Basic Point of Care Ultrasound

Ultrasound (USS) at the point of care is becoming an increasingly important skill for critical care practitioners.

The cost of a reasonable USS with Echo capability now costs about the same as motorbike whereas 15 years ago it was the cost of a house

Session Objectives

- Hold the Probe
- Move the Probe
- Orientate the Probe
- Co-ordinate a needle and the probe
- Perform a 'PS-LAX' and Sub-costal "wiggle view"
- Demonstrate a basic 'FAST scan'

What is a point of care US scanning (POCUS)?

POCUS) has moved from 'novelty' to necessity, especially in the Emergency Department. It is most commonly used for straight forward "questions" at the beside to facilitate better decision making in both critical and stable patients. The Emergency Department doctor should be able to do basic scans including FAST (eFAST), AAA and Basic Echo. It should also be considered the standard of care for guidance when placing central lines.

What are the advantages?

- Portable, Real Time, Available 24 hours
- Quick
- Repeatable (serial scans)
- Safe (no radiation)
- Simple
- Relatively fast to complete a limited study – can complement a formal US

Any down sides?

- Can be harmful if misinterpreted
- Infection spread
- Study limited by operator skill, equipment and patient factors
- Controversy of credentialing, training and skill maintenance

How do I orientate, move and hold the probe?

Orientation

- Generally USS is carried out in a standard (international) fashion. This is with the marker on the probe to the patient's right or the patient's head
- Orientation is an important starting point when doing a bedside point of care USS study. Orientation in Echo is very different to the 'standard'

- In most bedside USS studies we line up the DOT on the probe with the DOT on the screen

- This can be easily tested by applying gentle digital pressure to the probe

- Most USS scans have the dot on the screen lined up with the RIGHT side of the patient or in the vertical plane pointing towards the PATIENT'S HEAD

Movements of the Probe

- Movements include Heel Toe, Translation, Rotation and Angulation
- Watch our video at - www.youtube.com/watch?v=Q7yo1aDI4zw

- There are 4 movements of the probe:
    - TRANSLATION
    - ANGULATION (often referred to as cephlad or caudal – toward the head and feet respectively)
    - ROTATION
    - TILT (commonly known as Heel-Toe)

- Movements should be very slow and subtle – in any USS scan it is easy to gain and lose your image very easily with over vigorous movements of the probe

- Generally we hold the probe firmly but not in a vice like manner

- 3 or 4 fingers should be holding the probe with 1 or 2 fingers on the patient for support and improved control

Position of the Ultrasound Examiner

- For most USS scans go to the left of the bed as you would for a normal clinical examination. Hold the probe with your dominant hand gently (vice like grips are a big "no")

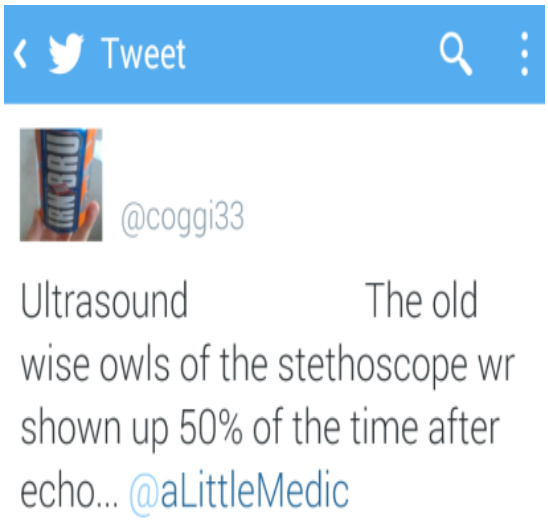
- For all Echo studies use your left hand to move the probe (with support from your free right hand if required)

- Sit on the patient's left side so you can easily adjust the machine with your free right hand

What about ECHO?

Cardiac USS, or Echocardiography, is becoming increasingly accessible at the point of care delivery due to extraordinary advanced in technology in the last 10 years

- The main Transthoracic Echocardiography (TTE) windows are:
  - Parasternal
  - Apical
  - Subcostal



More about the USS Machine

- Modern point of care machines such as General Electric, Phillips and the Sonosite (shown below) have a high degree of functionality for a number of Point of Care studies

- The USS transducer contains a piezoelectric crystal. This crystal (element) produces the ultrasound beam which penetrates and reflects back. The USS element has a special property that allows transformation of electrical signals into mechanical energy or mechanical energy into electrical signals.
- Most USS waves are absorbed but some waves are reflected especially at interfaces of tissues with varying densities.

- As a result of these properties an USS image can be created on the screen using advanced (and now very fast) computer software.

