Management of Venous ulcer.

www.healiaswoundsolutions.com
Venous ulceration is the most common type of leg ulceration. Sixty to 80% of leg ulcers have a venous component. The Lothian and Forth Valley Study examined 600 patients with leg ulceration and found that 76% of ulcerated legs had evidence of venous disease and 22% had evidence of arterial disease. Ten to 20% of cases had both arterial and venous insufficiency. Nine per cent of ulcerated legs were in patients with rheumatoid arthritis. Five per cent of the patient group had diabetes. Chronic venous leg ulceration has an estimated prevalence of between 0.1% and 0.3% in the United Kingdom. Prevalence increases with age. Approximately 1% of the population will suffer from leg ulceration at some point in their lives.

Venous ulcers are often recurrent, and open ulcers can persist from weeks to many years. Severe complications include cellulitis, osteomyelitis, and malignant change. Although the overall prevalence is relatively low, the refractory nature of these ulcers increase the risk of morbidity and mortality, and have a significant impact on patient quality of life. The financial burden of venous ulcers is estimated to be $2 billion per year in the United States.

**Pathophysiology**

The pathophysiology of venous ulcers is not entirely clear. Venous incompetence and associated venous hypertension are thought to be the primary mechanisms for ulcer formation. Factors that may lead to venous incompetence include immobility; ineffective pumping of the calf muscle; and venous valve dysfunction from trauma, congenital absence, venous thrombosis, or phlebitis. Subsequently, chronic venous stasis causes pooling of blood in the venous circulatory system triggering further capillary damage and activation of inflammatory process. Leukocyte activation, endothelial damage, platelet aggregation, and intracellular edema contribute to venous ulcer development and impaired wound healing.

**Assessment, diagnosis and referral**

Essential in comprehensive assessment is the identification of the aetiology of the leg ulcer. Specifically, an assessment to identify the aetiology of the ulcer is essential before commencing compression therapy as damage to the lower limb can result if compression is applied to underlying arterial aetiology.

Assessment should seek to identify comorbidities that may influence treatment of the VLU and/or require concurrent management. Comorbidities that require further investigation and management include peripheral arterial disease, rheumatoid arthritis, vasculitis, a past history of multiple skin cancers (lesions) and diabetes mellitus.
**Medical and surgical history**

A clinical history indicative of a leg ulcer of venous origin includes:

- confirmed venous disease
- family history of leg ulceration
- varicose veins
- previous or current DVT
- decrease of calf muscle pump function
- phlebitis
- surgery or trauma of the affected leg
- chest pain, haemoptysis or pulmonary embolism
- occupations of prolonged standing or sitting
- obesity
- multiple pregnancies.

The patient’s leg ulcer history helps develop a comprehensive picture of the disease history. Information that can assist in diagnosis and development of a treatment plan includes:

- the duration of the current ulcer
- previous ulcers and the time they have taken to heal
- time spent free of venous ulcers
- strategies used to manage previous venous ulcers.

**Pain assessment**

A pain assessment that investigates pain with a validated pain scale should be conducted.

This may include:

- location of the ulcer-related pain
- quantity/severity of the pain
- quality/characteristics of the pain
- when pain occurs (for example, at dressing changes, background pain)
- triggers and relievers
- impact of the pain on QOL.

**Psychosocial, QOL and social assessments**

Conduct psychosocial assessments using appropriate, validated assessment tools.
These may include: Mini mental examination, QOL scales for specific health populations, for example the Cardiff Wound Impact Schedule (CWIS) and Chronic Venous Insufficiency Questionnaire (CVIQ) have both been validated in patients with venous disease.

