Venous Disease and Ulcers

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Faculty

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Ms. Mamou has worked in various rehabilitation settings and has first-hand experience of how pressure ulcers impact patients' recovery and quality of life. She has held positions as staff nurse, unit coordinator, educator, and director of nursing in home health care. She has been involved in developing and implementing several staff education programs in a variety of settings. She was most recently employed as a wound ostomy and continence nurse at East Alabama Medical Center in Opelika, Alabama.

Faculty Disclosure

Contributing faculty, Maryam Mamou, BSN, RN, CRRN, CWOCN, has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

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The division planner and director have disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Audience

This course is designed for nurses in all care settings who may care for patients with venous disease or ulcers.

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Course Objective

The purpose of this course is to enable nurses to accurately assess and treat venous disease and venous ulcers and to provide patient and family education for preventive care and lifestyle changes.

Learning Objectives

Upon completion of this course, you should be able to:

- 1. Identify the different components of the venous system, and explain the pathophysiology of venous insufficiency.
- 2. Discuss the epidemiology of venous disease.
- 3. Outline the signs and symptoms of venous disease.
- 4. Cite the various diagnostic tests used to identify and classify venous disease and ulcers.
- 5. Evaluate the role of compression therapy and surgical interventions in treating venous disease and venous ulcers.
- 6. Review the importance of patient education in preventing the reoccurrence of venous ulcers.



Sections marked with this symbol include evidence-based practice recommendations. The level of evidence and/or strength of recommendation, as provided by the evidence-based source, are also

included so you may determine the validity or relevance of the information. These sections may be used in conjunction with the course material for better application to your daily practice.

INTRODUCTION

Venous insufficiency is the most prevalent vascular disorder and can result in significant morbidity, including lower extremity ulcers. Venous leg ulcers, also referred to as venous insufficiency ulcers, stasis ulcers, and varicose ulcers, are a major health problem in the United States. They are a common and disabling condition and often reoccur. The healing time is long—taking several weeks to several months; approximately 60% of venous ulcers remain unhealed after six months [1; 2]. As the population ages, the frequency of venous ulcers is also increasing. They are one of the most prevalent forms of chronic wounds, and healthcare professionals should have a clear understanding of their impact on patient care [1].

AN OVERVIEW OF LOWER EXTREMITY VENOUS ANATOMY

Veins are part of the circulatory system and are responsible for carrying blood from all parts of the body back to the heart. Whereas blood in the arteries is bright red in color, blood in the veins is dark red due to the high concentration of carbon dioxide it is carrying. In most instances, veins follow the same routes as their companion arteries [3].

The study of the circulatory system dates back to the time of Hippocrates, and it is said that he was one of the first to discover the connection between venous disease and ulceration formation [4]. However, the distinction between arteries and veins was not always clearly understood. During the Middle Ages, it was thought that veins and arteries formed two distinct conduit systems, with veins carrying liquids that provided nutrients to the body and being closely aligned with the liver [4]. This concept of venous circulation continued until the 1600s [4]. Though it was observed that both arteries and veins carried blood, it took years of research to fully understand how they functioned [4].

THE STRUCTURE OF VEINS

Similar to the other vessels in the circulatory system, the vein walls are composed of three layers. The innermost layer of epithelial tissue is the tunica intima, the tunica media is the middle layer, and the outer layer is the tunica externa. The tunica externa is made up of collagen and elastic fibers and is the thickest layer of the vein walls [3].

Vein walls vary in size, with the smallest veins having a diameter of 0.5 cm and the largest (the superior and inferior venae cavae) having a diameter of up to 3 cm [3]. Veins have the ability to distend to accommodate varying degrees of blood volume flowing through them; however, they do not have the capacity to withstand high pressures [3]. The lumen in veins is much larger than that found in the arterial system [3]. This is important because the size of the lumen determines the resistance to blood flow [3].

TYPES OF VEINS

Deep Venous System

Veins in the legs are divided into three major groups based on their relationship to the muscular fascia: deep veins, superficial veins, and perforator veins [5]. The deep venous system consists of the posterior and anterior veins and includes the common iliac veins, the femoral veins, and the popliteal veins [3]. These veins are located under the muscular fascia inside the muscle compartments of the leg, usually in close proximity to their companion arteries [5]. However, there is considerable variability in individual anatomy [6]. The deep veins are responsible for draining blood from the lower extremity muscles.

Superficial Venous System

The greater and lesser saphenous veins form the superficial venous system, also known as the saphenous system [5]. Superficial veins lie above the deep fascia and drain the cutaneous microcirculation [6]. The great saphenous veins are the longest veins in the body; they travel up from the dorsum of the foot to the groin and are located in the subcutaneous tissues [3]. Superficial veins are noticeable in some persons as a blue continuous line passing along the leg beneath the skin [3].

The Perforator Veins

The perforator veins are the branches that cross the muscular fascia to connect the deep veins with the superficial veins in a ladder-like system [5]. There are more than 90 perforator veins in a human leg [5]. The normal path of blood flow in the lower extremities is from the superficial to the deep veins via the perforator veins [7].

BICUSPID VALVES

Veins are equipped with flap-like bicuspid valves, which are made from the inner lining of the veins (i.e., the tunica intima) [3]. Blood is governed by the rule of gravity, and without intervention, it will flow downwards. The venous valves prevent the backward flow of blood in the veins by closing together in the middle of the vein to form a barrier [8]. The bicuspid valves in the veins of the lower extremities are opened when an individual is at rest in the supine position [6]. Valve closure occurs when the pressure gradient is reversed, following a brief period of antegrade flow.

The great saphenous veins are equipped with up to 20 valves along their entire course, the majority of which are found below the knee [3]. The perforator veins are also equipped with numerous valves to ensure one-way flow of blood from the superficial to the deep veins [6].

MUSCLE PUMPS

The leg muscles and the pumping action of the heart play a major role in venous blood flow, but the blood-holding capacity of the lower extremity veins when an individual is standing is regulated by two factors: the venous valves and the calf muscle pump [6]. Around 90% of venous blood return from the lower extremities flows through the deep veins and is facilitated by the action of muscle pumps in the foot, calf, and thigh [6]. Among these three pumps, the calf pump is the most important and is responsible for the greatest pressures [6]. During ambulation, this pump is responsible for propelling 70% of the blood out of the calf [8]. When the calf muscle pump contracts, blood is pushed out of the veins and the resting pressure in the veins decreases. Because blood flows from areas of high pressure to areas of low pressure, this decrease in the pressure gradient in the deep venous system after contraction allows blood to flow from the superficial veins to the deep veins via the perforating veins [6]. As long as the valves of the venous system are functioning correctly, there is little retrograde blood flow [9].

If the calf muscle pump is functioning below capacity or fails completely, high venous pressures will develop, which can ultimately lead to the development of varicose veins, edema, and venous ulcers. Many variables can adversely affect the contraction of the calf muscle pump, including vascular insufficiency, neurologic disease, injury, bone and joint conditions, and limited mobility [9]. Temporary or permanent immobilization resulting in an inability to contract the leg muscles causes sluggish circulation in the venous system and can lead to venous insufficiency [3].

