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Chronic venous insufficiency:
A review for nurses

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Abstract: Chronic venous insufficiency (CVI) is a potentially debilitating disorder associated with serious complications such as lower extremity venous ulcers. This article reviews the incidence and pathophysiology of CVI, nursing assessment, diagnosis and interventions, and patient education needed to manage the disease and prevent complications.

Keywords: cellulitis, chronic venous disease, chronic venous insufficiency, compression therapy, CVI, stasis dermatitis, varicose veins, venous ulcers

A DISEASE of the venous circulation, chronic venous insufficiency (CVI) may affect close to 40% of the population in the US.[1] Although the disorder is associated with potentially serious complications such as lower extremity venous ulcers, it is often undetected in its early stages. This article reviews the incidence and pathophysiology of CVI, nursing assessment, diagnosis and interventions, and patient education needed to manage the disease and prevent complications.

Incidence of CVD and CVI

According to Gujja and colleagues, "varicose veins are a common manifestation of chronic venous disease [CVD] and affect approximately 25% of adults in the western hemisphere."[2] Compared with CVI, CVD is a broader term covering any disorder related to or caused by veins that become diseased or abnormal.[3] These include varicose or spider veins, leg edema and pain, skin changes in the legs, venous ulcers, and phlebitis. CVI describes CVD

with more advanced features, such as venous ulcers or significant edema (see *Coming to terms with venous disorders*). The focus of this article is CVI.

The prevalence of CVI over the past few decades has been difficult to estimate due to varying and/or inconsistent standards of evaluation and diagnosis. However, an estimated 7 million people worldwide have some degree of CVI, and about 3 million develop venous ulcers, the most common type of leg ulcers. Venous ulcers cost the US healthcare system 2 to 3 billion dollars a year.[4]

Coming to terms with venous disorders[9]

Chronic venous disorders: A general term covering the full spectrum of structural and functional abnormalities of the venous system.

Chronic venous disease: Indicates that structural or functional abnormalities such as venous valvular incompetence or venous obstruction are present for a prolonged period and produce signs and symptoms requiring further investigation or treatment.

Chronic venous insufficiency: Describes chronic venous disease with more advanced clinical signs, such as significant edema, skin changes, or ulceration.

How CVI develops

In simple terms, CVI is inadequate venous blood return, or venous pooling, over a long period that leads to venous distension and venous hypertension.[5] See *Reviewing the venous system of the lower extremities* and *Normal venous physiology* for a quick refresher on venous anatomy and physiology.

CVI can result from various physiologic changes, such as deep vein thrombosis (DVT), venous valve damage or trauma, valve incompetence, or varicose veins (dilated, elongated, thickened, or twisted subcutaneous veins that no longer control blood flow adequately).[6] Varicose veins are 3 mm or more in diameter and may involve saphenous veins and tributaries or nonsaphenous superficial leg veins. Ulceration develops when venous hypertension, circulatory stasis, and tissue hypoxia trigger an inflammatory reaction and fibrosclerotic remodeling of the skin.[5,6]

In advanced CVI, venous circulation to the lower extremities slows and the metabolic demands of the cells are not met.[5] Impaired tissue nutrition can cause stasis dermatitis or cellulitis, and any injury can lead to cellular death and eventually venous ulcers. In 74% of patients who develop venous ulcers, ulceration is triggered by a specific event such as cellulitis, trauma, edema, dermatitis, dry skin, or insect bites.[4]

Because venous circulation is compromised, transport of biochemicals needed for inflammatory and immune responses to the affected area is impaired. Consequently, the risk of infection in venous ulcers is high.