<table>
<thead>
<tr>
<th>Clinical indicators of venous leg ulcers</th>
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<tbody>
<tr>
<td>Signs or symptoms in isolation may not be clinical indicators of VLUs. A grouping of the following signs and symptoms is indicative of an ulcer of venous origin.</td>
</tr>
<tr>
<td>Predisposing factors</td>
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<td>Associated changes in the leg</td>
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<tr>
<td>Ulcer location</td>
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<tr>
<td>Ulcer characteristics</td>
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<tr>
<td>Ulcer-related pain</td>
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<tr>
<td>Surrounding area</td>
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<tr>
<td>Peri-ulcer</td>
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</tbody>
</table>

Ulcer assessment includes:

- Measurement of the ulcer size
- Amount and type of exudates
- Appearance of the ulcer bed
- Condition of the ulcer edges
- Signs of clinical infection (for example, inflammation, increased pain, increased exudate, pyrexia)
- Peri-ulcer skin
- Ulcer odour.
<table>
<thead>
<tr>
<th>Investigation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Blood pressure (BP)</strong></td>
<td>Measures the pressure of the blood on the vessel walls using a sphygmomanometer. It provides an indication of the possible presence of arrange of cardiovascular diseases. The systolic BP is used in the calculation of ABPI.</td>
</tr>
<tr>
<td><strong>Ankle brachial pressure index (ABPI)</strong></td>
<td>A non-invasive vascular test using Doppler ultrasound that identifies large vessel peripheral arterial disease in the leg. It is used to determine adequate arterial blood flow in the leg before use of compression therapy. Systolic BP is measured at the brachial artery and also at the ankle level. Using these measurements, ABPI is calculated as the highest systolic blood pressure from the foot arteries (either dorsalis pedis or posterior tibial artery) divided by the highest brachial systolic pressure, which is the best estimate of central systolic blood pressure. An ABPI of 0.8 to 1.2 is usually considered indicative of good arterial flow in the absence of other clinical indicators for arterial disease. An ABPI of less than 0.8 and a clinical picture of arterial disease should be considered as arterial insufficiency. An ABPI above 1.2 is suggestive of possible arterial calcification.</td>
</tr>
<tr>
<td><strong>Duplex ultrasound</strong></td>
<td>A non-invasive test that combines ultrasound with Doppler ultrasonography, in which the blood flow through arteries and veins can be investigated to reveal obstructions.</td>
</tr>
<tr>
<td><strong>Photoplethysmography (PPG)</strong></td>
<td>A non-invasive test that measures venous refill time by using a small light probe that is placed on the surface of the skin just above the ankle. The test requires the patient to perform calf muscle pump exercises for brief periods followed by rest. The PPG probe measures the reduction in skin blood content following exercise. This determines the efficiency of the musculo-venous pump and the presence of abnormal venous reflux. Patients with problems with the superficial or deep veins usually have poor emptying of the skin and abnormally rapid refilling usually less than 25 seconds.</td>
</tr>
<tr>
<td><strong>Pulse oximetry</strong></td>
<td>A non-invasive test that measures the red and infrared light absorption of oxygenated and deoxygenated haemoglobin in a digit. Oxygenated haemoglobin absorbs more infrared light and allows more red light to pass through a digit. Deoxygenated haemoglobin absorbs more red light and allows more infrared light to pass through the digit. There is insufficient evidence to recommend this investigation as the primary diagnostic tool.</td>
</tr>
<tr>
<td><strong>Toe brachial pressure index (TBPI)</strong></td>
<td>A non-invasive test that measures arterial perfusion in the toes and feet. A toe cuff is applied to the hallux (or second toe if amputated) and the pressure is divided by the highest brachial systolic pressure, which is the best estimate of central systolic blood pressure. The TBPI is used to measure arterial perfusion in the feet and toes of patients with incompressible arteries due to calcification which may occur in patients with diabetes and renal disease.</td>
</tr>
<tr>
<td><strong>Transcutaneous oxygen (TCPO2)</strong></td>
<td>Measures the amount of oxygen reaching the skin through blood circulation. There is insufficient evidence to recommend this investigation as the primary diagnostic test.</td>
</tr>
</tbody>
</table>
Investigations to support diagnosis

