42 Ultrasound

Pros
- no radiation
- non invasive
- easy access
- expedite management (e.g. thoracostomy, OT)
- dynamic test (e.g. PTX, testicular torsion)
- easily repeatable
- Good sens/spec for right question

Cons
- Inter-operator variability/operator dependant
- Poor documentation/Image archiving
- Delay other procedures or Ix
- Poorly specific: fluid can be anything
- Poorly sensitive: **need 250ml** to see in abdo etc
- Limited views e.g. retroperitoneum in AAA rupture
- Indeterminate findings eg bowel gas, obese

SETUP

- Patient
- Probe
- Preset
- Position

Patient

- Correct patient
- Patient prepared eg fasted, full bladder

Probes

Type	Fq/Array	Properties/Uses
Linear	**5-15 MHz** Linear	High res/poor depth - neurovascular, - musculoskeletal - testicular
Curvilinear	**2-5 MHz** Curved	Low res/good depth - abdo - pelvis - obs
Cardiac	**1-5 MHz** Phased	Lowest res/best depth & doppler - cardiac - lungs

Presets

- Depends on machine, but used to match pathology sought

Other

Handling
- Marker to ***head or right*** (cardiac marker on left)

Movements
- Rotate
- Fan
- Heel/Toe
- Slide

Artifacts

Operator
- Contact/gel
- TGC
- ↑ Gain ++

Other
- Acoustic shadowing (eg bone)
- Acoustic enhancement (bladder)
- Edge shadowing
- Multipath
- Mirror Image
- Velocity
- Reverberation
- Beam width effects

Artifact Solving
- ↓ gain
- alter probe angle
- scan 2 planes
- move pt
- breathing manoeuvres
  eg deep insp = abdo diet
- gradual graded compressions
- change view eg lateral for aorta

Benefits of gradual graded compression
- ↓ distance to target
- able to use high fq transducer
- push loops of bowel out of field
- improve contact

KNOBOLOGY

- Depth: use smallest depth for better resolution
- Focus: more FP = slower frame
- TGC: time gain compensation for various depths
- Overall gain
- Dynamic range: ↓ = ↑ contrast
- Zoom: ↓ resolution but easier to measure small things
- Frame avg: not good for moving things
- Cine memory
- B-mode colour (chroma): colour effect
  - **Red = towards transducer**
  - **Blue = away from transducer**
- Harmonics
- Manual frequency change
- Colour gain
- Scale/PRF

EFAST

1. Lungs: bilateral 2nd ICS/MCL
2. Abdomen: RUQ, LUQ, POD
3. Cardiac: subxiphisternum

Lungs

Pneumothorax
- No lung sliding (insensitive - see lung USS for ddx)
- ***Stratosphere/Barcode sign*** on M-mode
- ***Lung point sign*** (most accurate, test size)

Normal lung
- Lung sliding
- ***Seashore***: Cx wall no movt (waves), pleural line movt (sand)
- ***Comet-tail artefact*** (seen in 60% of normal pt)

Abdomen

1 Hepato-renal space
2 Spleno-renal angle
3 Pouch of Douglas

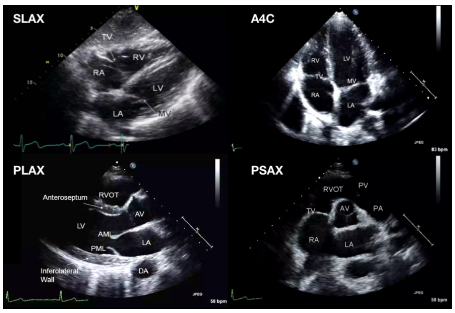
- 1cm = 1L
- ***100-500ml to see free fluid***
  > 800ml 96% sensitive
  > 200ml 90% sensitive
- Can't diff fluid: blood, urine (ruptured bladder), ascites, intraluminal fluid

Heart

- Subxiphoid approach
- Looking for pericardial effusion only
- Most sensitive place to look is btwn ***RV wall & L lobe liver***
- See below for more cardiac

CARDIAC

View		Use
Subcostal Long Axis	SLAX	- mechanical activity - pericardial fluid - wall motion - LV vs RV
Parasternal Long Axis	PLAX	- pericardium *Doesn't lookout LV*
Parasternal Short Axis	PSAX	- aortic & mitral valves - papillary muscles
Apical 4 Chamber	A4C	- chamber size - muscle mass



Effusions

- small < 0.5cm
- moderate 0.5-2cm
- large > 2cm ± ***swinging heart motion***
- ± loculated

Tamponade

- Large effusion
- ***RA*** collapse/inversion during ***systole/late diastole*** (SLAX)
- ***RV*** collapse during ***diastole*** (A4C)
- ***Paradoxical septal motion*** (A4C)
- ***Snaking effect*** of RA/RV collapse
- ↓ Chamber filling
- IVC dilated, ↓ insp variation
- Trans-tricuspid peak flow variation > 25%
- Trans-mitral peak flow variation > 20%

