

Peripheral vascular disease (PVD) is a leading health concern in the United States, with an estimated prevalence of 8.5 million. The incidence of PVD is growing due to increasing rates of obesity and diabetes, as well as an aging population. Peripheral vascular disease is categorized as either venous, arterial, or mixed. A differential assessment is essential to identify the type of PVD and to plan management strategies to prevent further vascular dysfunction. This article describes assessment of patients with PVD, risk factors, treatments, and patient education.

# Peripheral Vascular Disease

**P**eripheral vascular disease (PVD) is a leading health concern and is increasing in incidence due to obesity, diabetes, and an aging population. It affects approximately 8.5 million Americans, and more than 200 million worldwide (Benjamin et al., 2019). The cost for treating patients with a comorbidity of PVD is approximately \$7,000 annually per patient (Scully et al., 2018). Peripheral vascular disease is uncommon in patients under 50 years of age, but increases in prevalence with age and affects a substantial number of older adults (Criqui & Aboyans, 2015). Given that home care patients are typically 65 years or older, home care clinicians are highly likely to treat patients with PVD and use advanced assessment to create a therapeutic plan of care.

Vascular disease is categorized as either venous, arterial, or mixed. A differential assessment is essential to identify the type of PVD and plan management strategies. Venous dysfunction includes degrees of damage ranging from cosmetic concerns with spider telangiectasias or superficial varicosities, to chronic venous ulceration (Rasmussen et al., 2019). Venous disease is more common in females and older adults, and those with a family history (Kelechi et al., 2020). Venous vascular disease accounts for 75% of lower extremity ulcerations (Parker et al., 2017).

Peripheral arterial disease (PAD), though less frequent, is associated with increased patient

morbidity (Mills et al., 2014). If arterial dysfunction is not recognized and tissues do not receive adequate oxygenation, tissue death is certain. Peripheral arterial disease is most often secondary to atherosclerosis (Mills et al.). High glucose levels leading to peripheral neuropathy may also lead to skin breakdown, poor wound healing, and potential limb loss (Gerhard-Herman et al., 2017).

Mixed venous and arterial insufficiency involves not only sluggish venous return of blood to the heart but also an arterial component where arterial damage decreases blood flow. In this situation, signs and symptoms of both venous and arterial compromise are observed. See Table 1 for a summary of types of common vascular disorders.

## Peripheral Venous Vascular Disease

### Risk Factors and Assessment

The types and severity of venous vascular diseases are classified according to the Comprehensive Classification System for Chronic Venous Disorders (CEAP) system and the Venous Clinical Severity Scale. Factors considered in the CEAP system are listed in Table 2 (Lurie et al., 2020). In addition to ulcers, clinical signs and symptoms of muscle fatigue, heaviness, swelling when the legs are in a dependent position, and eczema may be present (Wrona et al., 2015). The patient's occupation can help identify risk factors

Constance F. Swenty, DNP, RN, CWON, and Mellisa Hall, DNP, RN, AGPCNP-BC, FNP-BC



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that place increased burden on the venous valves, such as sitting or standing in place for prolonged periods. Dependent edema is the classic early finding of venous dysfunction and is measured by the degree of pitting that remains on the extremity after slight pressure with a finger. Edema (Table 3) is rated on a scale of 0 (absent) to 4+ (very deep pit that lasts up to 2–5 minutes). Rating edema is important to evaluate the success of interventions. Also assess for brownish pigmentation of the lower extremities—the result of prolonged venous congestion leading to permanent hemosiderin staining from the heme component of stagnant whole blood (Firsowicz et al., 2019).

