reasons.

Diagnosis

While varicose veins often are diagnosed by the history and physical examination, diagnostic tests may be ordered.

- *Doppler ultrasonography* or *duplex Doppler ultrasound* may be performed to identify specific locations of incompetent valves. This test is particularly useful before surgery to identify valves that allow reflux of blood from the femoral, popliteal, or peripheral deep veins into the superficial veins (Tierney et al., 2005).
- *Trendelenburg test* may be performed to determine the underlying cause of superficial venous insufficiency. The leg is elevated, then an elastic tourniquet is placed around the distal thigh. The varicosities then are observed as the client stands. When valves of the deep veins are incompetent, the veins remain flat on standing; they rapidly distend when the superficial venous valves are the underlying cause.

Treatments

Although there is no real cure, conservative measures are the core of treatment for most clients with uncomplicated varicose veins. These measures often relieve symptoms and prevent complications by improving venous circulation and relieving pressure on venous tissues. Properly fitted graduated compression stockings are commonly prescribed. They compress the veins, propelling blood back to the heart. Compression stockings augment the muscle pumping action of the legs. When worn during times of prolonged standing and in combination with frequent leg elevation, compression stockings often prevent progression of the condition and development of complications.

Regular, daily walking also is important. Prolonged sitting and standing are discouraged, although elevating the legs for specified periods during the day is beneficial. Leg elevation promotes venous return, prevents venous stasis, and decreases leg heaviness and fatigue.

Compression Sclerotherapy

In compression sclerotherapy, a sclerosing solution is injected into the varicose vein and a compression bandage is applied for a period of time. This obliterates the vein. Venous blood is rerouted through healthy vessels whose valves are not compromised. Compression sclerotherapy may be used to treat small, symptomatic varicosities. It may be the primary treatment, or it may be used in conjunction with varicose vein surgery. While compression sclerotherapy may be done for cosmetic reasons, complications such as phlebitis, tissue necrosis, or infection may occur and need to be considered prior to the procedures.

Surgery

Surgical treatment of varicose veins generally is reserved for clients who are very symptomatic, experience recurrent superficial venous thrombosis, and/or develop stasis ulcers. The objective of surgery is to remove the diseased veins. It may be considered for cosmetic reasons.

Surgery usually involves extensive ligation and stripping of the greater and lesser saphenous veins (Kasper et al., 2005). The evening before surgery, the surgeon marks all incompetent superficial and perforating varicose veins with a permanent ink marker. Under either regional or general anesthesia, the greater saphenous vein is removed and the connected smaller tributaries that have not naturally clotted off are tied off. Multiple small incisions may be made over the varicosities, allowing removal of the affected segments of the vein. Incompetent tributaries that communicate with larger vessels also are ligated. For clients with less extensive disease or clients seeking cosmetic improvement, surgery may involve only the removal of the lesser saphenous vein through an incision in the popliteal fossa.

Postoperative care includes applying pressure bandages for a minimum of 6 weeks, elevating the extremities to minimize postoperative edema, and gradually increasing amounts of ambulation. Sitting and standing are prohibited during the initial recovery period, and are gradually reintroduced as deemed appropriate by the surgeon.



NURSING CARE

Health Promotion

Health promotion activities to reduce the incidence of varicose veins include teaching all clients, particularly young women, the benefits of regular exercise continued over the lifetime. Discuss the effect of prolonged sitting or standing on the legs, and encourage the client whose occupation involves these activities to periodically get up and move or to sit with the legs elevated. Encourage all clients to maintain normal weight for their height.

Assessment

Focused assessment of the client with varicose veins includes the following:

- *Health history*: Complaints of leg pain, aching, heaviness, or fatigue; ankle swelling; history of venous thrombosis.
- *Physical examination*: Visible, dilated, tortuous superficial veins in lower extremities.

Nursing Diagnoses and Interventions

In planning and providing nursing care for clients with varicose veins, emphasis is placed on the importance of health teaching to manage the symptoms of varicose veins, particularly because there is no cure for the disease. Nursing care for clients who have undergone surgical treatment for varicose veins focuses on assessing and promoting wound healing and preventing infection. Nursing diagnoses may include those related to pain, impaired tissue perfusion and skin integrity, and a risk for impaired neurovascular function.

Chronic Pain

Varicose veins can lead to pooling of venous blood in the lower extremities. Venous congestion can cause a dull ache or feeling of pressure in the legs, particularly after prolonged standing. As

venous pressure rises, arterial circulation and delivery of oxygen and nutrients to tissues is impaired. Tissue ischemia contributes to the pain. The pain associated with varicose veins tends to be chronic, developing and progressing gradually over a long period of time.

- Assess pain, including its intensity, duration, and aggravating and relieving factors. *Pain assessment allows collaborative planning with the client to identify appropriate interventions.*
- Inquire about current measures being used by the client to manage pain and its effects. Ask about the effectiveness of current management strategies and the desire to change. *Chronic pain management ultimately falls to the client. Strategies to address the pain must meet the client's needs.*

PRACTICE ALERT

Suggest keeping a diary of pain intensity, timing, precipitating events, and effectiveness of relief measures. Systematic tracking of pain is an important measure in improving its management.