Vascular assessment
The aim of vascular assessment is to distinguish arterial aetiologies from venous and other aetiologies and assess the extent of venous insufficiency. Doppler ultrasound measurement of ABPI is the investigation most frequently used to identify arterial aetiology. However, results can be unreliable when ABPI is conducted by untrained health professionals and in patients with calcification or diabetes. It may also be difficult to perform accurately in patients with severe oedema, lymphoedema, very painful ulcers or extensive ulceration. TBPI may prove more accurate for identifying arterial perfusion in the feet and toes of patients with diabetes and renal disease with an ABPI of greater than 1.3 mmHg. Pulse oximetry could be considered to support the diagnosis of a venous ulcer; however, there is insufficient evidence (one low-quality study) to recommend this investigation as a primary diagnostic tool.

Biochemical analysis
Appropriate biochemical analysis may include:
- blood glucose
- haemoglobin
- urea and electrolytes
- serum albumin
- lipids
- rheumatoid factor
- auto antibodies
- white blood cell count
- erythroctye sedimentation rate
- C-reactive protein
- liver function tests

Microbiology and histopathology
Microbiology assists in the identification of infection and histopathology can identify malignant or other aetiologies. Investigations may include:
- bacterial wound swab or biopsy for bacteriological analysis
- wound biopsy if malignancy or other aetiology is suspected.

Diagnosis and Grading
The CEAP classification is an international consensus method of assessing venous disease. It incorporates clinical, aetiological, anatomical and pathophysiological evaluation. The scale consists of seven classifications from C0 to C6 that describe the severity of the patient’s venous disease. Patients presenting with one or more active VLUs would be classified as C6, which describes the most severe venous disease. Patients with evidence of healed VLUs are categorised as C5 due to the high risk of recurrent ulceration.
**CEAP Clinical classification**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>C0</td>
<td>No signs of venous disease</td>
</tr>
<tr>
<td>C1</td>
<td>Telangiectasias or reticular veins</td>
</tr>
<tr>
<td>C2</td>
<td>Varicose veins</td>
</tr>
<tr>
<td>C3</td>
<td>Presence of oedema</td>
</tr>
<tr>
<td>C4a</td>
<td>Eczema or pigmentation</td>
</tr>
<tr>
<td>C4b</td>
<td>Lipodermatosclerosis or atrophie blanche</td>
</tr>
<tr>
<td>C5</td>
<td>Evidence of a healed Venous Ulcer</td>
</tr>
<tr>
<td>C6</td>
<td>Active Venous Ulcer</td>
</tr>
</tbody>
</table>

**Venous Clinical Severity Score**

The VCSS has been discussed extensively in studies examining the outcome of therapy for venous disease. The ease of use of the VCSS makes it attractive as a stand-alone scoring instrument for longitudinal surveillance of venous disease in patients undergoing therapy.

**CRITERIA FOR SPECIALIST REFERRAL**

Possible indicators for specialist referral include:

- Diagnostic uncertainty
- Atypical ulcer characteristics or location
- Suspicion of malignancy
- Treatment of underlying conditions including diabetes, rheumatoid arthritis and vasculitis
- Peripheral arterial disease indicated by an ABPI less than 0.8
- ABPI above 1.2
- Contact dermatitis
- Ulcers that have not healed within three months
- Recurring ulceration
- Healed ulcers with a view to venous surgery
- Antibiotic-resistant infected ulcers
- Ulcers causing uncontrolled pain.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Absent=0</th>
<th>Mild=1</th>
<th>Moderate=2</th>
<th>Severe=3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>None</td>
<td>Occasional, not restricting activity or requiring pain medication daily</td>
<td>Moderate activity limitation; occasional pain medication daily,</td>
<td>Severe limiting activities or requiring regular use of pain medications</td>
</tr>
<tr>
<td>Varicose Veins</td>
<td>None</td>
<td>Few scattered</td>
<td>Multiple; great saphenous veins, confined to calf and thigh</td>
<td>Extensive; thigh and calf or great and small saphenous distribution</td>
</tr>
<tr>
<td>Venous Edema</td>
<td>None</td>
<td>Evening ankle swelling only</td>
<td>Afternoon swelling, above ankle</td>
<td>Morning swelling above ankle and requiring activity change, elevation</td>
</tr>
<tr>
<td>Skin Pigmentation</td>
<td>None</td>
<td>Diffuse, but limited in area and old (brown)</td>
<td>Diffuse over most of gaiter distribution (lower third) or recent pigmentation (purple)</td>
<td>Wider distribution (above lower third) plus recent pigmentation</td>
</tr>
<tr>
<td>Inflammation</td>
<td>None</td>
<td>Mild cellulitis, limited to marginal area around ulcer</td>
<td>Moderate cellulitis, involves most of (lower third)</td>
<td>Severe cellulitis (lower third and above) or significant</td>
</tr>
<tr>
<td>Induration</td>
<td>None</td>
<td>Focal, circummalleolar</td>
<td>Medial or lateral, less than lower third of leg</td>
<td>Entire lower third of leg or more</td>
</tr>
<tr>
<td>Number of Active Ulcers</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>&gt;2</td>
</tr>
<tr>
<td>Active Ulcer Duration</td>
<td>None</td>
<td>&lt;3 months, &gt;3 months &lt;1 year</td>
<td>Not healed &gt;1 year</td>
<td></td>
</tr>
<tr>
<td>Active Ulcer Diameter</td>
<td>None</td>
<td>&lt;2 cm</td>
<td>2-6 cm</td>
<td>&gt;6 cm</td>
</tr>
<tr>
<td>Compression Therapy</td>
<td>Not used or patient not compliant</td>
<td>Intermittant use of stockings</td>
<td>Wears elastic stocking most days</td>
<td>Full compliance, stockings + elevation</td>
</tr>
</tbody>
</table>

Total Score
Treatment

Treatment options for venous ulcers include conservative management, mechanical treatment, medications, and surgical options. In general, the goals of treatment are to reduce edema, improve ulcer healing, and prevent recurrence. Although numerous treatment methods are available, they have variable effectiveness and limited data to support their use.

Conservative Management

COMPRESSION THERAPY

Compression therapy is the standard of care for venous ulcers and chronic venous insufficiency. A recent Cochrane review found that venous ulcers heal more quickly with compression therapy than without. Methods include inelastic, elastic, and intermittent pneumatic compression. Compression therapy reduces edema, improves venous reflux, enhances healing of ulcers, and reduces pain. Success rates range from 30 to 60 percent at 24 weeks, and 70 to 85 percent after one year. After an ulcer has healed, lifelong maintenance of compression therapy may reduce the risk of recurrence. However, adherence to the therapy may be limited by pain; drainage; application difficulty; and physical limitations, including obesity and contact dermatitis.

Caution

Trials investigating the effectiveness of compression therapy were generally conducted in populations without diabetes, cardiovascular disease, malignancy or mixed aetiology ulcers. Compression should be used with greater caution in these populations and may be contraindicated in some patients. Other contraindications in the high-risk patient may include:

- heart failure
- peripheral arterial disease
- an ABPI below 0.8 mmHg or above 1.2 mmHg
- peripheral neuropathy
- some vasculitic ulcers.