LOWER EXTREMITY VENOUS CIRCULATION

The human heart is responsible for pumping blood throughout the circulatory system. Blood circulates through the capillaries, and then enters the venules, the small veins that carry the deoxygenated blood from the tissues. Venules join together to form the larger veins, which return the blood to the right side of the heart [3]. There is a small but significant pressure difference between the heart and the venous system, and when the left ventricle contracts, this generates sufficient pressure to assist with venous blood flow back to the heart [3]. The function of leg veins is to return blood from the lower extremities to the heart, and this is accomplished in conjunction with the muscles in the legs. The volume of blood that flows through the venous system back to the heart is referred to as venous return [3]. The normal blood pressure in veins is much lower than in arteries, and bleeding from a severed vein will be slow and steady, rather than the quick bursts seen with arterial bleeding [3]. The artery and companion vein(s) often share a vascular sheath, allowing arterial pulses to aid venous return.

Muscle pumps in the foot, calf, and thigh work together to drive blood out of the lower leg (against gravity) and back to the heart. As noted, the calf muscle pump is the most vital component of this process. Bicuspid valves prevent back-flow of blood to the foot and ankle.

PATHOPHYSIOLOGY OF VENOUS INSUFFICIENCY

Chronic venous insufficiency encompasses many different venous conditions that result from impaired venous return and resultant venous stasis. Malfunction of the venous valves, referred to as valvular incompetency, is the first step in the development of venous disease [10]. In valvular incompetency, the valves fail to close completely and allow retrograde blood flow, which results in venous hypertension. Chronic venous hypertension, the hallmark of chronic venous insufficiency, leads to the development of lower extremity complications [7].

The end result is pooling of blood (stasis) in the venous system, which can lead to initiation of the inflammatory process and on-going capillary damage [11]. With inflammation, there is activation of the white blood cells and endothelial damage, which are contributing factors to venous ulcer formation and delayed healing [11].

There are several reasons venous valves may not function properly, including congenital absence of the valves, venous thrombosis/phlebitis, and trauma [11]. Ambulation is necessary for contraction of leg muscles and activation of the calf muscle pump, and extended periods of immobility can lead to an increase in venous pressure.

EPIDEMIOLOGY OF VENOUS DISEASE

Chronic venous insufficiency is defined as persistent ambulatory venous hypertension of the lower extremities that can cause pain, skin changes, edema, and ulceration [12]. It is the most prevalent vascular disorder and, if left untreated, can result in the development of a venous ulcer. As noted, the most common cause of chronic venous insufficiency is venous reflux, particularly of the superficial deep veins [11]. Manifestations include telangiectasias, reticular veins, and varicose veins, the latter of which affects an estimated 40 million adults in the United States [12; 49]. In addition, more than 6 million individuals (approximately 1% to 3%) in the United States have more advanced lower extremity venous disease, including venous ulcers [12; 50]. Studies indicate there are 640,000 new lower extremity leg ulcers in the United States each year, and it is estimated that venous ulcers are responsible for 60% to 80% of wounds of the lower extremities [5; 9; 51; 52]. Up to 2% of adults will develop a venous ulcer at some point in their lives [2; 5]. In the longterm care setting, the prevalence of venous ulcers is higher, with an occurrence rate of approximately 2.5% among all new admissions [13].

SEX/GENDER

In the Edinburgh Vein Study, involving 1,566 subjects, the prevalence of chronic venous insufficiency was 9.4% in men and 6.6% in women [14]. However, research indicates that the female-to-male ratio of varicose vein prevalence is 3:1 [12; 50]. Venous ulcers also occur more frequently in women than in men, with an overall occurrence rate for women of 1.42 per 100 person-years and 0.76 per 100 person-years for men [11; 13].

AGE

In the United States, approximately 50% of individuals 50 years of age or older have varicose veins; chronic venous insufficiency becomes more common with advanced age [49]. Data from the Edinburgh Vein Study indicate the prevalence rate doubled in men (21%) and women (12%) older than 50 years of age [14]. The likelihood of developing a venous ulcer also increases with age, possibly as a result of progression of the disease. In one study, nearly half of participants experienced deterioration (including skin changes) after 13 years [15]. Of persons with venous ulcers, approximately 22% develop their first ulcer by 40 years of age and 72% develop an ulcer by 60 years of age [9]. An increasing number of older adults have mixed venous and arterial disease, which presents more challenges for effective treatment [9].

RACE

There is some evidence that chronic venous insufficiency is more common in white individuals than in racial/ethnic minorities [16; 17]. However, when present, venous disease in black patients is more likely to present at a more advanced stage at a younger age compared with white patients, resulting in increased ulcer debridement, deep vein thrombosis rates, and hospital charges [17].

OVERWEIGHT AND OBESITY

Overweight and obesity is a major modifiable risk factor in the development of venous insufficiency and ulcers. The increase in abdominal pressure and adipose tissue associated with excess weight causes changes in the macro- and microcirculation of the lower extremities, thus increasing the risk of venous insufficiencies and development of venous ulcers. Studies have shown that overweight women (BMI 25 to <30) have a 50% increased risk of developing varicose veins compared with women who are within the healthy BMI range (18.5 to 24.9). In addition, women with a BMI greater than 30 are three times as likely to develop varicose veins [49; 52].

COSTS

Due to the chronic nature of venous insufficiency and ulcers, they are costly. Patients may experience a significant socioeconomic impact as a result of direct care-related costs, disability, reduced productivity, and impaired quality of life [12]. In the United States, the approximate cost of venous ulcer care (e.g., practitioner costs, inpatient hospitalization, compression therapy, wound care products, medication) is estimated at nearly \$5 billion annually [5; 52].

ASSESSMENT AND DIAGNOSIS

PATIENT HISTORY

When taking a patient history, it is important to explore risk factors for lower extremity venous disease [9]. Some of the more common prevailing risk factors are [5]:

- A history of deep vein thrombosis or leg ulcer(s)
- A family history of venous disease
- Multiple pregnancies, particularly in a short time span
- Older age
- Obesity
- Leg surgery or trauma
- Sedentary occupation and lack of exercise
- Drug injections into the veins of the lower extremities

There are also certain conditions that can trigger venous ulceration, including dry skin, cellulitis, insect bites, burns, and contact dermatitis [5]. These potentiating conditions are found in more than 70% of patients who present with venous disease and ulcers [5]. It is important to note that leg trauma does not have to be recent or severe to cause venous disease, and many times the patient may not recall the trauma.

It is also important to inquire about any prior instances of thromboembolism and if the patient has a history of venous ulceration [10]. A history of venous ulcers greatly increases the likelihood of future ulcer development. For female patients, it is important to enquire about varicosities close to the vagina [10]. A full review of current medications should be done, as well as ascertaining the patient's allergies, if any [10].

If the patient currently smokes, information should be gathered about the length of time he/she has been a smoker and how many cigarettes are smoked on a daily basis. If the patient previously smoked, establish how many years it has been since he or she quit.

A large number of those with venous disease also have one or several comorbidities, many of which are chronic conditions. Comorbid conditions have a negative impact on venous health and ulcer healing and should be thoroughly reviewed when assessing the patient and monitored throughout the course of treatment.

PHYSICAL EXAMINATION OF THE LOWER EXTREMITIES

Diagnosing lower extremity venous insufficiency relies mainly on clinical findings. A physical examination of both extremities should be done from midthigh level to the toes [5]. Patients will sometimes query why it is necessary to examine their "good leg," and the best response is that a comparison between both legs will help to indicate the severity of the venous disease. If feasible, it is better to examine patients while they are standing [10].