Patient risk factors

The numerous risk factors associated with CVI include advanced age, female gender, obesity, pregnancy, DVT, previous leg injury, and family history of varicose veins.[5] People who stand for prolonged periods, often sit with legs crossed at the knees, and/or wear constrictive clothing are at risk for developing venous distension, which can lead to CVI. In addition, structural dysfunction of the calf muscles or incompetent valves (reflux, stenosis, obstruction, or compression) can contribute to CVI.[7]

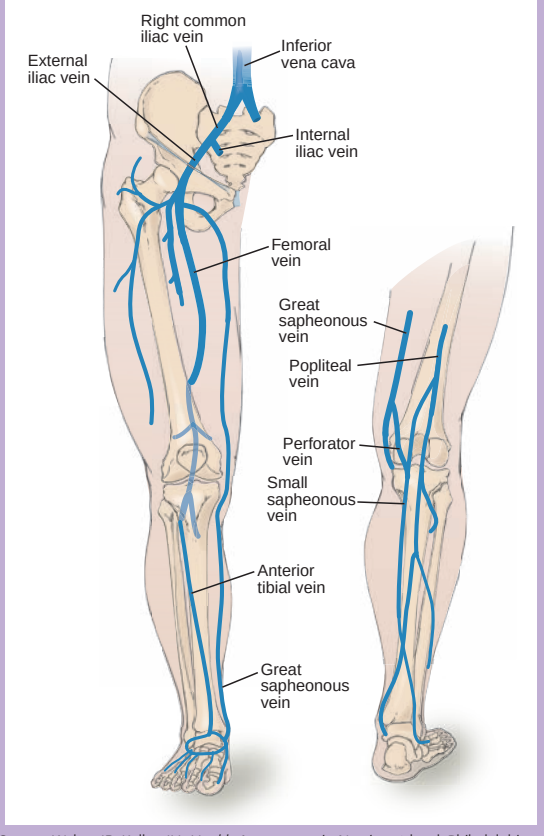
Clinical assessment

Patients typically complain of aching or pain in the leg, a feeling of having heavy or tired legs, and lower extremity edema. This discomfort can impair mobility.[4,7,8]

The Clinical-Etiology-Anatomy-Pathophysiology (CEAP) criteria, developed by international consensus, classify lower extremity venous disease based upon clinical signs, etiology, anatomic location, and pathophysiologic abnormality. Clinical signs included in the CEAP criteria include:[8,9]

- telangiectasia (dilated intradermal venules less than 1 mm in diameter)

Reviewing the venous system of the lower extremities



Source: Weber JR, Kelley JH. *Health Assessment in Nursing.* 6th ed. Philadelphia, PA: Wolters Kluwer Health; 2018.

and reticular veins (dilated bluish subdermal veins 1 to 3 mm in diameter).
• edema, which often starts in the feet and ankles and can extend to the calf region. It typically worsens with prolonged sitting or standing when legs are in a dependent position and subsides when legs are elevated. Edema may be unilateral, especially early in disease progression.
• skin pigmentation changes due to hemosiderin deposits from the breakdown of red blood cells that have extravasated through damaged capillaries into the dermis. Hyperpigmentation on the anterior lower leg is common.
• stasis dermatitis, also called venous eczema (an eczematous rash characterized by pruritus, erythema, scaling, weeping, erosions, and crusting).
• lipodermatosclerosis (fibrosing panniculitis of subcutaneous tissue). Initially, this manifests as a firm induration at the medial ankle but may extend up the leg as disease progresses.
• venous ulceration. Lower extremity venous ulcers, which may be single or multiple, are typically located low on the medial ankle but may develop anywhere on the lower leg. These shallow wounds are characterized by irregular edges without undermining, moderate to heavy serous or serosanguinous exudate, and a ruddy red granulation base. (See *Assessing a venous ulcer*.)

