Emergency Medicine Interest Group (EMIG) 2016

Welcome to the flipped classroom (learning objectives summary) for the 2016 Emergency Medicine Interest Group (EMIG) Procedures Workshop.

Overview

- Tuesday and Wednesday 12/7/16 and 13/7/16
- Location and Time: 5pm – 6pm: at Clinical School, Westmead Hospital
- Four 15 minute Stations – "Procedures Workshop"
- On both days Pizza and refreshments will be available from 4.45pm

Directions

- Westmead Adults Hospital – go to main entrance - walk past Zouki cafe towards lecture theatres and library – turn RIGHT just before dental corridor bridge near the library

Station 1 – Ultrasound Demo – The 'FAST SCAN'

Notes on Basic Ultrasound

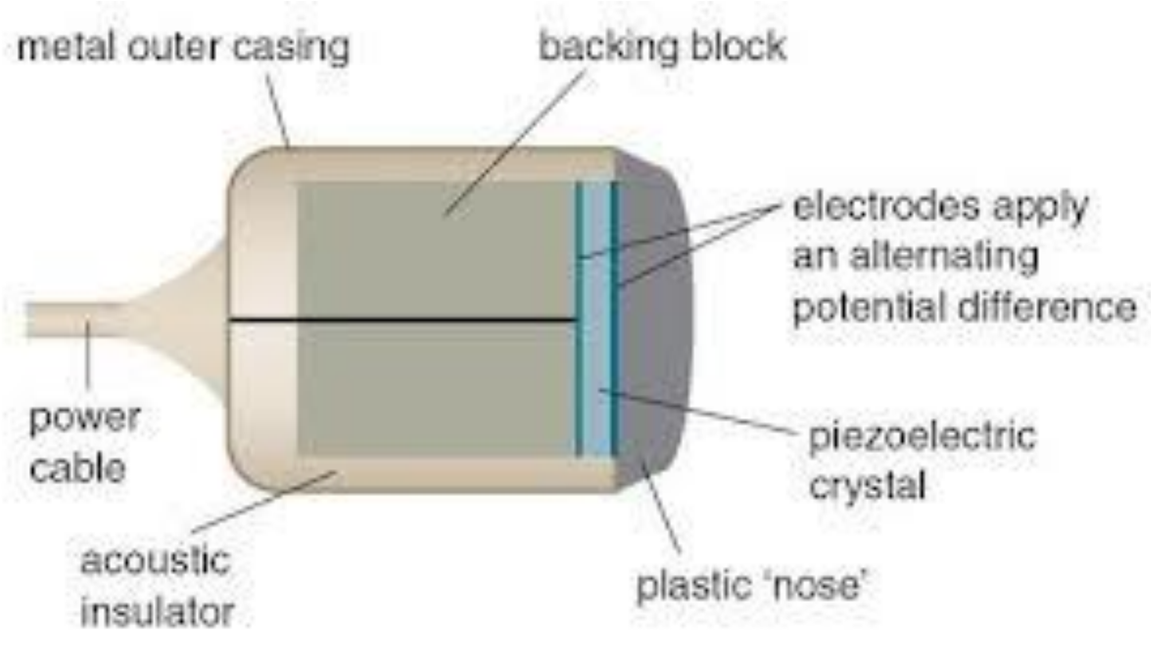
Transducers

The transducer contains the piezoelectric element or 'crystal'.

This crystal produces the ultrasound beam which travels into the body and then reflects off the tissues back to the crystal.

The transducer translates one form of energy to another. An ultrasound transducer contains a piezoelectric crystal that can translate electrical signals into mechanical energy or mechanical energy into electrical signals.

The transducer uses a pulse echo technique to obtain an image. Initially, a sound wave is produced by electricity within the transducer and directed into the patient. The reflected sound waves are received by the transducer and converted into electrical signals, and an image can be created.



TYPES OF TRANSDUCERS

- **Linear array** transducers produce rectangular images and offer the best overall image quality.
- **Curved array** transducers combine advantages of the sector and linear formats and are optimally used when the sonographic 'window' is large.
- **Sector array** transducers produce slice of pie shaped images and are optimal for examining larger organs from between the ribs.

