

Section F: General considerations

What qualification or training is required for sonographers performing duplex ultrasound to investigate chronic venous disease?

Recommendation F1: We recommend that sonographers who perform duplex ultrasound in Australia and New Zealand to assess for chronic venous disease in the lower limb should have a recognised qualification. Student sonographers should be supervised by a sonographer or other qualified specialists in vascular ultrasound who have experience in performing venous insufficiency scans.

Level of Evidence: Moderate

Strength of Evidence: Strong

Consensus: High

Summary Statement

Two existing evidence-based guidelines^[9, 60] recommend that personnel who perform duplex ultrasound for CVD are credentialled or qualified. Direct evidence to support this is not available, however based on a survey of American sonographers in relation to carotid ultrasound,^[170] sonographers themselves are likely to believe that qualification is important to reduce unnecessary repeat examinations, and limit examinations performed in a technically inappropriate manner. Accreditation was also identified as an important factor in examination quality in a survey of staff of Intersocietal Accreditation Commission (IAC) accredited vascular testing facilities in North America.^[171] A key feature of the standards used for this accreditation is credentialling and continuing education of all staff. Other existing guidelines also recommend sonographers performing venous insufficiency examinations should be appropriately credentialled.^[83-84, 172]

In Australia, qualified sonographers must meet the educational requirements to be eligible for registration with the Australian Sonographer Accreditation Registry (ASAR) as either an accredited general or vascular sonographer.^[34] Benefits under the Medicare Benefits Scheme (MBS) are only payable if the sonographer is suitably qualified, involved in a relevant and appropriate Continuing Professional Development (CPD) program and are registered with ASAR.^[173] In New Zealand, credentialled or qualified sonographers will have met the educational requirements to be registered as a sonographer with the New Zealand Medical Radiation Technologists Board (NZMRTB).

Although the sonographers in Australia and New Zealand undergo rigorous training and education to qualify for their roles, it is essential that they not only meet the required credentialling standards but also feel comfortable and confident in performing the examinations. The body of knowledge required by a sonographer includes a thorough understanding of the anatomy (including common variants) and nomenclature, physiology, pathophysiology, and the clinical course pertaining to CVD, as well as ultrasound physics and instrumentation.^[21, 133] Training should include theoretical information, practical training and clinical training.^[81] This guideline establishes the groundwork for duplex ultrasound examinations for CVD, emphasising the importance of standardised protocols irrespective of the service location and the varying levels of expertise. Using this guideline will enhance diagnostic accuracy, reliability and repeatability. In addition, we strongly encourage sonographers to actively engage in CPD to stay abreast of the latest advancements in ultrasound technology, diagnostic techniques, and venous treatments. Upholding CPD practices ensures that sonographers maintain and improve their knowledge and skills, ultimately enhancing the overall quality of patient care.

In this guideline we do not make a recommendation of how much clinical training is required for a sonographer to gain competence in duplex ultrasound for CVD, as this will vary by sonographer. Indeed, existing published requirements and estimates for the number of cases required to achieve competency vary widely. For example, it has been suggested that a minimum of 250-400 supervised venous insufficiency examinations is appropriate,^[35] but the IAC recommends 100 cases.^[133] The requirement to obtain the Certificate in Clinician Performed Ultrasound (CCPU) issued by Australasian Society for Ultrasound in Medicine (ASUM)^[174] is a minimum of 50 venous insufficiency ultrasound scans of the lower extremity, whereas the Society for Vascular Technology of Great Britain and Ireland recommend at least 600 scans, and at least three years full-time equivalent scanning experience.^[175]

What are potential limitations and difficulties that may be encountered in the examination?

Sonographers should record on their worksheet or sonographer report if they encountered any limitations or difficulties when performing the examination. The scan may also require an extended time to ensure a complete examination.

Difficult body habitus

Duplex ultrasound (US) can be technically compromised due to difficult body habitus, such as obesity. Common areas that are difficult to visualise include the groin for imaging the common femoral vein (CFV) and saphenofemoral junction (SFJ), the adductor canal or lower thigh for the femoral vein (FV), and the calf for both deep and superficial veins. Strategies to improve imaging include patient position to improve venous distention (erect or reverse Trendelenburg), and using a lower frequency transducer. [83,113]

Ineffective provocative manoeuvres

Assessment of venous incompetence relies on creating a sufficient pressure gradient across the venous segment under examination using effective provocative manoeuvres.

