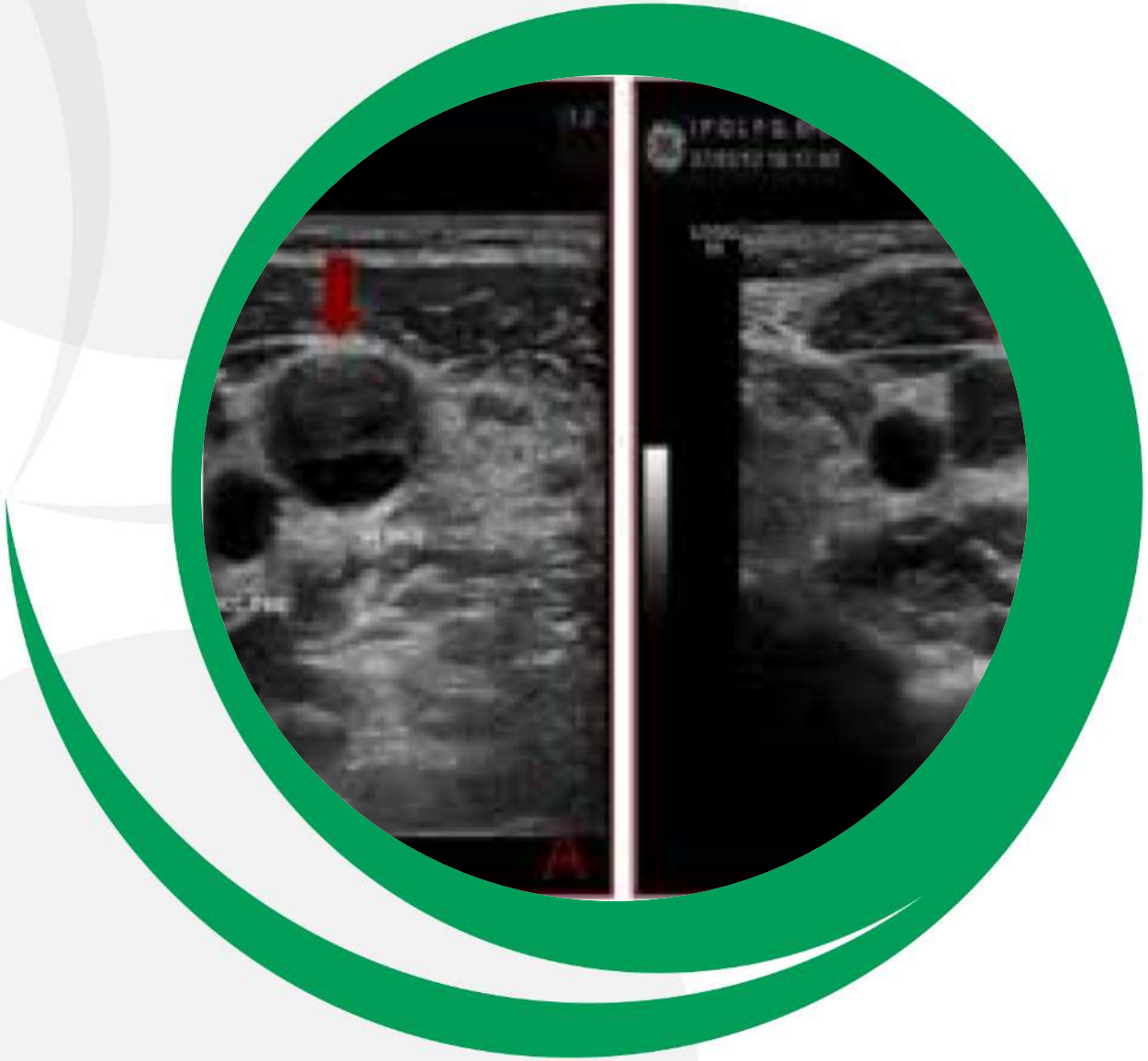


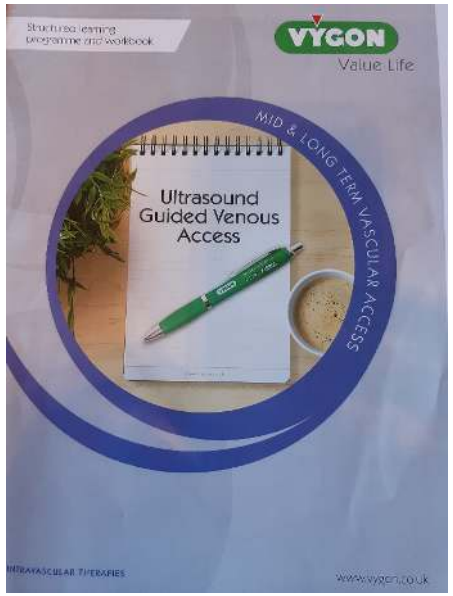
VYGON

Ultrasound Guidance

for Venous Access

Ultrasound Guidance for Venous Access

Content



Ultrasound Guidance for Venous Access

Agenda

- Theory - Why ultrasound guidance?
- Theory - Basic ultrasound physics
- Theory - Anatomy as it relates to ultrasound
- Theory - Vascular Access using ultrasound

Ultrasound Guidance for Venous Access

Learning Outcomes

- Develop and understand the principles of sound.
- Equip you with a basic understanding of the principles of ultrasound.
- Develop an understanding of how ultrasound waves are impacted by tissue.
- Develop understanding of skills required to perform ultrasound guided vascular access

Ultrasound Guidance for Venous Access

Why Ultrasound Guidance?