<u>SOME OF THESE WILL BE SHOWN TO YOU BY A FACILITATOR:</u>

Obtaining an Ultrasound Image – First Steps

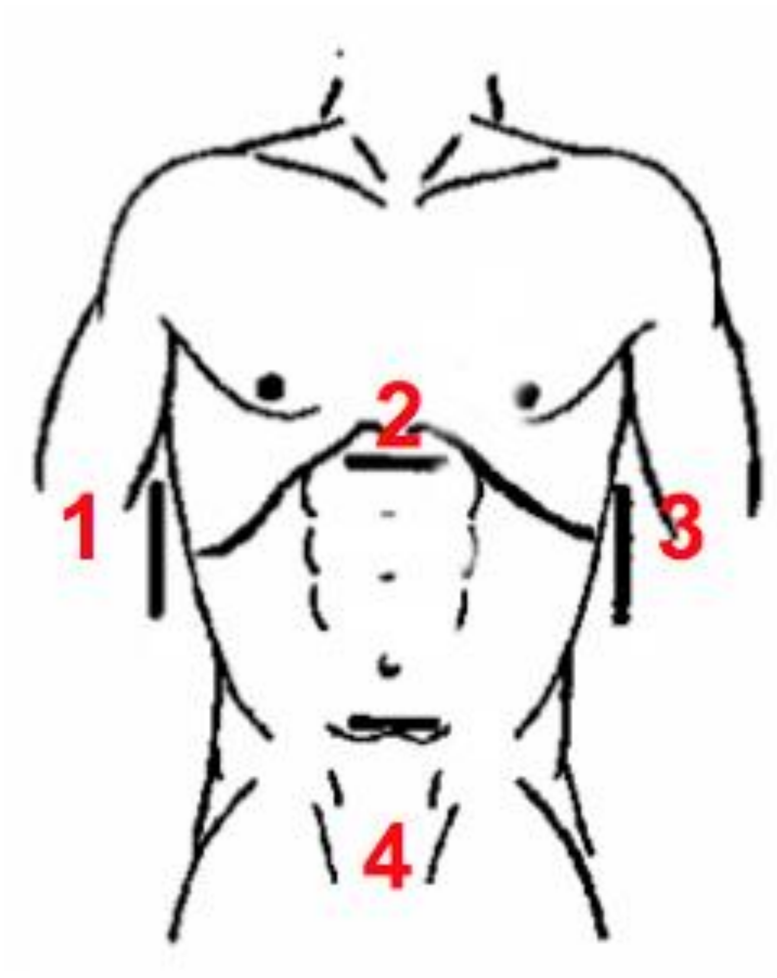
1. Turn on the Ultrasound Machine – place on left side of patient within reach
2. Adjust the bed to a comfortable height
3. Apply Gel to the Transducer
4. Select the type of scan (e.g. obstetric)
5. Orientate yourself to the probe (gently touch the transducer) – normally the dot or emblem on the top right of the screen aligns with the dot or mark on the transducer ---- Orientate yourself to the patient: scan in two planes with the 'dot' on the probe to the patient's right side or towards the patient's head.

How to Improve your Images

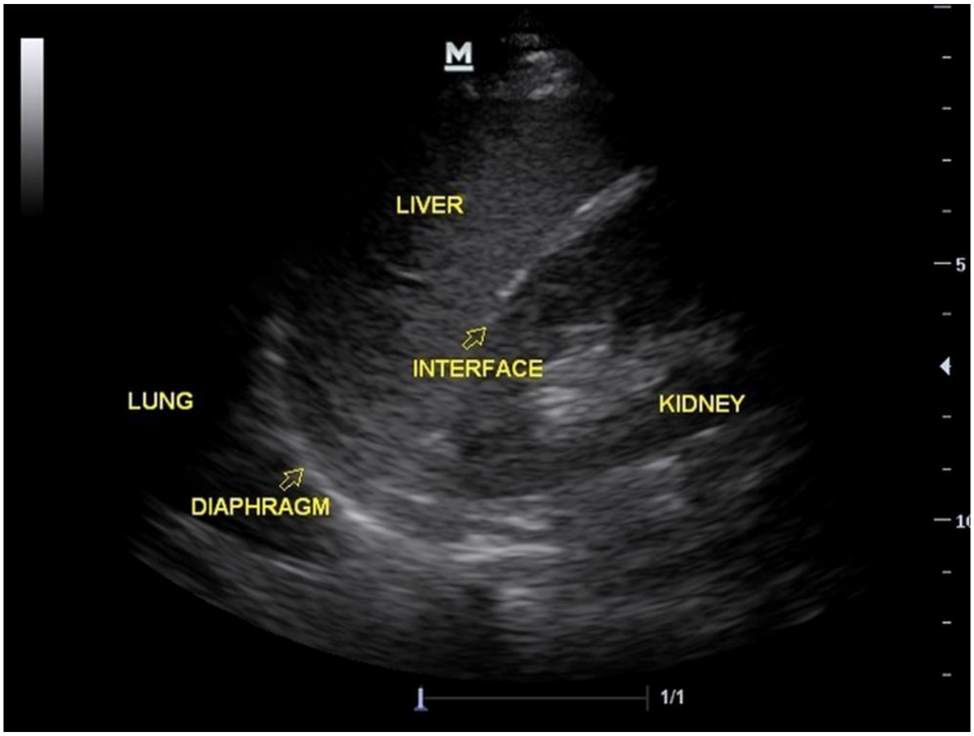
1. Use extra ultrasound GEL
2. Change transducers or change 'pre-sets' on the machine
3. Place focal zone at area of interest
4. Narrow field of view
5. Decrease depth of tissue of interest
6. Avoid non-uniform tissue which causes beam distortion
7. Move the patient! (e.g. get them to roll on their side)
8. Try tissue harmonics.
    - This works with mid-depth structures but doesn't usually help with very superficial or deep structures.