Swelling in Lower Extremities

One of the early changes that individuals with venous insufficiency notice is swelling in their legs and a feeling of heaviness. Most patients will report that elevating their legs will reduce the swelling. Edema is an important finding in venous insufficiency, and the patient should be asked when he or she first noticed the swelling and how it has progressed over time. In venous disease, edema is usually first noticed around the ankles, and with time, it gradually progresses up the patient's leg to include the calf area. Edema may be present for a considerable length of time before progressing, for example to a venous ulcer [5].

It is important to examine both extremities for the presence of edema. Chronic venous insufficiency will result in edema on the affected side, which progresses as the disease worsens. The sudden appearance of unilateral edema may be a sign of acute deep vein thrombophlebitis and requires immediate medical attention [7].

There are two forms of edema: pitting and nonpitting. Non-pitting edema presents as a swollen area that is hard to the touch. With pitting edema, pressure in the swollen area results in a persistent indentation. Pitting edema around the ankle that worsens through the day is a typical finding in advanced venous disease.

Serial bilateral ankle and calf measurements are useful to monitor the progress of edema. This consists of first measuring from the sole of the foot to just above the patient's ankle, then measuring the circumference at this point on both ankles. This same process is repeated for the widest area of the patient's calf on both extremities. In patients with edema, these measurements should be repeated at least weekly (with each wound assessment) using the same distance from the sole of the patient's foot each time to accurately determine the progression of the edema.

Skin Changes

Chronic venous insufficiency affects the skin and fat tissue, and some individuals with venous disease have no symptoms other than skin changes accompanied by distended veins [18]. There is often thinning of the epidermis, and with longstanding venous disease, the texture of the skin on the lower legs changes, becoming shiny, indurated, and usually darker than the surrounding skin [10]. If there is no component of arterial disease present, the patient's feet will feel warm to the touch and the dorsalis pedal and popliteal pulses will be palpable [18]. The presence of hair on the legs and feet is an indication of sufficient arterial supply and should be noted during the physical examination. Hemosiderin staining is a brownish or grayish discoloration of the skin caused by blood leaking into the tissues and breakdown of red blood cells [19]. Atrophie blanche is a change in skin texture and color attributed to venous insufficiency and presents as atrophic areas of white or pale skin [20].

Stasis dermatitis, also known as venous dermatitis or venous eczema, is dry, scaling skin of the lower extremities [18]. The first presentation is a reddishbrown skin discoloration, typically of the medial ankle. As the disease progresses, eczematous changes may be present, with weeping patches and plaques. Stasis dermatitis is often the first and most common skin change associated with venous disease. It is extremely pruritic (with insidious onset), which is a source of significant discomfort for patients.

Lipodermatosclerosis

Lipodermatosclerosis is an inflammation and hardening of the subcutaneous fat and dermal tissue found in longstanding venous insufficiency. It is caused by protein accumulation in the tissues, most noticeably in the "gaiter area" of the leg (between the knee and ankle) [18]. Lipodermatosclerosis presents as hard, waxy, hyperpigmented tissue with swelling of the surrounding areas. This has given rise to the description of a "bottle leg" formation [18].

Vein Abnormalities

Ankle flaring, a symptom of venous disease, presents as a cluster of distended small veins around the malleolus [5]. Telangiectasias (e.g., "spider veins") and reticular veins are also common and present as dilated intradermal and subdermal venules. These findings are more common in women than men and can develop in the absence of more serious venous insufficiency [21].

Varicose veins are one of the most common signs of venous insufficiency. They are dilated, elongated, tortuous superficial veins that become progressively larger, typically 3 mm or greater in diameter [21]. In some cases, patients may experience superficial thrombophlebitis in these veins, but they are often asymptomatic aside from the appearance.

Assessing Pulses and Temperature in the Lower Extremities

During the physical examination, the femoral and pedal pulses should be assessed. The pedal pulses include the dorsalis pedal pulses, located between the first (great) toe and the second toe on the dorsum of the foot, and the posterior tibial pulse, located behind the medial malleolus. In younger patients, it may be possible to palpate these pulses; however, in older patients, use of a handheld Doppler is often necessary to detect a pulse beat [22].

It has been documented that individuals with venous disease and those who progress to venous ulceration have higher skin temperatures around the ankle than the general population [5]. A sudden elevation in temperature more than 4 degrees Fahrenheit may be indicative of a developing leg ulcer [5].

Venous Refill Time

Venous refill time should be assessed at presentation and regularly during treatment to get an overall measurement of venous reflux [24]. It is generally recorded as the number of seconds needed for the veins of the foot and lower leg to refill when the leg is in a dependent position.

Trendelenburg Tourniquet Test

In the past, the Trendelenburg tourniquet test (also referred to as the Brodie-Trendelenburg test) was used as a clinical exam technique to assess valve competency in the lower extremities and the severity of varicose veins. However, the results of this test are not considered reliable or accurate, and it has largely been replaced by duplex ultrasound testing [23].

NUTRITION ASSESSMENT

Unfortunately, nutritional status is not often assessed in patients with venous disease, and nutritional deficiencies are underdiagnosed and underreported in this patient group [5]. A full nutritional assessment should be part of the initial patient evaluation.

Protein deficiency and inadequate calorie intake are common findings in patients with venous ulcers, and there is a correlation between protein deficiency and wound size at the 12-week mark [5]. Vitamin C deficits and low serum albumin levels are also common in persons with venous ulcers [5]. Resolution of these deficiencies should be included in the treatment plan, as venous ulcers will not heal in patients who are nutritionally compromised.

DIAGNOSTIC TESTING

The location and severity of venous reflux will help to determine the choice of treatment. Diagnostic testing used in the assessment of venous disease has been organized into three levels [24]. Level one is the patient work-up, which takes place during the initial intake process and includes the physical examination and continuous-wave, handheld Doppler studies [24]. All individuals who present with venous insufficiency should have a level one assessment. Level two encompasses more complex vascular laboratory studies, such as scanning, plethysmography, and venous pressure [24]. These studies will provide more detailed diagnostic information and further help to determine the course of treatment. Level three studies include phlebography and varicography and are done for more complex cases and as pre-operative preparation [24].

Duplex Ultrasound

Venous ultrasound is an important tool to determine the source of venous insufficiency [18]. A duplex ultrasound is used to locate malfunctioning perforator veins that may exist between the superficial and deep veins [10]. The American College of Phlebology has also recommended assessment of the patency and competency of the common femoral and popliteal veins [25]. Duplex ultrasound is regarded as the most reliable noninvasive test for diagnosing venous insufficiency [5].

Photoplethysmography and Air Plethysmography

Photoplethysmography, which assesses the degree of venous reflux and measures venous filling times, may also be helpful. Normal venous refill time is 20 seconds or longer [5]. Shorter refill times are indicative of venous reflux or obstruction.

Air plethysmography testing is used to evaluate the degree of calf muscle pump impairment. A cuff surrounding the calf measures changes in limb volume during specific maneuvers (e.g., leg lift), allowing for assessment of outflow and filling rates. Normal venous filling occurs at a rate of <2 mL per second; rates greater than 4 mL per second indicate venous reflux and correlate with the level of venous insufficiency [12].

Venography

Computed tomographic or magnetic resonance venography is normally done to outline the venous system before surgical intervention is undertaken [5]. It will also give insight regarding obstructions or compression, if present.

