

Ultrasound

- High frequency sound wave, 20kHz (2-10MHz)
- Speed of waves thru tissues differ
- Elements: transducer (convex/curved, linear, sector/small footprint probe)
- Transducer generate u/s beam and detect the returning echo
- Linear probe used for superficial structure eg thyroid, breast, testes, musculoskeletal structure
- Sector used for pediatric and neonatal examination
- Interaction of ultrasound and matter
 - Depend on acoustic properties of matter causing:
 - Reflection
 - Reflection at tissue interface (forming echo)
 - Mechanical → electrical signal
 - Air-tissue interface (reflect all incident beam) - gel applied to displace the air and minimize large reflections
 - Bone-tissue interfaces reflect substantial fractions of beam
 - NO IMAGE thru air or bone → formation of area void of echoes called shadowing
 - Echo strongest at abdomen (gas) > organ (speckled) > fluid (no echo - dark appearance)
 - Refraction
 - Refraction give rise to artifact (change in acoustic velocity as passing from one medium to another)
 - Scatter
 - Scatter gives rise to the characteristic speckle patterns of various organs and is important in contributing to the image grayscale range
 - Attenuation
 - Attenuation, the loss of intensity with distance, is caused chiefly thru scattering and tissue absorption (energy absorbed)
- Echogenicity (tissue appearance relative to others)
 - Anechoic
 - Isoechoic
 - Hypoechoic
 - Hyperechoic
- Artifact
 - Posterior acoustic shadow - bones or stones
 - Posterior acoustic enhancement - when sound wave travels thru homogenous fluid

- Reverberation echoes (resonance) - strong reflecting boundaries → sound waves reflected back and forth → parallel lines
- Ultrasound images

	Real structure	Artifacts
Black	Pure fluid	Acoustic shadow
Grey	Parenchyma Alveolar consolidation Thick fluid Thrombosis	Acoustic enhancement
White	Bone or calculus Fat Interface	Air

- Advantages of ultrasound
 - No ionizing radiation; safe for pregnancy
 - No known side effects
 - Cheap
 - Portable
 - Minimal preparation of patients
 - Painless; non-invasive
 - Direct vision for biopsy
- Factor affecting assessment
 - Patient's body habitus
 - Position of the particular organ
 - Availability of ultrasound window
 - Experience of the sonographer

Abdominal ultrasound	<ul style="list-style-type: none"> - Abdominal pain eg PUO or suspected abscess - Jaundice - Non specific abdominal mass - Hepatitis B/C carrier - Abdominal trauma - NBM 4-6 hours for liver and GB ultrasound - Supine position
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	<ul style="list-style-type: none"> - Longitudinal, transverse and coronal - Deep inspiratory/intercostal positioning of probe
KUB ultrasound	<ul style="list-style-type: none"> - Renal failure/impairment → classification or renal failure (look at GFR value) - Haematuria - Suspected renal mass or calculus - Young hypertension ← looking for renal stenosis - Full bladder for KUB ultrasound
Pelvis ultrasound	<ul style="list-style-type: none"> - Pelvic mass or pain - Abnormal vaginal bleed or discharge - Amenorrhea - Confirm IUCD - Genital tract developmental abnormality - Bladder symptoms - Follicular monitoring in infertility - Full bladder as preparation
Neonatal cranial ultrasound (placing probe on the open fontanelle)	<ul style="list-style-type: none"> - Intracranial or intraventricular bleed - Hypoxic damage - Congenital abnormality - large/small head, fontanelle bulge - Complications of meningitis - Using sector probe of 5 or 7.5 MHz
Neck ultrasound	<ul style="list-style-type: none"> - Palpable mass - characterization of nodule (benign or malignant) <ul style="list-style-type: none"> - Goiter: solitary or multinodular - Guide biopsy of neck mass - 7.5 - 10 MHz linear/convex probe
Scrotal ultrasound	<ul style="list-style-type: none"> - Pain: torsion vs infection - Swelling - Trauma - Apparently absent testicles - Used 7.5 or 10 MHz linear transducer

Breast ultrasound	<ul style="list-style-type: none"> - Palpable mass - solid or cystic - Confirms nature of mass detected on mammography - Patient less than 40 years old - Palpable mass hidden by dense tissue on mammogram (young patient) - Used 7.5 - 10 MHz linear array probe
Doppler ultrasound	<ul style="list-style-type: none"> - Renal graft - Lower limb - DVT - Carotid arteries - stenosis, plaque characterisation - Post angiography - TRO pseudoaneurysm

- Teaching
 - Normal urea:creatinine → 1:20
 - Chronic renal failure: ratio maintain
 - Acute renal failure: ratio distort
 - Indication for renal ultrasound: find cause - often cause are post renal eg obstruction
 - How to differentiate BPH and prostate Ca
 - Location: BPH in transient area and prostate Ca in peripheral area
 - DRE
 - PSA: if down means BPH, no need further intervention
- Fluoroscopy
 - Barium swallow is contraindicated in case of perforated oesophagus → can cause peritonitis (the barium itself)
 - The gastrografin if aspirated can cause pulmonary oedema
 - If patient is contraindicated to both barium and gastrografin, used ???
 - Contraindication of barium swallow

Intravenous Urography (IVU)

- (intravenous urography and pyelography, excretory urography/pyelography)
- Anatomic and functional information about the urinary tract
- Indication
 - Hematuria, gross or microscopic
 - Transitional cell carcinoma
 - Urolithiasis
 - Suspected ureteral leak (post-op or trauma)
- Contraindication
 - Pregnancy
 - Allergy to contrast media (gastrografin LOCM - 300 mg I/ml)
 - Adult: 50 ml
 - Children: 1 ml/kg
 - Proven or suspected hypersensitivity to iodine
 - Previous reaction to contrast media
 - Asthma
 - Renal insufficiency (urea > 12 mmol/L)
- Preparation
 - Bowel cleansing (laxative, no solid food, just clear fluid diet)
 - Cover for mild contrast medium allergy (antihistamine, steroid)
 - No food for 5 hours prior to examination
 - Allow clear fluid
 - Empty bladder immediately before examination
- Sequence of IVU
 - Plain radiograph → immediate film → 5-min film
 - Compression
 - 15 min film: AP, renal areas
 - Release film: supine AP - to show the whole urinary tract
 - Post micturition film
 - No compression if:
 - After recent abdominal surgery
 - After renal trauma
 - Large abdominal mass (AAA)
 - When 5-min film already shows distended calyces.