Focused Assessment with sonography in trauma (FAST)

FAST Pictures – The 4 views

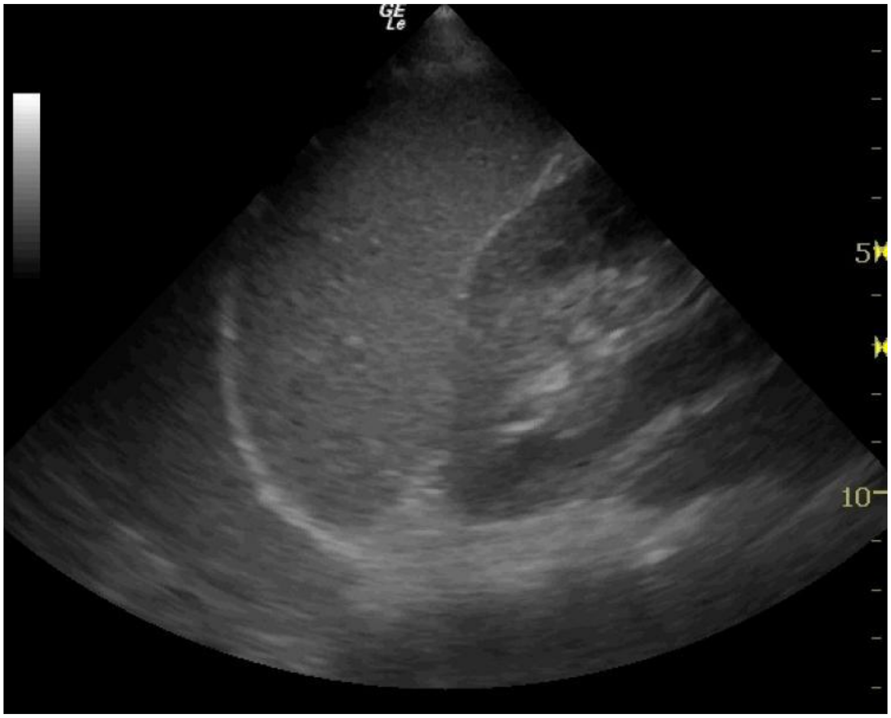


RIGHT UPPER QUADRANT - Normal



RIGHT UPPER QUADRANT WITH FREE FLUID
(This is assumed to be blood in the context of trauma)