Laboratory Studies

Laboratory studies used in the assessment of venous disease and to determine eligibility for treatment approaches include hemoglobin, hematocrit, and prothrombin time [5]. For patients on anticoagulant therapy, it is important to keep in mind that there may be increased bleeding from venous ulcers.

Ankle-Brachial Index Monitoring

All patients with venous insufficiency should have ankle-brachial index (ABI) studies done regularly, usually every three months [5]. The ABI is a noninvasive, indirect measurement of arterial blood flow to the lower extremities. Approximately 26% of those with venous problems also have arterial insufficiency, and the ABI value will help determine if the diagnosis is severe arterial disease, mixed arterial and venous pathology, or primarily venous disease [26; 27]. An ABI value greater than 0.8 indicates primarily venous disease, while a value of 0.5–0.8 suggests a mixed etiology [24]. An ABI value less than 0.5 points to severe arterial disease, and compression therapy is not recommended for these patients [5].



The Guideline Subcommittee of the European Dermatology Forum recommends ankle-brachial-pressure index should always been determined before pressure therapy is given.

(https://onlinelibrary.wiley.com/ doi/10.1111/jdv.13848. Last accessed February 19, 2023.)

Level of Evidence: Expert Opinion/Consensus Statement

An ABI reading greater than 1.3 is indicative of incompressible blood vessels, usually found in patients with diabetes. This result is inaccurate and requires further testing (e.g., duplex ultrasound, transcutaneous oxygen measures, photoplethysmography) to obtain a correct reading [25; 26].

ABI testing is done by comparing the systolic blood pressures in the ankle to the systolic brachial blood pressures [28]. When obtaining an ABI reading, start by explaining the procedure to the patient and allowing him or her to rest in the supine position. The most accurate results are obtained when the patient is relaxed in a comfortable position with an empty bladder [26]. After about 15 minutes, take brachial blood pressure readings in both arms; the higher of the systolic pressure readings will be used to calculate the ABI value. Next, place the blood pressure cuff around the ankle just above the malleolus. If there is a wound present, cover it with a dressing before applying the cuff. Apply ultrasound gel below the medial malleolus and move the handheld ultrasound probe slowly in a half circle around the ankle until a pulse is detected. Hold the probe at a 45-degree angle pointing upward to meet the blood flow. Inflate the blood pressure cuff until the audible pulse signal disappears, then slowly release the cuff until the pulse is heard again, indicating the systolic pressure. Complete this process for both ankles, again noting the highest systolic pressure reading.

To calculate the ABI value, divide the highest ankle systolic pressure by the highest brachial systolic pressure. For example, if the ankle systolic pressure is 90 mm Hg and the highest brachial systolic pressure is 100 mm Hg, this will result in an ABI of 0.9.

ABI testing should not be done for patients with severe foot or leg pain or suspected deep vein thrombosis, as there is a possibility of dislodging the clot [26]. In addition, patients who are unable to remain supine for the duration of the test are ineligible.

CEAP CLASSIFICATION

The clinical-etiology-anatomy-pathophysiology (CEAP) classification system is used to determine the severity of venous disease and was originally developed in 1994 by the American Venous Forum. It has since been updated and revised, most recently in 2020, and continues to be the standard for classifying venous disease (*Table 1*) [11; 24; 29; 47].



The Guideline Subcommittee of the European Dermatology Forum recommends the use of the full CEAP classification in all cases of venous ulcer. This is done via a combination of physical examination and technical aid (especially

duplex ultrasound).

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Level of Evidence: Expert Opinion/Consensus Statement

CEAP CLASSIFICATION FOR VENOUS DISEASE	
Clinical	
CO	No visible or palpable signs of venous disease
C1	Telangiectasias or reticular veins
C2	Varicose veins
C2r	Recurrent varicose veins
C3	Edema
C4	Changes in skin and subcutaneous tissue secondary to chronic venous disease
C4a	Pigmentation and eczema
C4b	Lipodermatosclerosis and atrophie blanche
C4c	Corona phlebectatica
C5	Healed venous ulcer
C6	Active venous ulcer
C6r	Recurrent venous ulceration
Sª	Symptomatic, including ache, pain, tightness, skin irritation, heaviness, muscle cramps, and/or other complaints attributable to venous dysfunction
A ^a	Asymptomatic
Etiology	
Ec	Congenital
Ep	Primary
Es	Secondary (post-thrombotic)
Esi	Intravenous
Ese	Extravenous
Ec	Congenital
En	None identified
Anatomy	
As	Superficial veins
Ad	Deep veins
Ар	Perforator veins
An	No identifiable venous location
Pathophysiology	
Pr	Reflux
Ро	Obstruction
Pr,o	Reflux and obstruction
Pn	No venous pathophysiology identifiable
^a These categories are annotated by a subscript letter.	
Source: [29] Table 1	

As the name implies, the CEAP classification system consists of four dimensions. The clinical dimension is probably the most widely used and encompasses what the veins look like. The etiology dimension describes the nature of the underlying cause of the venous insufficiency, while the anatomy dimension identifies the veins affected. Pathophysiology describes the cause of the condition—whether it is reflux, obstruction, or a combination of both [7; 29].

VENOUS ULCER ASSESSMENT

Diagnosing venous ulcers correctly is necessary to ensure that appropriate treatment is implemented [9]. These wounds should be clearly distinguished from other ulcers of the lower extremities, classified, and documented. The first step in this process is to obtain a complete clinical history from the patient, followed by a physical examination and full wound assessment [5].

Venous ulcers normally develop on the medial malleolus, ankle, or posterior calf; over a perforating vein; or along the route of the great or small saphenous veins. They do not occur above the knee or in the area of the forefoot [20; 22]. In appearance, the ulcers are usually irregular and shallow, with granulation tissue and fibrin evident in the wound bed [11].

A single ulcer or several wounds may be present. If left untreated, the ulcer can extend completely around the patient's leg. The amount of drainage from a venous ulcer varies from mild to copious, and the periwound area is often macerated; scaling and crusting may also be present [5].

A venous ulcer is described as chronic when it persists for longer than three months. Ulcers that have been present for more than 12 months and are greater than 6 cm in diameter are regarded as having a poor prognosis for healing [11].

Wound Assessment

A complete assessment of the venous ulcer, including photographic documentation, should be done when a patient first presents and at all subsequent visits (ideally weekly). This is helpful in tracking healing progress and can provide positive reinforcement to patients who may find treatment long and arduous. Wound assessment should take place in a private area that allows the patient to be positioned comfortably and has adequate lighting to provide for proper visualization of the wound, the periwound area, and the entire lower extremity.

A decrease in wound size is predictive of eventual full healing. If there are no changes in the wound dimensions after four weeks, a full review of the treatment plan is warranted [5]. Wounds that do not decrease in size by approximately 30% during the first four weeks of treatment have a 68% likelihood of not being healed within 24 weeks [5]. Leg ulcers that show no signs of improvement after six weeks of treatment should be biopsied to rule out malignancy or other causes that would prevent healing (e.g., collagen-vascular diseases, bacterial or fungal infection) [30].

During the assessment patients should be asked about chronic leg cramps and restless legs syndrome [18]. Chronic pain and insomnia should also be noted [18].

Wound Measurement

Accurate measurement of the wound is probably the most important feature of wound assessment [7]. It provides information on the initial size and progression or non-progression of healing, allowing for valuable feedback on the effectiveness of clinical interventions [31].