Although compression may relieve lower limb oedema, the aetiology should be determined and the patient’s condition monitored closely when compression therapy commences, due to a risk of fluid overloading the systemic circulation. High levels of pain following application of compression should be assessed urgently.
<table>
<thead>
<tr>
<th>Compression system</th>
<th>Also referred to as</th>
<th>Description and function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multi-component system</strong></td>
<td>Two-, three- and four-layer bandaging (4LB)</td>
<td>A compression system with more than one layer or aspect. Most bandaging systems include at least a padding layer and bandages so are classified as multi-component systems. Can also refer to a system that consists of several layers using a combination of elastic and inelastic bandages (i.e. 4LB system). This system is also available as a kit.</td>
</tr>
<tr>
<td><strong>Inelastic compression bandages</strong></td>
<td>Short-stretch bandages</td>
<td>Bandages with minimal or no elastomers. Low extensibility and high stiffness (high SSI). Low resting pressure and high working pressure.</td>
</tr>
<tr>
<td><strong>Single-component bandage system</strong></td>
<td></td>
<td>Compression bandaging system that has only one layer or aspect to the system. Most bandage systems currently used in practice include a padding layer and so are not described as single-component systems.</td>
</tr>
</tbody>
</table>
| **Medical-grade Compression hosiery** | Tubular stockings, compression stockings, multi-layer hosiery systems | Available in a range of compression levels. International consensus on compression scales is lacking and different scales are used around the world. Two scales and/or classifications of compression hosiery commonly used Scale one:  
  • extra light (5 mmHg)  
  • light (15 mmHg)  
  • mild (18–24 mmHg)  
  • moderate (20–40 mmHg)  
  • strong (40–60 mmHg)  
  • very strong (>60 mmHg)  
  Scale two:  
  • Class I  
  • Class II  
  • Class III  
  • Class IV |
| **Unna boot**                       |                                                     | Although there are several systems referred to as Unna’s boot, it is commonly a gauze bandage impregnated with zinc paste under a cohesive inelastic bandage. |
| **Pneumatic compression**           | Pump compression                                    | Pressure is applied via a boot inflated by a machine either continuously, intermittently or in sequential cycles.                                         |

Inelastic. Inelastic compression therapy provides high working pressure during ambulation and muscle contraction, but no resting pressure. The most common method of inelastic compression therapy is the Unna boot, a zinc oxide–impregnated, moist bandage that hardens after application. The Unna boot
improves healing rates compared with placebo or hydroactive dressings. However, a 2009 Cochrane review found that adding a component of elastic compression therapy is more effective than inelastic compression therapy alone. Also, because of its inelasticity, the Unna boot does not conform to changes in leg size and may be uncomfortable to wear. In addition, the Unna boot may lead to a foul smell from the accumulation of exudate from the ulcer, requiring frequent reapplications.

Elastic. Unlike the Unna boot, elastic compression therapy methods conform to changes in leg size and sustain compression during both rest and activity. Stockings or bandages can be used; however, elastic wraps are not recommended because they do not provide enough pressure. Compression stockings are graded, with the greatest pressure at the ankle and gradually decreasing pressure toward the knee and thigh (pressure should be at least 20 to 30 mm Hg, and preferably 30 to 44 mm Hg). Compression stockings are removed at night, and should be replaced every six months because they lose pressure with regular washing.

Elastic bandages are alternatives to compression stockings. A recent meta-analysis showed that elastic compression therapy is more effective than inelastic therapy. In addition, high compression has been proven more effective than low compression, and multilayer bandages are more effective than single layer. The disadvantage of multilayer compression bandages is that they require skilled application in the physician’s office one or two times per week, depending on drainage.

Intermittent Pneumatic Compression. Intermittent pneumatic compression therapy comprises a pump that delivers air to inflatable and deflatable sleeves that embrace extremities, providing intermittent compression. The benefits of intermittent pneumatic compression are less clear than that of standard continuous compression. It also is expensive and requires immobilization of the patient; therefore, intermittent pneumatic compression is generally reserved for bedridden patients who cannot tolerate continuous compression therapy.