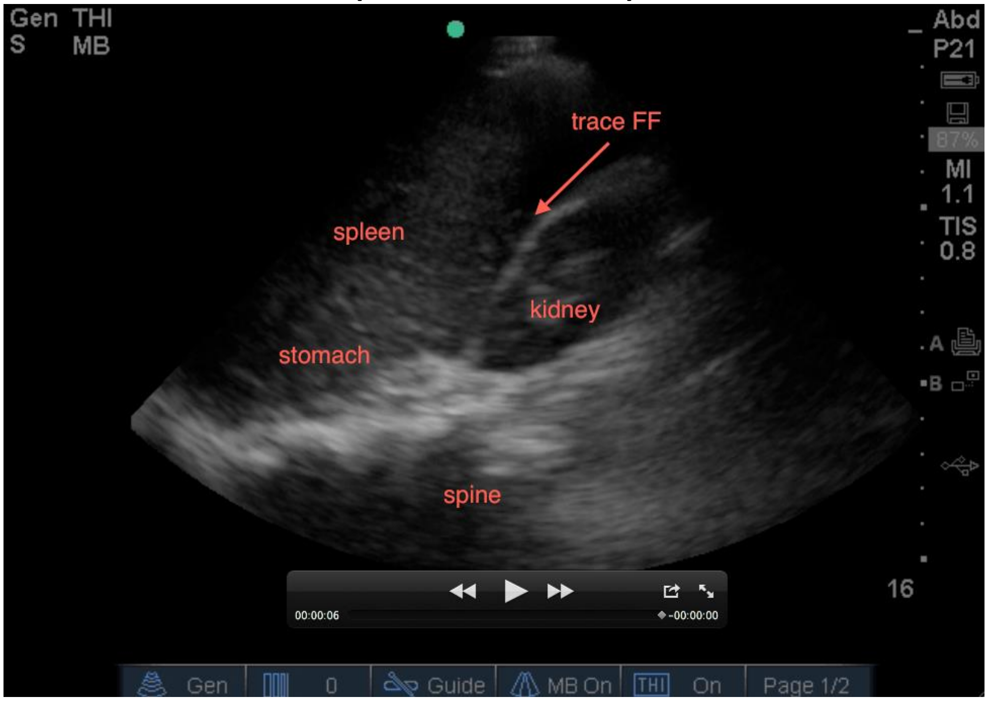
LEFT UPPER QUADRANT - Normal



LEFT UPPER QUADRANT SCANS WITH FREE FLUID
(This is assumed to be blood in the context of trauma)

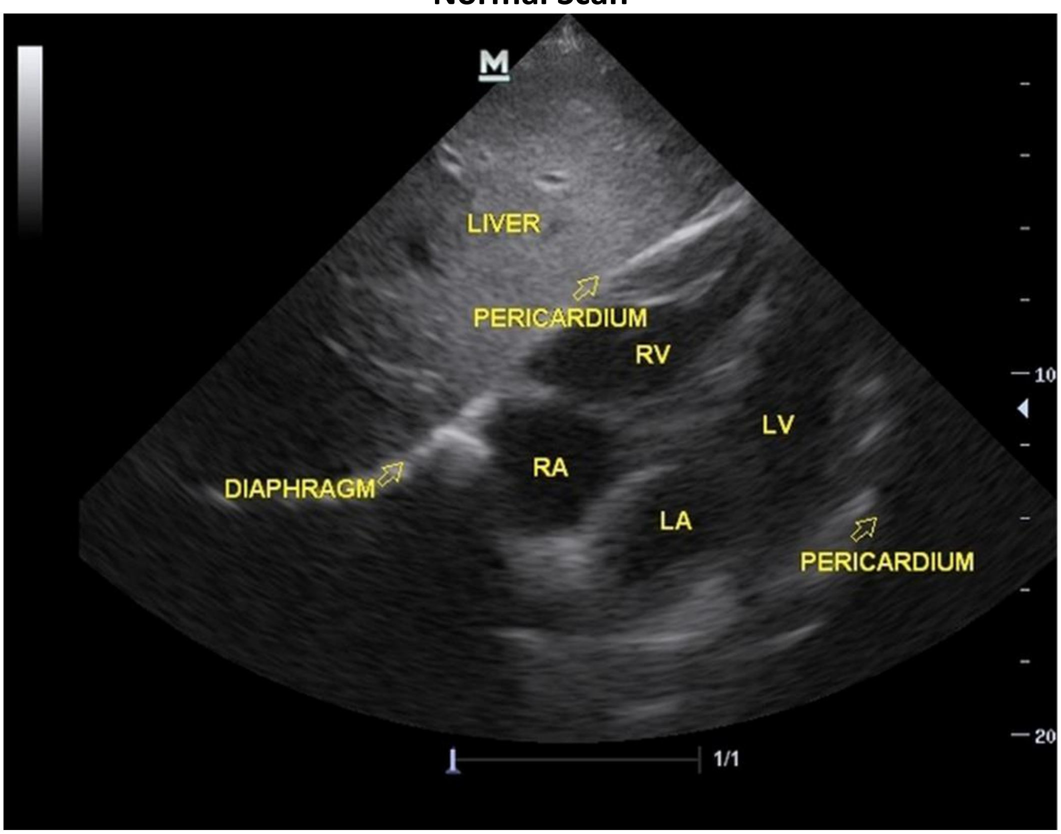
(Abnormal Scan 1)

(Abnormal Scan 2)