Wounds should always be measured in centimeters, using a plastic or paper ruler. Wound length is measured from head to toe; width is measured from hip to hip [32]. The depth of the wound can be obtained by gently inserting a sterile cotton-tipped applicator into the wound bed and marking it at skin level. The applicator is then measured using a metric ruler [32].

Tunneling and Undermining

Sinus tracts and undermining impair healing, and it is important to immediately identify their presence [31]. A sinus tract is a tunnel that extends from any part of the wound and can bore through subcutaneous tissue and muscle [31]. This tunnel creates dead space, which can result in abscess formation and further impede the healing process [31]. A sinus tract can be measured using a sterile cotton swab [31]. Undermining is defined as destruction of the tissue under the skin around the edges of the wound. The easiest way to measure and describe undermining is by using the face of the clock [31]. With the patient's head representing 12 o'clock, sweep the area of undermining or probe the tunneling to ascertain the depth. For example, undermining along the right border would be recorded as extending from 1 o'clock to 5 o'clock with a depth of 4 cm [31]. It is important to check around the entire perimeter of the wound, as undermining can occur in more than one location.

Wound Bed

It is also vital to assess and document the appearance of the wound bed. If the wound bed has a mixture of tissue in it, this should be documented by an approximate percentage (e.g., the wound base is 75% granulation tissue and 25% slough). Granulation results in "beefy" red tissue with a shiny, moist granular appearance, while necrotic tissue is gray, brown, or black. Eschars are typically gray to black and dry or leathery in appearance [33]. Slough tissue is yellow/white to gray in color. It may be stringy or thick and appear as a layer over the wound bed [33]. The presence of thick slough or eschar is an indicator of arterial insufficiency [45]. Epithelial tissue will often begin to grow in from the edges over the wound surface. This tissue is generally pink and shiny. As a quick reference color guide, red is associated with normal healing, yellow indicates slough or dead tissue, and black is necrosis [33].

Surrounding Skin

The condition of the surrounding skin surface up to 4 cm from the edge of the wound circumferentially should also be assessed and documented. Its characteristics should be noted, particularly color and integrity [18]. Maceration from excessive drainage may indicate that the dressing used is not appropriate and a different product is needed. Circumferential redness up to 2 cm from the wound is indicative of cellulitis.

TREATMENT

Problems with venous circulation are not new, and reports of venous disease were recorded in the early days of medical practice. The first reported documentation of varicose veins and their treatment can be traced back to ancient Egypt [4]. In the Middle Ages, nuns discovered the benefits of massaging and applying tight wraps to legs with edema.

The earliest treatments for venous disease were vein stripping and ligation [4]. Today, treatment of venous disease is primarily surgical, and surgical intervention for varicose veins is one of the most frequently performed nonemergent surgical procedures in the United States [34].

If a venous ulcer has not yet developed, the primary goal of treatment of chronic venous insufficiency is to reduce venous hypertension and prevent ulceration. The plan of care for these patients will include weight management, compression therapy, leg elevation, setting realistic goals to become more physically active, and patient education. If an ulcer is present, the goal is to achieve complete healing and prevent ulcer reoccurrence.

Complete healing of a venous ulcer takes an average of 24 weeks. Nearly 15% of ulcers do not heal, and the five-year reoccurrence rate is up to 40% [24]. The selection of treatment options for patients with venous ulcers is often influenced by and modified because of the presence of other health issues. Diabetes, lymphedema, obesity, malnutrition, and intravenous drug use can all impact treatment efficacy and can lead to delayed healing [24]. When evaluating the treatment plan for a non-healing venous ulcer, one of the factors to re-assess is the presence of other health conditions and how well they are being managed. A holistic approach is essential in treating venous disease and venous ulcers. Better healing outcomes are achieved when a multidisciplinary team approach is used along with evidence-based wound care [24]. The team involved in the treatment of venous disease should include physician specialists, podiatrists, surgeons, nurses who have training and/ or experience in wound care, social workers, and discharge planners. The role of discharge planners and social workers in the care of these patients is often overlooked. However, the financial burden and lifestyle changes venous disease imposes on patients make assistance beyond physical care crucial to achieve successful outcomes.

There are five major treatment options for patients with venous disease [24]:

- Compression therapy
- Local wound care for venous ulcers
- Surgical interventions
- Medical treatment
- Advanced technology

As noted, conservative management is normally the first treatment option for patients without ulcers, including leg elevation, exercise, and compression therapy [21]. Treatment modalities generally focus on symptom management, such as reducing swelling or edema and eliminating lipodermatosclerosis [11; 21].

Leg elevation has been shown to be effective in reducing edema. Ideally, patients with leg edema should elevate their legs above the level of the heart for 30 to 45 minutes three to four times daily, unless there are medical contraindications to doing this [35]. Patients for whom this is not feasible should be encouraged to elevate their legs to a degree that is comfortable and to maintain that position for as long as possible.

MANAGING SYMPTOMS OF VENOUS DISEASE

Pain

Venous insufficiency-related pain does not radiate to other areas of the body and is not adversely affected by joint movement; the pain is localized to the area of venous disease and ulcer location, if present. Pain can reach a level of severity that makes walking difficult and eventually impossible. Numbness and tingling may also be present.

Pain associated with venous ulcers is usually described as moderate-to-severe stabbing, throbbing, or aching pain [9]. Patients state that pain worsens with prolonged standing, especially for long periods of time. Elevating the affected leg usually diminishes pain. It is reported that venous ulcer pain can linger for up to three months after wound healing [9]. Usual pain management techniques and pharmacology should be used to ensure patient comfort.

Pruritus

As discussed, stasis dermatitis, which occurs with longstanding venous disease, can be intensely pruritic, with some patients describing the sensation of itching as worse than the pain. However, scratching can lead to injury of already compromised skin surfaces and venous ulceration, with the possibility of infection, delayed healing, and scarring [36]. In addition, the amount of leg or foot itch is correlated with CEAP classification and degree of pain [36].

Patients with venous disease have identified itching as a factor that negatively impacts their quality of life [36]. Clinicians caring for patients with venous compromise should recognize that pruritus can pose a serious problem, and it should be included in the assessment process and addressed in the treatment plan [36].

Curative treatments are not always possible, but focusing on restoring the natural equilibrium of the skin should be the goal. Antihistamines can be used to decrease the sensation of itching, and emollient products can help to restore the skin's natural barrier [36]. Topical steroid ointment may be used to reduce inflammation and alleviate itching, but in most cases, it should not be used for more than two weeks [5].

Nonpharmacologic interventions for managing pruritus include stress management training and guided imagery [36]. Validating patients' experiences with itching and allowing them time to express their frustrations are also useful coping mechanisms.

COMPRESSION THERAPY

Compression therapy is still the mainstay of treatment of venous disease. Compression helps to heal venous ulcers more quickly by reducing edema in the affected extremity and increasing venous return toward the heart [9; 24]. As swelling in the extremity decreases, circulation to the skin surface provides improved oxygenation to promote healing [10]. Ambulatory patients should be encouraged to walk as much as possible after compression is applied in order to obtain maximum benefit from the therapy [10].



Several options are available for compression therapy, including elastic tubular support bandages, adhesive elastic wraps, hook-and-loop closure wraps, Unna boots, and multilayer compression (composed of two, three, or four layers of bandages) [13]. A multilayer, high-compression approach involving an elastic bandage provides better results for venous ulcer healing compared with non-elastic compression [44].