- Teach and reinforce nonpharmacologic pain management strategies such as progressive relaxation, imagery, deep breathing, distraction, and meditation. *The effectiveness of such strategies is well documented. Nonpharmacologic measures provide a variety of options for controlling pain while maintaining independence. These measures also can reduce reliance on analgesics.*
- Collaborate with the client to establish a pain control plan. *Collaborative planning for pain management increases the client's sense of control and reduces powerlessness. This, in turn, enhances the ability to cope with pain and its effects.*
- Regularly evaluate the effectiveness of planned interventions and pain management strategies. *Regular evaluation allows modification of the care plan as needed, as well as providing a measure of disease progression. Increasing or poorly controlled pain may necessitate additional collaborative interventions to manage the disorder.*

Ineffective Tissue Perfusion: Peripheral

Varicose veins and venous stasis impair delivery of nutrients and oxygen to peripheral tissues as elevated venous pressures interfere with blood flow through the capillary beds. Improving venous blood flow reduces venous pressures and promotes arterial flow to peripheral tissues.

- Assess peripheral pulses, capillary refill, skin color and temperature, and extent of edema. *Assessment of arterial flow and tissue perfusion provides baseline and continuing data for evaluating the effectiveness of interventions.*
- Teach application and use of properly fitted elastic graduated compression stockings. *Elastic compression stockings compress the veins, promoting venous return from the lower extremities. During ambulation, the stockings enhance the blood-pumping action of the muscles. Because elastic stockings inhibit blood flow through small superficial ves-*

sels, they should be removed at least once each day for at least 30 minutes.

PRACTICE ALERT

Instruct to maintain a program of regular exercise, such as walking for 20 to 30 minutes several times a day. Exercise stimulates circulation and promotes blood flow through the vascular system. When ambulation is restricted, active ROM exercises help maintain muscle tone, joint mobility, and venous return.

- Advise to elevate the legs for 15 to 20 minutes several times a day and to sleep with the legs elevated above the level of the heart. *Elevating the legs promotes venous return, reducing tissue congestion and improving arterial circulation. Improved venous return also increases the cardiac output and renal perfusion, promoting elimination of excess fluid and decreasing peripheral edema.*

Risk for Impaired Skin Integrity

Ineffective venous valve function impairs venous return and increases venous pressures. These increased pressures oppose arterial blood flow and the delivery of oxygen and nutrients to the cells. As a result, tissues are vulnerable to any additional insult, and may break down.

- Assess lower extremity color, temperature, moisture, and for evidence of pressure or breakdown on admission and at each visit. *Initial and continuing assessment allows timely detection of early signs of skin and tissue breakdown. This, in turn, allows early institution of measures to prevent further tissue damage and promote healing.*
- Teach foot and skin care measures such as daily cleansing with nondrying soap, gentle drying, and lotions to prevent skin dryness and cracking. *Cleansing removes potentially harmful microorganisms and stimulates circulation. Care is taken to keep the skin moist and supple, promoting its function as the first line of defense against infection.*
- Discuss the importance of adequate nutrition and fluid intake. *Adequate nutrients are necessary to maintain tissue integrity and promote healing. A diet high in protein, carbohydrates, and vitamins and minerals promotes growth and maintenance of skin cells, provides energy, and helps prevent skin breakdown. Adequate hydration helps maintain the moisture and turgor of skin, reducing the risk of drying and breakdown.*

Risk for Peripheral Neurovascular Dysfunction

Severe varicose veins can lead to chronic venous insufficiency, impaired arterial circulation, and ultimately, disrupted sensation in the affected extremity. Impaired neurologic function increases the client's risk for injury and infection of the extremity, because minor trauma may go unnoticed.

- Assess circulation, sensation, and movement of the lower extremities. *Disrupted circulation and venous congestion may interfere with sensory and motor function of the affected extremity. The potential for nerve and muscle involvement is especially high in clients with venous stasis ulcers.*

PRACTICE ALERT

Instruct to report signs of neurovascular dysfunction, such as numbness, coldness, pain, or tingling of an extremity. Early recognition of neurovascular dysfunction facilitates institution of interventions to prevent complications. Because the postoperative hospital stay following varicose vein surgery or venous stasis ulcer repair is brief, manifestations of neurovascular dysfunction may initially be detected by the client. Careful assessment and prompt reporting help prevent potential complications such as skin breakdown, infection, and nerve damage.

- Teach measures to protect the extremities from injury, such as always wearing shoes or firm slippers, cotton socks to absorb moisture, and testing the temperature of bath water with a thermometer or the upper extremities before stepping in. *Sensation in the lower extremities may be affected by poor circulation, necessitating additional measures to protect the legs and feet from injury.*

Community-Based Care

Most clients with varicose veins provide self-care at home. Include the following topics when preparing the client and family for home care:

- Leg elevation and exercise program
- Application and use of graduated elastic compression stockings
- Foot and leg care (see Box 35–4)
- Measures to avoid injury and skin breakdown
- Symptoms or potential complications to report to the physician.