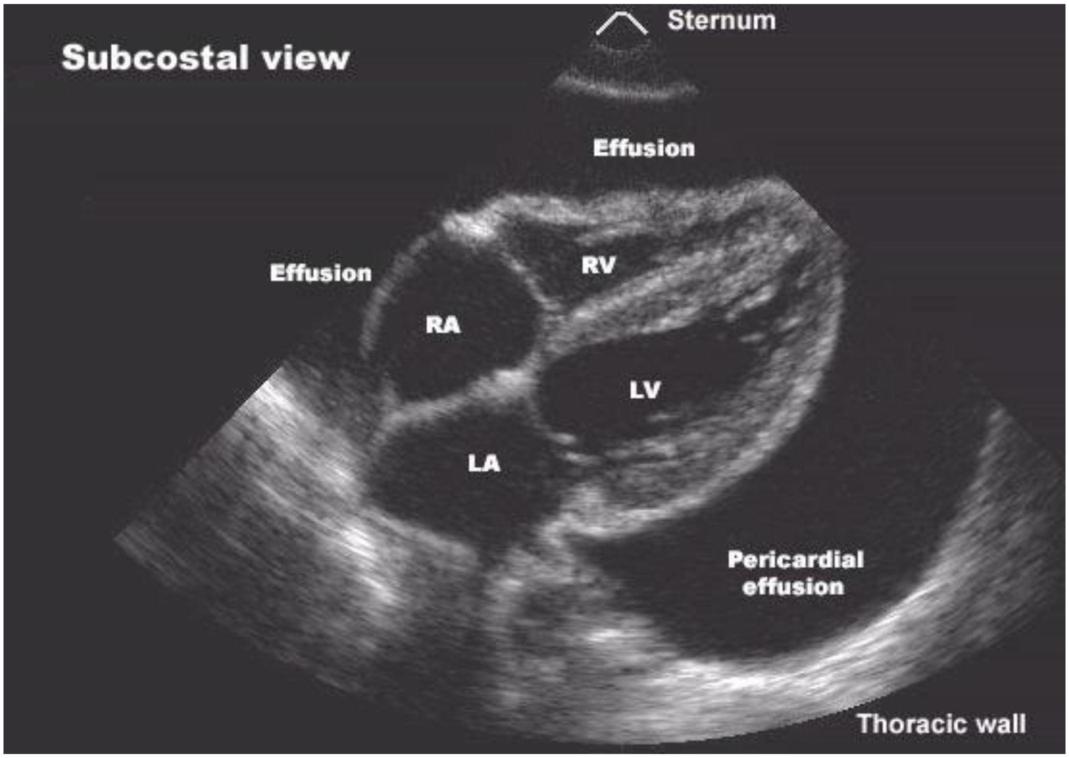


CARDIAC SCAN
(Looking for blood around the heart)

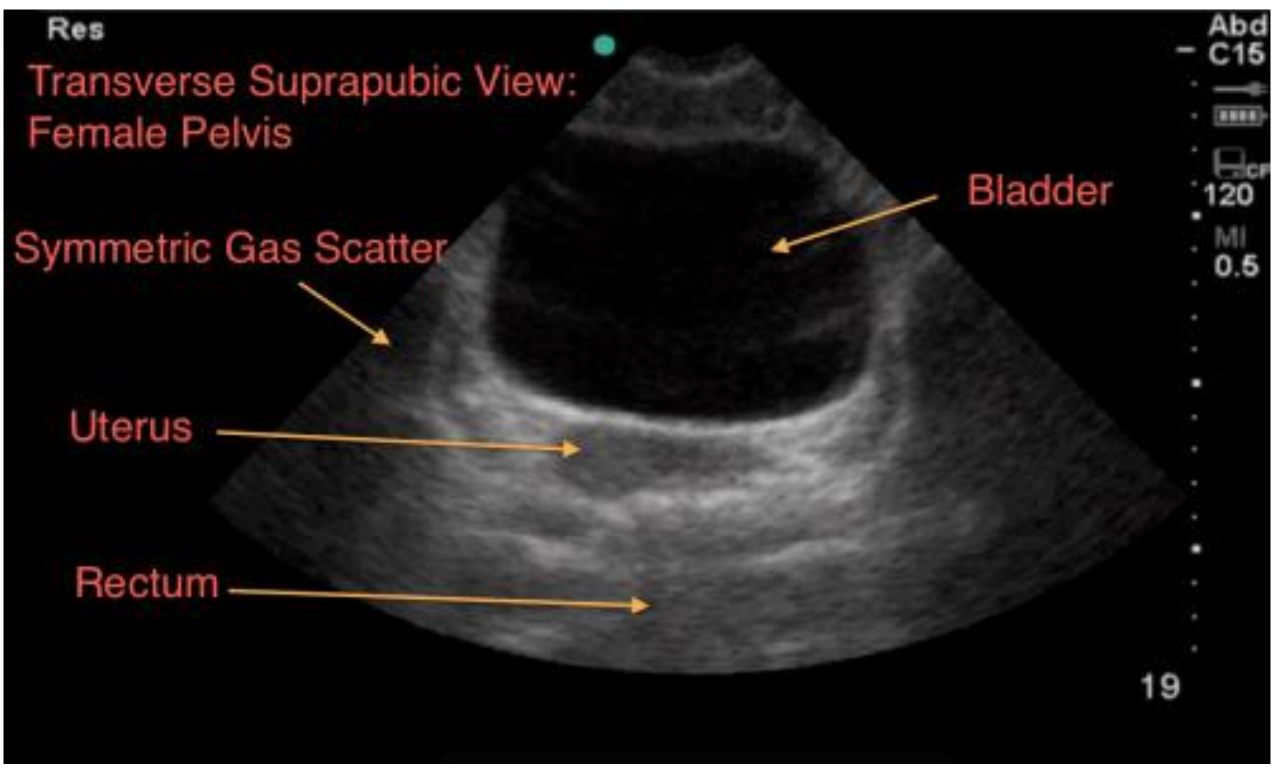
Normal Scan



Abnormal – Pericardial Effusion



Pelvic View – FAST Scan



Physics

Medical ultrasound imaging consists of using high-pitched sound bouncing off tissues to generate images of internal body structures.

