Ultrasound Guided Venous Access in Emergency Department

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Purpose: The purpose of this SDLP is to facilitate the completion of one of the three phases of learning necessary to become accredited in the use of the ultrasound guided venous access device.
These three phases include;

1. Self-Directed Learning – Participants should read the Ultrasound Guided Venous Access learning package.

2. Small group practical session – Participants must attend the small group simulated practical session prior to attempting supervised cannulation attempts.

3. Supervised venous access attempts – Participants to complete eight successful supervised cannulation attempts

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Introduction

Venous access in the emergency department can sometimes be very challenging. The use of ultrasound scanning (USS) guided venous access allows cannulation of veins that are neither visible nor palpable and reduces the need for a central line and its potential complications (Shokoohi, Boniface, McCarthy, 2013, p198-203 and Au, Rotte, Grzybowski, Ku, Fields, 2012, p1950-4).

The traditional approach carries numerous inherent problems. Anatomically the location of vessels can vary considerably. Veins can be difficult to palpate in patients who are obese/oedematous or distorted as a result of scarring from previous cannulation attempts.

Patients with difficult access are routinely subjected to multiple insertions increasing their risk of complications, discomfort and time to perform lab tests Ultrasound-guided venous access results in higher overall and first-pass success rates and very low complication rates (Keyes, Frazee, Snoey, Simon, Christy, 1999, p711-4 and Costantino, Parikh, Satz, Fojtik, 2005, p456-61).

In addition to emergency physicians and residents, emergency nurses and technicians can be safely and effectively trained to perform ultrasound-guided venous access. This can result in a reduced work load for medical staff and earlier treatment and initiation of investigation for the patient (Weiner, Sarff, Esener, Shroff, Budhram, Switkowski, 2012; epub ahead of print: and Witting, Schenkel, Lawner, Euerle, 2010, p70-5).

Disclaimer

Aim

After completing this SDLP you should be:

- Able to identify which patients are suitable for USS guided venous access
- Aware of the appropriate settings on an ultrasound machine for venous access and how to optimise images
- Be starting to understand how to safely recognise veins and be aware of the ultrasound differences between veins and arteries

Learning Outcomes or Learning Objectives

Completion of this learning package will enable the Registered Nurse and medical practitioner to complete the related competencies, and therefore demonstrate an understanding of the following:

- To identify which patients are suitable for USS guided venous access
- To be aware of the appropriate settings on an ultrasound machine for venous access and how to optimise these images
- To safely recognise veins and be aware of the ultrasound differences between veins and arteries

Learning Package Outline

The package is designed to be a self-directed learning experience that will guide you through the literature and clinical issues related to ultrasound guided venous access.

This package is developed within an adult learning framework so not all activities need to be documented but it is expected that you will complete them in order to facilitate your learning.

Problem based learning

This program is based on a problem-based approach to learning. This approach has been chosen to enhance critical thinking, and to create a body of knowledge that the RN or medical practitioner can apply to prac-

tice.

Problem based learning (PBL) is characterised by the use of patient specific problems or situations as a context for developing problem-solving skills and for acquiring clinical knowledge.

How to use this resource or Instructions for participants

- It is expected that this SDLP will take you 1 hour to read
- At the completion of this learning package you are asked to complete the small group practice.
- There is a suggested reference list and it is by no means complete. Please read widely to facilitate your learning.

Ultrasound Guided Venous Access

Ultrasound scanning (sonography) is a safe, painless technique used to visualise tissues and organs inside the body. It uses high-frequency sound waves, which cannot be heard by humans, to produce images of structures inside the body. When sound waves are directed into the body, some are absorbed by body tissues and others reflect. The sound waves that bounce back are measured by the ultrasound machine, and are transformed into an image of a particular body area.

Ultrasound produces good images of organs that are soft or filled with fluid (such as veins), but it is less effective for examining air-filled organs or bones.

