Renal Stone Disease
What is a Stone?

• A Precipitation of secretions within an excretory organ
• Four sites: Renal, Prostatic, Biliary, Salivary
• **Stone Formation** needs Supersaturation of urine with solute in solvent
• Urine is acidic in morning, alkaline after meals, concentrated overnight
• Process of: **Nucleation** → **Crystal Aggregation** → **Crystal Growth**
Modifiers of Formation

- **Inhibitors**
  - Citrate - Complexing Ca to lower effective urinary [Ca]

- **Complexors**
  - Substances that form soluble complexes to decrease saturation
  - E.g. Magnesium, Oxalate, ‘Functional’ Terminal Ileum

- **Promoters**
  - Stimulate crystallization
  - E.g. Low urinary volumes, Dietary NaCl
Who Forms them?

- **Typically:**
  - Male > Female
  - Sedentary > Active
  - Low Fluid Intake
  - Abnormal Urinary Tract resulting in stasis
    - PUJO / Chronic Retention / Stricture disease

- **Atypically:**
  - Familial defects in Renal Function (E.g. Cystinuria)
  - Recurrent UTI’s (E.g. Struvite M.A.P. Stones)
  - Foreign Body (E.g. The ‘forgotten stent’)

How do stones present?

• **Symptoms**
  • Renal Angle Colic
  • Visible Haematuria
  • Recurrent UTI / Pyelonephritis / Pyonephrosis

• **Signs**
  • Pyrexia
  • Tender Renal Angle

• ‘Silent’ Obstruction
  • Dilatation ≠ Obstruction
Types of Stone

• Non Calcium – Usually Radiolucent
  • Infection Stones – 7% (Struvite or M.A.P.)
  • Uric Acid – 10%
  • Cystine – 1%
  • Xanthine

• Calcium Containing
  • Ca Oxalate – 60%
    • Pure
    • Mixed Brushite ($\text{PO}_4^{3-}$) / Apatite
  • Ca Phosphate – 20%
Imaging

• NC-CT modality of Choice with ‘superiority’ over IVU (EAU Guidelines 2012)
• Equivalence with other imaging in acute colic (Greenwell T et al)
• Dilated≠Obstructed (J Urol. 1979 O’Reilly PH et al)
Treatment Strategy

- Maximise Spontaneous Stone Passage
- **Intervene**: stone progression; stone complications; low chance of passage
- Prevent further Urolithiasis
- **Factors**: Patient, Renal, Stone, Clinical
- Do all Stones need active treatment?
- Can any stones be ignored?
- Intracorporal vs Extracorporal?
Active Stone Treatment

• Pharmacotherapy for MET
  • **SM mediators:** Alpha-Blockers / Ca Channel Blockers
  • **Analgesia:** NSAID’s / Limited Role for Opioids in acute colic setting (Holdgate A, Cochrane 2004)

• Extra-Corporeal Lithotripsy (ESWL)
  • **Types:** EM / PE / EM

• Intra-Corporeal Lithotripsy (RIRS & URS)
  • **Access:**
    • Retrograde Uretero-Renoscopy
    • Antegrade Nephroscopy / Uretero-Renoscopy
  • **Energy:**
    • Laser Lithotripsy / Electro-Mechanical / Ballistic
ESWL - Electrohydraulic

• High-voltage spark discharge causes explosive vaporization of water
• Water at the electrode tip is vapourised causing a gas bubble to rapidly expand
• Shockwave generated and reflected by metal plate
ESWL - Piezoelectric

- High-voltage pulse rapidly expands ceramic (barium titanate) elements that make up a spherical ‘dish’
- Rapid expansion with electrical current causes shock wave generation
ESWL - Electromagnetic

- Two electrically conducting cylinder shaped plates
- Separated by an electrical insulator
- Electrical current passed through produces a strong magnetic field that results in rapid movement and generation of a shock
Intracorporal Lithotripsy

• Issues of: **Access & Energy**
• Rigid Ureteroscopy
  – UO, Pelvic brim, PUJ
  – Single, Double or No Wires
• Flexible Ureteroscopy
  – RIRS vs Antegrade approaches
  – Within access sheath
  – Difficult Ureteric Access due to end of scope
  – For ureteric navigation if failed access sheath passage
Intracorporal Lithotripsy

- Cystoscopic placement of Wires
- Always after retrograde pyelogram & Always with XR C-arm
- **Techniques:** Safety, Dual Wire
- **Material:** Nitinol, Steel, PTFE Coated
- SENSOR (Boston Scientific) - Hydrophillic Tip but extra mechanical strength
- TERUMO wire (RF)
- ‘Standard’ Wire (Cook)
Lasers

- Light Amplification by the Stimulated emission of Radiation
- Holmium : Yttrium AluminiumG
  - 2100nM wavelength – Invisible as outside visible spectrum
  - Only 0.4mm tissue penetration
- Greater SFR + Fragmentation with less perforation compared to mechanical ICL
- Safer, more effective, shorter operation time & postoperative recovery  
  (Jeon SS Int J Urol. 2005)
Flexible Ureterorenoscopy

- Internal/External Diameter (Eg. 11/13Fr)
- Allows access to all calyces
- Single 3Fr access channel allows laser fibre transit to stone or tumour
- Digital vs Optical
JJ Stents

- Introduced in 1970’s (Finney RP 1978)
- JJ vs End-Flushing / French & Length
- Flexible polymers coated in Bismuth or Barium
- Nephrostomy vs Stenting
  - For urgent decompression of renal collecting systems, both equally effective (Pearle MS J Urol 1998)
- Stenting in relation to ESWL
  - No difference in Stone Free Rates between Stented & Non-Stented patients (El-Assmy J Urol 2006)
  - Decreased stone-free rates unless Ureteric Stone >2cm with obstruction
JJ Stents

• **In Stone Disease**
  - Solitary Kidney, Sepsis, Obstruction, Symptom Relief, Impacted Stones, Post ESWL if >20mm
    (EAU Guidelines 2011)

• **Ureteric Injury**
  - Iatrogenic, Penetrating Traumatic

• **Ureteric Stricture**
  - Routine stenting after URS for distal stones is unnecessary
    (Srivastava J Endourol 2003)
JJ Stents

- **Stents REDUCE** stone passage
  - Diminished peristalsis
  - Impaired stone passage \(\text{(Lennon GM Eur Urol. 1997)}\)

- **Stents ‘symptoms’ in 80% of patients**
  - Indwelling ureteral stents: evaluation of symptoms, quality of life and utility \(\text{(Joshi HB et al J Urol. 2003)}\).

- **Alpha Blockers for Stent Symptoms**
  - Relief of stent related symptoms: review of engineering and pharmacological solutions.
  - Alpha Blockers single most beneficial strategy for relief of stent symptoms \(\text{(Dellis A et al J Urol. 2010)}\)