The Frequency

Frequency refers to the number of cycles of compressions in a sound wave per second, with one cycle per second being 1 hertz. While the term ultrasound generally refers to sound waves with frequencies above 20,000 Hz (the frequency range of audible sound is 20 to 20,000 Hz), diagnostic ultrasound uses frequencies in the range of 1-10 million (mega) hertz.

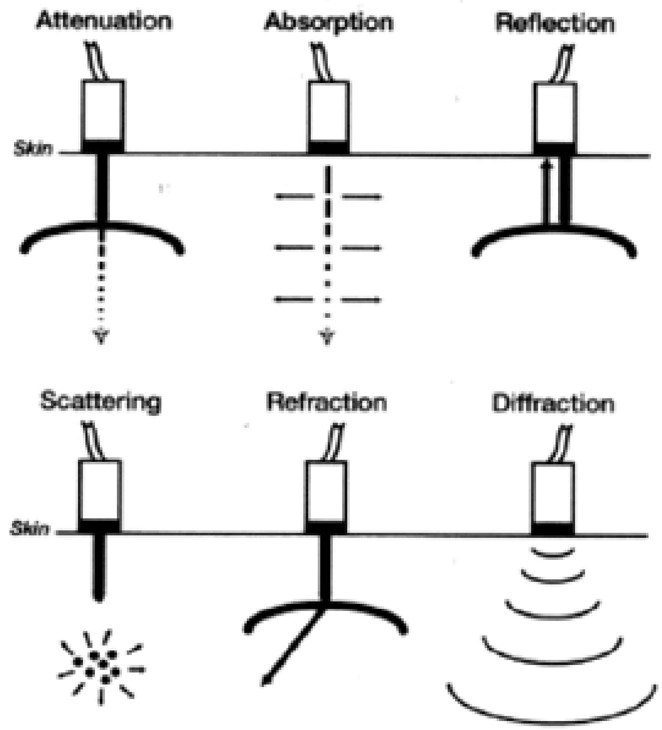
The Wavelength

The wavelength is the distance traveled by sound in one cycle, or the distance between two identical points in the wave cycle i.e. the distance from a point of peak compression to the next point of peak compression. It is inversely proportional to the frequency.

Wavelength is one of the main factors affecting axial resolution of an ultrasound image. The smaller the wavelength (and higher the frequency) - the higher the resolution, but lesser penetration. Therefore, higher frequency probes (5 to 10 MHz) provide better resolution but can be applied only for superficial structures and in children.

Lower frequency probes (2 to 5MHz) provide better penetration albeit lower resolution and can be used to image deeper structures.
Propagation Velocity = the velocity at which sound travels through a particular medium and is dependent on the compressibility and density. Usually, the harder the tissue, the faster the propagation velocity.

Boundary	% Reflected
Fat/ muscle	1.08
Fat/kidney	0.6
Soft tissue/water	0.2
Bone/fat	49
Soft tissue/air	99



Basic Emergency USS Indications

- Focused Abdominal Sonography in Trauma (FAST)
- Early Pregnancy Ultrasound
- Abdominal Aortic Aneurysm (AAA) and Inferior Vena Cava (IVC)
- Peripheral and Central Venous Access

Other advanced indications

  - Echo and 'RUSH' Protocol
  - Procedural Guidance
  - Bladder Ultrasound
  - Renal Ultrasound
  - 'E-FAST' and Chest Ultrasound
  - Ocular Ultrasound
  - Foreign body removal

Ultrasound Jargon Glossary

Anechoic

- Fluids such as blood, urine and bile appear black or anechoic.

Attenuation

- Progressive weakening of the ultrasound beam as it passes through the tissues.

B Mode Brightness Modulation

- Echo signals are amplified, electronically processed, pre and post processing to compensate for loss of energy with depth in tissue. Displayed in shades of grey {strong reflectors = white; echo free areas appear black}.

Duty Factor

- The ratio of time spent sending signals to the time spent receiving signals. The duty factor for diagnostic ultrasound is less than 1%.

Frequency

- The number of times the wave is repeated per second.

Gain

- This refers to the overall brightness of the image.

Hyperechoic

- Bone transmits very little sound energy and therefore produces a bright image (hyperechoic).