- Hundreds of thousands of vascular access devices placements per year in NHS
    - Short - term
    - Long - term
- Blind landmark technique to locate vessel and guide needle into target vessel increases risks to patient.
- Recently ultrasound has been used to access veins for peripheral access (cannula, PICCs, arterial).

Ultrasound Guidance for Venous Access

Why Ultrasound?

- Ultrasound is the most commonly used imaging technology used worldwide.

- ***Why?***

- Popular due to:
  - Availability – portability
  - Speed
  - Low cost
  - Patient friendly / safety – no radiation

Ultrasound Guidance for Venous Access

Guidelines to support

- National Institute for Clinical Excellence (NICE) (2002)
- Centre for Disease Control (CDC) (2012)
- EPIC3 (2014)
- Cochrane Report (Brass et al 2015)
- Association for Professionals in Infection Control and Epidemiology (APIC) (2016)
- Infusion Nurses Society (INS) (2016)
- Association of Anaesthetists of Great Britain and NI (AAGBI) (2016)

Ultrasound Guidance for Venous Access

Literature to Support

- Randolph (1996)
- Rotschild (2001)
- Keenan (2002)
- Calvert (2003)
- Brealey et al (2009)
- Lamperti et al(2012)
- Cochrane Report – CVC's (2015)
- etc. etc. etc....

Ultrasound Guidance for Venous Access

Literature Support

"the use of real-time two-dimensional ultrasound for the placement of central venous catheters substantially decreased mechanical complications and reduced the number of attempts at required cannulation and failed attempts at cannulation compared with the standard landmark placement."

Ultrasound Guidance for Venous Access

Blind Technique associated with:

- Missed Target
- Multiple Punctures
- Failure
- Wrong Target
- Arterial Puncture
- Nerve damage

Ultrasound Guidance for Venous Access

Venous Access Using Ultrasound

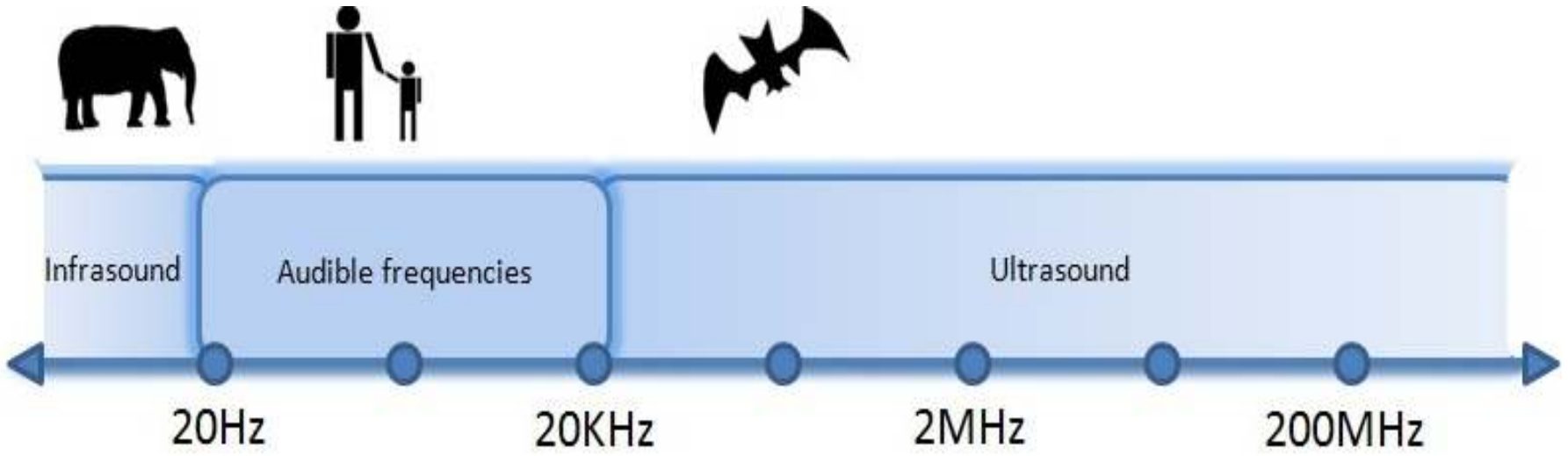
- Is not difficult, requires minimal training
- Reasonably short learning curve
- An excellent teaching tool