Provide information about suppliers for elastic stockings and any other required supplies. If venous stasis ulcers have developed, consider referral to home health services for regular assessment of healing and additional teaching.

DISORDERS OF THE LYMPHATIC SYSTEM

The lymphatic system, which includes the lymphatic vessels and the lymph nodes, is a unique part of the circulatory system. The lymphatic system returns plasma and plasma proteins filtered out of the capillaries from interstitial tissues to the bloodstream. This fluid is called *lymph*. The lymphatic system consists of closed capillaries leading to larger lymphatic venules and lymphatic veins. These vessels contain smooth muscle and one-way valves that help move fluid toward the heart. Lymphatic vessels share the same sheath as arteries and veins; arterial pulsations and skeletal muscle contractions compress the lymphatic vessels to assist in maintaining lymph flow. As lymph moves through the lymphatic system, it is filtered through thousands of bean-shaped lymph nodes clustered along the vessels. Within these nodes, phagocytes remove foreign material from the lymph, preventing it from entering the bloodstream.

THE CLIENT WITH LYMPHADENOPATHY

Lymphadenopathy, enlarged lymph nodes, may be localized or generalized. Localized lymphadenopathy usually results from an inflammatory process (e.g., streptococcal pharyngitis or an infected wound). The node enlarges as lymphocytes and monocytes proliferate within the node to destroy infectious material. Palpable lymph nodes often develop in response to minor trauma or a localized infection. Generalized lymphadenopathy usually is associated with malignancy or disease. Malignant cells or other abnormal cells invade the node, causing it to enlarge.

Lymphangitis, inflammation of the lymph vessels draining an infected area of the body, is characterized by a red streak along the inflamed vessels, pain, heat, and swelling. Fever and chills also may be present. Local lymph nodes are swollen and tender.

Treatment for lymphadenopathy and lymphangitis focuses on identifying and treating the underlying condition. Elevating the body part and applying heat to inflamed lymphatic ves-

sels help reduce swelling and promote blood flow to the affected area.

THE CLIENT WITH LYMPHEDEMA

Lymphedema may be a primary or a secondary disorder, resulting from inflammation, obstruction, or removal of lymphatic vessels. It is characterized by extremity edema due to accumulation of lymph. *Primary lymphedema* is uncommon, affecting about 1 in 10,000 people. It affects females more frequently than males, and may be associated with a genetic disorder such as Turner syndrome or Klinefelter syndrome. See the accompanying Genetic Considerations box.

Secondary lymphedema is an acquired condition, resulting from damage, obstruction, or removal of lymphatic vessels. The most common worldwide cause of secondary lymphedema is *filariasis*, infestation of the lymphatic vessels by filaria, a nematode worm. Other important causes of secondary lymphedema include recurrent episodes of bacterial lymphangitis, obstruction of lymph vessels by tumors, and surgical or radiation treatment for breast cancer (Kasper et al., 2005).

GENETIC CONSIDERATIONS**Primary Lymphedema**

- Primary lymphedema develops as a result of agenesis, hypoplasia, or obstruction of lymphatic vessels.
- *Congenital lymphedema* appears shortly after birth; two other forms of lymphedema develop later, one at the time of puberty (*lymphedema praecox*), the other usually after age 35 (*lymphedema tarda*).
- Congenital lymphedema and lymphedema praecox may be inherited as an autosomal dominant trait with variable penetrance.
- Lymphedema also may be inherited (although less commonly) as an autosomal or sex-linked recessive disorder (Kasper et al., 2005).

Pathophysiology and Manifestations

Obstruction of lymph drainage prevents fluid and protein molecules from interstitial tissues from returning to the circulation. The protein molecules increase the osmotic pressure in interstitial tissues, drawing in additional fluid that causes edema in the soft tissues. One or both extremities may be affected.

The edema begins distally, progressing up the limb to involve the entire extremity. Initial edema is soft and pitting; with chronic congestion, subcutaneous tissues become fibrotic, causing thick, rough skin and a woody texture of the limb (*brawny edema*). In contrast, the edema associated with venous disorders is softer, and the skin often is hyperpigmented with evidence of stasis dermatitis. Lymphedema generally is painless, although the limb may feel heavy.

INTERDISCIPLINARY CARE

Interdisciplinary care for the client with lymphedema focuses on relieving edema and preventing or treating infection. The disorder may be difficult to treat effectively, and can lead to progressive disability due to the weight and awkwardness of the affected extremity.

Diagnosis

Abdominal or pelvic ultrasound and CT scans are used to detect obstructing lesions. MRI can show edema and identify lymph nodes and enlarged lymphatic vessels. More invasive procedures such as lymphangiography and radioactive isotope studies may occasionally be necessary to identify the lymphatic defect causing lymphedema.