Venous stasis dermatitis develops over time as tissues subjected to chronic venous hypertension develop inflammatory changes. Skin will appear reddened and slightly warm from stasis, as opposed to tenderness that is characteristic of acute bacterial cellulitis. Treatment of venous stasis is focused on underlying pathology to prevent the development of cellulitis (Rasmussen et al., 2019). Venous stasis ulcers are most common on the lateral and medial aspects of the lower extremities. Ulcers located from the ankle proximal to the midcalf are often shallow and have serous exudate. The area of breakdown may be mildly tender or painless if there is coexisting peripheral neuropathy. The depth, height, and width of the ulcer

**Table 1. A Comparison of Arterial, Venous, and Vasculitis Lower Extremity Conditions**

	Arterial	Venous Insufficiency	Vasculitis
Definition	Lack of blood flow via arteries to the extremities that can be caused by atherosclerosis, clots, or damages, diseased, or weak.	Ulcers resulting from veins that do not efficiently return blood from the lower limbs to the heart. Valves in the veins channel the flow of blood toward the heart. When valves are damaged, blood leaks and pools in the legs and feet.	An autoimmune connective tissue inflammatory disorder that targets blood vessel.
Location	Toes; pressure area such as heels, malleolus, shin	“Gaiter Area,” midcalf to ankle. Medial or lateral malleolus is most common site	Commonly occur on the lower legs but can occur anywhere in the body.
Wound Description	Well demarcated ulcers that appear to be “punched out”; overlying necrotic eschar; extremely painful and experience intermittent claudication. Skin is shiny and thin with decreased hair. Pulses are diminished or absent.	Shallow ulcers; irregular borders; covered in yellow fibrinous exudate; pain is mild to moderate; pulses are present; erythema; Telangiectasia of feet and ankles; peripheral edema; varicosities; brown discoloration due to hemosiderin	Palpable purpura, red macules, nodules, ulcers, vesicles, or blisters can be noted. Are acutely painful. The degree of the manifestations is dependent upon the size of the vessel affected.
Diagnosis	Ankle-brachial index testing	Clinical examination Venous duplex ultrasonography	Biopsy of the lesion for histological evaluation.
Treatment	<ul style="list-style-type: none"> <li>• Treat underlying etiology as smoking, hypertension, diabetes</li> <li>• Encourage lifestyle changes as avoiding cold climates, reducing smoking, changes of tight clothing that restricts</li> <li>• Increase physical activity such as walking daily</li> <li>• Maintain good nutrition or reduce weight if obese</li> <li>• Refer for revascularization</li> </ul>	<ul style="list-style-type: none"> <li>• Edema: Conservative treatment includes leg exercises, lower extremity elevation, compression therapy</li> <li>• Skin changes: moisturizers</li> <li>• Ulcers: wound care management and compression</li> <li>• Telangiectasia can be treated with sclerotherapy or lasers</li> <li>• Varicose veins: ablation therapy</li> </ul>	<ul style="list-style-type: none"> <li>• Medical management depends on the specific diagnosis, system affected, and severity of the flare</li> <li>• Monitoring is essential for following the disease course and drug toxicity</li> <li>• Steroids for emergent treatment to reduce inflammation</li> </ul>

*Note.* Based on information from Mills et al. (2014), Munoz-Grajales & Pineda (2015), Rasmussen et al. (2019), and Wound, Ostomy and Continence Nurses Society (2014).

should be noted in each assessment, as well as the presence of exudate, tenderness, erythema, or wound odor. Venous ulcers are often noted to have a chronicity, spanning many months with repeated cycles of healing and ulceration (Parker et al., 2017).

### Treatment

Elevation of the affected extremities, muscular activity, and gradual compression of veins in the lower extremities are simple and inexpensive methods to promote venous return. Static compression therapy with bandages such as Unna Boots or multilayer bandage wraps provides a constant pressure gradient to move fluid from the distal extremity to the proximal in order to reduce edema (Rabe et al., 2018). The bandage is wrapped from direction of toes to below the popliteal fossa. A pressure of 35 to 40 mmHg at the ankle is necessary to prevent exudate (Rabe et al.). Compression is evaluated by assessing the extremity below the wrap or stocking for color, warmth, and sensation. The patient should not experience pain at the proximal or distal aspect of the compression wrap, nor should arterial flow be compromised, which would be evidenced by pain, coolness, or pallor/rubor. Current evidence suggests antiembolism stockings that provide low pressures (<20 mmHg) are not designed for therapeutic compression to treat venous disease but may be useful for patients with varicosities and to prevent further symptom exacerbation (Kelechi et al., 2020). The type and amount of compression should be ordered by the healthcare provider. Weekly measurements of the calf and ankle circumference provide objective data to determine the effectiveness of the treatment.