Pulmonary Embolism

- IVC: dilated, no resp variation (m-mode) ± thrombus
- RV: distended (normally 60% LV),
  McConnell's sign (RV apex contracts well)
  ± Thrombus
- LV: empty & hyperdynamic → ***kissing LV walls***
- IVS: flat, displaced into LV, D-shaped LV in PSAX
- Lung: wedge shaped infarction
- DVT

LV Function

- *Hyperdynamic vs normal vs depressed vs akinetic*

Cavity size
- PLAX
- normal LVIDd = 4-5.5cm vs LVIDs = 3-4cm
- LVIDd - LVIDs = Fractional shortening (FS)
- ***EF = 2 x FS***
- ***Kissing ventricle*** = hyperdynamic/under-filled

MV excursion
- PLAX
- tip to septum < 6mm is normal (↓EF if not)
- opening > 1cm is normal (↓EF if not)
- assumes normal MV

Base > Mid-cavity in systole
- Previous AMI/RWMA

CPR

- CPR efficiency
- ROSC
- IV access
- rule out 4H & 4T
- differentiate pseudo vs true PEA

VASCULAR & VOLUME

veins: collapsable, non-pulsatile, thin walled, valves

Volume

IVC
- Measured 2-3cm from jcn of RA, normally 1.5-2.5cm
- ***> 50% collapse*** (use m-mode) = under-filled
- If intubated need to measure ***IVC distensibility***

IJV
- Crude: Pt 30°, look at how high before collapses

Caveats
- Ventilated patients (reverse dynamics) - ***< 12% variation***
- Diuretics & vasodilators make difficult
- R heart failure, valvular disease
- ↑ intra-abdominal pressure (trauma, obesity, lap surg)

Aorta

IVC (vs Ao) on USS
NB both can pulsate
- IVC on right
- thin walled
- Collapses with insp
- No ant branches
- Venous pulsation
- No calcification

Abdominal Aortic Aneurysm
- Landmark: ant/left of vertebral body
- Measure ***outer wall to outer wall*** in AP
- USS has low sensitivity in detecting retroperitoneal fluid
- ***Abnormal > 3cm***
- Break in wall (post in 67%)
- Retroperitoneal haematoma
- Hypo-echoic in thrombus = acute
- Floating thrombus

Dissection
- Dissection difficult to identify - free flap sometimes seen

LUNG

Lines

	A-Lines	B-Lines
Description	Horizontal	Vertical 'laser beams'
Pathology	Dry interstitiam	Wet interstitiam
Causes	Normal Atelectasis ***Asthma*** ***COPD***	***Oedema*** (> 3 in 1 field) ***Pneumonia*** (focal) ARDS Fibrosis, PE, Cancer

Other Signs

	Description	*Causes*
Pleura	Thin	oedema, contusion
	Thick	ARDS, Pnemonia
	Irregular	Fibrosis, Pnemonia
Sliding[1]	Pleural sliding	Many - see below
Hepatisation	Looks like liver	Pneumonia
Shred Sign	Hepatised/Normal	Pneumonia
Lung-point	Air/Lung	Pneumothorax
Lung pulse	No sliding, pulsatile	Atelectasis

[1]On m-mode described as 'marching ant' or 'seashore' (sliding) or 'barcode' (no sliding)

DDx for no lung sliding on USS
- Inflammation/ARDS, atelectasis, fibrosis
- Infection: pneumonia
- COPD bleb
- Phrenic n. palsy
- Breath holding. Intubation (oesph, main bronchus)
- Adhesions

OBSTETRICS

Early Pregnancy

Objectives: Confirm IUP, viability, assess for free fluid

Timing

- ***Discriminatory zone = 6000 IU/ml ~ 5/40***
- TA 1 wk behind TV
- 5/40 gestational sac ~2mm, double decidual ring
- 6/40 yolk sac → foetal pole (grain of rice)
- 7/40 cardiac activity (use m-mode, FP > 9mm)

DDx of bHCG > 6000 with empty uterus

- Ectopic
- Complete miscarriage
- Twin preg/molar (too small to see)
- Heterotopic

DDx of bHCG > 6000 with empty sac

- Ectopic }
- Early IUP } also ***DDx for bHCG < 6000***
- MC } + empty uterus/sac
- Missed MC
- Molar

GALLBLADDER

- Wall ≤ 3mm AP
- CBD ≤ 6mm (gallbladder in situ), ≤ 10mm (no gallbladder)
- Pancreatic duct < 2mm
- Differentiate wall polyps from stones with doppler

OTHER USES

- DVT
- Testicular torsion
- Renal/Stone
- Fracture identification & reduction
- Intussusception