- *Lymphangiography* uses injected contrast media to illustrate lymphatic vessels on x-rays. Organic dyes are used to identify a distal lymphatic vessel, and then a contrast medium is injected into the vessel for visualization of the lymphatic system of the limb. In primary lymphedema, lymph vessels are absent or hypoplastic (underdeveloped). In secondary lymphedema, lymph channels often are dilated; it may be possible to determine the level of obstruction (Kasper et al., 2005).
- *Lymphoscintigraphy* involves injecting a radioactively tagged substance into distal subcutaneous tissues of the extremity, then mapping its flow through the lymphatic system. The pattern of lymph fluid distribution and transport is abnormal in clients with lymphedema.

Treatments

Meticulous skin and foot care is vital to prevent infection in the affected extremity. Shoes should always be worn to reduce the risk of injury. Careful cleansing and use of emollient lotions are recommended to prevent drying of the skin. Exercise is encouraged, as are frequent periods of leg elevation. The foot of the bed is raised by 15 to 20 degrees at night to promote lymph flow. Elastic graduated compression stockings may be ordered for use during the day. In some cases, an intermittent pneumatic compression device to reduce edema may be prescribed for home use.

Antibiotics are given to prevent and treat infection, which can be recurrent and difficult to eradicate. Diuretic therapy may be used intermittently, particularly when primary lymphedema is exacerbated by the menstrual cycle or seasonal variability (Tierney et al., 2005).

Clients who do not respond to conservative treatment measures or who experience recurrent episodes of cellulitis and lymphangitis may require surgical treatment. Microvascular techniques may be used to create anastomoses between obstructed lymphatic vessels and adjacent veins, providing channels to redirect lymph into the venous system. Successful surgery may improve both extremity function and its cosmetic appearance (Tierney et al., 2005).



NURSING CARE

Nursing care for clients with lymphatic disorders focuses on reducing edema, preventing tissue damage related to the edema, and promoting effective coping with the effect of the disorder on body image and function.

Nursing Diagnoses and Interventions

Nursing diagnoses for the client with lymphedema may include *Impaired Tissue Integrity*, *Excess Fluid Volume*, and *Disturbed Body Image*.

Impaired Tissue Integrity

Obstructed lymphatic flow leads to fluid congestion of the interstitial spaces of subcutaneous tissue. The resulting edema compresses and damages tissues of the affected extremity. Subcutaneous tissues become fibrotic, reducing their protective functions of shock absorption and insulation. In addition, obstructed lymphatic flow reduces the effectiveness of lymph nodes in filtering and removing foreign material and pathogens from the body. This increases the risk for local tissue infection such as *cellulitis*, a diffuse bacterial infection of the skin. Cellulitis increases the risk for skin and tissue breakdown and, if not effectively treated, can lead to sepsis.

PRACTICE ALERT

Frequently inspect the skin of the affected extremity, documenting condition with each assessment. Promptly report areas of pallor, redness, or apparent inflammation. Breaks in the skin surface allow microbial invasion, and increase the risk for infection. Prompt identification and treatment of any lesions is vital to prevent further tissue breakdown and infection.

- Apply well-fitting elastic graduated compression stockings or intermittent pneumatic pressure devices as ordered. *Elastic stockings and/or pneumatic pressure devices oppose the movement of fluid out of capillaries and improve its reabsorption into vascular spaces for transportation back to the heart.*

PRACTICE ALERT

Remove elastic stockings and intermittent pressure devices every 8 hours or at each home visit to inspect the underlying skin for evidence of redness, irritation, dryness, or breakdown. Elastic graduated compression stockings, antiembolic stockings, and pneumatic compression devices compress small vessels nourishing the skin and subcutaneous tissue. Periodic removal not only allows inspection of the underlying skin, but also allows restoration of blood flow to these small vessels and the tissues.

- Instruct to elevate the extremities while seated and during sleep. *Elevation of the extremities diminishes venous congestion, promotes venous return, facilitates arterial circulation and tissue perfusion, and helps reduce the accumulation of excess fluids in interstitial spaces of the affected extremity.*

PRACTICE ALERT

Use preventive skin care devices as indicated. Collected fluid in the affected extremity increases its weight and interferes with regular movement. The increased weight places greater pressure on surfaces of the limb that come in contact with furniture. Protective devices such as egg-crate foam, sheepskin, pillows, or padding help prevent tissue compression, promoting circulation and reducing the risk of skin and tissue breakdown.

- Keep skin clean and dry, especially in interdigital spaces. Teach skin and foot care to the client and family. *Clean, dry skin provides the first line of defense against infection. Significant limb edema can interfere with reaching the distal extremity and cleaning interdigital spaces. The dark, moist spaces between the toes are an excellent environment for bacterial growth. Teaching fosters self-care and independence, as well as preparing the client and family to manage this often chronic condition.*
- Discuss the importance of adhering to the therapeutic regimen. *Lymphedema generally is a chronic condition; effective management requires active client participation in planning and implementing care to reduce edema and maintain tissue integrity.*

Excess Fluid Volume

In lymphedema, obstruction, destruction, or congenital malformation of lymphatic vessels interferes with the normal circulation of lymphatic fluid. As a result, lymph collects in the subcutaneous tissues of the affected extremity, causing excess fluid volume of that extremity. Some clients may benefit from intermittent diuretic therapy and dietary sodium restriction.