LEG ELEVATION
Leg elevation when used in combination with compression therapy is also considered standard of care. Leg elevation requires raising lower extremities above the level of the heart, with the aim of reducing edema, improving microcirculation and oxygen delivery, and hastening ulcer healing. In one small study, leg elevation increased the laser Doppler flux (i.e., flow within veins) by 45 percent. Although leg elevation is most effective if performed for 30 minutes, three or four times per day, this duration of treatment may be difficult for patients to follow in real-world settings.

Mechanical Treatment
Topical negative pressure, also called vacuum-assisted closure, has been shown to help reduce wound depth and volume compared with a hydrocolloid gel and gauze regimen for wounds of any etiology. However, clinically meaningful outcomes, such as healing time, have not yet been adequately studied. There is currently insufficient high-quality data to support the use of topical negative pressure for venous ulcers. In addition, the therapy generally has not been used in clinical practice because of the
challenge in administering both topical negative pressure and a compression dressing on the affected leg.

PHARMACOLOGICAL AGENTS USED TO INCREASE HEALING RATES
Despite compression therapy, typically 30% of ulcers will not have healed at one year. This has led to the evaluation of a number of potential pharmacological agents which may prevent or reduce damage to the microcirculation which occurs as a result of the underlying venous hypertension, and thus promote healing.

PENTOXIFYLLINE
Pentoxifylline (Trental) is an inhibitor of platelet aggregation, which reduces blood viscosity and, in turn, improves microcirculation. Pentoxifylline (400 mg three times per day) has been shown to be an effective adjunctive treatment for venous ulcers when added to compression therapy. Pentoxifylline may also be useful as monotherapy in patients who are unable to tolerate compression bandaging.31 The most common adverse effects are gastrointestinal (e.g., nausea, vomiting, diarrhea, heartburn, loss of appetite). Despite a number of studies to support its effectiveness as adjunctive therapy, and possibly as monotherapy, the cost-effectiveness of pentoxifylline has not been established.

ASPIRIN
Like pentoxifylline therapy, aspirin (300 mg per day) combined with compression therapy has been shown to increase ulcer healing time and reduce ulcer size, compared with compression therapy alone. In general, adding aspirin therapy to compression bandages is recommended in the treatment of venous ulcers as long as there are no contraindications to its use.

Micronised purified favanoid fraction
Micronised purified favanoid fraction (MPFF) consists of diosamin and favanoids. It is thought to have an effect in reducing venous distension and increasing lymphatic drainage, thereby reducing oedema. When there are no contraindications, micronised purified favanoid fraction may be used to decrease the healing time for VLUs. (Grade C)

Phlebotics
Phlebotics are vеноactive drugs that are reported to have effects on both the macrocirculation (for example, improving venous tone) and microcirculation (for example, decreasing capillary hyperpermeability). The group of drugs known as phlebotics consists of both natural favanoids that are manufactured from plant extracts and synthetic products. There is inconsistent evidence on the effectiveness of phlebotics in preventing the development of VLUs in patients with venous disease. (Grade C)

ILOPROST
The synthetic prostacyclin iloprost is a vasodilator that inhibits platelet aggregation. In one study, intravenous iloprost (not available in the United States) used with elastic compression therapy significantly reduced healing time of venous ulcers compared with placebo. However, the medication is very costly and there are insufficient data to recommend its use.

Skin and ulcer hygiene

Leg and ulcer hygiene is important in maintaining overall skin integrity. Regular washing of the ulcer removes exudate and topical product residue that may aggravate peri-ulcer skin. Compression bandaging often restricts the patient’s ability to maintain regular hygiene of the leg, so it is important this is attended to at bandage changes to reduce odour and promote skin integrity.

Leg hygiene

Cleanse the leg with a pH-appropriate skin cleanser. To obtain optimal ulcer and skin pH, avoid the use of alkaline soaps and cleansers.

Normal hygiene of the leg should be attended at each dressing change and the leg dried gently with a clean towel. Hygiene could be achieved through:

- showering in potable water
- washing the leg in a dedicated bowl of potable water
- wiping the leg with a moist cloth.
- Applying a moisturiser contributes to the maintenance of the healthy skin.