The adequacy of the augmentation manoeuvre is sufficient if a spike of forward flow during the manoeuvre can be visualised; if the response is insufficient then alternate augmented methods should be used. If augmented forward flow is not detectable during the proper application of augmentation manoeuvre, then venous thrombosis should be suspected.

The adequacy of the Valsalva manoeuvre is sufficient if there is cessation of forward flow with the manoeuvre. If the patient has difficulty understanding or performing the actions needed for an effective Valsalva manoeuvre, the sonographer can simulate this manoeuvre by instructing the patient to take a deep breath and resist pressure that is applied to the abdomen while holding his or her breath. The sonographer pushes on the patient's abdomen during the breath hold, and the patient's resistance to the push simulates the Valsalva manoeuvre. [41]

Patients with small veins that need assessment

The smaller the veins, especially minor cosmetic veins, the more difficult they are to assess. It is helpful to book patients with minor varicose veins towards the end of the day as incompetence usually worsens over the course of the day. The room should be warm, and sometimes performing the duplex US examination in a lighted room will ease locating the veins. The patient should be asked where the problem veins are in case they are not easily evident. [35]

Right Heart failure

Cardiac disease and CVD often coexist in elderly patients. Clinically, these patients commonly present with bilateral leg oedema, a sensation of heaviness, and/or leg ulcers. When right atrial pressure is elevated, venous waveforms may display pulsatile reversed flow on spectral traces, creating a deceptive appearance of reflux flow (**Images 100-101**). It is essential to differentiate this from venous reflux resulting from valvular failure. When performing a duplex US examination, a straightforward compression of the SFJ with a demonstrated absence of pulsation in the GSV, provides confirmation that venous backflow is caused by right heart failure. [176]

Immobile patients, patients who have difficulty standing

A step stool with a handle can be beneficial for patients, providing them with a secure grip and a sense of safety. Positioning the patient directly in front of or leaning onto the bed can reduce patient fatigue. Patients with arthritis or osteoarthritis may experience pain and tiredness when standing on one leg, requiring short breaks for rest. Care should also be taken when scanning vulnerable patients, such as elderly frail patients or

those with dementia, who may struggle with maintaining their balance. For patients unable to bear weight or at a higher risk of falls, duplex US examination in the reverse Trendelenburg position is recommended, particularly if a tiltable bed is available.

Fainting

It is not uncommon for patients to feel lightheaded, dizzy, or even faint during the duplex US examination for CVD due to the standing position, especially among younger patients. The exact cause of vasovagal syncope is not yet clearly understood. However, it may be related to the dilation of the veins in the upright position and insufficient blood flow to the brain, attributed to a neurological reflex.

The main concern with vasovagal syncope is that the patient may fall and become injured. Therefore, sonographers should closely monitor the patient for signs such as the onset of a hot flush, sweating, pale skin, and silence. Sometimes, turning off the Doppler sound effect can also help patients reduce anxiety and emotional stress. Other preventative measures include recommending that the patient eats a meal before the duplex US examination, maintaining good ventilation in the scanning room, using a step stool with handles, having a second person assist the patient with standing, advising the patient to avoid watching the ultrasound screen, and maintaining constant communication with the patient during the scan. In case of faintness, the patient should be advised to quickly sit or lie down with the leg elevated. First aid procedures and relevant departmental protocols should be followed. Medical support should be sought if necessary. ^[35, 82]