PRACTICE ALERT

Monitor intake and output and/or weight (daily or weekly). Use consistent scales, timing, and clothing for accurate weight measurements. Intake and output records and short-term changes in weight reflect fluid balance. Measures of fluid balance permit evaluation of the effectiveness of interventions such as restricted sodium intake and diuretic therapy.

- Discuss the rationale for restricted sodium intake if ordered. Teach ways to maintain the recommended sodium restriction, and assist to choose foods that are low in sodium. *Sodium causes retention of extracellular water; restricting dietary sodium may help prevent additional fluid accumulation in interstitial spaces.*
- During acute periods, assess the affected extremity daily for increased edema; measure girth of the extremity using consistent technique. *The size of the affected extremity provides a measure of the effectiveness of ordered interventions and progression of the disorder.*

Disturbed Body Image

The disproportionate size of an extremity or extremities due to lymphedema can profoundly affect body image. During early

stages of the disease, conservative measures may effectively reduce the edema and size of the affected limb. However, as the disease progresses, conservative measures may become less effective, leading to more permanent disfigurement. Mobility may be impaired, and the client may develop an increasingly negative self-perception.

- Encourage discussions about usual coping patterns and perception of self. *Knowledge of existing coping patterns and behaviors helps the nurse assess the client's ability to cope with the current situation. This knowledge is then used to reinforce effective coping mechanisms and help develop more effective coping strategies. This exchange also allows the client to voice feelings related to actual or perceived changes in body image.*
- Accept the client's perception of self and of the impact of the changes in appearance. *Nonjudgmental acceptance of the client's view of self and of the effects of changes in appearance builds trust and promotes rapport. A trusting relationship promotes the client's ability to take an active role in managing the disorder, participate in healthcare decisions, and adhere to the plan of care. Nonjudgmental listening also promotes mutual respect and demonstrates caring and compassion.*
- Encourage active participation in self-care. Assist with identifying alternative self-care strategies when the extent of edema interferes with performing some aspects of self-care such as trimming toenails or washing feet. *The client initially may have difficulty viewing or touching the affected body part. Gentle encouragement and support from the nurse helps the client assume self-care and accept the affected body part. Brainstorming to identify alternative care strategies promotes the client's independence even when total self-care is not feasible.*

Community-Based Care

When preparing the client with chronic lymphedema and family to manage the disorder, include the following teaching topics:

- Recommended program of exercise and elevation of the extremity
- Foot and skin care
- Use of elastic graduated compression stockings and/or intermittent pressure devices
- Importance of wearing elastic stockings during the majority of waking hours, removing them once during the daytime and while sleeping
- Measures to prevent infection in the affected extremity, such as wearing gloves while gardening
- Signs and symptoms to report to the healthcare provider (e.g., manifestations of tissue breakdown or infection, increasing edema, or evidence of compromised circulation)
- Use and precautions associated with any prescribed medications
- Sodium-restricted diet if ordered.

Provide information about contacts for questions, and make referrals as needed. Evaluate the need for home health, home maintenance assistance, and other services such as physical or occupational therapy.

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NCLEX-RN® Review
Care Plan Activity: Lymphedema
Case Study: Abdominal Aortic Aneurysm
MediaLink Application
Calcium Channel Overdose
Peripheral Vascular Disease
Links to Resources



CHAPTER HIGHLIGHTS

- Essential hypertension, blood pressure of 140/90 or higher with no clearly identified cause, rarely causes symptoms but is a major risk factor for coronary heart disease, heart failure, stroke, and renal insufficiency.
- Prehypertension, a newly identified category, is an average blood pressure of 120–139/80–89. Clients with prehypertension are advised to make lifestyle changes indicated for hypertension (weight loss, exercise, dietary changes, limited alcohol intake, and stress reduction), but generally are not treated with medications unless other risk factors such as diabetes or kidney disease are present.
- Systolic hypertension, an elevated systolic blood pressure without elevation of the diastolic pressure, is common in older adults and contributes to complications such as coronary heart disease and stroke.
- Medications to treat hypertension include diuretics, alpha- and beta-adrenergic blockers, ACE inhibitors and angiotensin II blockers, calcium channel blockers, and vasodilators. A combination of two or more drugs often is required for effective blood pressure control.
- Aneurysms, abnormal dilation of a blood vessel, commonly affect the aorta and the iliac arteries, particularly in older men. A slowly expanding abdominal aortic aneurysm that does not produce symptoms or impair flow through the renal arteries may not be repaired, particularly in an older client. Percutaneously inserted endovascular splints provide an alternative to surgery for abdominal aortic aneurysms.
- Peripheral vascular disease, obstruction or occlusion of peripheral arteries by atherosclerotic plaque, is common and a leading cause of disability and amputation.
- Smoking cessation and regular daily exercise are key components of treatment for peripheral vascular disorders such as atherosclerosis, thromboangiitis obliterans, and Raynaud's disease.
- Venous thrombosis, particularly of the deep veins of the legs and pelvis, develops as a result of venous stasis, blood vessel damage, and increased coagulability of the blood. The developing clot may fragment or break loose, becoming an embolus that typically lodges in the pulmonary circulation (pulmonary embolus). Chronic venous insufficiency and venous stasis may develop as a result of deep venous thrombosis.
- Prophylactic anticoagulation and mobilization of the client are the primary preventive measures for venous thrombosis. Monitoring coagulation studies and assessing for evidence of bleeding (overt or covert) are important nursing measures for the client on anticoagulant therapy.
- Lymphadenopathy (enlarged lymph nodes), lymphangitis (inflammation of the lymph vessels), and lymphedema are the most common disorders affecting the lymph system.