A variety of Modes are available to help with image interpretation:

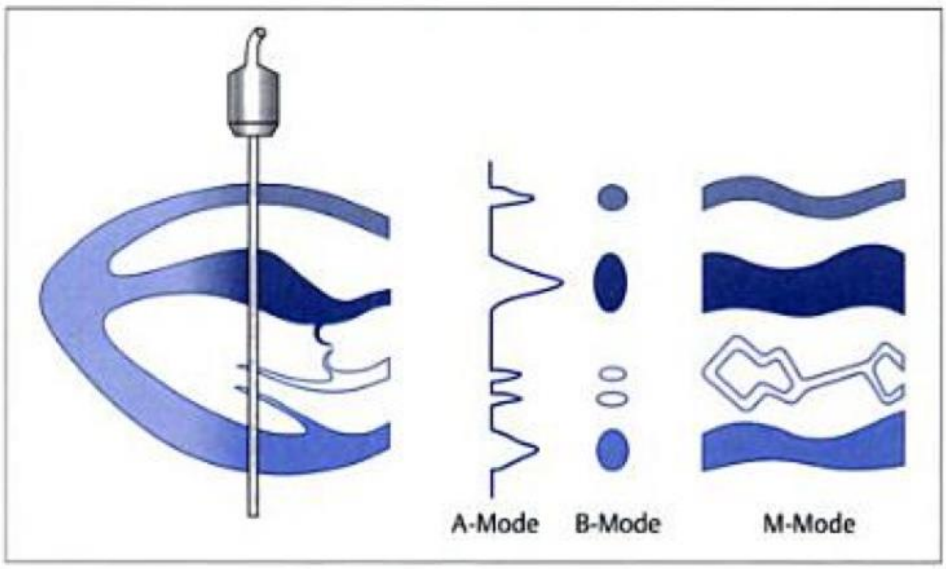
- B mode (Brightness Mode)

  The most familiar setting seen on the USS machine

  - Press "2D" on the Sonosite Machine to start this mode
  - Displays a 2D cross-sectional image of the tissue under the probe
  - In B mode there is scaling so that the amount of reflection is reflected by the proportional brightness of the displayed dot
  - A detector array allows a real time image to be displayed at > than 30 frames per second

- A mode (Amplitude Mode)
  - Rarely used in practice – USS is displayed as graph of vertical deflection against time

- M mode (Motion Mode)
  - Like B mode uses Grey Scale
  - M mode is used to display moving structures for comparison over a set time period



Berhold Block - Comparison of USS Modes

- Pulse Wave (PW)
    - Denoted as "PW" on most machines – allows for measurement of local velocity movements at a specified depth in the examined tissue
    - Localised shifting in the frequency of the USS wave reflects underlying blood flow velocity
    - As a result 'Pulse Wave' can be measured and displayed and is widely used in Echo

- Colour Flow Mapping (CW)
    - Colour Mode uses measurements of the velocity and direction of liquid (blood) flow to place a real time a colour pattern on top of the B mode image
    - This can be used to examine dynamic flow
    - Flow is remembered by "B A R T" – '*Blue Away and Red Towards'*

- The USS machine can produce a variety of real-time images and software allows for freezing images, on screen comparison, measurement and calculations

- Most Echo capable machines allow on screen ECG to aid with interpretation of the cardiac cycle

More reading

Further reading on Basic USS and Echo can be found here:

"ACEM College Basic Ultrasound PDF

Cardiology Explained – Echo

EchoBasics – www.echobasics.de/tte-en.html

GE – www3.gehealthcare.com/en/Products/Categories/Ultrasound

Phillips – www.healthcare.philips.com/main/products/ultrasound

Sonosite – http://www.sonosite.com.au

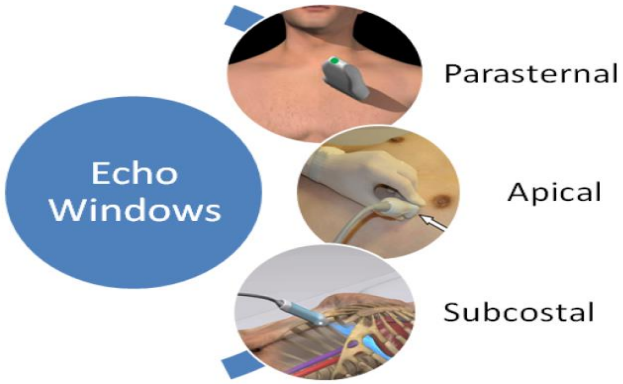
PUB MED Review – www.ncbi.nlm.nih.gov/books/NBK2215

ACEM USS – https://emergencypedia.files.wordpress.com/2014/05/basic-ultrasound.pdf