Wounds

Venous leg ulceration (VLU) resulting from CVI accounts for 70-80% of lower limb ulcers.^[31] Ultrasound has proven effective in identifying the source(s) of reflux responsible for VLU. Patients with VLU typically exhibit multilevel disease affecting deep, superficial, and perforating veins.^[44] In one study, an incompetent perforating vein could be found in 32% of legs with a chronic venous ulcer.^[176] Therefore, assessing perforator incompetence within the ulcerated area is crucial for the management of VLU. According to Society for Vascular Surgery and the American Venous Forum guidelines (2024),^[9] refluxing perforating veins (outward flow exceeding 0.5 seconds) are defined as "pathologic" if they have a diameter of more than 3.5 mm. The care for VLU should be provided by wound care specialists or nurses, and the approach to removing wound dressings for duplex US examination may vary based on individual professional preferences and institutional protocols. If the dressing is retained, and veins in the ulcerated area are not imaged, the ultrasound report should include this information at a minimum. When investigating veins in the ulcerated area, a sterile ultrasound probe cover and gel should be used. Provocation manoeuvres for testing reflux in superficial or perforating veins should be applied away from the ulcerated region. If the ulcerated area is above the saphenous or peroneal nerve, performing calf compression may be painful. Using a soft wool dressing can help disperse the pressure during compression.

Are there any ethical concerns?

Sonographers should refer to the ASA Sonographer Code of Conduct [asa sonographer code of conduct \(sonographers.org\)](https://www.asasonographers.org/asa-sonographer-code-of-conduct) and ASA consent guidelines (see links at end of this section), and any relevant specific national, state, or local policies or procedures.

There would be few reasons to deny a patient this venous insufficiency examination due to its low risk.^[8] Examples would be patient refusal, or threat to patient or sonographer safety after reasonable step to mitigate safety risks have been considered or implemented. Sonographers should engage in shared decision making with their patients. Duplex US is a low-risk procedure and therefore written consent is not required unless otherwise indicated by local protocols.

In the case of examining children, safe and sensitive practice should be adhered to. Although not common, children may present for duplex US evaluation of the lower limb veins due to Klippel-Trenaunay syndrome or

post-thrombotic syndrome. Venous disease in school-aged children has been estimated at 0.2% to 2.9%, and the incidence of physiologic venous reflux described as approximately 13% in children aged 14 to 16 years. ^[177]

Assessment of the groin is necessary when performing duplex US for CVD. This should be explained by the sonographer, with the reasons why this is necessary, and the sonographer should recognise any cultural sensitivities. In some cases, it may be considered necessary to offer a chaperone. ^[82]

Refer to:

Guide to Consent for Medical Ultrasound Examinations	Clinical Guidelines: Consent for Medical Ultrasound Scans (sonographers.org)
The Guide to Consent and Chaperones for Intimate Medical Ultrasound Examinations	https://www.sonographers.org/publicassets/023b27c7-047b-ef11-9133-0050568796d8/Guide-to-Consent-for-Intimate-Examinations-Sept-24.pdf

When should a bilateral examination be performed?

A number of existing clinical guidelines comment as to whether a bilateral examination should routinely be performed. One clinical guideline states that both limbs should be investigated even if only one limb shows evidence of venous disease. ^[81] Three clinical guidelines state that the decision to perform a bilateral or unilateral assessment would depend on the patient's clinical presentation, ^[39, 82, 84] and therefore the decision is usually based on the referrer's preference. All four of the identified clinical guidelines addressing this question were in agreement that department policies should be followed. ^[39, 81-82, 84] The trade-off between identifying CVD in a leg without symptoms (in a bilateral examination) compared to the productivity gains in performing unilateral examinations needs to be considered. One study demonstrated that in 95% of patients who had bilateral scans, a unilateral scan was sufficient to inform the treatment ^[178] Sonographers should be guided by their referrer preferences and departmental guidelines. If a unilateral examination is performed, and transmitted pulsatility or loss of phasicity in the CFV is detected, then a spectral trace of the contralateral CFV would be beneficial to confirm the influence of either a cardiac cause or an intra-abdominal or pelvic obstruction. ^[45, 84]

What instrumentation and settings are required to perform the exam?

Room requirements and preparation

The duplex US examination should be performed in a room where the lighting can be adjusted to settings for good visualisation of the lower limb to establish the distribution of varices and skin changes, and for optimum visualisation of the images on the visual display monitor of the ultrasound machine.