Since their conception, Unna boots have been the most widely used form of compression for venous ulcers [13]. The device is not actually a boot but a paste bandage impregnated with zinc oxide, glycerin, gelatin, and sometimes calamine [13]. This dressing applies compression via the slow drying and shrinkage of the bandage. Depending on facility protocol, the Unna boot is usually changed three days after the first application and weekly thereafter.

The Unna boot should be applied from just above the patient's toes to approximately 1 inch below the knee. Different application methods may be used. The boot may be pleated as it is applied to avoid wrinkles and creases, or it can be cut through and applied in overlapping strips. With each spiral, there should be a 75% to 80% overlap. The gauge is then covered with an elastic, self-adhesive bandage with 50% overlap and 50% stretch to provide additional compression [18].

The Unna boot provides inelastic compression, meaning that the pressure gradient is high while the patient is walking but low (or lacking) when the patient is resting. As such, multilayer compression bandages may supply more effective compression for non-ambulatory patients than the Unna boot. The Unna boot also does not adapt to changes in the patient's leg size, which can lead to complaints of pain and discomfort [11].

Multilayer bandages are often more effective in maintaining the pressure gradient beneath the compression. Multilayer compression includes an orthopedic wool bandage that is applied spirally around the patient's leg. This helps to absorb drainage and protect boney prominences. The second layer is a cotton crepe bandage that is spirally wrapped around the patient's leg. The third layer is an elastic bandage that conforms to the patient's leg. This bandage may be applied in a spiral fashion (with 50% stretch and 50% overlap) or in a "figure eight" configuration that will increase the amount of compression applied. The fourth and final layer is an elastic cohesive bandage that is wrapped in a spiral fashion and holds the inner layers in place [13]. Short-stretch bandages are usually used for compression; long-stretch bandages are not a good choice, as they stretch when the calf muscle is contracting and provide minimal compression. Two-layer compression systems lead to the same level of venous ulcer healing as the four-layer options, are more comfortable, and provide for a better quality of life for the patient [30; 44]. Elastic wraps often come with markings on the surface to indicate appropriate application (e.g., rectangular shapes that will change to squares when the bandage is applied with the correct amount of tension) [13].

The degree of compression therapy can be categorized as light, moderate, or high [5]. Light compression applies 20–30 mm Hg of pressure to the ankle area and is recommended for patients with venous insufficiency who are unable to tolerate higher levels of compression. Approximately 35–40 mm Hg of compression (moderate) is regarded as the most appropriate level for venous ulcer wound healing. A high level of compression is obtained with a pressure gradient of 40–50 mm Hg. As noted, there is strong evidence that approaches that achieve higher levels of compression (i.e., 35 mm Hg or greater), including multilayer elastic systems, achieve the best healing outcomes [9].

The patient's pain level should be taken into consideration when choosing compression therapy. Patients who are experiencing pain may better tolerate an inelastic support system to start, until pain and edema levels are under control [9].

Compression cannot be used for all patients with venous insufficiency; it is contraindicated for individuals with decompensated chronic congestive heart failure and those with mixed arterial and venous disease in which diminished arterial circulation is a significant risk factor [9]. Compression should not be used in any patient with an ABI less than 0.5 (i.e., with arterial disease). Carefully monitored, modified light compression (20–27 mm Hg at the ankle level) can be used in patients with an ABI of 0.6–0.8 [18].

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In addition, many patients are unwilling to wear continuous compression. In these cases, intermittent pneumatic compression (IPC) may offer a viable alternative. IPC therapy uses an air pump and a "sleeve" with one or several bladders [24]. The sleeves are wrapped around the patient's leg(s), and the air pump is used to inflate and deflate the bladders at set intervals [24]. Depending on the type of IPC used, there are variations in the compression cycles that can be set to meet the patient's therapeutic needs [24]. IPC should not be used with patients who have edema related to chronic heart failure, active phlebitis, deep vein thrombosis, cellulitis, or wound infection [13].

Applying Compression Bandages

Before applying compression bandages, it is important to explain the procedure to the patient and address any questions or concerns he or she may have. The patient's ankle circumference should also be measured. If the circumference is less than 7.5 inches, extra padding should be added around the ankle area. This can be done using a piece of the first roll of orthopedic padding. As swelling decreases, it is important to recheck the ankle circumference weekly and to adjust the padding as necessary. A very thin extremity and boney prominences should also be protected with extra padding to prevent bruising when compression is applied.

The patient's foot should be maintained in a neutral position (i.e., foot flexed to 90 degrees). The first layer of compression starts just above the patient's toes and is wrapped in two anchor turns. Continue wrapping up and around the patient's ankle, then fold back down to enclose the heel. Using a spiral wrapping technique, proceed up the patient's leg, overlapping 50% with each turn. Continue wrapping to about 1 inch below the patient's knee, then cut away any unused bandage. The second and third layers of the compression bandages are applied in the same manner. However, the third layer is the light compression bandage, and only one turn should be applied at the top of the leg (just below the knee). If more than one layer of bandage is applied, it can cause too much pressure in this area. Extra bandage should be cut off and discarded.

The fourth layer is the cohesive compression bandage and should be applied with 50% stretch and 50% overlap. Two- and three-layer compression bandaging systems are applied in the same way.

Compression bandages can be left on for up to seven days. However, if wound drainage seeps through, the wrapping should be changed. During changes in bandaging, the wound is assessed and redressed.

Patient Teaching

The greatest risk factor with compression of any type is arterial occlusion, and patients and family/caretakers should be aware of this possible complication. Face-to-face teaching should be done after the compression is applied, and written instructions should be sent home with the patient along with contact information if problems arise. The following points should be included in compression instructions:

- If the patient experiences pain, tingling, or numbness in his/her foot or toes, if swelling develops, or if the toes become a blue/gray color, the compression should be removed immediately. If the tingling, numbness, pain, or discoloration continues after the compression is removed, the patient should return to the wound clinic or go to the emergency room.
- Patients should not stand or sit in the same position for more than 30 minutes without moving.
- Patients should be advised to keep the legs raised above the level of the heart as much as possible to decrease swelling.

• The compression wraps should be kept dry and clean. When showering, compression bandaging should be completely protected in a waterproof covering; baths may be preferred. If a compression wrap or Unna boot does get wet or damaged, it should be removed. If a wound is present, it should be covered with a clean dressing and the patient's physician or clinic should be contacted.

Compression Stockings

Comfortable compression stockings are effective in preventing the reoccurrence of venous ulcers and improving patient quality of life [10]. Patients should be advised to wear gradient elastic compression stockings, which provide more compression in the foot, with reduced levels of pressure moving up the leg [10]. Usually, the physician will recommend the best level of compression for the patient. The patient's legs should be measured at the ankle and calf level by a trained clinician to ensure that the stockings fit correctly.

Compression stockings are available in most large stores or pharmacies or mail ordered from several companies and can be worn with the patient's normal footwear. Patients and caretakers should be advised to buy at least two pairs of stockings to facilitate washing and drying. Manufacturer instructions should be followed for washing, but in most instances, hand-washing and air-drying are preferred. Lower levels of compression are better than no compression at all or stockings that are "left in the drawer" [9]. However, patients should be informed that nonmedical support hosiery and anti-embolism stockings (with a pressure gradient of 8–18 mm Hg) are not suitable for compression therapy and were not made for this purpose [5].