The venous clinical severity score is a disease-specific instrument that is complementary to the CEAP classification.[10] Key clinical parameters (pain, varicose veins, venous edema, pigmentation, inflammation, induration, number of active ulcers, duration of active ulcers, size of active ulcers, and compliance with compression therapy) are graded from zero to three depending upon severity (none = 0, mild = 1, moderate = 2, severe = 3).[9]

Diagnostic evaluation

CVI is often clinically apparent from key signs (edema, skin changes, and venous ulceration), but a complete health history and physical assessment are necessary to confirm the diagnosis and detect or rule out coexisting disorders such as peripheral arterial disease (PAD).[11]

Assessment of lower extremity pulses (femoral, popliteal, posterior tibial, and dorsalis pedis) can help identify or rule out PAD. Lower extremity pulses are usually present in patients with pure venous disease, but significant edema may make them difficult to detect. An *ankle-brachial index (ABI)* should be performed in any patient with weak or absent pulses, and in those with symptoms or risk factors for PAD. An ABI is important not only to screen for PAD but also to determine the level of compression therapy that can be safely used to treat CVI.[4] If a patient has mixed arterial and venous disease, the treatment plan must be revised because compression therapy, the gold standard treatment for CVI, is contraindicated in patients with severe PAD.

Duplex ultrasonography is safe, cost effective, and reliable, and can help clinicians differentiate DVT and CVI.[2,11] Using ultrasonography, clinicians can determine the presence and direction of blood flow through the veins, detect any reflux or obstruction of blood flow, and establish the location of obstructions.[4]

Air plethysmography (APG) and *photoplethysmography (PPG)* are simple, noninvasive tests that measure blood

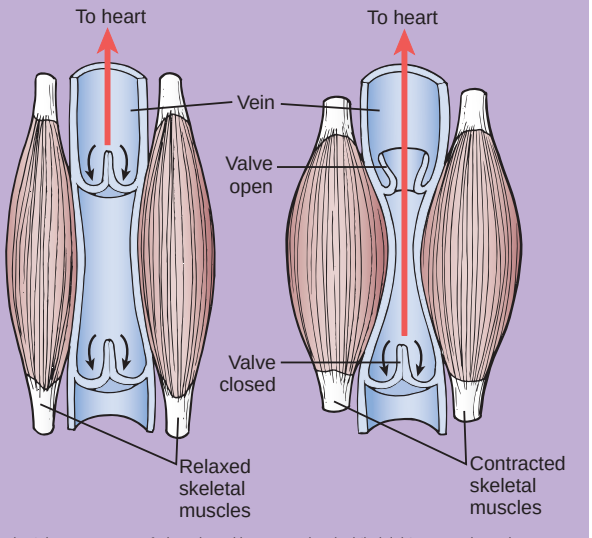
Normal venous physiology[24]

The venous system is a low-pressure system that returns blood to the heart. The venules collect blood from the capillaries, and the veins transport blood back to the right heart. Blood from the systemic veins flows into the right atrium of the heart.

The veins and venules are thin-walled, distensible, and collapsible vessels that can enlarge and store large quantities of blood. Veins are also muscular, which allows them to contract or expand to accommodate varying amounts of blood. When blood is lost from the circulation, the veins constrict to maintain circulating blood volume.

Because the venous system is a low-pressure system, blood flow must oppose the effects of gravity. In a person in the standing position, the weight of blood in the vascular column causes an increase of 1 mm Hg in pressure for every 13.6 mm of distance below the level of the heart. Were it not for the valves and the action of skeletal muscles counteracting the effects of gravity, venous pressure in the feet of a standing adult would be about 90 mm Hg.

With the help of skeletal muscles that surround and intermittently compress the leg veins in a milking manner, valves move blood forward to the heart. This pumping action, known as the venous or muscle pump, is so efficient that under normal circumstances, the pressure in the feet of a walking adult is less than 20 mm Hg.