The examination room should be warm to promote vasodilation and to avoid vein constriction which can occur in a cold environment. ^[45, 81] It is preferable to perform the examination on a hard, hydraulic, tiltable table with foot supports, brakes and up and down movement capabilities (**Images 102-105**). ^[35, 45, 86] This facilitates patient and sonographer positioning for an optimum examination and safety. If a tiltable table is not available, then appropriate support should be provided for the patient to accommodate standing and semi-erect positions with weight bearing on the contralateral leg, or the sitting position. ^[109] A second person may be helpful in these cases to provide additional support to the patient and relieve sonographer ergonomic stresses.

Equipment:

An ultrasound machine is required to have real-time B-mode, colour and spectral Doppler duplex/triplex imaging capabilities ^[21, 44-45] and digital storage capabilities. ^[85]

A range of transducers should be available, to allow for imaging of all veins at the highest clinically appropriate frequency, understanding the trade-off between resolution and beam penetration. ^[44, 83, 85] Higher frequencies should be used to investigate the superficial veins, and lower frequencies may need to be used to assess deep veins, or the veins of patients with obesity or oedematous limbs. Transducers with linear footprints are the most suitable, but in some cases, it may be necessary to use a curved array transducer. ^[8, 45, 48]

Regular equipment maintenance should be planned and performed on all equipment used for vascular ultrasound, the frequency of which may be governed by local regulations and accreditation requirements. [83,109]

Ultrasound Equipment Settings:

The settings of the ultrasound equipment should be optimised for the depth and location of the target anatomy. [113] If focal zones are adjustable, the focal zone(s) should be set at the deep wall of the vein of interest. [45, 81]

B-mode

The gain and time-gain compensation (TGC) should be set so that the imaged vein can be clearly distinguished from its surrounding connective tissue. Fine-tuning the TGC at the appropriate depth, placing the focal zone just below or at the level of the area of interest, reducing the dynamic range, and utilising rejection, edge enhancement and speckle noise reduction imaging can enhance contrast resolution. This allows for better delineation of the vessel wall and a clearer visualisation of the vein lumen in the absence of thrombosis or red blood cell aggregates. The vein lumen is normally echo free, unless cell aggregates are present with very slow flow, in which case slow moving echogenic foci will be seen. [45, 81]

Colour Doppler

Colour gain should be optimised for wall-to-wall filling. If set too high, the colour may “bleed” out to the surrounding tissues and obscure any disease that is present. If set too low, false intraluminal defects may be demonstrated. [81, 113] It is conventional to use blue to represent orthograde venous flow towards the heart and red for the retrograde or reverse (venous reflux) flow away from the heart. [81] However, the sonographer should be aware that the colour representation can vary depending on the orientation of the transducer and the path of the vein. Colour inversion could potentially cause a misinterpretation of the flow direction in the examined vein.

Low flow settings are also required to detect slow venous flow. [81] This includes a low colour scale (or pulse repetition frequency) at 4 to 14 cm/seconds, a low to medium wall filter and a medium-high colour persistence. [113]

In the past, it has been necessary to reduce the colour box size to achieve acceptable frame rates or temporal resolution. Current, modern, high-end ultrasound equipment with multiple beam formers allows for faster acquisition of image frames even with a large colour box placed at considerable depth. The colour Doppler box should be placed with a favourable Doppler angle such as $\leq 60^\circ$. [35]

Spectral Doppler

Similar to colour Doppler, spectral Doppler should be performed using a favourable Doppler angle $\leq 60^\circ$ [35] and low pulse repetition frequencies and wall filters, with an appropriate sample gate based on the size of the interrogated vein to demonstrate low flow. [45, 81, 113]

To demonstrate valve closure and differentiate it from noise artefact, a slow sweep speed is required to avoid interpreting it as reflux. [113] Venous flow must be documented below the baseline prior to augmentation to validate flow reversal above the baseline. [175]

If aliasing artefact occurs, the Doppler scale and baseline should be adjusted to avoid the Nyquist limit. [112]

Ancillary equipment

- A cuff inflation system is optional, depending on the availability and preferences of the sonographer. [85]
- A tape measure or ruler, and/or a method of marking the skin may be useful to indicate the position of specific veins, such as perforating veins, in relation to a surface landmark.