The major drawback is that people may find it difficult to don the stockings independently, especially if they have arthritis or neurologic deficits. There are stockings available with a side zipper that makes them easier to apply and remove, although they may be more expensive. It is also possible to purchase an inner silk lining sleeve to facilitate sliding the compression stocking on and off. Several brands of compression stockings also come with a wide band at the top, which provides a better grip [10]. Some people find that wearing rubber gloves helps to get the stockings on easily, but others do not find this helpful.

Compression stockings have been described as "operator dependent," meaning they must be worn to be effective [10]. It should be emphasized to patients and caregivers that compression therapy is a lifetime commitment. Many patients may mistakenly believe that the stockings are only worn until swelling is abated, but all at-risk patients should continue to use them.

Patients and their families should also be educated about the correct use of compression. Compression stockings should be put on first thing in the morning, before the patient gets out of bed; patients should not wait until swelling is noticed to apply the stockings. It is not advisable to apply moisturizing lotion to the legs just before putting on the stockings, as this makes the skin sticky and can make it more difficult to get the stockings on [10].

Compression stockings should be replaced about every six months to maintain maximal level of compression. It is important to note that Medicare and most private insurances will only cover the cost of compression stockings if a venous ulcer is present; there is no reimbursement for compression therapy to prevent the reoccurrence of venous ulcers.

PENTOXIFYLLINE

Pentoxifylline (Trental), a derivative of xanthine, is an effective adjunct in the treatment of venous disease. It reduces blood viscosity and platelet adhesion and aggregation and increases fibrinolytic activity and microcirculation [11; 28]. When pentoxifylline is used in conjunction with compression, the healing rate of venous ulcers is significantly increased [37]. The recommended (off-label) dosage is 400 mg three times daily, and common side effects include nausea, gastrointestinal disturbances, dizziness, and headache [11; 28; 37].

HORSE CHESTNUT SEED OIL

Horse chestnut seed oil has also been suggested to manage edema and relieve itching and other symptoms of chronic venous insufficiency, such as leg heaviness and pain [5]. The active ingredient in this herbal preparation is escin, a triterpenic saponin [38; 39]. Meta-analyses of horse chestnut seed extract (available as an oral tincture, tablets, or topical gel) have found that it is superior to placebo in reducing leg pain, edema, leg volume, leg circumference, and pruritus, but no differences were found when compared with traditional therapies (e.g., compression) [38; 40]. Potential adverse effects are typically mild (nausea, dizziness, headache), making horse chestnut seed extract a potentially attractive option for patients. However, the available evidence is limited, and larger randomized controlled studies are necessary to confirm the efficacy [38].

BIOENGINEERED THERAPY

Bioengineered therapy in conjunction with compression therapy is an option for the treatment of venous ulcers that have not healed after 30 days [30]. Single-layered and bilayered bioengineered skin cellular substitutes do not provide a graft covering to the wound, but rather donate multiple growth factors to the wound bed to stimulate healing [24]. The Wound Healing Society states that bilayered artificial skin in conjunction with compression therapy is better than compression and a simple dressing [41].

ULTRASOUND THERAPY

Low-frequency ultrasound therapy may be considered when wound healing fails to progress after four weeks of standard care [42]. In one clinical trial, this treatment decreased healing times for venous ulcers compared with usual care [30]. However, a systematic review of several studies showed no clear evidence that ultrasound therapy increased healing rates, and researchers indicated that most evidence is rated as low or very low quality due to risk of bias and imprecision [48]. The assumed mechanism of action involves improvements in the microenvironment of the wound [30]. To date, there is no established standard for ultrasound therapy in the treatment of venous leg ulcers, but limited studies indicate that a minimum of two to three sessions per week is necessary in order to see results [42].

OPENING CLOSED WOUND EDGES

In full thickness wounds, the process of re-epithelialization occurs only from the wound edges, and undermining, tunneling, or rolled wound edges can inhibit wound healing. The simplest way to open closed wound edges is the treat them with silver nitrate sticks, known as AgNO3 cauterization. This requires a physician's order and is achieved by rolling the moistened tip of a silver nitrate stick along the wound edge, which causes it to turn a grayish color and to slough off over several days [18]. Subsequent treatments may be necessary to open the complete circumference of the wound edges. A topical anesthetic may be applied 15 minutes prior to beginning the silver nitrate treatment in order to prevent associated pain [18].

SURGICAL TREATMENT OF VENOUS INSUFFICIENCY

The goal of surgical treatment of venous insufficiency is to either remove or permanently close non-working veins. There is some debate of whether venous surgery increases the healing rate of existing venous ulcers, but it has been proven to decrease the rate of ulcer reoccurrence, and it is considered definitive treatment for chronic venous insufficiency. One of the most problematic issues with venous ulcers is the reoccurrence rate, which can be more than 40% [2]. As such, prevention of ulcer occurrence is one of the most important aspects of treating venous insufficiency.

Venous Stripping

In the past, venous stripping was regarded as the "gold standard" for treatment for venous insufficiency. During this procedure, the problematic vein is removed through small incisions in the patient's leg [19]. This results in elimination of venous reflux and stasis and eradication of the bulging vein [43].

Most commonly, venous stripping removes the saphenous vein. The procedure may be done with local or general anesthesia. A small incision is made in the groin, and second incision is made close to the knee. A wire stripper is inserted to disconnect the vein at both locations and remove the vein from its location [43]. Tiny incisions are made along the length of the patient's leg in areas where there are bulging veins to facilitate removal of tributary varicose veins that were not directly attached to the saphenous vein [43]. The patient's leg is then wrapped in compression bandages from the ankle to the thigh to decrease pain and minimize bruising. This compression is maintained in place for several days [43].

Other Approaches

Over the past decade, other procedures, such as venous ablation and foam sclerotherapy, have become popular in the treatment of venous disease, in many cases replacing venous stripping as the treatment of choice. These procedures are minimally invasive and result in less pain for the patient [21].

Venous Ablation

Venous ablation uses laser technology to destroy the inner lining of the saphenous vein and prevent blood flow. The procedure is done under local anesthesia, requires fewer incisions, and allows for a faster return to regular activities. It has a success rate of more than 90% [43].

Another option is adhesive ablation, which uses a cyanoacrylate glue to occlude the vein [46]. This approach minimizes adverse effects, as it is nonthermal and non-tumescent.

Foam Sclerotherapy

Foam sclerotherapy may also be used to treat venous insufficiency. Ultrasound guidance is used to navigate a needle filled with the sclerosant drug and air (microfoam) to the appropriate location, where the mixture is injected directly into the vein [43]. This results in scarring of the inside of the saphenous vein and blocked circulation. It is done as an outpatient procedure and can be repeated, if needed.

Subfascial Endoscopic Perforator Surgery

Subfascial endoscopic perforator surgery (SEPS) is a minimally invasive procedure that alleviates perforator disease, which is characterized by perforator vein incompetence and resultant venous reflux. The procedure involves disconnection of abnormal perforator veins. In addition to improving venous sufficiency, SEPS may increase venous ulcer healing when used along with compression therapy [5; 30]. SEPS has low rates of infection and is instrumental in reducing ulcer reoccurrence [30].