Venous ulcers require treatment that follows basic wound care principles. The wound should be cleaned with noncytotoxic cleaners with every dressing change. The surrounding skin should be protected from serous wound fluid by applying a skin barrier. If dermatitis is present, use of an emollient is indicated. Accurate wound assessment is needed to monitor the wound's progress or delay in healing. Should dermatitis become severe, a topical steroid may be ordered for 1 to 2 weeks to reduce inflammation and itching (Ratliff et al., 2016). Current evidence-based guidelines recommend the use of cooling treatment (gel pack) to relieve uncomfortable itching caused by dry, scal-

**Table 2. CEAP Classification: Summary of Clinical Signs and Symptoms**

CLINICAL CLASSIFICATION	
C0	No visible or palpable signs of venous disease
C1	Telangiectasies or reticular veins
C2	Varicose veins
C3	Edema
C4a	Pigmentation and eczema
C4b	Lipodermatosclerosis and atrophie blanche
C5	Healed venous ulcer
C6	Active venous ulcer
S	Symptoms including ache, pain, tightness, skin irritation, heaviness, muscle cramps, other patient concerns coinciding with venous dysfunction
A	Asymptomatic

*Note.* Based on information from Lurie et al. (2020).

**Table 3. Grading Edema**

0	No edema present
1+	Slight pitting, no visible distortion, disappears rapidly
2+	A somewhat deeper pit than 1+, but no readily detectable distortion; edema disappears in 10 to 15 seconds
3+	Noticeably deep pit that may last more than a minute; dependent extremity looks fuller and swollen
4+	Very deep pit that lasts up to 2 to 5 minutes; dependent extremity is grossly distorted

*Note.* Based on information from Seidel et al. (2018).

ing skin (Kelechi et al., 2020). Devitalized tissue should be debrided by a qualified healthcare provider.

Patients with skin breakdown associated with severe vein dysfunction may benefit from referral to a physician for venous ablation if conservative treatment for a minimum of 6 months is not effective (Rasmussen et al., 2019). Venous ablation offers improvement in wound healing by reducing venous volume and venous hypertension. It is contraindicated in patients who have both superficial and deep vein disease (Rasmussen et al.).





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Also assess for brownish pigmentation of the lower extremities—the result of prolonged venous congestion leading to permanent hemosiderin staining from the heme component of stagnant whole blood.

#### Patient Education

Venous insufficiency is considered a chronic condition that requires long-term compression therapy to manage the symptoms of edema and pain. Patient education focuses on walking, raising the legs above the level of the heart for 30 minutes 3 to 4 times daily, and toe pointing exercises performed 5 to 10 times over 1 to 2 minutes, several times per day. The movement and compression of the muscles with walking and exercise will increase blood to the heart and decrease fluid in the extremities. Wraps should feel as if they are giving firm support yet be comfortable. They may be uncomfortable with the initial application, but pain should subside. If pain increases, or there is discoloration or numbness of toes, the wrap/bandage should be immediately removed.

Instruct patients to apply moisturizing creams or petroleum jelly when the skin is still damp and avoiding soap that can dry skin. If compression stockings are used, two should be purchased so one can be washed while the other worn. Skin moisturizers are important for skin care, but patients should know they will decrease longevity of stockings. Teach patients to allow the moisturizer to absorb into the skin before applying stockings. Stockings should be washed after worn for 1 day using a delicate cycle with minimal detergent. Heat destroys the elastic fibers so they should be air dried.

## Peripheral Arterial Disease

### Risk Factors and Assessment

Up to 50% of patients with PAD are asymptomatic, making patient history key in identification of risks (Criqui & Aboyans, 2015). The risk factors for PAD include male gender, over 50 years of age, history of smoking, diabetes, African American ethnicity, family history of PAD, and hypertension (Criqui & Aboyans; Mills et al., 2014). Another significant risk factor is elevated lipids including low-density lipoprotein, cholesterol, and triglycerides that contribute to atherosclerotic disease. For adults 20 years and older, triglycerides should be less than 150 mg/dL, total cholesterol <150 mg/dL, and low-density lipoprotein <100 mg/dL (Seidel et al., 2018). An increased homocysteine level, linked to arterial damage leading to blood clots, has been a controversial topic regarding treatment of PAD. At this time, dietary treatment to decrease homocysteine has shown no significant improvement in outcomes (Gerhard-Herman et al., 2017).