How long should the venous insufficiency ultrasound examination take?

Examination time will vary depending on local protocols, the condition of the patient, the clinical complexity of the investigation, and the experience of the sonographer. Despite these variations it is useful to provide a recommended length of appointment time for a comprehensive examination for booking purposes. The Society for Vascular Ultrasound (United States of America) recommends 45 minutes for a unilateral examination, and 70 minutes for a bilateral examination.^[85] Similarly, 30-45 minutes has been recommended for a unilateral examination and 60-75 minutes for a bilateral examination.^[35] In a recent survey of Australian sonographers (respondents n=97), the most commonly allotted appointment time for a unilateral examination was 30-45 minutes (46.4%), and an allocation of greater than 60 minutes was only reported by two sonographers.^[64] Another study reported examination times to average from 50-70 minutes, but it is unclear if this was for a unilateral or bilateral examination.^[87]

Unilateral study: It is reasonable for a unilateral booking to be 30-45 minutes (a longer time may be required if sonographer is required to produce schematic/worksheet at end of the appointment, or if the sonographer is in training for this examination).

Bilateral study: It is reasonable for a bilateral booking to be 60-90 minutes (a longer time required if sonographer required to produce schematic/worksheet at end of appointment, or if the sonographer is in training for this examination).

What are relevant safety issues, and risk of injuries? How should they be mitigated?

Published studies have established the prevalence of work-related musculoskeletal disorders in sonographers, with reported incidence rates as high as 98%. Among all vascular ultrasound scans, venous insufficiency (VI) examinations and vein mapping of the lower extremity veins are recognised as physically challenging with difficulties primarily attributed to the standing position which is essential for accurate venous reflux testing.

Sonographers have the right to adapt, shorten, or discontinue the scan if they feel that either the patient or themselves are not safe. An account of adapted or shortened examinations, with justifications should be documented, together with any alternate arrangements or suggestions.

Ergonomics

Workplaces offering VI scanning should provide their sonographer workforce with equipment that offers ergonomic solutions to minimise the risk of work-related musculoskeletal disorders. If augmentation or calf squeeze, which is considered the most effective method for eliciting reversed flow, is performed without considering ergonomics or without access to appropriate equipment, sonographers can find themselves performing the test in uncomfortable positions. For instance, they may have to bend over and reach down to enable manual augmentation with the non-scanning arm, engaging in static and extended arm abduction, maintain a stable transducer position without any arm support for prolonged periods, and endure excessive twisting of the torso and/or neck due to the need to watch the screen while performing the assessment.^[89, 179-182]

Both patient comfort and sonographer experience can be improved by scanning the patient in a reverse Trendelenburg position when a tiltable bed is available. To minimise the strain of repetitive manual augmentation, the toe-elevation manoeuvre may be used as an alternative. The use of powered augmentation devices can be used. An ultrasound system with a height-adjustable control panel can be beneficial, eliminating the need for the sonographer's non-scanning arm to reach up for controls. This can be further extended by setting up a second display monitor on the floor or attaching the screen to the bed with a rotating arm to reduce the need for head and neck rotation. Back posture may be improved by having the sonographer

sit on a yoga ball or a low chair. Examples of ergonomic room setups can be found in the Image Gallery (Images 102-105).

There are several established guidelines that can be followed for the purposes of improving ergonomics and alleviating the risk of injuries due to the awkward scanning posture. Other strategies to minimise injury include maintaining a varied case mix, reducing the number of scans performed by one sonographer in a day and avoiding consecutive VI scans.

Refer to:

- Guidelines, Policies and Statements ASA and ASUM joint Guidelines for reducing injuries to all Ultrasound Users (2020) [ASA-ASUM WRMSD GL-Web-Version-11-2020.pdf \(sonographers.org\)](#)

Infection Control

Sonographers should follow infection control guidelines.