TEST YOURSELF NCLEX-RN® REVIEW

- 1 A potential blood donor whose blood pressure is found to average 180/106 on two different readings tells the nurse, "I don't understand how it could be so high—I feel just fine." The appropriate response by the nurse is:
 1. "This is probably just a false reading due to 'white coat syndrome.' Don't worry about it."
 2. "It is unusual that you are not having some symptoms such as severe headaches and nosebleeds."
 3. "High blood pressure often has few or no symptoms; that's why it is called the 'silent killer.'"
 4. "You probably should have your blood pressure rechecked in 3 months or so and then follow up with your primary care provider if it is still high."
- 2 The nurse teaching a client about the DASH diet determines that additional teaching is necessary when the client states:
 1. "I'm glad I can still eat as much pasta as usual; I was afraid I would have to give up my weekly lasagna."
 2. "It will be a challenge to incorporate all those servings of fruits and vegetables into my diet."
 3. "Having a handful of nuts when the pre-dinner 'munchies' hit is a good idea."
 4. "I will enjoy having frozen yogurt as my bedtime snack on occasion."

- 3** The nurse teaching a client about his new prescription for Diovan HCT, a combination angiotensin II receptor blocker and thiazide diuretic, includes which of the following in his instructions? (Select all that apply.)
1. Use a potassium-based salt substitute to prevent hypokalemia while taking this drug.
 2. Use caution when rising from bed or a chair to prevent dizziness.
 3. Take the drug at bedtime to reduce the risk of falling due to light-headedness.
 4. Report a persistent disruptive cough to your physician.
 5. You may stop taking this drug once your blood pressure is within the normal range for 2 months.
- 4** A client is complaining of new-onset calf and foot pain. The nurse notes that the leg below the knee is cool and pale, and that dorsalis pedis and posterior tibial pulses are absent. The priority nursing intervention is to:
1. notify the physician.
 2. place a cradle over the leg to prevent pressure from bedding.
 3. position the leg flat, supported in anatomic position.
 4. prepare to initiate heparin therapy.
- 5** An 86-year-old client with a newly diagnosed abdominal aortic aneurysm wonders if he will need surgery to repair the aneurysm, even though he feels fine. The nurse's response is based on the knowledge that:
1. the risk of surgical repair is lower than the risk that the aneurysm will rupture.
 2. opening the abdomen for the surgical procedure greatly increases the risk of rupture.
 3. surgery is indicated for type A aneurysms.
 4. a percutaneously inserted endovascular stent may be considered because of his age.
- 6** An expected assessment finding in a client with peripheral atherosclerosis would be:
1. pallor of the legs and feet when dependent.
 2. increased hair growth on the affected extremity.
 3. higher blood pressure readings in the affected extremity.
 4. impaired sensation in the affected extremity.
- 7** All of the following are appropriate home care measures for the client with peripheral vascular disease. Place them in order of priority.
1. foot and leg care
 2. smoking cessation
 3. daily inspection of feet and legs
 4. regular daily exercise
 5. weight loss strategies
- 8** The nurse evaluates her teaching of a client admitted with deep venous thrombosis as effective when the client states:
1. "I'll use a hard-backed, upright chair when sitting instead of my recliner."
 2. "I'll get my blood drawn as scheduled and notify the doctor if I have any unusual bleeding or bruising."
 3. "I understand why I am not allowed to exercise for the next 6 weeks and will take it easy."
 4. "I'll have my wife buy a low-cholesterol cookbook and we'll make an appointment with the dietician to learn about a low-fat, low-cholesterol diet."
- 9** A client with visible varicose veins tells the nurse that she wants to have surgery to remove them, because "my legs ache every evening and they are really ugly!" The most appropriate response would be:
1. "Often measures such as elevating your legs and elastic stockings can relieve the discomfort associated with varicose veins."
 2. "Surgery will have a good cosmetic effect, but will not relieve the discomfort associated with varicose veins."
 3. "All varicose veins should be surgically removed to restore adequate blood flow to your legs and prevent gangrene."
 4. "Surgery is never indicated unless the varicose veins are interfering with circulation. Have you tried cosmetic measures to cover them up?"
- 10** Which of the following nursing interventions is of highest priority for the client with lymphedema?
1. Elevate affected extremities at night.
 2. Assist to don elastic compression stockings during the day.
 3. Carefully dry and apply emollient lotion to affected extremities after bathing.
 4. Reinforce the importance of taking prescribed diuretics.