Source: Porth CM. *Essentials of Pathophysiology: Concepts of Altered Health States.* 4th ed. Philadelphia, PA: Wolters Kluwer; 2014.

volume changes during postural changes or physical activity. APG is used to assess venous outflow during cuff deflation on a limb; PPG utilizes a photosensor to assess blood volume in a limb.[2]

Invasive catheter-based *venography* is rarely needed to confirm a CVI diagnosis but may be performed in some patients to localize venous outflow obstructions, rule out DVT, or evaluate varicose veins before surgery. Venography is associated with a small risk of complications such as DVT and adverse reactions associated with I.V. contrast media administration.[11,12]

Medical management

A comprehensive multidisciplinary approach is recommended to care for patients with CVI, especially as they transition from acute care settings to home care or oversight by a wound care center. The cornerstones of CVI management are leg elevation, exercise, and compression therapy to oppose the hydrostatic forces of venous hypertension in the lower extremities.[7] The goals of treatment are to improve symptoms, reduce edema, prevent or heal venous ulcers, and slow disease progression.

Compression therapy can be performed with compression stockings, paste gauze boots, layered bandaging or wraps, or compression pumps.[4] In ambulatory patients with significant edema, compression wraps or bandages are usually the best choice initially. Patients should wear them all day and whenever they are ambulatory.

All compression wraps should be applied from the base of the toes and go to the notch of the knee, below the patella. The amount of therapeutic compression is usually 30 to 42 mm Hg at the ankle.[13] An evidence- and consensus-based algorithm for compression was published in 2016.[14] Intermittent pneumatic compression sleeves/pumps can be used for patients who have mobility issues, need higher levels of compression, or cannot tolerate compression stockings or wraps.

Antiembolism stockings, also known as antiembolism hose, should not be used to manage venous edema. These stockings are designed to be worn while in bed and are meant for DVT prevention.

Assessing a venous ulcer

As shown here, venous ulcers are typically shallow, with irregular edges and a granulating base. Other classic characteristics are hyperpigmentation (hemosiderosis) and location above the medial malleolus.

Source: Bobonich MA, Nolen ME. *Dermatology for Advanced Practice Clinicians.* Philadelphia, PA: Wolters Kluwer; 2015.

Wearing compression stockings

Compression stockings are indicated for long-term CVI management to control edema and reduce the risk of venous ulcers. Patients should be instructed to apply them when they wake up in the morning, when edema is minimal.[4]

Compression stockings are prescriptive and individually sized to fit each leg so they can be worn daily. Patients should be measured by a specialist trained in edema management or by specialists who distribute the garments, and patients and/or family caregivers must be taught to apply them correctly.

Available in different grades of compression, compression stockings come in various lengths—knee high, thigh high, and pantyhose—and are designed to distribute pressure across the length of the stocking. Application can be difficult for patients and may reduce their adherence to therapy. Various strategies and tools are available to assist patients with stocking application and encourage daily use (see *Tips for applying compression stockings*).

Research indicates that about two-thirds of patients who are prescribed some type of compression therapy adhere to treatment, leaving one-third of patients who do not.[15] The reasons have not been well researched, and more studies are needed. However, the literature suggests that failure to adhere to treatment may stem from such issues as limited mobility, pain, uncomfortable compression stockings or wraps (especially with higher degrees of compression), appearance of compression stockings or wraps, difficulty applying compression stockings, difficulty with wearing shoes, and cost.[15-17] In addition, observations from the first author's clinical practice suggest that resistance to compression therapy may be related to improper sizing or resizing following a change in the patient's weight or leg size.

Other therapies

Various medications have been used to help manage CVI, including venoactive drugs such as the flavonoids and drugs affecting venous blood flow and preventing thrombosis, such as aspirin, pentoxifylline, sulodexide, and defibrotide. However, evidence supporting their benefit is scant.[18]

Sclerotherapy, vein ablation therapy, and endovenous ablation techniques (radiofrequency ablation or endovenous laser ablation) are all interven-

tions that may be performed to treat or correct venous flow in patients with CVI.[19] Surgical management of CVI may include surgery for truncal vein or venous tributaries, perforator vein surgery, or valve reconstruction.[4] Interventions are selected based on severity of disease and often guided by anatomic considerations.