- ASA Clinical Statement: Infection prevention and control (2021) [UPDATE---PUB_0874_CS-Infection-Prevention-and-control-update.pdf \(sonographers.org\)](#)
- ASA Clinical Statement: Safe use and storage of ultrasound gel (2021). [PUB_0872_Safe_Use_and_Storage_of_Ultrasound_Gel_FEB21.pdf \(sonographers.org\)](#)

Patients with VLU often present with compression bandages and dressings. Ideally these should be removed to allow a comprehensive examination. Compression bandages can easily be removed. They can cover a much larger area than the specific wound area that the dressing covers. To remove the dressing may require nursing assistance with wound aftercare. If dressing removal is not practicable, contact with open wounds can be avoided by using variable transducer angles to assess the area deep to the wound.

ALARA (As Low as Reasonably Achievable) principle

The use of diagnostic ultrasound is considered safe if used prudently. ^[183] Sonographers should be aware of the thermal index (TI) and the mechanical index (MI) when scanning. The TI indicates the potential for tissue heating, and the MI indicates the potential for non-thermal effects. Sonographers should aim to keep these indices as low as possible when scanning, without compromising the diagnostic value of the examination, and keep examination times as short as possible.

How should the venous insufficiency examination be reported?

The sonographer who performs the examination must be able to correctly interpret and report their findings in accordance with local protocols. The sonographer must document the ultrasound examination to allow proper interpretation by referring doctors, reporting physicians and vascular care providers. This includes the recording of B-mode, spectral (with Doppler flow demonstrated below the baseline prior to reflux provocation manoeuvres to validate flow reversal demonstrated above the baseline), and colour Doppler images.

Additionally, the sonographer should provide a detailed outline of sonographic findings using standardised text and a vein mapping worksheet (schematic diagram). The schematic diagram is a core element in facilitating understanding of the venous system and haemodynamics, aiding in determining the suitability of target veins for appropriate treatments. It should illustrate all assessed venous anatomy (irrespective of whether they are competent, or incompetent), including anatomical variations, vein diameter, and venous competency, (refer to Table E1, section E). Enhancing the schematic diagram by using colour coding and symbols to denote pathologies can improve its effectiveness for result interpretation and communication (see *Supplementary file 3*). Video recordings may be useful but are not usually required. ^[35, 43, 48, 81-82, 113]

The outline of sonographic findings (otherwise referred to as sonographer report or preliminary report) should be provided to the reporting doctor or appropriate health care provider as soon as practicable after the examination. This should be provided urgently in cases where the result of the examination requires immediate medical attention.^[82] Examples are bleeding ulcer, superficial or deep venous thrombosis. Specifically, the following should be recorded:

Patient and examination information

- Patient full name, date of birth and ID number when available
- Date of the examination
- Time of the examination
- Sonographer's initial and surname
- Patient history and clinical information: this information may be sourced from the referrer, existing medical records, the patient's symptoms at the time of the examination, clinical observations or tests (e.g. presence of visible clinical signs, such as varicose veins and their locations) made by the sonographer at the time of examination or reports from past imaging examinations. It is necessary to record information that is relevant to the duplex US examination, the clinical question or any incidental findings. Note should be made of any variations to clinical presentation as described by referrer or change in patients' clinical presentation since previous duplex US examinations.
- Technical considerations
 - the position that the patient was examined in.
 - which leg (s) was examined, and which veins were assessed.
 - the method of reflux provocation manoeuvre (is useful but not essential).
 - any limitations to the examination, including those affecting image quality, or the ability to answer the clinical question.
 - if the examination was extended or reduced in scope from departmental protocol, with justifications provided. This includes variances relating to patient or sonographer safety.
- Diagnostic Findings
 - The answer to the clinical question. In the case of duplex US for CVD this would normally include 1) the location, extent and sonographic appearance of thrombus if present, 2) the location and extent of refluxing veins and varices, 3) the affected veins within the refluxing venous pathway including the source of reflux and connecting tributaries, 4) measurements of vein diameter and reflux duration when applicable, 5) anatomical variations, differential diagnosis or complications relevant to the clinical question, and 6) comparison with previous duplex US examinations.
 - In cases of recurrent varices (i.e. post-surgery), it is useful to determine and record if a recurrence has occurred at a previously ligated junction or whether a previously treated saphenous trunk has recanalised.
 - The reflux duration thresholds used to identify refluxing veins should be defined.