Inclusions

Suitable opportunities for ultrasound-guided venous access include the following situations:

- Failure of venous access by the traditional technique
- Venous access of a patient who is severely dehydrated or shut down • Venous access in patients who are obese
- Venous access in the presence of peripheral oedema
- In patients with known difficult venous access (e.g. Intravenous

drug use or those with previous multiple IV access attempts such as chemotherapy patients)

- Cannulation in the presence of burns that overlie the cannulation site

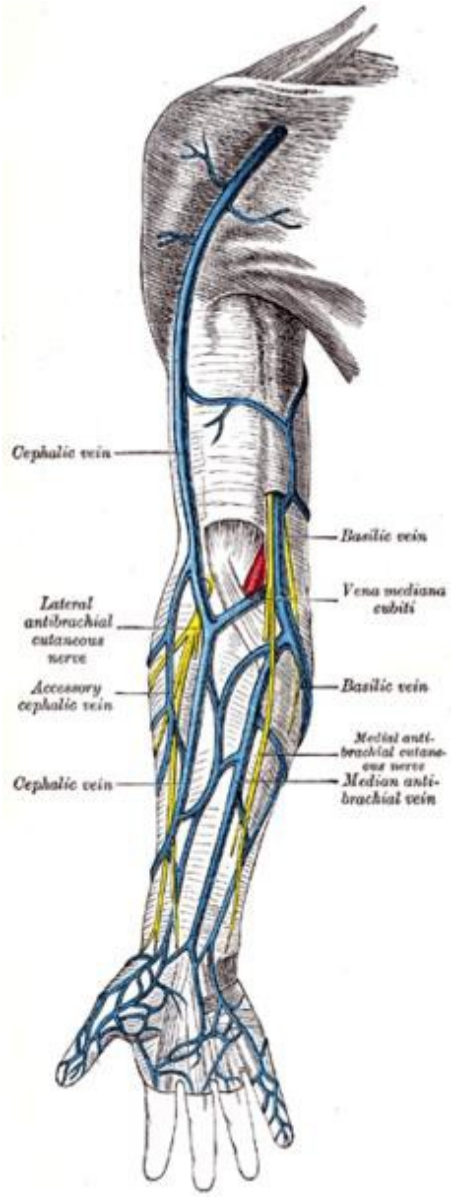
Exclusions

Ultrasound guided venous access is suitable for most patients however certain clinical situations may dictate the need for rapid venous access where delays may result in a negative outcome for the patient (such as cardiac arrest). In this scenario intra-osseous access may be more suitable, but can be left at the discretion of the physician in-charge.

- History of axillary node dissection
- Arteriovenous fistula (AV) or planned AV fistula in end-stage renal failure
- Infective process (cellulitis, erysipelas, lymphangitis, etc) in region close to prospective cannulation site

Technique

Anatomy and Safe Identification of Vessels



It preferable to access the most DISTAL vein available - more proximal veins are ideally reserved for emergency situations. In the upper limb, target veins include the Cephalic, Basilic or brachial veins.

However in patients with difficult venous access the normal anatomy may be distorted and vein selection may be limited to whatever vein is visible. Choosing which vein to cannulate is based on the 3D's, the veins:

- Diameter (the larger the better)
- Depth (distance from skin surface)
- Direction of travel (straight veins are easier to cannulate)

(Blaivas, Brannam, Fernandez, 2003 p1307-11).

It is preferred to select a vein that conforms to the 3D's but in difficult circumstances the operator should choose the best vein on show

Upper limb venous anatomy taken from Wikipedia http://en.wikipedia.org/wiki/Cephalic_vein

Vessels on ultrasound

Fluid on ultrasound typically appears black, as it is a good conductor of sound and reflects very little of the soundwave generated. Vessels are fluid filled spaces and typically in the transverse view will appear as circular structures with a black centre.

Veins and arteries can appear very similar at first glance but it is important we know how to differentiate them.

Vessels Pre-compression

Artery

Vein

Vessels Post-compression

Artery

Vein

The following characteristics of each can be used to delineate veins from arteries:

- Arteries can often be seen to pulsate even under compression.
- Veins compress when gentle pressure is applied with the probe.
- Colour on US is not a great method to differentiate between arteries and veins as it only tells you of the direction of flow. That direction can change based on how you hold the probe.
- Doppler mode to ascertain an arterial pulsatile waveform is a far more reliable method.