Image Resolution

- Spatial- detects anatomically separate structures
- Contrast- show tissues of different characteristics
- Temporal- changes over time eg. cardiac
- Colour- Spatial and temporal aspects of blood flow

Interfaces

- Differences or variations in acoustic impedance. The magnitude of the acoustic impedance mismatch determines the strength (amplitude) of the echo arising from it, described as “strong” or “weak” reflector.

Piezoelectric Element

- A substance capable of converting electrical energy to sound energy and vice versa. This conversion is called the piezoelectric effect.

Period

- Time taken for one wave cycle.

Probe

- See *transducer*

Pulse Duration

- The time taken to complete one short burst of sound waves in pulse echo mode.

Pulse Echo Mode

- A system where the transducer sends a short burst or "pulse" of sound waves and then waits for the "echo" to return.

Resolution

- The ability to distinguish between two close objects. High resolution means a clear picture and is improved by using higher frequency ultrasound; related to frequency. Resolution is a trade-off for penetration. 2-3 MHz- Multipurpose 5 MHz- Moderate resolution 7 MHz- High resolution 12-14 MHz- Ultra high resolution.

Sagittal Plane

- Divides the body into a right half and a left half. (NB see also *transverse plane*, below)

Spatial Pulse Length

- The distance occupied by one short burst of sound waves in pulse echo mode. Short SPL improves resolution. Short SPL obtained by using higher frequency.

Spatial Resolution

- Axial - along the axis of the US beam.
- Lateral - perpendicular to the beam axis (less accurate).

Scan Converter

- The Gray scale image depends on:
- - Strength of echoes *and*
- - The length of time until the echo returns (distance from the transducer).

Shadow

'An object that does not let ultrasound through casts an acoustic shadow. On the screen one sees the bright object with a black shadow distally.'

T.G.C.

- Time Gain Compensation knobs allow one to augment weaker echoes to obtain an even picture. Echoes from deeper structures have to pass through more tissue and are therefore weaker than echoes from superficial structures. TGC allows you to adjust for this.

Transducer

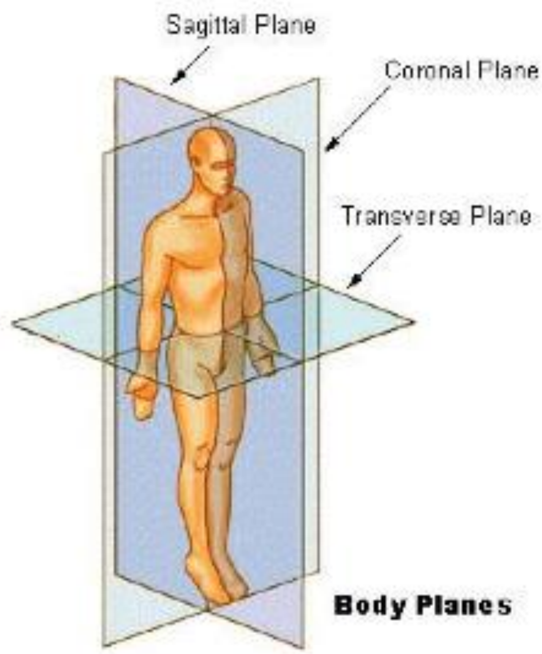
- The object held in the hand. The transducer contains the piezoelectric element or crystal. This crystal produces the ultrasound beam which travels into the body and then reflects off the tissues back to the crystal.

Ultrasound

- Audible frequency range ends at 20 000 Hz. Anything above 20 000 is defines as ultrasound. Frequencies used for medical imaging are above 1 million Hz (1 megahertz). When people say a transducer is a “3.5” or a “5.0” they mean 3.5 or 5.0 megahertz.

Transverse

- Plane divides body into a top half and a bottom half.



Wavelength

- The distance occupied by one wave cycle. Resolution improves with higher frequency ultrasound. Unfortunately, higher frequencies cannot penetrate deeply into the tissue. An obese patient may require a lower frequency to obtain enough penetration. Along with the penetration comes worse resolution.

Station 2 – Basic Airway Management

- Focus on **Bag Valve Mask Ventilation**
- We suggest 2 person technique and continued practice after the workshop. This is an essential skill that should be the cornerstone of airway management in and Emergency.