B-mode images

- Transverse images with and without transducer compression, demonstrating patency of the veins assessed (optional).
- If DVT or SVT is present:
 - Its extent
 - Length
 - Appearance of the thrombus by echogenicity to characterise as acute, non-acute or post-thrombotic scarring (chronic).
 - Obstruction (occlusive vs non-occlusive).
 - If a thrombosed vein has recanalised, become incompetent and to what extent?
 - How far from the saphenofemoral or saphenopopliteal junction is the thrombus?

- The diameter of the veins when measured.
- The presence of sonographically visible varices and their location.
- The presence of any veins that are aneurysmal, hypoplastic, absent, or have been removed for bypass grafting or stripped.
- Anatomical variations that could potentially complicate treatment or reflux pathways.
- The presence of any differential diagnosis, incidental findings or complications.

Spectral Doppler images

- Representative images of the veins that have been assessed using reflux provocation manoeuvres, with reflux duration measurements using calipers if reflux is demonstrated. Ideally, reflux should be demonstrated according to conventions. I.e., normal venous flow is displayed below the baseline, and reversed flow (reflux) should be displayed above the baseline. As a cautionary note, anyone interpreting images should be aware of how to interpret flow direction on images.
- Any additional images that demonstrate location and extent of reflux, if possible, its origin and drainage.
- Doppler waveforms distal to suspected obstruction.
- Sampling of the treated vein with appropriate settings, showing successful ablation or sclerosis.

Refluxing veins

- All contributing sources of venous reflux and their location (e.g., incompetent SFJ, perforating veins, tributary veins originating from non-saphenous origins such as perforating veins or pelvic veins).
- The location and extent of incompetent venous segments.
- Which veins constitute the reflux pathway including saphenous vein and connecting tributaries.
- Any pathology relevant to the venous incompetence or in close proximity to the incompetent veins. Record its nature and location.
- If reflux is segmental or axial.
- Measurement of the length of a straight incompetent vein, together with selection of an access point, measurement of the depth for any sub-fascial segment, and identification of any impediments to the passage of a guide wire or catheter/fibre are beneficial for the treatment process.
- The presence and location (measured from a landmark such as groin, knee crease or ankle malleoli) of perforating veins near active or healed venous ulcers.

Colour Doppler

Colour Doppler is a useful adjunct to the examination, by providing rapid assessment of veins. However, the recording of colour Doppler images in cine loop is only necessary if the pathology being demonstrated is not possible with spectral Doppler imaging. Reflux by colour Doppler images should be demonstrated according to conventions. I.e., red is for reverse flow (reflux). As a cautionary note, anyone interpreting images should be aware of how to interpret flow direction on images.

What criteria should be used to triage patients by urgency for performing and reporting the duplex ultrasound examination?

Urgency for ultrasound examinations is usually determined by clinicians (e.g., general practitioners, vascular surgeons, dermatologists) who have medical training, and have holistic knowledge of the clinical needs of their patients. This enables them to make informed decisions regarding the priority of the scan based on individual patient's clinical conditions.

In the absence of a medical practitioner at the ultrasound facility, sonographers can adopt an existing evidence-based approach for scheduling an ultrasound appointment, provided a valid ultrasound request is available. They should also prioritise the issuing of preliminary reports to referring doctors to communicate any acute findings. The method used should be systematic, considering the patient's clinical presentation and potential complications, ensuring that timely ultrasound findings address the patient's clinical needs, therefore improving patient safety and facilitating prompt treatment, whether conservative or interventional. To assist, Table F1 has been developed and adapted from The Venous and Lymphatic Triage and Acuity Scale (VELTAS), which is a consensus document developed during the COVID-19 pandemic,^[184] to classify clinical conditions by urgency. The indications in this table may be medical information the sonographer received at the time of booking, or information that the sonographer obtained when performing the examination. It is outside of the sonographer's scope of practice to make diagnostic clinical assessments.