See *Test Yourself answers in Appendix C.*

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UNIT 10 BUILDING CLINICAL COMPETENCE

Responses to Altered Peripheral Tissue Perfusion

FUNCTIONAL HEALTH PATTERN: Activity-Exercise

- Think about clients with altered activity-exercise patterns and hematologic or peripheral vascular disorders for whom you have cared during your clinical experiences, and how the disease/disorder affected their activities.
 - What were the clients' major medical diagnoses (e.g., hypertension, anemia, leukemia, aneurysm, peripheral vascular disease, chronic venous insufficiency)?
 - What kinds of manifestations did each of these clients have? How were these manifestations similar or different among clients with different health conditions?
 - How did the clients' patterns of activity and exercise contribute to their health problems? Conversely, how did the clients' health status interfere with their daily activities and ability to exercise? Did the clients exercise regularly? Were the clients' symptoms affected by exercise, temperature changes, or changes in position? Did you observe changes in skin color, condition or temperature, hair distribution, or sensation? What other chronic medical conditions were present? What was your clients' history of alcohol or tobacco use?
- The Activity-Exercise Pattern describes patterns of activity, exercise, leisure, and recreation. Disorders that affect the blood or vascular system can lead to insufficient physiologic energy for activities, disrupting the activity-exercise pattern.

Blood transports oxygen, nutrients, hormones, and metabolic wastes; is vital to immune function; maintains hemostasis and contributes to homeostasis. Changes in the amount or composition of blood affect its function and ability to meet cellular metabolic demands, leading to manifestations such as:

 - Fatigue (low RBC or hgb levels ► reduced oxygen-carrying capacity ► tissue hypoxia ► decreased cellular energy production ► weakness, fatigue, shortness of breath with activity)
 - Frequent infections (impaired WBC production or increased WBC destruction ► impaired immune surveillance ► increased incidence of infections)
 - Bruising, petechiae, bleeding tendency (impaired bone marrow function ► decreased platelet production ► impaired ability to form stable clots ► bleeding into tissues and external)
- With each heartbeat, blood moves through a system of vessels that transport oxygenated blood to organs and tissues and return deoxygenated blood to the heart and lungs. The lymphatic system filters and returns excess tissue fluid (lymph) to the bloodstream.

Disorders of peripheral blood and lymphatic flow include constriction, obstruction, inflammation, and spasm. Arterial obstruction leads to tissue ischemia and insufficient oxygen to meet metabolic needs. Obstruction of a vein or lymph vessel increases pressure behind the obstruction, pushing fluid into interstitial spaces (edema), and interfering with oxygen delivery to the tissues. Manifestations often associated with peripheral vascular disorders include:

 - Intermittent claudication and impaired sensation (arterial occlusion ► decreased blood flow ► tissue ischemia ► pain, neuron damage ► paresthesias, impaired sensation)
 - Edema (venous or lymphatic vessel obstruction ► increased fluid pressure in capillary beds ► imbalance between capillary fluid loss and resorption ► increased interstitial fluid)
- Priority nursing diagnoses within the Activity-Exercise Pattern that may be appropriate for clients with hematologic or peripheral vascular disorders include:
 - *Ineffective Peripheral Tissue Perfusion* as evidenced by changes in skin color and temperature, lack of hair growth, skin irritations or ulcers
 - *Activity Intolerance* as evidenced by weakness, fatigue, vital sign changes with activity
 - *Fatigue* as evidenced by difficulty completing usual daily activities, frequent desire to rest
 - *Impaired Home Maintenance* as evidenced by inability to maintain family roles
 - *Risk for Peripheral Neurovascular Dysfunction* as evidenced by changes in color, temperature, sensation of extremities.
- Two nursing diagnoses from other functional health patterns often are of high priority for the client with altered hemotologic or peripheral tissue perfusion:
 - *Impaired Tissue Integrity* (Nutritional-Metabolic)
 - *Effective Therapeutic Regimen Management* (Health Perception-Health Management)

Directions: Read the clinical scenarios below and answer the questions that follow. To complete this exercise successfully, you will use not only knowledge of the content in this unit, but also principles related to setting priorities and maintaining client safety.

CLINICAL SCENARIO

You have been assigned to work with the following four clients for the 0700 shift on a cardiac medical-surgical unit. Significant data obtained during report are as follows:

- Theresa Cartwright is a 34-year-old female admitted for anticoagulant therapy after developing a deep venous thrombosis after a fall down the steps and hitting her calf. She was started on heparin yesterday and needs blood drawn for an activated partial thromboplastin time (aPTT) to determine her morning dose of heparin.
- Bessie Gregg is a 56-year-old with a 10-year history of alcoholism. She was admitted 2 days ago with pallor, shortness of breath, heart palpitations, weakness, and fatigue. She is agitated and requesting to be discharged.