Ulcer care

- Avoid cleansing the ulcer aggressively unless the goal of care is debridement or removal of foreign bodies.
- Clean wound management technique (using potable water) should be used in most instances. Aseptic wound management techniques should be considered when:
  - the patient is immunosuppressed
  - the wound-healing environment is compromised.

Management of surrounding skin

Prevalence of venous eczema in patients with venous hypertension is between 3% and 12%. Red, inflamed skin with flakiness or scaling indicates venous eczema. The skin may have blistering or cuts.
Venous eczema can result from venous hypertension. Hypersensitivity to topical products also occurs frequently in patients with VLUs, particularly those of long duration requiring ongoing dressings.

- Red skin near the ulcer may be related to infection, venous eczema and/or hypersensitivity that will require further investigation and treatment.

- Review current topical agents with consideration to hypersensitivity.

- Consider applying a topical barrier preparation to the peri-ulcer skin to protect it from exudate.

- Venous eczema may be treated with a wide range of products including:

  - topical corticosteroids
  - topical zinc-impregnated bandages
  - other dermatological preparations.

**ANTIBIOTICS/ANTISEPTICS**

Bacterial colonization and superimposed bacterial infections are common in venous ulcers and contribute to poor wound healing. However, a recent Cochrane review of 22 RCTs of systemic and topical antibiotics and antiseptics for venous ulcer treatment found no evidence that routine use of oral antibiotics improves healing rates. Studies comparing topical antibiotics and antiseptics, such as povidone-iodine solution (Betadine), peroxide-based preparations, ethacridine lactate, and mupirocin (Bactroban), have found some evidence to support the use of the topical antiseptic agent cadexomer iodine. More high-quality data are needed to better evaluate the effectiveness of topical preparations.

Oral antibiotics are recommended to treat venous ulcers only in cases of suspected cellulitis. Suspected osteomyelitis warrants an evaluation for arterial disease and consideration of intravenous antibiotics to treat the underlying infection.

**HYPERBARIC OXYGEN THERAPY**

Hyperbaric oxygen therapy has also been proposed as an adjunctive therapy for chronic wound healing because of potential anti-inflammatory and antibacterial effects, and its benefits in healing diabetic foot ulcers. However, data to support its use for venous ulcers are limited.

**Surgical Management**

Overall, acute ulcers (duration of three months or less) have a 71 to 80 percent chance of healing, whereas chronic ulcers have only a 22 percent chance of healing after six months of treatment. Given the poor healing rates associated with chronic ulcers, surgical evaluation and management should be considered in patients with venous ulcers that are refractory to conservative therapies.

**DEBRIDEMENT**
Removal of necrotic tissue and bacterial burden through debridement has long been used in wound care to enhance healing. Debridement may be sharp (e.g., using curette or scissors), enzymatic, mechanical, biologic (i.e., using larvae), or autolytic. However, there are few high-quality studies that directly evaluate the effect of debridement versus no debridement or the superiority of one type of debridement on the rate of venous ulcer healing. In addition, most wounds with significant necrotic tissue should be evaluated for arterial insufficiency because purely venous ulcers rarely need much debridement.

SKIN GRAFTING

Human skin grafting may be used for patients with large or refractory venous ulcers. It is performed with autograft (skin or cells taken from another site on the same patient), allograft (skin or cells taken from another person), or artificial skin (human skin equivalent). However, skin grafting generally is not effective if there is persistent edema, which is common with venous insufficiency, and the underlying venous disease is not addressed. A recent Cochrane review found few high-quality studies to support the use of human skin grafting for the treatment of venous ulcers.

