Ulceration of the Lower Limb: An Introduction to Medical and Surgical Intervention

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Introduction

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Ulceration of the Lower Limb: An Introduction to Medical and Surgical Intervention

Keywords:
Lower limb ulceration, venous ulcer, arterial ulcer, neuropathic ulcer, pressure ulcer

Introduction
Ulceration of the lower limb is defined as the loss of epithelial integrity of the skin in the area between the ankle and knee, and as such can have multiple aetiologies. The majority are of venous origin, however arterial and neuropathic classes represent a significant proportion of disease burden. In all cases, occurrence should be used as an index of systemic disease progression, rather than an isolated incident. While preventative measures can be taken, the incidence and subsequent socioeconomic burden and patient morbidity remain a challenge within the healthcare community. The primary aim of this article is to provide trainees with a systematic approach to lower limb ulcer identification, investigation and treatment with a view to improve vigilance and patient morbidity in the hospital setting.

Clinical Assessment
When a patient presents with ulceration of the lower limb in a primary or secondary care setting, a thorough assessment consists of three phases: the patient as a whole, both limbs of the patient and of the ulcer itself. An appreciation of patients’ comorbidities is crucial in identifying risk factors to healing, recurrence, and fitness for surgery. Furthermore, time invested in establishing the impact on the patients’ quality of life, concerns and treatment expectations is necessary for a successful outcome for both parties.

Venous
Persistent venous insufficiency allows retrograde flow from deep to superficial venous systems and thus creates an environment of chronic venous hypertension. Relevant risk factors include varicose veins (Figure 1), deep vein thrombosis, obesity, pregnancy, leg fracture or previous surgery on the lower limb.

Secondary precipitants of venous incompetence include any conditions predisposing conditions deep vein thrombosis (protein C, protein S, and anti-thrombin III deficiency), infection or thrombophlebitis. On examination of the patient, venous ulcers are typically situated in the gaiter area of the lower limb (Figure 2) with characteristic gentle sloping edges.
Other features that suggest venous aetiology include:

- Venous eczema – itchy, scaly, erythematous and tender
- Haemosiderin deposition – brownish discolouration caused by breakdown of haemoglobin which has seeped out of the circulation
- Pitting oedema
- Varicosities
- Lipodermatosclerosis – fibrosed and indurated dermal and subcutaneous tissue layers
- Atrophie blanche – white fibrotic areas due to repeated scarring

Inadequately treated venous ulcer can result in an increase in the size of the ulcer as well as chronicity as seen in figure 3.

Arterial

An estimated 22% of chronic ulcers have an arterial origin, and within this group the unifying aetiology is that of peripheral arterial disease with sustained secondary tissue hypoxia. Underlying atherosclerosis of medium and large vessels are the most common cause, hence pertinent cardiovascular risk factors such as hypertension, diabetes, raised lipid profiles, family history, smoking history and previous cardio- or cerebrovascular events should be elicited in the patient history. Disease severity can be assessed by claudication distance or rest pain. Thromboembolic precipitants such as vasculitis, thromboangiitis and haematological disorders (sickle cell anaemia and thalassaemias) should not be neglected as they too carry increased risk of chronic ischemia.

Examination findings suggestive of arterial disease include:

- Typical arterial ulcer which is painful, punched out edges. These are usually situated on the toes, heels, and bony prominences of the foot (figure 4).
- Surrounding skin pallor, cool to touch
- Atrophic changes including shiny skin, hair loss with wasting of the calf or thigh musculature
- Gangrene
- Reduced or absent pulses. Objective measure severity of arterial disease can be determined by the Ankle Brachial Pressure Index (ABPI)
- Positive Buergers test in severe ischaemia

Symptoms of acute arterial disease

- 6Ps: Pallour, Pain, Paraesthesia, Pulselessness, Paresthesia, Perishing cold
Neuropathic
Currently five percent of ulcers encountered will be secondary to micro- and macrovascular complications of diabetes, and as such the nature can be venous, arterial, neuropathic (see Figure 5) or a combination thereof.\(^1\)

Sheering, frictional forces of gait leading to callous formation is the leading precipitating factor in the development of neuropathic ulcers. As such they are commonly sited on the pressure points of gait, such as the plantar aspect of the toes and foot under the metatarsal heads.