Ultrasound Guidance for Venous Access

Basic Ultrasound and Venous Anatomy

Definition of US

- Mechanical Pressure Wave
- Measured in Hertz (HZ)



Ultrasound Guidance for Venous Access

Wave defined by: Frequency, Wavelength & Aptitude

- Frequency is a measure of pressure cycles over time.
- Wavelength is the distance from crest to crest.
- Amplitude is the distance of the highest peak or crest value

Ultrasound Guidance for Venous Access

Wavelength & Frequency

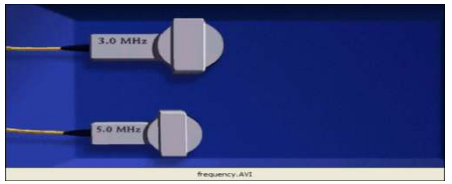
Inverse relationship between wavelength and frequency

- Shorter wavelength = Higher frequency
- Longer wavelength = Longer frequency

Ultrasound Guidance for Venous Access

Frequency v Resolution

The thickness of the crystal determines the frequency



High Frequency

- 5 – 10 Mhz
- Vibrates at a higher cycle
- Wavelength closer together
- Less penetration
- Shallow structures
- Greater resolution

Low frequency

- 2 - 3.5 Mhz
- Vibrates at a lower cycle
- Wavelength spread out
- More penetration
- Deeper structures
- Less resolution

Ultrasound Guidance for Venous Access

Ultrasound Imaging

1. Transducer elements (crystals) convert electrical to mechanical energy and vice versa (Piezoelectric Effect).
2. Initiate sound wave by system
3. Transmission through tissue
4. Causes tissues to compress
5. Reflection off of structures
6. Signal returns to system (transducer)
7. Image produced

This all happens simultaneously

Ultrasound Guidance for Venous Access

Image Formation

- Electrical signal produces a series of ‘dots’ on the screen
- Need to be aware of anatomy to interpret these ‘dots’
- Brightness of dots is proportional to the density of the structure/ time of return
- Brighter = More dense (echo return is faster).

Ultrasound Guidance for Venous Access

US Appearance of Blood Vessels

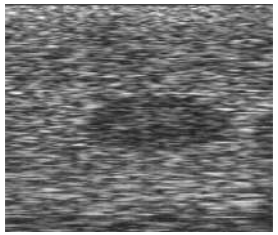
Brachial vein	Echopoor (BLACK)
Brachial artery	Echopoor
Brachio cephalic Vein	Echopoor (Valves)
Muscles	Less echogenic
Clavicle	Echogenic
Basilic vein	Echopoor
Nerves	Honeycomb appearance

Ultrasound Guidance for Venous Access

Echogenicity

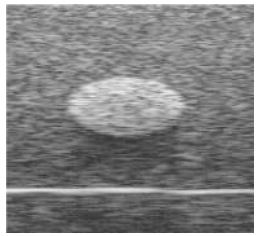
Hypoechoic

Less echogenic than surrounding tissue



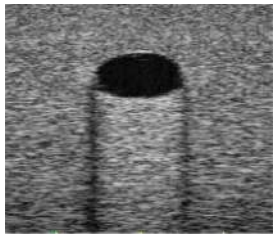
Hyperechoic

More echogenic than surrounding tissue



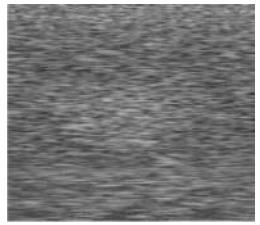
Anechoic

Absence of Echoes



Isoechoic

Same echogenicity as surrounding tissue

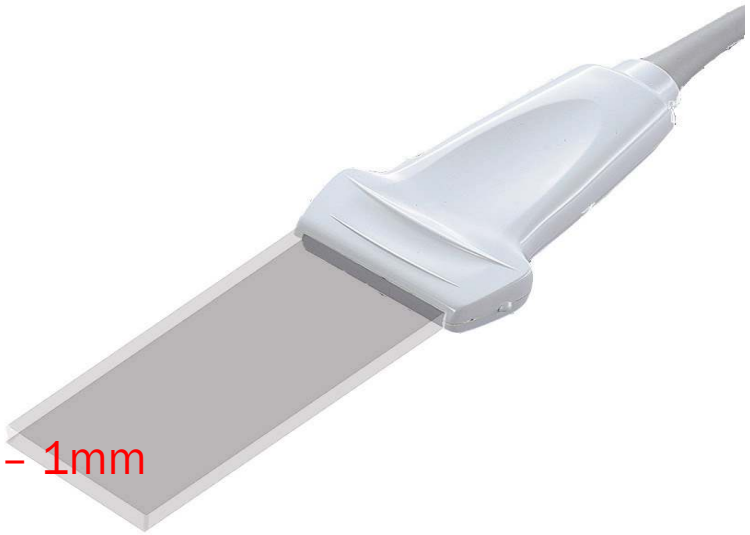


Ultrasound Guidance for Venous Access

Transducer

Beam Profile

- Length of the transducer face x 1 mm thick
- Length of beam dependent upon selected depth



Beam width – 1mm

Ultrasound Guidance for Venous Access

Transducer Orientation

- Markings are located on one side of transducer only and correspond to orientation marker on screen.