Positioning

Position the patient and equipment so that all involved are comfortable and the operator has a direct line of vision between the desired site of access and ultrasound screen

Ultrasound set up

- Turn on the machine and ensure the linear probe is selected.
- Apply the tourniquet in a high arm or axillary position and when ready position the probe over the skin (start in the antecubital fossa) with the probe indicator pointing

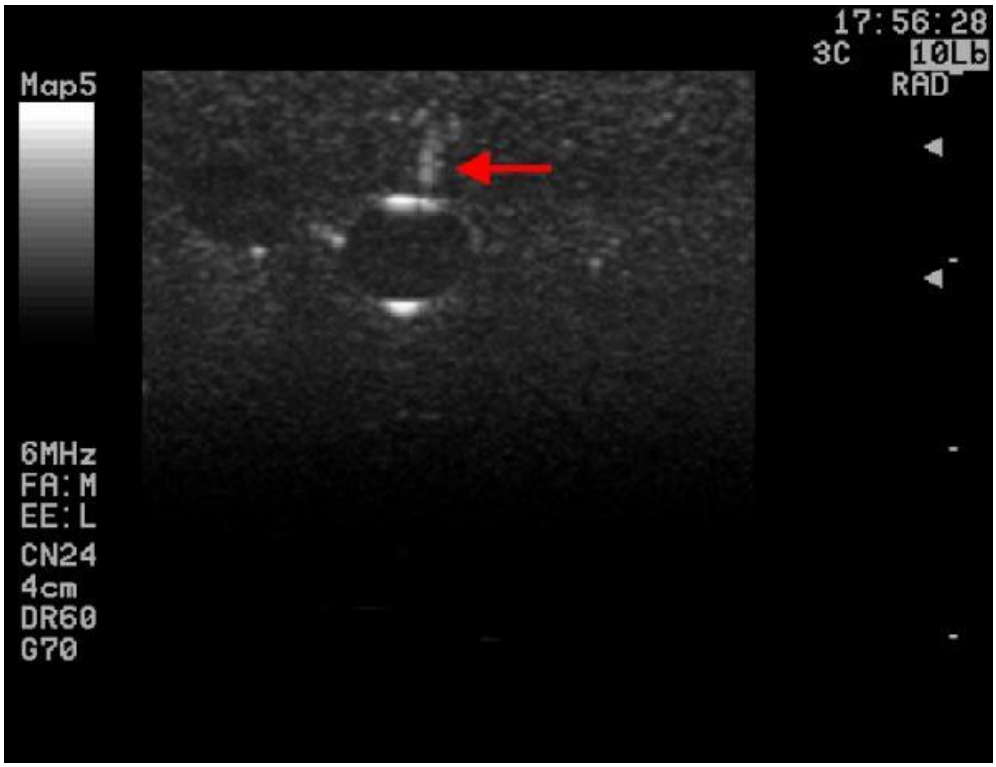
to the patients right side

- Optimise the image on the ultrasound scanner by adjusting the near and far fields and depth
- Identify an appropriate vessel in the transverse view and drag the probe up and down the vessel to determine the depth and direction in which it travels
- Try to pick the best point of entry using the 3D's rule
- sterilize access point with skin preparation
- Choose either the transverse or longitudinal method of entry

(Tip – hold the needle in the dominant hand and the probe in the non- dominant hand)

Transverse Method

The transverse method involves identifying the desired vein in the transverse plane and centering the vessel on the ultrasound screen. The point of skin entry should be as close to the probe as possible at the midpoint of the transducer footprint.



(Red arrow indicates the needle as it advances close to the vessel. Image taken from emedicine - http://emedicine.medscape.com/article/1433943-)
(Tip – If the needle tip is lost, dragging or fanning the probe back and forth over the needle or gently bouncing the needle within the soft tissue may obtain a better sense of where the needle tip is located).

The operator should then identify the needle tip on the screen by fanning the probe back and forth just beyond the point of needle insertion and advance the needle toward the vein at a 45 degree angle. When advancing the needle, while being careful not to damage the probe with the cannula tip, focus on the ultrasound screen and not on the probe or skin surface. Directly visualize the needle tip by sliding the probe along with the needle as it advances through the skin. It is important to locate the needle tip as failure can lead to misdirection and difficulty assessing the proximity of the needle tip to the target vessel.