Assessment of ulcers
Leg ulcers of differing aetiologies have their own characteristics which have been alluded to in the text above, and are summarized in table 1 below.

When describing an ulcer, the characteristics including size, position, shape, borders, tissue status (sloughy or granulation) and depth at time of presentation should be documented, and if possible the use of supportive photography is recommended to monitor disease progression. Atypical morphology, sudden alteration in characteristics or failure to respond to 12 weeks of active therapy may be indicative of neoplastic change and prompt specialist referral.\(^3\)

![Figure 5: Grade 3 or 4 pressure ulcer in the heel of a patient with spina bifida](image)

<table>
<thead>
<tr>
<th>Location</th>
<th>Arterial</th>
<th>Venous</th>
<th>Neuropathic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distal limb over bony prominences</td>
<td>Loyal to the venous anatomy of the limb, typically over the medial malleoli and the gaiter area</td>
<td>Friction sites and pressure points such a peripheral edges, metatarsal heads, ankles and toes</td>
<td></td>
</tr>
<tr>
<td>Heel, metatarsal heads, toes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td>Punched-out, well demarcated edges</td>
<td>Ranges from discrete areas with shallow sloping boarders to elevated margins encompassing the circumference of the lower limb</td>
<td>A callus my be associated and signify long standing frictional forces.</td>
</tr>
<tr>
<td>Capillary refill time</td>
<td>Prolonged</td>
<td>Reduced</td>
<td>Variable owing to the absence or presence of mixed arterial disease</td>
</tr>
<tr>
<td>ABPI</td>
<td>0.7 – 1.0 mild disease</td>
<td>0.5 – 0.7 mild to moderate</td>
<td>ABPIs performed to exclude mixed aetiology</td>
</tr>
<tr>
<td></td>
<td>0.3 – 0.5 severe</td>
<td>&lt;0.3 critical ischaemia</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Characteristic clinical findings of venous, arterial and neuropathic ulcers to help in correct identification

Investigations
Investigations, especially in a specialist setting, are used to confirm the aetiology, guide management and monitor disease progression. The correct diagnoses allow the most successful intervention to be chosen, and as a consequence, hopefully reduce complications of the disease.

- Blood Tests: Full blood count (FBC), inflammatory markers (ESR and CRP) assesses infective or inflammatory states. A baseline renal function is useful when referring patients for imaging and interventional procedures. Blood glucose or HbA1c can be helpful in identification of new onset diabetes or treatment compliance.
- Bacterial swabs: Routine swabbing of ulcers yields low sensitivity owing to colonization of ulcers with skin commensals. However, in cases where clinical suspicion of infection are present (pain, tenderness, malodour, pyrexia), swabbing of the ulcers allows clinicians to choose the most appropriate antibiotics. Wound care and debridement of necrotic tissue allows clinicians to better assess viable tissues as well as reducing bacterial infections.\(^4\)
• Biopsy: As mentioned above, a low threshold for ulcer biopsy should be maintained, especially in ulcers that present in atypical area and fail to respond to three months of treatment to exclude malignant change.

• Radiographs: Ulceration extending into deeper structures, non-healing or signs of active infection should alert one to the possibility of deep soft and hard tissue infections, specifically osteomyelitis. The treating clinician should have a low threshold for requesting orthogonal radiographs to search for signs consistent with osteomyelitis: periosteal reactions, areas of lucency with sclerotic halos and soft tissue swelling which should prompt aggressive treatment. Prolonged broad spectrum intravenous antibiotics covering both gram positive and negative agents, debridement of diseased bone and soft tissue and draining of a deep abscess can be limb and lifesaving.