The USS Probe

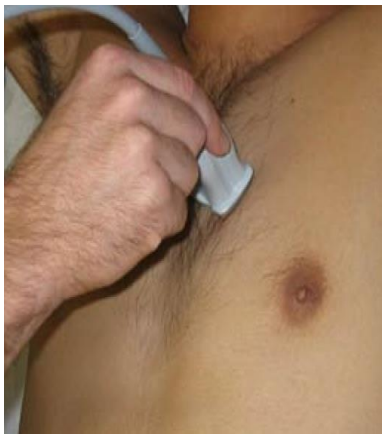
- There are various different types of transducer including linear, curved linear and sector arrays arrangements.
- These probes have a variety of different frequencies reflecting their penetration and image detail.
- In the case of Transthoracic Echo we use a curved linear probe with a small "foot print":

The Cardiac Transducer

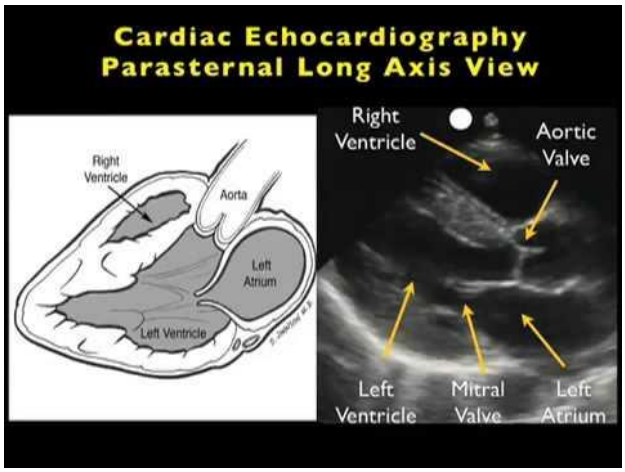


Standard TTE Views

Parasternal Long Axis (PLAX) – probe is on the left sternal edge and probe marker (dot) is pointed towards the right shoulder – dot on the screen (as always in TTE preset) is on the right of the screen. Patient should be leaning towards their left side



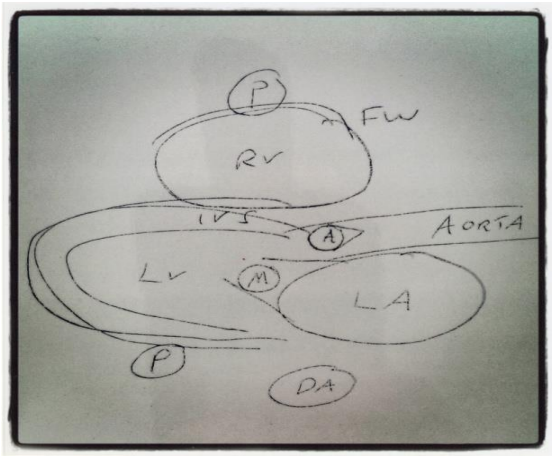
PLAX Probe Position



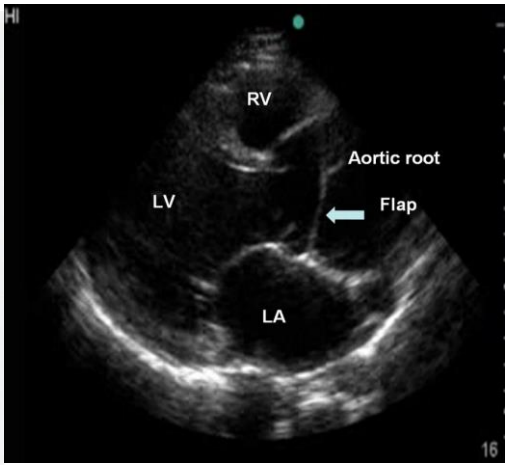
Anatomy

Key

- P = Pericardium
- FW = Free Wall
- IVS = Intra-ventricular Septum
- A = Aortic Valve
- M = Mitral Valve
- LV = Left Ventricle
- RV = Right Ventricle
- LA = Left Atrium
- DA = Descending Aorta



Basic PLAX Echo



Aortic Disseciton

Subcostal Views

- When you are struggling at 3am – try the 'subcostal wiggle view'
- The probe is placed below the sternum with an overhand grip pointing toward the left shoulder.
- We use the liver as an acoustic window.
- Downward pressures is typical applied on the probe and respiration will change the view obtained.
- IVC - may be useful for estimating 'fluid responsiveness' by measuring size and collapse of the IVC
- Views at this window include:
    - 4 Chambers
    - A 'Short Axis' view
    - Views of the Inferior Vena Cava
    - Views of the Descending Aorta

Subcostal 4 Chamber View