- Scott Jacoby is a 25-year-old with Down syndrome. He was admitted yesterday with an upper respiratory infection. On assessment he was pale, T 101°F, P 100, R 30 with dyspnea on exertion, BP of 118/86, and multiple bruises and petechiae on his arms and legs. He is scheduled for a bone marrow examination this morning.
- Robert Tucker is a 65-year-old admitted 3 hours ago with moderate pain in the midabdominal region. On admission, a pulsating mass was felt in the midabdomen and a bruit was found over the same area. He is now complaining of severe pain in the midabdominal area.

Questions

- 1 In what order would you visit these clients after report?
 1. _____
 2. _____
 3. _____
 4. _____
- 2 What top two priority nursing diagnoses would you choose for each of the clients presented above? Can you explain, if asked, the rationale for your choices?

	Priority Nursing Diagnosis #1	Priority Nursing Diagnosis #2
Theresa Cartwright		
Bessie Gregg		
Scott Jacoby		
Robert Tucker		

- 3 Mrs. Cartwright needs further teaching regarding anticoagulant therapy when she makes which statement?
 1. "The heparin will be continued for four to five days for the Coumadin to reach a good effect."
 2. "I need to continue to have blood drawn to watch my drug levels as long as I am taking these drugs."
 3. "I cannot continue to take birth control pills while I am taking these drugs."
 4. "I need to take the medication at the same time every day for the drug to be effective."
- 4 The nurse explains to Mrs. Gregg that she needs a diet high in folic acid to treat her manifestations. Mrs. Gregg understands this diet when she picks which meal plan?
 1. chili with kidney beans, roll, and milk
 2. pork roast with baked potato and lemonade
 3. spaghetti with meat sauce and iced tea
 4. chicken and dumplings with coffee
- 5 Which is the most important for the client with leukemia to report?
 1. constipation and straining with bowel movements
 2. fever and burning on urination
 3. weight loss and decreased appetite
 4. dyspnea and shortness of breath with exercising
- 6 Which nursing interventions should reduce the risk of rupture of an aneurysm?
 1. Administer anticoagulant therapy medications.
 2. Instruct patient to hold the breath while moving.
 3. Maintain the patient on bed rest with the legs flat.
 4. Place the patient in a room near the nurse's station.

- 7 Which discharge instructions does the nurse teach the hypertensive client? (Select all that apply.)
 1. Maintain normal body weight.
 2. Eat a diet rich in fruits and vegetables.
 3. Reduce potassium intake.
 4. Limit alcohol to no more than 20 oz. of beer or 6 oz. of wine per day.
 5. Engage in aerobic exercise for 1 hour three times a week.
 6. Stop smoking.
- 8 Which nursing diagnosis has the highest priority for the client with varicose veins?
 1. *Body Image Disturbance*
 2. *Impaired Tissue Perfusion*
 3. *Activity Intolerance*
 4. *Risk for Infection*
- 9 With a history of Raynaud's disease, which is a priority teaching instruction for the client?
 1. Enter a smoking cessation program.
 2. Reduce dietary fats and carbohydrates.
 3. Wear gloves and socks in cold weather.
 4. Begin an exercise program.
- 10 A prescription for the calcium channel blocker diltiazem (Cardizem) is ordered for the client with hypertension. What will the nurse instruct the client regarding administration of the medication?
 1. Limit fluids to decrease the development of peripheral edema.
 2. Notify the physician for a pulse of less than 60 beats per minute.
 3. Increase fiber in the diet because diarrhea may be a side effect.
 4. Report tachycardia and an increase in blood pressure.
- 11 When the client is placed on warfarin (Coumadin) therapy, which laboratory studies would you expect to draw? (Select all that apply.)
 1. activated partial thromboplastin time (aPTT)
 2. international normalized ratio (INR)
 3. partial thromboplastin time (PTT)
 4. complete blood cell count (CBC)
 5. white blood cell count (WBC)
 6. prothrombin time (PT)
- 12 A client with history of hemophilia fell and cut his leg while hiking in the woods. Which intervention should the client do until help arrives?
 1. Apply a tourniquet above the cut.
 2. Splint the leg to prevent movement.
 3. Apply pressure to the femoral artery.
 4. Apply gentle pressure over the cut.

CASE STUDY



Grace Schmidt is a 49-year-old female who works as a teaching assistant at an elementary school. She comes to the medical clinic complaining of a throbbing headache and dizziness. Her height and weight are 5'6" and 245 pounds. Upon assessment her vital signs are P 100, R 16, BP lying is 180/115, sitting is 170/110, and standing is 165/105. Her skin is cool and dry. Her capillary refill is 4 seconds. She denies smoking, drinks an occasional glass of wine, and does not participate in a regular exercise program. She states that her job can be stressful at times. Nutrition assessment indicates a diet high in fats and sodium. She denies any family history of hypertension or heart disease. She is married and has a daughter and son who live in the same town. A medical diagnosis of hypertension is determined.

Based on Mrs. Schmidt's assessment, blood pressure readings, and weight, the priority nursing diagnosis of *Ineffective Health Maintenance* is identified for planning nursing care.