The most common symptoms of PAD are calf pain and intermittent claudication, although these indicators may be absent. Intermittent claudication is leg pain that occurs with walking and is relieved by rest. The pain is usually described as aching or cramping and, as PAD progresses, the pain can occur at rest. Also ask the patient if they have a history of nonhealing lower extremity sores.

The exam should include inspection of the lower extremities with the patient in a supine position with socks off. Compare the legs to one another, as PAD may occur in one leg and not the other. The exam may reveal chronic tissue changes including thinning, hairlessness, dependent rubor, pallor on limb elevation, thickened yellow toenails, or diminished pulses (Walsh, 2016). Pedal pulses are graded on a 0 to 3+ scale (with 0 being absent, 1+ being weak, 2+ normal, and 3+ bounding). They should be equal bilaterally. Palpation of the posterior tibial pulse is the preferred location as some individuals have congenitally absent pedal pulses (Weir et al., 2014).

Significant PAD may be present when pallor appears after the extremity is elevated for 30 to 60 seconds. Conversely, dependent rubor, a deep red color of the legs when they are in a dependent position is another sign suggestive of PAD. The patient may also find that pain is relieved when the leg is in a dependent position. The lower extremities may be cool to touch. Poor arterial flow can result in tissue loss from minor trauma that doesn't heal

(Weir, 2014). Ulcers due to PAD are often located on the feet, especially the toes. Lower extremity edema is not considered a symptom of PAD.

Using a helpful, common tool, the clinician can perform a bedside ankle-brachial index (ABI) to determine arterial flow by comparing the systolic brachial blood pressure with the ankle blood pressure. The systolic ankle pressure, performed with a doppler, is divided by the brachial pressure and should be  $> 0.9$ . If 0.9 or less, PAD should be suspected (Wound, Ostomy and Continence Nurses Society, 2014). Take the blood pressure in the right arm followed by the right ankle. Repeat on the left side. Refer the patient for imaging with an arterial doppler and confirm the location of the arterial dysfunction, should you suspect a low ABI. An arteriogram will provide greater detail to the level of occlusion and is performed prior to surgical intervention (Gerhard-Herman et al., 2017).

### Treatment

Management of PAD is directed toward relieving symptoms, decreasing progression of occlusion, and preventing complications. Treatment includes managing pain, smoking cessation, exercise, managing lipid values, and wound care and prevention. Murphy et al. (2015) reported that supervised exercise provided improvement in functional status and quality of life. A referral to physical therapy will assist the patient to develop an exercise plan. Aspirin is the first-line antiplatelet therapy with other antiplatelets therapy such as Clopidogrel for patients with symptomatic disease. Additional research into the overall benefits of aspirin continues (Mahmoud et al., 2017). Medications, such as cilostazol or naftidrofuryl, act to dilate blood vessels and increase oxygen to the tissues that reduces pain while walking. Adding medications such as statins and antihypertensives may also support the cardiac system (Seidel et al., 2018).

Wounds related to PAD are distinctly different from those of venous disease. Protect arterial wounds with a dry dressing that does not apply additional pressure. Infection is a major complication and can be addressed by swabbing the wound with topical povidone iodine (Wound, Ostomy and Continence Nurses Society, 2014). The dressing selection will depend upon the amount of drainage. Gauze packing is used to fill any depth or tunneling. A low ABI indicates poor arterial flow to the lower extremity. Compression should be used cautiously if the ABI is less than 0.80 and not at all

if less than 0.50 (Kelechi et al., 2020; Ratliff et al., 2016). A compression wrap constricts the arterial flow that further decreases blood flow and oxygen to the lower extremity. Wounds that are draining, abscessed, or manifest wet gangrene may need debridement by a wound specialist or physician. Revascularization is considered after the infection is controlled (Weir et al., 2014).