LOCAL WOUND CARE

General principles of wound care should be implemented when treating a venous ulcer. Ulcers should be cleaned when first diagnosed and then with every dressing change. The purpose of wound cleaning is to remove nonadherent debris from the wound bed in order to promote healing and make the wound less susceptible to bacterial overgrowth and infection. While cleaning the wound, it is necessary to minimize trauma to the wound bed and healthy tissue.

If debridement is needed, for example, if infection is present, sharp surgical debridement under local anesthesia is in most instances the best option. Depending on the size of the wound this can be done either in the outpatient wound clinic or in the surgical center. Regular (weekly) debridement is routinely done to maintain the wound in a healing state and to prevent the build-up of biofilm on the wound surface.

Wound dressings are a pivotal aspect of wound care. Dressings insulate the wound from the external environment, provide a barrier to prevent infection, maintain a moist environment, wick fluid from areas of tunneling, and absorb drainage [18]. Ideally, a wound dressing should also provide for gaseous exchange, allowing oxygen, carbon dioxide, and water vapor to pass in and out through the dressing [7]. Several wound dressing options are available. Bacterial colonization and infection are frequently found in venous ulcers, and antimicrobial dressings such as cadexomer iodine have showed good results in treating these wounds. Oral antibiotics are only indicated when cellulitis is present.

Silver dressings are a good choice and work well under compression. Foam dressings have been shown to reduce pain and decrease leakage and wound odor. While these dressings can be applied under compression, thicker versions (4–7 mm) may cause indentations at the foam edge [5; 42]. Tapering the edges of foam dressings may help ameliorate this problem.

Availability and cost should also be kept in mind when selecting a dressing. Certain dressing types may not be covered by private insurances or Medicare.

SKIN CARE

Increased swelling in the affected leg causes small slits and breaks in the skin, often with copious amounts of weeping. Skin care can help prevent breaks in the skin, but it can also introduce additional risks in some patients. Patients with venous ulcers are particularly susceptible to contact reactions, and even topical antibiotics can cause sensitivity reactions in susceptible patients. Other products associated with stasis dermatitis include creams and gels containing lanolin and perfumes [5]. Care should be taken when choosing and applying topical lotions and medications to avoid the possibility of allergic reactions and the development of contact dermatitis, as this significantly increases the risk of venous ulceration [26]. Maintaining skin cleanliness and moisturizing frequently can protect skin integrity. The skin should be cleaned with water and a gentle soap, preferably a pH-balanced cleanser. Alkaline products remove skin lipids, which increases water loss and weakens the barrier function of the skin. Hot water for bathing and scrubbing and using harsh cleaning agents should also be avoided. A soft cloth should be used to pat rather than rub the skin dry. The nurse or physician should be notified of any redness, discoloration, or skin breakdown.

It is important to individualize the frequency of skin cleansing based on the patient's age, skin texture, and dryness or excessive oiliness of the skin. A daily bath may not be needed for all patients.

PATIENT AND FAMILY EDUCATION

It is not uncommon for individuals with venous disease to delay seeking treatment, often due to misconceptions regarding their condition. Many people believe that their symptoms are not serious enough to warrant medical attention. Patients will frequently treat wounds at home for weeks, and sometimes months, before seeking medical care; however, this can lead to an increased risk of non-healing and difficult-to-heal venous ulcers. Varicose veins are often regarded as a cosmetic problem—an unsightly consequence of aging, but not a threat to well-being. These myths can be successfully addressed through patient education.

Most people are not aware that without treatment venous insufficiency will progress and can have debilitating consequences. Men are more likely than women to present with advanced stages of venous disease because they are less likely to seek early treatment for lower extremity pain and swelling [18]. Patients with venous ulcers and their caregivers should be taught how to assess the wound with each dressing change done in the home. This should include the signs of wound infection, such as changes in the amount of wound drainage, odor, and the color of the wound bed (e.g., changing from a bright red to a dark ruddy color). Changes in the periwound area, including alterations in appearance, swelling, tenderness, and pain level, are also important to note. The occurrence of any of these symptoms should prompt the patient and/or caregiver to contact his or her physician immediately.

An honest discussion should be held with the patient and significant others about what treatment is going to entail, including the necessity for weekly visits to the wound clinic for debridement and dressings changes. If a patient has difficulty keeping appointments, treatment will not be successful and healing may not be achieved.

It is vital to listen carefully to patients' concerns about treatment. Patients may be worried about missing work, transportation to appointments, wound care at home, and/or the cost of supplies. All members of the team caring for the patient should be aware of the concerns and support the patient to explore solutions. The input of the team social worker and/or case manager is particularly important at this time.

Many individuals with venous disease do not have sufficient knowledge to manage their condition successfully in the long term. The focus should be extended beyond wound healing and to making changes to maintain a healthy lifestyle. If a patient smokes, the benefits of smoking cessation for wound healing should be discussed. Weight management, safe exercise (e.g., walking), and prevention of trauma to the lower extremities should be explored with the patient/family. Concrete suggestions are better than general recommendations. For example, a patient may be instructed to take a brisk walk every day, not to cross his/her legs, and not to stand for more than 30 minutes at a time.

For patients who are unable to walk, an alternative exercise is sitting in a rocking chair and using the feet to push back while rocking steadily. This helps to increase calf muscle pump function and provides ankle flexion exercise [5]. Non-ambulatory patients should be encouraged to do this several times per day.

More attention is now being paid to the impact that venous disease and especially venous ulcers have on the quality of life for patients. Those with venous disease often have a less favorable perception of their overall health status than those who do not have venous problems, especially if edema and changes in skin texture are present [22]. Patients with venous ulcers report having less vitality, and leg pain may cause isolation and depression. Financial concerns related to treatment and care are a major source of worry and anxiety for many patients. Interestingly, successful healing of a venous ulcer does not always lead to a patient reporting an improvement in perceived quality of life [22].

Questions related to quality-of-life issues should be included in the initial patient assessment and with all follow-up visits. Inquiries should be specific and directed to what, if any, changes venous disease and venous ulceration (if present) have necessitated in their usual daily activities, including work, recreational activities, and social interactions [22].

CONCLUSION

As noted, venous insufficiency is the most prevalent vascular disorder and can result in significant morbidity, including lower extremity ulcers. As clinicians and educators, nurses play a vital role in the care of patients with venous disease and venous ulcers. A clear understanding of the symptoms, assessment and diagnosis, and treatment options will help nurses build therapeutic relationships with patients that can translate into more positive healing outcomes.

Implicit Bias in Health Care

The role of implicit biases on healthcare outcomes has become a concern, as there is some evidence that implicit biases contribute to health disparities, professionals' attitudes toward and interactions with patients, quality of care, diagnoses, and treatment decisions. This may produce differences in help-seeking, diagnoses, and ultimately treatments and interventions. Implicit biases may also unwittingly produce professional behaviors, attitudes, and interactions that reduce patients' trust and comfort with their provider, leading to earlier termination of visits and/or reduced adherence and follow-up. Disadvantaged groups are marginalized in the healthcare system and vulnerable on multiple levels; health professionals' implicit biases can further exacerbate these existing disadvantages.

Interventions or strategies designed to reduce implicit bias may be categorized as change-based or controlbased. Change-based interventions focus on reducing or changing cognitive associations underlying implicit biases. These interventions might include challenging stereotypes. Conversely, control-based interventions involve reducing the effects of the implicit bias on the individual's behaviors. These strategies include increasing awareness of biased thoughts and responses. The two types of interventions are not mutually exclusive and may be used synergistically.

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