The Procedure Overview:

1. Assess your patient's need for an airway intervention
    - Check for **D**anger, **R**esponsiveness of Patient. Remove obvious obstruction from **A**irway then Listen, Look and Feel for **B**reathing:
2. **Key Points to Successful Ventilation**
    - Use two providers wherever possible http://www.ncbi.nlm.nih.gov/pubmed/23937957
    - Maintaining a good seal is important for ventilating the patient. This is done in basic terms by lifting the face into the mask and applying a steady downward counter pressure to the mask.
    - Try placing your little, ring and middle fingers of your left hand on the mandible in the shape of the letter 'M' and your thumb and fore finger on the mask in the shape of a 'C'.
    - Now try gentle squeezing the bag to Ventilate.
3. Don't Bag too fast - we recommend aiming for 10-12 breaths / min.
4. If Ventilation is hard consider an adjuvant device such an oro-pharyngeal device or a laryngeal mask airway (LMA)
5. Remember to connect the device to an Oxygen Supply
6. If you can't ventilate the patient along ask a colleague to help you by squeezing the bag while you use two hands to manipulate the airway to provide a good seal.
7. Failure to Ventilate can be associated with '*MOANS*':
    - *• **M**ask Seal (Size, hands, shape, beard, trauma)*
    - *• **O**besity/Obstruction*
    - *(Resistance, shape, faster desaturation)*
    - *• **A**ge (Over 55 and pregnant women are harder)*
    - *• **N**o Teeth (Face 'falls' inward)*
    - *• **S**tiff Lungs (Asthma, COPD etc)*

Station 3 – Intubation using the Video Laryngoscope (C-MAC)

- Focus on **Basic Intubation Technique** using a video laryngoscope and video. A C-mac Video Laryngoscope will be available for demonstration of anatomy.

The Procedure Overview:

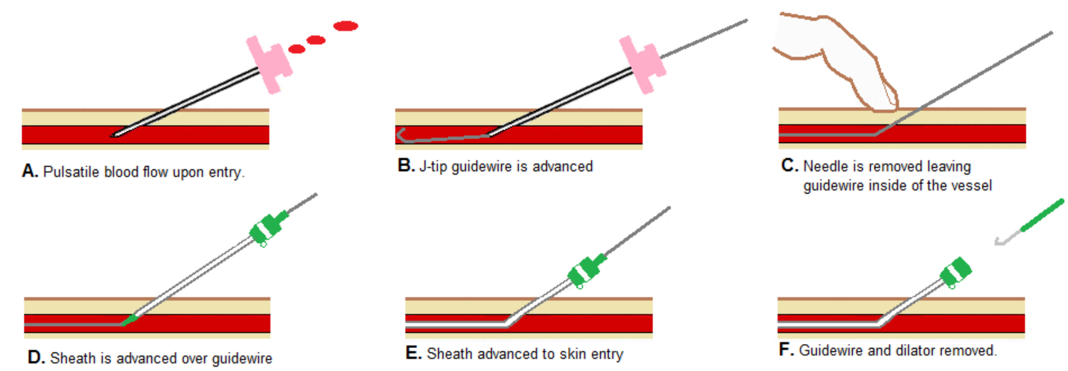
1. **Prepare your Equipment** in Advance of Procedure - you need ET tubes, suction (working), equipment for ventilation (bag mask), pillow or head ring for head position, adjuvant equipment such as introducers and alternative blades to hand.
2. Check the **Laryngoscope is working** (is the light on +/- camera working?)
3. Hold handle in **Left Hand** (right hand is free to move the head)
4. Place the Laryngoscope blade into the **Right side of the mouth** with help of an assistant if necessary
5. Sweep the **Tongue across to the left** in order to push it out of the way…
6. Insert the blade until you **Visualise the Epiglottis**
7. **Lift the Laryngoscope Handle forward** with steady force (do not 'lever' teeth).
8. Look to **Visualise the Vocal Cords**
9. Place the **ET Tube through the cords** (and ensure to visualise it going through).
10. Be careful not to put ET tube in too far (if you do you may go past the carina and only ventilate the right lung)
11. **Connect the Bag** and Valve Mask, **Ventilate** the Patient Gently and then Inflate the Cuff until any leaks disappear
12. **Check the air entry** on both sides in 3 positions to ensure equal air entry and then **Secure** the ET tube with tape or tie

We have prepared a video for you to learn and revise this skill:

https://www.youtube.com/watch?v=BTh2JvVoy0I

Station 4 – Advanced Vascular Access Introduction

Seldinger Technique - We will be using a simple part task trainer and expired single lumen central lines for this station. There will an opportunity to try your hand at a basic seldinger procedure



Intravenous (IV) and Intraosseus (IO) Access

- a focus and discussion on alternative measures to obtain access to the circulation in an Emergency
- Intraosseus (IO) – hands on chance to use the 'EZIO' drill for IO access

Intraosseous Access

- Immediate alternative to vascular access
- Needle inserted into bone
- Non-collapsible vein
- Infuses into systemic circulation via bone marrow
- Equal predictable drug delivery and pharmacological effect
- Flow rates 125ml/min

- Hoskins, S. 2011. Pharmacokinetics of intraosseous and central venous drug delivery during cardiopulmonary resuscitation. *Resuscitation*. Pub Ahead of Print.