Table F1: A guide to triaging venous insufficiency examinations by urgency for sonographers [adapted from ^[184]]

Triage category	Clinical categories	Clinical indications	Implications for sonographers
Emergency	Venous thrombo-embolism	- Massive pulmonary embolism with or without deep vein thrombosis - Acute ilio-femoral deep vein thrombosis with phlegmasia or sepsis - Acute paradoxical embolism and stroke - Venous gangrene	If any of these indications are mentioned in a referral or ultrasound request, the sonographer should first consider performing a lower extremity deep vein thrombosis examination before investigating chronic venous insufficiency. The examination must be performed and reported immediately. Any acute findings, such as deep vein thrombosis, vascular tumours or bleeding due to large varix, should be immediately communicated to a medical practitioner, whether the reporting or referring doctor.
	Chronic venous disease	- Life-threatening blood loss from a bleeding varix - Acute septicaemia or uncontrolled sepsis in a leg wound	
	Vascular anomalies	Severe coagulopathies such as Kasabach Merritt Syndrome.	
	Venous trauma	Life or limb-threatening venous trauma	
	Lymphatic disease	Acute septicaemia or uncontrolled lymphangitis or secondary infection	
Urgent	Venous thrombo-embolism	Pulmonary embolism, deep vein thrombosis or extensive superficial venous thrombosis	If any of these indications are mentioned in a referral or ultrasound request, the sonographer should first consider performing a lower extremity deep vein thrombosis examination before investigating chronic venous insufficiency. The examination should be performed and reported urgently. If the sonographer identifies acute thrombosis in the deep or superficial veins during the scan, this finding should be communicated to a medical practitioner, either the reporting or referring doctor, as soon as possible because the condition may deteriorate quickly and become an emergency.
	Chronic venous disease	- Temporarily controlled bleeding varices - Infected wounds and ulcers with risk of septicaemia - Squamous cell carcinoma in a venous ulcer	
	Vascular anomalies	- Acute complications including infection, bleeding and thrombosis - Cardiac failure secondary to AVM - Vascular malignancies	
	Venous trauma	Non-life or limb-threatening venous trauma	
	Lymphatic disease	Lymphoedema with extensive lymphangitis or secondary cellulitis and risk of septicaemia	
Semi-urgent	Venous thrombo-embolism	Symptomatic non-extensive superficial vein thrombosis	If any of these indications are mentioned in a referral or ultrasound request, then the examination is not considered as a medical emergency or urgent scan. The scan should be prioritised ahead of non-urgent cases but after emergency and urgent cases, ensuring it is performed within 90 days following the initial management by the referring doctor. If during a duplex ultrasound to investigate chronic venous insufficiency, the sonographer identifies a superficial vein thrombosis, or pelvic venous insufficiency, varicoceles then this finding should be conveyed to a medical practitioner (reporting doctor or referring doctor) in a timely fashion.
	Chronic venous disease	- CEAP: C3-C6 - Highly symptomatic chronic venous disease, irrespective of CEAP classification - Highly symptomatic pelvic venous insufficiency, varicocele	
	Vascular anomalies	- Complex or extensive vascular tumours and malformations - Ulceration and cutaneous complications	
	Venous compression	Highly symptomatic venous compression syndromes	
	Lymphatic disease	Chronic lymphoedema with secondary infection or cutaneous changes.	
Non-urgent	Venous thrombo-embolism	Chronic symptomatic post-thrombotic obstruction	If any of these indications are mentioned in a referral or ultrasound request, then the examination is not considered urgent or semi-urgent. The scan should be performed as soon as practicable, taking into account of patient preferences and the case load of the ultrasound facility, but within 6 months following the initial management by the referring doctor. It is unlikely for a non-urgent study to become urgent or semi-urgent or emergency. However, the sonographer should use their clinical judgement to prioritise the scan according to the patient's needs. The result of the duplex ultrasound examination should be made available to the referring doctor in a timely fashion.
	Chronic Venous disease	- CEAP: C0s-C2 - Mildly symptomatic pelvic venous insufficiency, varicocele	
	Vascular anomalies	Uncomplicated benign vascular tumours and malformations.	
	Venous compression	Mildly symptomatic venous compression syndromes including May-Thurner syndrome	
	Lymphatic disease	Chronic lymphoedema or lipoedema	