Basic Radiography and Ultrasound - How to perform a cystogram, urethrogram and MCUG; Radiation protection

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Principle of X-ray

• X-ray imaging begins with a beam of high energy electrons crashing into a metal target and a filter near the x-ray source blocks these low energy rays, which means only the high energy rays pass through a patient toward a sheet of photographic film.

• X-ray can penetrate liquids, gas and solids. The point of penetration is based on the intensity, quality and wavelength of the X-ray beams.
• When the beam passed through the material. It formed a negative image on the film.
• The image depends on the density of the tissue.
• The higher the density the brighter the image.

• Advantage- easily available and interpretation.
• Dis-advantage- radiation, radio-lucent stone can be miss.
Principle of ultrasound

• Its follow ‘Piezoelectric effect’ & reverse Piezoelectric effect.
• The traducer produce sound wave range from 2-15 MHz.
• Common for abdomen 2.5-3.5, 5-7.5 for superficial structure.
• It provides real time image.
Mode of ultrasound

- **A- mode** - Amplitude mode, single transducer scan a linear line through the tissue. Calculus, tumour are detected using A-mode.

- **B- mode** - also knows as 2D mode, 2 or more linear waves passed thr thr the tissue and formed 2 dimension image.

- **C-mode** - A+B modes

- **M- mode** - motion mode, use to determine the velocity of the organ structure.
• Doppler mode- produce colour effect and to pick up the blood flow, blood flow toward the probe form red colour, away from probe formed blue colour.
  - Colour doppler
  - Continuous doppler
  - Pulsed wave doppler- the pulsed wave produced by traducer and there is an delay in picking up the wave, this will picked up the side of original of the velocity.
  - Duplex scan- 2D + pulsed wave doppler.
• Harmonic – a high frequency wave is produce and pass thr thr the tissue, this mode can reduces the noise and artifacts and produced a better image.
• Advantage- real time image, hence procedure can be carry out. No radiation. Easy to operated and learn.

• Dis- advantage- operable dependent, obscured by gas shadow.
Stone

- Calcium - calcium oxalate, phosphate, maleate. (75%)
- Uric acid - gout and post chemo. (5-8%)
- Struvite - UTI. (15%)
- Cystine - metabolic disorder - cystineuria. (1%)
• Although 90% of the stone are radio-opaque

» BUT plain X-ray

• Sensitivity - 45-59%
• Specificity - 71-77%

• ANDREW J. PORTIS, CHANDRU P. SUNDARAM. Diagnosis and Initial Management of Kidney Stones. Am Fam Physician. 2001 Apr 1;63(7):1329-1339.
Cystogram, urethrogram, MCUG

• Involved injecting contrast media.

• Contrast can be divided into Ionic and non-ionic.

• Ionic- Diatrizoate, Matrizoate.

• Non- ionic- Lopamidol, Lohexol, Lopromide.
Indication

• Study the outline of the bladder, urethral.
• Bladder lesion, fistula.
• Urethral stricture.
• VUJ reflux. Children with recurrent UTI.
• Voiding dysfunction.
• Urinary incontinent.
• Post trauma, surgical procedure to detected any leak.
• Posterior urethral valve.
Contraindication

• Pregnancy.
• Allergic to contrast agent.
• UTI.
Procedure

• Low fiber diet one day prior to scan, bowel preparation with Laxatives.
• Bladder must be empty before procedure either ask pt to void or catheterization.
• Bladder is catheterized with foley’s catheter.
• Preliminary film taken before injecting the contrast.
• Contrast agent injected.
• The amount of contrast is calculated.
  – Expected bladder capacity (mL) = (age + 2) × 30.

• Early filling view (AP) to detect the bladder lesion- tumour, ureterocele.
• 2\textsuperscript{nd} film, AP with full bladder, to look for diverticular.

• 3\textsuperscript{rd} film, oblique, look for post wall diverticulum and VUJ reflux.
• 4\textsuperscript{th} film, Left or right anterior oblique, ask pt to void. To demonstrate any posterior urethral valve or stricture.
• 5\textsuperscript{th} film, post voiding AP renal view to look for any reflux of contrast, as in VUJ reflux.
• 6\textsuperscript{th} film, post voiding bladder view, to look for residue contrast.
Urethrogram

• Pt at supine position and catheterized with Foley’s 16/18F. The balloon inflated 1-2cc water.
• The penis is pull to lateral and injecting the contrast.
• Before injecting the contrast, prelim film is taken.
• Serial of film are taken while injecting the contrast.
Complication

• Radiation.
• UTI.
• Haematuria, dysuria.
• Discomfort to pt.
• Allergic reaction, anaphyllytic shock.
Radiation protection

• Protecting people or environment from harmful ionizing radiation.
• Radiation had showed to increase the risk of Ca, skin burn.
• The people need radiation protection are worker, patient, public.
Technique.

- Timing, reduce the time of radiation exposure.
- Distance, increase the distance from the radiation.
- Justification, justified the need of radiological procedure.
- Limitation, limit the time of exposure.
- Shield, lead apron, leaded glass screen.
- Using radiation Dosimetry to monitor the user.

  - Both cystogram and CT are comparable in estimating the size of stone but ultrasound tend to oversetimation.