Ultrasound Guidance for Venous Access

Transducer Orientation

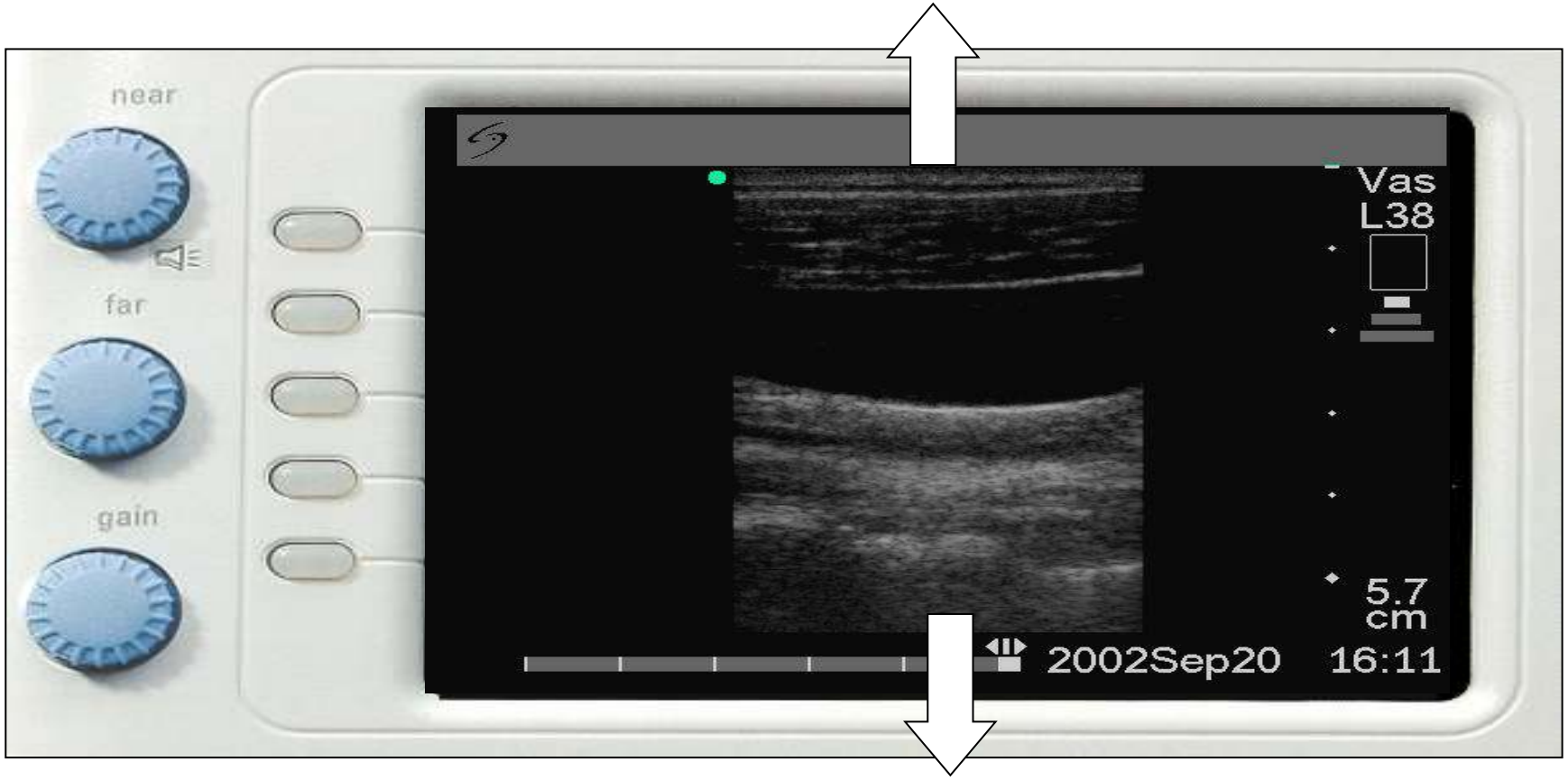
Transverse

Longitudinal

Ultrasound Guidance for Venous Access

Transducer

Transducer contacts skin



Deeper or away from the skin

VYGON
Value Life

Ultrasound Guidance for Venous Access

Why use Ultrasound Gel?