• Duplex ultrasonography is required especially when one seeks more invasive therapies for both venous and arterial diseases. In venous disease, duplex can detect any obstructions to flow e.g. deep vein thrombosis (where stripping of superficial venous system is contraindicated) and to detect the extent of valve incompetence. For arterial diseases, duplex ultrasonography provides visualization of narrowing, obstruction or dilatation of the arterial tree distal to the common femoral and is the investigation of choice for those presenting with limb claudication. However, views may be limited in heavily calcified vessels, and can be better interpreted in conjunction with radiological images.

• Ankle Brachial Pressure Index (ABPI): Calculated from the higher systolic blood pressure of the leg from the dorsalis pedis or posterior tibial pulse divided by the systolic brachial blood pressure. ABPI is a useful non-invasive test, although heavily calcified vessels can produce a false negative result. Values of <0.8 suggests arterial disease, and a value of <0.3 is suggestive of critical ischaemia requiring urgent referral.

• Digital subtraction angiography: This invasive procedure provides diagnostic and interventional potential. Pre and post contrast infusion imaging and subtraction of the background structures produces a detailed and superior composite image. If a short length stenosis is detected at the time of imaging, angioplasty with or without stenting can also be performed. Although described as the investigation of choice for those presenting with peripheral vascular disease, it has a substantial risk profile – including formation of pseudoaneurysm, embolization of thromboli and damaging the vessel wall.

• Computer tomography angiography (CTA): CTA generates composite three-dimensional images which are ideal for assessing the degree of blood vessel calcification, especially when imaging the aorta for consideration of abdominal aortic aneurysm repair. In peripheral vascular disease, this form of imaging can be used for patients unable to undergo magnetic resonance imaging for example, patients with metallic implants and claustrophobic patients. However, this modality exposes the patient to high dose radiation, and requires the injection of nephrotoxic contrast which is not ideal for patients with poor baseline renal function.

• Magnetic resonance angiography (MRA): MRA is the investigation of choice for peripheral vascular disease in conjunction with duplex ultrasonography as it is non-invasive, provides detailed imaging for contemplation of further treatment and does not require injection of contrast. It is however contraindicated in those with metallic implants, such as pacemakers or prosthesis, and may not be tolerated by patients who are claustrophobic.

Specialist referral is indicted in patients with the following features:

- Suspicion of malignancy
- ABPI <0.8, or urgent referral if <0.5
- Complicated by diabetes mellitus, rheumatoid arthritis, vasculitis or suspected dermatitis
- Atypical distribution of ulcers
- Non-healing ulcer (failure to progress after 12 weeks of treatment)

**Conservative Management**

The main aim of conservative management is to correct the underlying cause and regular wound care to improve healing. Any breach of the skin’s epithelial integrity impairs the ability of this organ to protect the body from pathological invasion. In the ulcerated state, moist, necrotic tissue is a breeding ground for bacteria and predisposes to secondary infections. Debridement and regular cleansing with normal saline are effective measures to reduce this risk.

A selection of dressings is available for ulcers, and the appropriate choice is driven by the ulcer condition rather than the aetiology. Dry, shallow ulcers can be covered with a simple non-adherent dressing, while exudative ulcers are better addressed with an alginate dressing.
For the wounds complicated by necrosis are better managed with hyaluronic acid dressings. At present, there is insufficient published evidence to establish whether the use of topical antiseptic dressings such as iodine, peroxide, silver, or manuka honey is beneficial. Nevertheless, these dressings are often seen in clinical practice.

**Venous**
The mainstay of venous ulcer healing, in the absence of arterial disease (ABPI >0.8) or neuropathy, is the use of graded compression stockings and these should be offered at the highest pressure in keeping with patient concordance. Practitioners should be vigilant of skin changes in the first 24-48 hours following application. Typically there are three lasses defined by the ankle pressure; class three describes an ankle pressure of 25-35mmHg that reduces to the order of 17mmHg with proximal progression. One can expect 66% and 89% of venous ulcers to be healed within 12 weeks and 24 weeks of treatment respectively, hence a low threshold for ulcer biopsy (to exclude malignancy) is required in cases where this is not achieved.