SURGERY FOR VENOUS INSUFFICIENCY

The role of surgery is to reduce venous reflux, hasten healing, and prevent ulcer recurrence. Surgical options for treatment of venous insufficiency include ablation of the saphenous vein; interruption of the perforating veins with subfascial endoscopic surgery; treatment of iliac vein obstruction with stenting; and removal of incompetent superficial veins with phlebectomy, stripping, sclerotherapy, or laser therapy.

In one study, ablative superficial venous surgery reduced the rate of venous ulcer recurrence at 12 months by more than one half, compared with compression therapy alone. In another study, surgical management led to an ulcer healing rate of 88 percent, with only a 13 percent recurrence rate over 10 months. There is no evidence demonstrating the superiority of surgery over medical management; however, evaluation for possible surgical intervention should occur early.

MANAGEMENT OF PAIN ASSOCIATED WITH VENOUS LEG ULCERS

Patients with VLUs regularly report moderate to severe pain using various descriptors. Venous ulcers are often reported to be particularly painful at dressing changes. Increased pain can increase healing times by decreasing patient concordance with management strategies (for example, compression, dressing attendance and exercise). Adequate pain management is essential to promote QOL and VLU healing. It is vital to conduct an initial assessment of wound-related pain and frequently reassess. A management plan should be developed and regularly reviewed.

EMLA® cream is a topical anaesthetic agent combining lignocaine and prilocaine. It is absorbed through the skin or ulcer to produce a numbing effect before painful procedures including wound debridement.
and dressing changes. It is also appropriate to use before skin grafting. The recommendation that EMLA® cream is effective in managing pain associated with VLU debridement.

**Electrotherapy**

Electromagnetic therapy exposes the patient to a magnetic field effect, usually in a pulsed fashion. It includes pulsed, short-wave diathermy, pulsed electromagnetic field therapy and diapulse. These therapies use different radio frequencies, energy frequencies, pulse lengths and energy powers. Their effect is theorised to be an energy boost to the ulcer through a calculated disruption to the ions, molecules, membranes and cells that can have physiological effects that promote healing. It is purported that electromagnetic therapy increases white cells and fibroblasts within a wound, stimulates osteogenesis and enhances blood flow.

**Exercise**

The deep veins in the lower extremities are surrounded by calf muscle that has a function in assisting venous blood return. When the calf muscle is relaxed, blood pools in the veins. When the calf muscle contracts there is a pumping action propelling blood back to the heart. This calf muscle pump function is optimised during heel-toe walking. In patients with impaired venous function, calf muscle exercises can improve the calf muscle function.

The exercises reported in the literature review were implemented in conjunction with compression therapy and consisted of two different regimens:

- Active planter flexion using resistance (4 kg) implemented under supervision for a minimum of seven days, with the exercises performed for a minimum of three sets daily of six minutes length.
- Heel raises conducted in three sets at 80% maximum repetitions on alternate days for 12 weeks.

**Nutrition and hydration**

Protein and individual amino acids, energy, a range of vitamins (including A, C and E) and zinc are all associated with wound healing. Optimal nutrition, particularly calories and protein, are essential for all wound healing.

- Nutritional requirements should be based on energy/caloric requirements with additional consideration to the stress response to illness.
- Protein requirements in healthy patients are 0.8 g protein/kg daily. This may need to be increased to 1.5 to 2 g protein/kg daily in patients with heavily exudating ulcers.
- Oral zinc supplements are not effective for improving wound healing unless zinc deficiency is diagnosed.
Patients with heavily exuding VLUs may require an increase in fluid intake if they have no fluid restrictions related to comorbidities, particularly in warmer weather.

PREVENTING RECURRENCE OF VENOUS LEG ULCERS

Progressive resistance exercise may help to promote calf muscle function.

Regular moisturising of the lower limbs helps to maintain skin integrity.

Elevation of the limbs when sitting and avoidance of standing for prolonged periods assists in controlling oedema.

Consider the continued use of compression therapy to reduce the risk of recurrence of VLUs.

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