

Table 6.2 describes investigations that can assist in the diagnosis of ulcer aetiology.

Table 6.2: Investigations	
Blood pressure (BP) ^{25,32,34,35}	Measures the pressure of the blood on the vessel walls using a sphygmomanometer. It provides an indication of the possible presence of a range of cardiovascular diseases. The systolic BP is used in the calculation of ABPI.
Ankle brachial pressure index (ABPI) ^{25,30,32-35}	<p>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.⁴¹ 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.</p> <p>ABPI = $\frac{\text{highest systolic foot pressure}}{\text{Highest systolic brachial blood pressure}}$</p>
Duplex ultrasound ³⁰	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. ⁴²
Photoplethysmography (PPG) ³⁰	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. ⁴³ The PPG probe measures the reduction in skin blood content following exercise. This determines the efficiency of the musculovenous 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
Pulse oximetry ^{33,35}	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. ^{33,35}
Toe brachial pressure index (TBPI)	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. ⁴⁴
Transcutaneous oxygen (TCPO₂) ³⁰	Measures the amount of oxygen reaching the skin through blood circulation. There is insufficient evidence to recommend this investigation as the primary diagnostic test. ^{33,35}

Doppler ultrasound measurement of ABPI is the investigation most frequently used to identify arterial aetiology.^{25,32-35} However, results can be unreliable when ABPI is conducted by untrained health professionals and in patients with calcification or diabetes.³⁴ It may also be difficult to perform accurately in patients with severe oedema, lymphoedema, very painful ulcers or extensive ulceration.³⁵

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.⁴⁴

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.^{33,35}

Biochemical analysis

Appropriate biochemical analysis may include:

- blood glucose^{25,30,32,34}
- haemoglobin³⁰
- urea and electrolytes³⁰
- serum albumin³⁰
- lipids³⁰
- rheumatoid factor³⁰
- auto antibodies³⁰
- white blood cell count³⁰
- erythrocyte sedimentation rate³⁰
- C-reactive protein³⁰
- liver function tests.³⁰

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 analysis³⁰
- wound biopsy if malignancy or other aetiology is suspected.^{30,33,34}

Recommendation

Patients with a non-healing or atypical leg ulcers should be referred for consideration of biopsy.
(CBR) Practice Points

- Bacterial swabs should only be taken when the ulcer shows clinical signs of infection.^{33,34}
- A structured, systematic leg ulcer assessment tool can assist in a clearly documented, accurate and comprehensive assessment. An example of an appropriate tool is the NZWCS Venous Ulcer Clinical Pathway³¹ and its companion tool the Venous Leg Ulcer Assessment Form.⁴⁵

Supporting literature

The literature search identified one low-quality study on pulse oximetry. No research was identified on other assessments for VLUs.

A low-quality observational cohort trial³⁵ investigated the reliability of pulse oximetry in assessing patients before commencing treatment of leg ulcers. Pulse oximetry was compared with the gold standard, Doppler ABPI. Participants (n=39) were attending a leg ulcer clinic; however, their specific selection for inclusion in the trial was not reported. Pulse oximetry and ABPI were both measured after the patient had reclined at a 40° angle for 15 minutes. Pulse oximetry was conducted on the patient's toe and finger to determine a toe finger oximetry index (TFOI) that was reported to be analogous to an ABPI measurement. Analysis of the ratio of TFOI and Doppler ABPI showed only fair agreement (kappa 0.29, weighted kappa 0.39). The researchers suggested pulse oximetry could be used to determine whether compression therapy is appropriate for patients presenting with leg ulcers.³⁵ (Level III evidence)

One international clinical guideline based on an SR of the literature also found no evidence of a level above case reports and non-analytical studies related to investigations besides pulse oximetry (one case control study) to support the diagnosis of a VLU. The guideline recommended the use of ABPI to assess for presence of arterial disease and provided evidence from a cohort trial conducted in patients with vascular disease (but not VLUs) to support the recommendation. The guideline also made a recommendation based on non-analytical trials that non-healing or atypical ulcers should be referred for consideration of biopsy.³³ (Expert opinion)