Patient teaching

Patients with CVI must be educated about how to reduce and control edema, maintain intact skin, prevent trauma, prevent and manage complications such as dermatitis and cellulitis, and manage pain. For example:

- Instruct patients to avoid crossing their legs when sitting or standing for prolonged periods.
- Encourage overweight patients to lose weight. Because obesity is a known risk factor for CVI, weight reduction can help relieve symptoms and slow disease progression.
- Explain the importance of compression therapy and encourage patients to adhere to therapy as prescribed. Tell them that consistently wearing compression stockings can help prevent edema and subsequent ulceration. Teach patients to apply the stockings first thing in the morning before getting out of bed and remove them at bedtime. Advise them to keep fingernails short to prevent damaging compression garments or scratching themselves during garment application.[4]

Because the skin becomes more fragile with disease progression, even minor injuries can trigger ulceration.

- Recommend leg elevation above the level of the heart for 30 minutes three to four times a day.[4] They can do this by lying in a recliner chair as far back as possible or lying in bed with legs elevated on pillows. A physical therapy consult may be needed for patients who are impaired by medical conditions such as arthritis, obesity, and deficits related to stroke.
- Advise patients who smoke to stop. Smoking causes thickening of vessel walls, decreasing perfusion to the affected limb.[20]
- Encourage patients to remain active. Ambulation and other activities that pump the calf muscles assist with venous return. Examples include uphill walking at least 30 minutes each day, performing toe lifts (raising up on toes), and dorsiflexion and plantar flexion of the ankles (ankle pumps).[4]
- Educate patients about risk factors for venous ulcers and strategies to reduce the risk, such as adhering to prescribed compression therapy and leg elevation. Patients with a long history of CVI are especially vulnerable to ulceration.
- Tell patients to inspect their skin daily for even minor injuries or insect bites, wash skin daily with mild soap and tepid water, use a skin moisturizer at least daily, protect the lower extremities from sun exposure, and keep skin on lower extremities covered to prevent injuries. Explain that a good skin care regimen is important because the skin becomes more fragile with disease progression and even minor injuries can trigger ulceration. Patients should use moisturizers that are free of fragrances, dyes, and perfumes.[21,22]
- Educate patients about any medication prescribed to manage CVI.
- Stress the importance of regular follow-up appointments with the healthcare provider to ensure optimum management of this chronic disease.

Tips for applying compression stockings[25]

Cover these points when teaching patients how to apply their compression stockings.

- Apply stocking first thing in the morning, before getting out of bed.
- Sit on the side of the bed or firm chair; do not try to apply while standing.
- Consider wearing rubber gloves to improve grip on the stockings.
- Reach into the toe of the stocking and grab the toe, while turning the remaining part down over top (inside out).
- Put tip/toe of stocking onto the top of the foot and begin rolling the stocking up over the foot, then heel, then leg.
- Avoid pulling the stocking up from the top as this can cause stretching or ripping.
- Smooth out any wrinkles, especially around the ankle.
- If the stocking becomes twisted, remove it and apply again.

Psychosocial support

In patients with CVI, quality of life can be undermined by the patient's inability to work due to pain, treatment modalities, and frequent medical or wound treatment visits. Besides causing depression and isolation, these factors can have a major economic impact on the patient's life.[13,16,19] According to Maddox, nurses tend to focus on the clinical aspect of treating wounds and spend less time helping patients deal with

the psychosocial effects.[23] Wellborn and Moceri reported similar findings from their study of patients living with CVI and venous ulcers.[17]

Nurses can help patients cope with the disease by providing thorough education on CVI treatment, encouraging them to establish strong social networks and relationships with healthcare providers, and by helping them find strategies to maintain their ability to engage in activities of daily living.[16,17]

Patients with CVI are living with a disease that requires continuous management and healthcare provider oversight. For best outcomes, early recognition and management are imperative to slow disease progression, minimize socioeconomic burden, and improve patients' quality of life. ■

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