- Coupling Agent
- Ultrasound is reflected at an air interface
- Gel provides medium for sound wave into the body by removing air gap

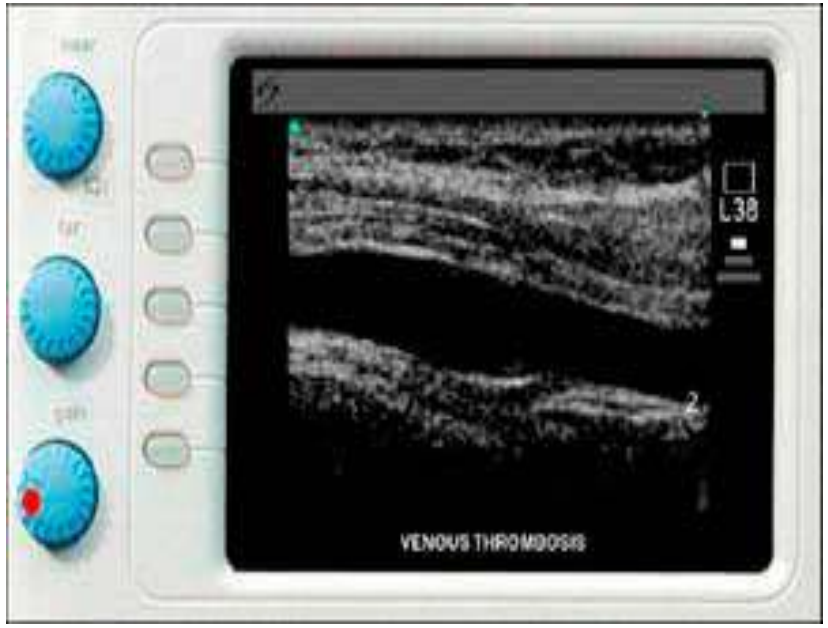
Ultrasound Guidance for Venous Access

Gain

- Gain controls the brightness of the displayed image
- Can be adjusted as near, far or overall
- One of the commonest mistakes in ultrasound imaging is the use of incorrect gain settings.
- Insufficient gain can result in missed structures of low reflectivity, such as thrombus.
- Excessive gain can result in false echos or oversaturation, which may obscure important diagnostic image characteristics such as shadowing or enhancement

Ultrasound Guidance for Venous Access

Image Optimization-Gain

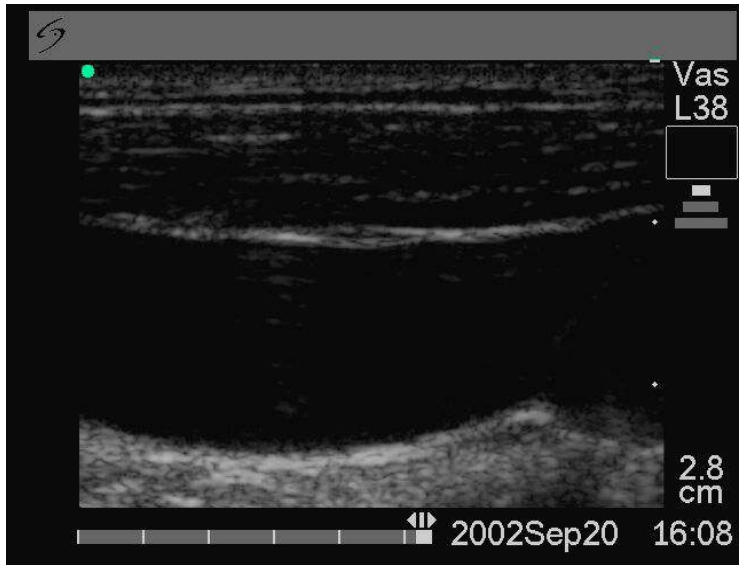


Ultrasound Guidance for Venous Access

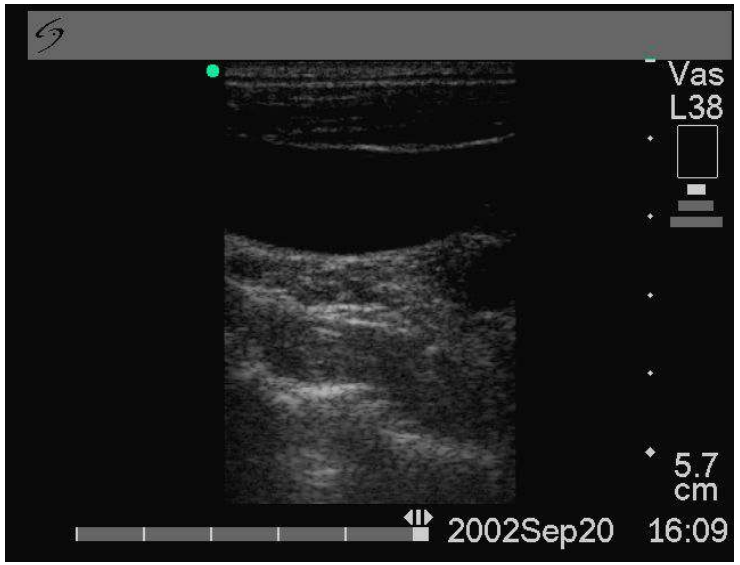
Depth

The choice of correct depth setting is a trade-off between achieving adequate field of view to resolve all relevant structures and maximising detail resolution.