Unfortunately a third of ulcers can persist for up to a year and in these cases, there is emerging evidence for the use of pharmacological therapy. Pentoxifylline has demonstrated healing enhancement by a further 21% in compression resistant ulcers, and 23% in those initially unsuitable for compression therapy, by a mechanism of microrevascularization.

**Arterial**
Addressing the underlying mechanism of disease is essential in these cases and is best achieved by using best medical therapy (BMT). This is a multimodal approach to reduction of the patient co-morbidities consisting of:

- Smoking cessation
- Supervised exercise focused on calf-muscles to develop collateral circulation and improve haemodynamics
- Weight control
- Lipid lowering therapy
- Anti-platelet therapy
- Improved glycaemic and hypertensive control

Analgesia in the management of chronic ischaemic pain is useful, however, persistent rest pain for over two weeks will require urgent vascular referral as definitive management may be warranted for treatment of critical ischaemia.

**Neuropathic**
The main aim of neuropathic ulcer treatment is to prevent repeated friction in ulcer-prone areas, and to prevent formation of new ulcers. Good glycaemic control for diabetics will help prevent further progression of peripheral neuropathy. Referral to the orthotic department may help in providing specialized shoes to reduce pressure on the ulcer.

**Surgical Intervention**
Although surgical intervention of venous ulcers aims at secondary prevention and arterial a definitive treatment, both circumstances are united in addressing the underlying pathology.

**Venous**
Patients with varicose veins who have residual function within the superficial and perforating systems are eligible for operative intervention. This can involve laser ablation, foam sclerotherapy or the traditional open varicose vein surgery dependent on patient factors and surgeon’s preference. The ESCHAR trial demonstrated that recurrence risk of ulcers after varicose vein intervention can be reduced by up to 90%.

In ulcers which are slow to heal, skin grafting may be an option. In the presence of lipodermatosclerosis or dystrophic calcification shave excision with split thickness skin grafting offers promising results. Patients with significant co-morbidities or wishing to avoid general anesthesia can be offered pinch skin grafting where small <0.5cm islands of healthy donor skin are harvested from the patient and embedded in the base of the ulcer wound.

**Arterial**
The three broad strategies for improving arterial flow are angioplasty, endarterectomy and bypass, while amputation is reserved for cases where restoration of flow is unachievable.

Angioplasty is indicated when short occlusions or stenosis are present in the iliac or superficial femoral arteries. Stent placement allows compression of the plaque against the vessel wall, thus increasing lumen patency and flow restoration. Endarterectomy is the treatment of choice for smaller vessel disease, where the vessel is clamped, an incision performed and the atherosclerotic plaque is dissected carefully from the vessel wall, and the vessel is repaired. Perhaps the most invasive surgical option is that of bypass surgery and as such is reserved for those patients unsuitable for angioplasty and endarterectomy. Extent of disease, anatomical position and patient factors and comorbidities determine the finer details of bypass revascularization.
It has to be borne in mind that in addition to the aforementioned aetiologies, leg ulceration may result from atypical causes such as connective tissue diseases (such as rheumatoid arthritis and systemic lupus erythematosus) that result in vasculitic ulcers as illustrated in figure 6.

Conclusions
Chronic leg ulceration is recognized as debilitating and disfiguring complication of systemic disease and as such contributes highly to patient morbidity and reduced quality of life. There are multiple medical and surgical treatment options but the key to successful management lies in identifying the aetiology and addressing the cause, hence a thorough history and clinical examination is imperative.

Pure venous ulcers are treated with graduated compression bandaging in the first instance (where patient compliance may be an issue). For those with associated varicose veins, surgical options can be explored. Arterial ulcers need prompt vascular referral as the presence of an ulcer indicates critical limb ischemia, and may warrant urgent surgical intervention. For the remaining 15% of chronic ulcers of a mixed arterial and venous pathology or those with neuropathic ulcers, a multidisciplinary approach is often required. However, in all cases, one must not forget to involve the patient in decision making, encourage lifestyle modifications and risk factor management.

References:
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