### Patient Education

Smoking cessation should be encouraged and nicotine replacement offered. The patient should know that smoking cessation will also help decrease the pain by increasing blood flow. A referral to a dietitian should be made to create a heart-healthy diet plan. Another concern for patients with PAD is prevention of trauma that places them at risk for nonhealing ulcers. Proper footwear and professional foot and nail care is essential. Patients with peripheral neuropathy cannot rely on pain as an indicator of tissue trauma. Teach all patients to perform daily inspection of lower legs and feet and report all wounds to their primary care provider.

### Vasculitis

An additional consideration is a patient who has a comorbidity of vasculitis with inflammation in the arterial endothelium. Vasculitis may present with similar symptoms as chronic arterial insufficiency. Chronic inflammatory changes can lead to narrowing, occluded, or compromised arteries (Merkel et al., 2019). The cause of vasculitis is usually idiopathic; however, etiologies can include autoimmunity (systemic lupus erythematosus and rheumatoid arthritis), drug reactions, or a result of a viral or bacterial infectious process (Merkel et al.; Munoz-Grajales & Pineda, 2015). Signs of vasculitis may include pain over the affected artery, fever, rashes, abdominal pain, arthralgia, myalgia, parenthesis, or renal dysfunction (Munoz-Grajales & Pineda). Elevation in C-reactive protein and elevated sedimentation rate support the diagnosis.

Medical management of vasculitis is dependent on the specific diagnosis, system affected, and severity of the flare. Classification of vasculitis is based upon the size of the vessel; however, treatment is not determined by the vessel size (American College of Rheumatology, 2019). Monitoring is essential in order to follow the disease course and recognize drug toxicity associated with the treatment. After remission has been attained, monitor-

ing must be continued for recurrence of the condition and organ involvement. Prompt recognition of recurrence is necessary for long-term management and to determine any changes in the condition requiring treatment adjustments. Table 1 summarizes diagnosis and treatment.

### Treatment and Patient Education

Glucocorticoids, known commonly as steroids, are the treatment of choice but should be used short-term due to potential side effects. Long-term glucocorticoids such as prednisone can cause weight gain, diabetes, and osteoporosis. For severe vasculitis, immunosuppressant medications that alter the immune system and mask the signs of infections are used (American College of Rheumatology, 2019; Munoz-Grajales & Pineda, 2015).

### Mixed Venous and Arterial Insufficiency

A combination of venous and arterial vascular disease can also be seen. Characteristics of venous insufficiency such as peripheral edema and hemosiderin staining can be noted in patients with arterial insufficiency. A diagnosis cannot be based on symptoms alone but requires ABIs to determine the degree of blood flow before treatment is initiated (Rasmussen et al., 2019).

### Psychological Concerns

Psychosocial concerns are associated with vascular compromise. Patients face many life challenges including chronic limb pain, the need for smoking cessation, a supervised exercise plan, diet changes, long-term wound care, and the threat of loss of a limb. Anxiety, uncertainty, and depression should be anticipated (Daskalopoulou et al., 2016; Kelechi et al., 2020) and referrals should be made to the appropriate supportive services.

### Conclusion

Home healthcare patients are at higher risk for vascular dysfunction due to their age and chronic health conditions (U.S.D.H., 2019). Patient history and advanced assessment are essential to recognize the signs and symptoms of PAD and PVD. Vascular health, including maintenance of arterial flow and prevention of venous dependent edema are critical in the preservation of skin integrity. As these are chronic conditions, patient education is essential. Prevention of venous stasis and arterial or venous ulcerations can avert

the need for months of healthcare services and lost workdays. ■

**Constance F. Swenty, DNP, RN, CWON**, is an Associate Professor, College of Nursing and Health Professions, University of Southern Indiana, Evansville, Indiana.

**Melissa Hall, DNP, RN, AGPCNP-BC, FNP-BC**, is a Professor and Chair of the Graduate Program, College of Nursing and Health Professions, University of Southern Indiana, Evansville, Indiana.

The authors declare no conflicts of interest.

Address for correspondence: Constance F. Swenty, DNP, RN, CWON, College of Nursing and Health Professions, University of Southern Indiana, 8600 University Blvd., Evansville, IN 47712 (cfswenty@usi.edu).

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DOI:10.1097/NHH.0000000000000936

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