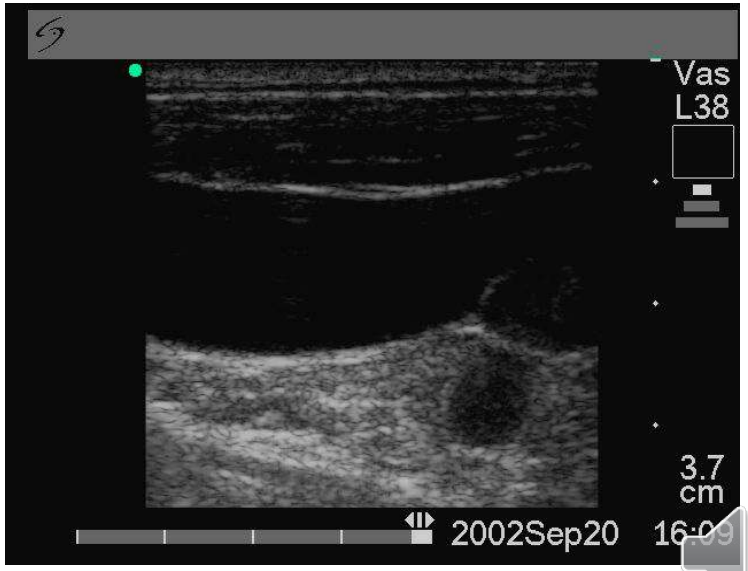
Too Close



Too Far



Just Right



Ultrasound Guidance for Venous Access

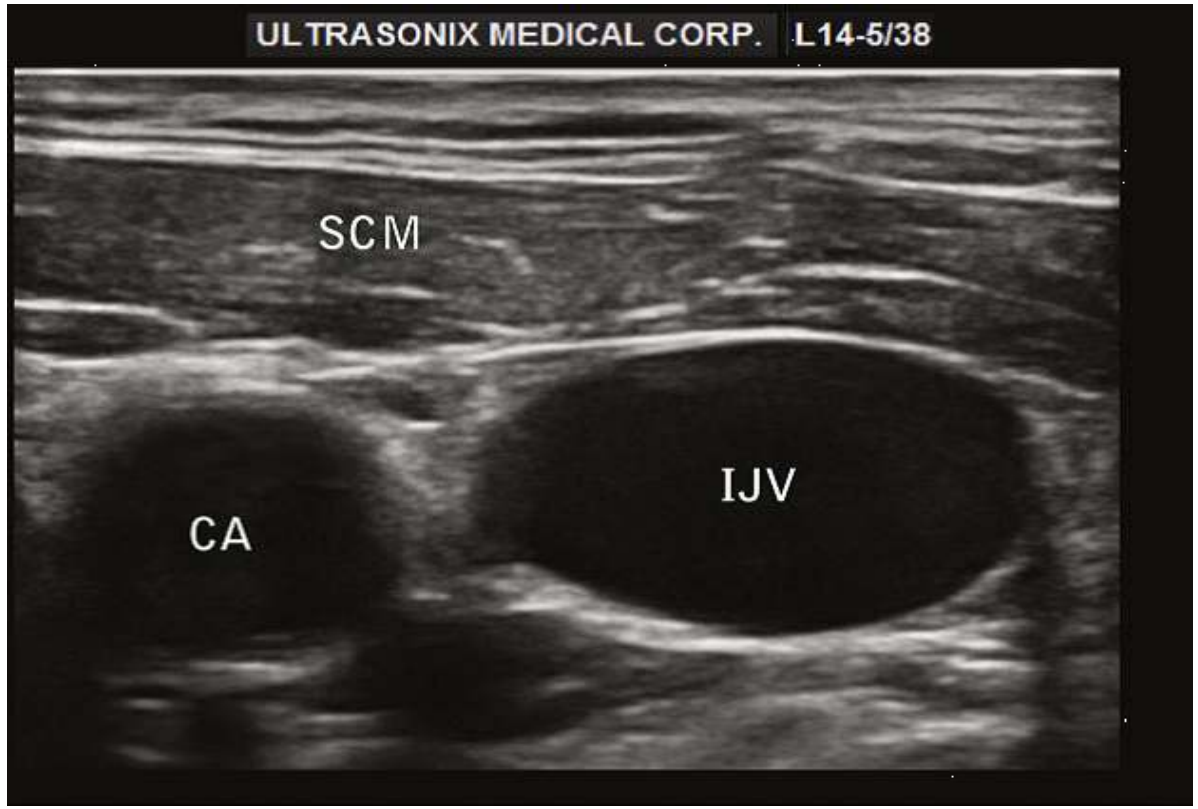
Conclusion

You need an understanding of ultrasound physics to help with:

- Transducer selection
- Gain, Depth and Frequency Settings
- Ultrasound modes
- Describing tissue Echo Characteristics

Ultrasound Guidance for Venous Access

Ultrasound Anatomy



VYGON Value Life

Ultrasound Guidance for Venous Access

Objectives

- Identify major vascular structures related to vascular access device type
- Identify the preferred access vessel for access location

Ultrasound Guidance for Venous Access

Applied Anatomy and Physiology

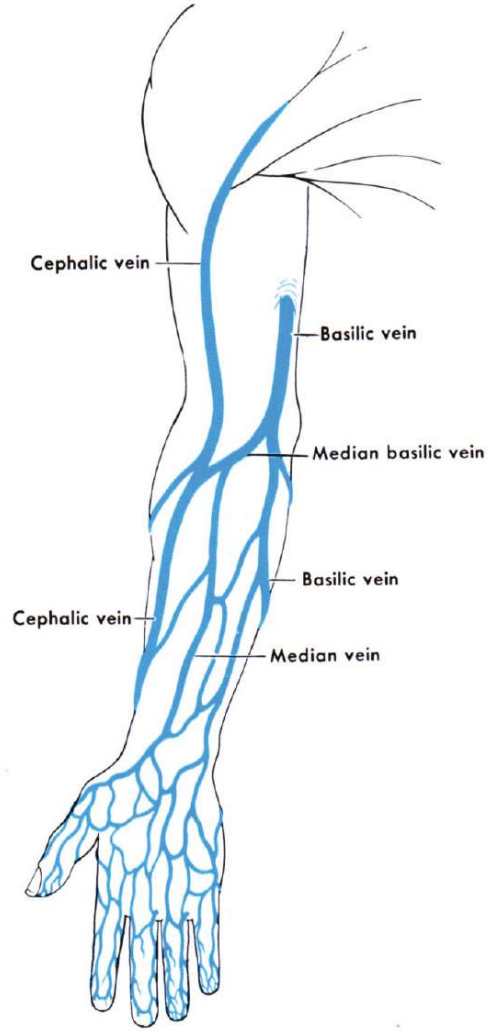
Basilic vein:

- Preferred vein as it provides the most direct route. Blood flow is greater than the cephalic.

Cephalic vein:

- secondary choice as the route is more tortuous.
- Veins of the ACF should be avoided as patient movement is restricted and catheter damage may occur.

Brachial Vein: Ultrasound guidance



Ultrasound Guidance for Venous Access

Basilic Vein

- The basilic vein is the first choice for insertion
- Originates on the ulnar or medial side of the forearm and ascends on the posterior surface of the arm.
- Just before reaching the elbow, it travels to the front of the arm where it joins the median cubital vein.
- The basilic vein joins the brachial vein becoming the axillary vein near the armpit.

Ultrasound Guidance for Venous Access

So…

How do we identify these on Ultrasound?

Ultrasound Guidance for Venous Access

Characteristics of Arteries & Veins

	Vein	Artery
Appearance	Black	Black
Movement	None ???	Pulsating
Compressibility	Yes	No
Valves	Yes	No
Size	Usually larger than artery	Usually smaller / rounder

Ultrasound Guidance for Venous Access

Thrombosis

White appearance

Usually non compressible

? CPD

Ultrasound Guidance for Venous Access

Ready to go!

Ultrasound Guidance for Venous Access

Ultrasound Guidance for Venous Access

Transducers

Transducers

- Linear
- Small footprint
- 5-10 MHz

Ultrasound Guidance for Venous Access

Getting the best image

☑ 2D greyscale image

☑ Depth/ Focal zone/Gain

☒ Spectral Doppler

☒ Colour Doppler

Ultrasound Guidance for Venous Access

Venous Access Using US

Prepare patient and scanner

- Use surgical ANTT:
- Full barrier precautions: Gown, sterile gloves, Cap, Mask
- Sterile probe cover / Sterile gel
- Patient fully draped with fenestration at insertion site
- Chlorhexidine 2% in 70% alcohol in single use applicator

Ultrasound Guidance for Venous Access

Preparing the Probe

Ensure air free coupling between all surfaces

Ultrasound Guidance for Venous Access

Seek out the needle tip

- Tilt & Slide the probe to seek out the needle tip.
- If you can’t see the tip stop
- Work slowly!

Ultrasound Guidance for Venous Access

Hold probe correctly

- Take control of the probe
- Stabilise your hand
- Have a cup of tea!