Venous access is confirmed with flashback of blood or with direct visualization of the needle tip within the lumen of the vessel. Blood can now be aspirated or a cannula inserted following the standard technique used when venous access is confirmed from the traditional method. The operator must remember to wipe the gel from the patients arm before securing a cannula or attaching a band aid as the adhesive will not work effectively on a lubricated arm.

<u>Longitudinal Method</u>

This is an alternative approach with the advantage that the entire needle can be visualized as it advances and enters the vein. The depth orientation is better with this approach and for some operators, this method is more intuitive.

Identify the desired vein as for the transverse approach and centre the probe over the middle of the vessel. In one swift movement rotate the probe perpendicular to the vein. Care must be taken to ensure the correct direction of the vessel is obtained prior to rotation as it may be lost when spun. Rotating either the proximal or distal tip of the probe can help to obtain an adequate longitudinal view which should include a full cross section of the vessel.

(Transverse view of the left Basilic vein rotated to achieve a longitudinal view)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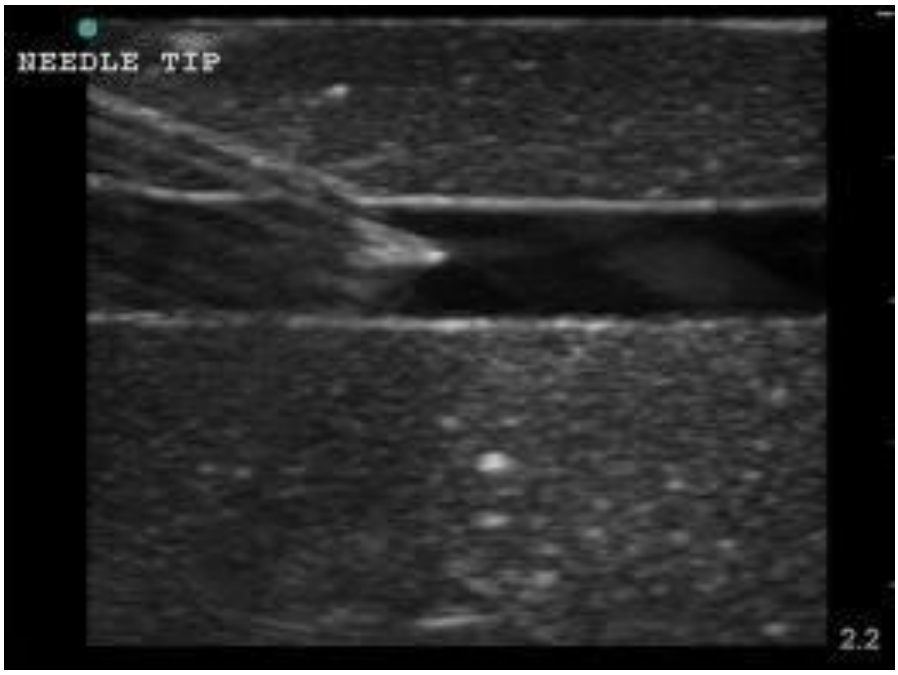
Once an adequate view has been achieved the needle can be inserted

inferiorly from the lateral surface of the probe foot print as close to the middle as possible.

Once inserted the needle should be visualised before advancing. If it is not seen the needle can be fanned left and right until it is seen on the skin. As it advances the needle should be observed under direct vision to pass through the skin and into the vein.



Venous access is confirmed in the same way as for the transverse technique.

The main disadvantage with the longitudinal technique is poor lateral resolution. A needle located just to the side of a vessel can be appear to be in the same plane, meaning the vein may not be penetrated or structures either side of the vessel may be accidentally accessed. Therefore this technique should be used with caution in the vein is within close proximity to an artery, in this instance the transverse view may be preferable. Either approach can be used in most cases however the transverse route is thought to be easier for novice ultra-sonographers to pick up (Brown, McNicholl, Wright 2008).

Post Procedure Care

The usual documentation procedures for time, site and date of cannula insertion should be followed and the probe should be cleaned with the recommended cleaning solution after probe cover removal. The Ultrasound machine should then be placed back where it belongs in the ultrasound area opposite Resus 1.

References

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