Ultrasound Guidance for Venous Access

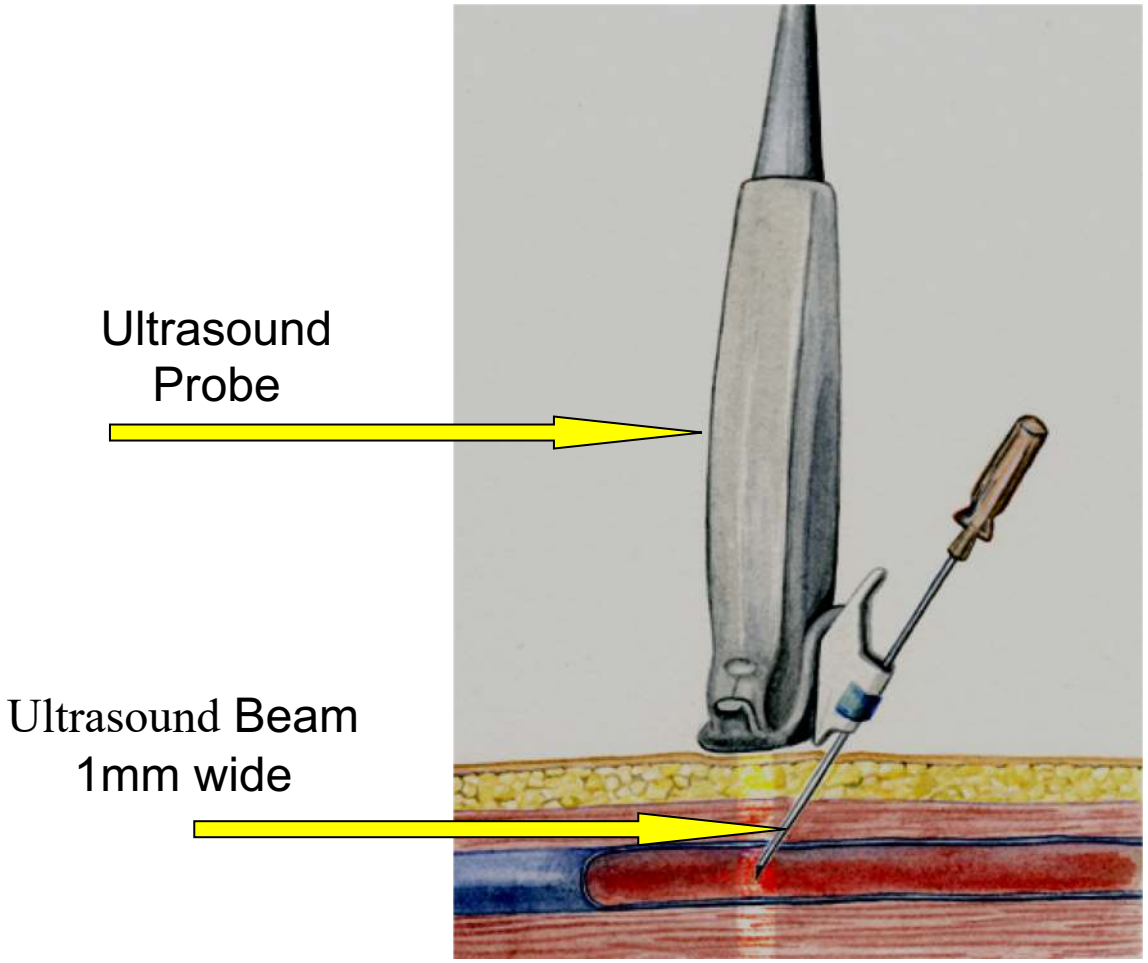
Puncture at steep angle

60º-65º

Relative to the skin

Vessel puncture must

take place in the US beam!



Ultrasound Guidance for Venous Access

Vessel puncture

- Scan and get target vein in the centre of the screen (ensure that it is compressible)
- Place needle in the centre of the probe
- Insert needle slowly
- Observe vessel wall and look for needle tip prior to puncture
- Vessel wall will compress as needle approaches
- Stop when needle tip enters vein

Ultrasound Guidance for Venous Access

Common mistakes

- Watching hands instead of screen
- Holding ultrasound probe incorrectly
- Collapsing vein with probe pressure
- Puncturing at wrong angle

Ultrasound Guidance for Venous Access

Next Steps

- Routine use of U/S
- Familiarise yourself with U/S use and identification of anatomy only
- Familiarise yourself with controls
- Continue use of phantoms until confident
- ? Venous access service / radiologists for supervision / support

Ultrasound Guidance for Venous Access

It’s not all rosy ☹

This patient endured about 30 attempts at ultrasound-guided PICC placement before he said **‘NO MORE!.’**

Photo shows about 20 attempts on right upper arm; about 10 more were on the left.

Sent by ambulance (90 miles each way) to a VAS.

PICC placed on first attempt by a vascular access nurse.

Ultrasound Guidance for Venous Access

Practice!!