Urinary Stone disease

Prof. T Sinha

Aetiology of Urinary Stones

Supersaturation crystallisation theory

Stone formation requires supersaturated urine

Supersaturation depends on solute concentration,

ionic strength & urinary pH

Greater the concentration of two ions more likely they are to precipitate

Role of Randall's plaques

Sub epithelial plaques on renal papilla

Provides a surface on which crystals can form and grow

Inhibitor lack theory

Calculi form due to lack of natural stone inhibitors

Commonest stone inhibitor in urine is Citrate

Magnesium, Pyrophosphate & Urine glycoproteins are some of the other inhibitors

Epidemiology of Renal stones

- Men are 2-3 times more affected
- Highest incidence in hot dry climate
- Higher incidence with higher BMI
- Higher incidence in sedentary occupations or working in high temperature
- Higher water intake beneficial

Epidemiology of Renal stones

- Men are 2-3 times more affected
- Highest incidence in hot dry climate
- Higher incidence with higher BMI
- Higher incidence in sedentary occupations or working in high temperature
- Higher water intake beneficial

Stone Composition

Calcium oxalate & Calcium Phosphate	- 80%
Uric acid	- 7%
Struvite	- 7%
Cystine	- 1-3%
Rare: Triamterene, Silica	
Indinavir, Xanthine, Adenine	< 1%

Calcium stone

Hypercalciuria > 200mg/day excretion in urine

Idiopathic hypercalciura

Absorptive hypercalciuria – increased absorption from gut

Renal hypercalciuria – increased renal tubular reabsorption

Resorptive hypercalciuria – Hyperparathyroidism , immobilisation, Milk alkali syndrome, Sarcoidosis

Oxalate stone

Oxalate is a normal waste product of metabolism

85% Oxalate in urine is from metabolic end product

15% Oxalate in urine is from diet.

Most dietary oxalate is decomposed by gut bacteria

Oxalobacter formigenes

Hyperoxaluria > 40mg/day excretion in urine

Oxalate stone

Primary oxaluria- genetic

Enteric oxaluria – chronic diarrhoeal state

Dietary oxaluria – Excess oxalate rich foods : Spinach, nuts, chocolate, tea, broccoli, strawberry

Ethylene glycol poisoning

Uric acid stone

Hyperuricosuria > 600 mg/day excretion in urine

Increased dietary purine intake

Gout, myeloproliferative disorder, multiple myeloma

Low urine pH – uric acid crystals dissolve in alkaline urine

Citrate

Hypocitraturia < 450 mg/day excretion in urine

Deficiency is associated with urinary stone formation

Deficiency is seen in those with Renal Tubular Acidosis Type 1, or thiazide therapy

Struvite Calculi

Composed of Magnesium Ammonium Phosphate

These are infection stones associated with urea splitting organisms – Proteus, Klebsiella, Pseudomonas

Found commonly in women and present as staghorn calculi

Foreign bodies and neurogenic bladder may predispose to urinary infections and subsequent struvite stones

Cystine Calculi

Due to inborn error of metabolism

Abnormal intestinal and renal tubular absorption of dibasic amino acids – **C**ystine, **O**rnithine, **L**ysine, **A**rginine

On X ray appear faintly opaque, ground glass stone

Cystine appears as hexagonal crystals on urine analysis

Rare Calculi

Xanthine stones are a result of xanthine dehydrogenase deficiency

Stones are radiolucent, yellow coloured

Indinavir stones occur in patients being treated for HIV. They are radiolucent

Silicate stones occur with long term treatment with antacids containing silica

Triamterene stones occur on long term antihypertensives containing triamterne

Symptoms & Signs

Pain in flank and costovertebral angle, causing by stretching of collecting system or ureter or distension of renal capsule

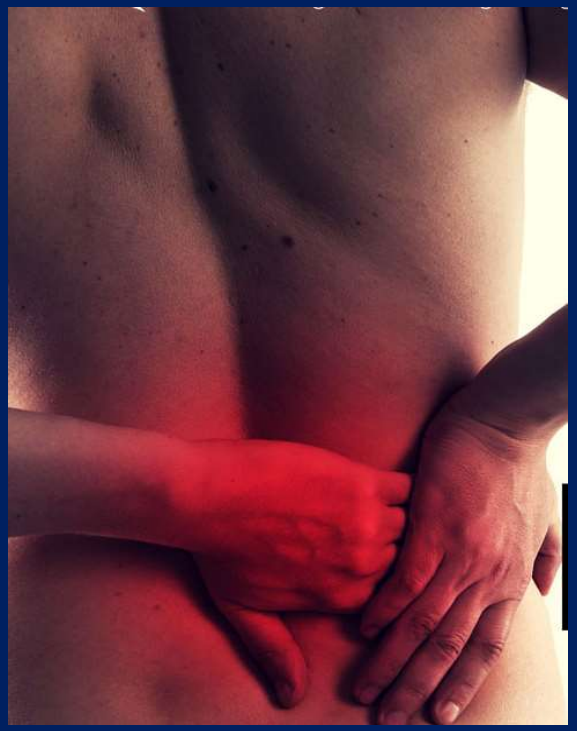
often associated nausea and vomiting

In the ureter pain is referred to the Ilio inguinal or genito femoral nerves causing pain radiating to testicles or labia

Small ureteric calculi can present with severe pain whereas large staghorn stones may only have dull ache

Pain is frequently abrupt and severe and patients move restlessly

Renal pain typical location



Symptoms & Signs

Mid ureteric calculi may mimic acute appendicitis on rt side and diverticulitis on the lt side

Ureteric stones near the uretero vesical junction cause urinary frequency, hesitancy and dysuria

Haematuria

Infection esp in struvite stones or secondary to obstruction & stasis

Investigations

Non contrast CT scan is the investigation of choice for acute pain

Ultrasound abdomen

Xray KUB

Intra venous urography

Medical Management

Pain: NSAID. Inj Diclofenac 50 -100 mg IM / IV

If pain persists then Narcotic analgesics

Expectant: Most ureteric calculi pass spontaneously, unless large, associated with infection, severe obstruction or symptoms when early intervention is needed

Medical Management

Medical expulsive therapy helps spontaneous passage of ureteric stones in the lower ureter

Drugs used are Alpha blockers e.g. Tamsulosin 0.4 mg OD

Low dose Corticosteroids

Medical Management

Alkalinisation of urine to dissolve uric acid, cystine & xanthine stones using sodium or potassium citrate or bicarbonate

D Penicillamine or alpha mercapto glycine for cystine stones

Allopurinol for treatment of gout to reduce uric acid synthesis

Hydrochlorothiazide for treatment of absorptive & renal hypercalciuria

cellulose phosphate for absorptive hypercalciuria

TYPES OF SURGERY FOR RENAL STONES

1. Non Invasive: ESWL
2. Minimally Invasive: PCNL
   Flexible Ureteroscopy
   Laparoscopic Pyelolithotomy
3. Open Surgery Pyelolithotomy
   Extended Pyelolithotomy
   Nephrolithotomy

ESWL
(Extra corporeal shock wave lithotripsy)

For renal and upper ureteric stones upto 1 -2 cms in size

There should be no obstruction to urine flow

Performed in kidneys with preserved renal function

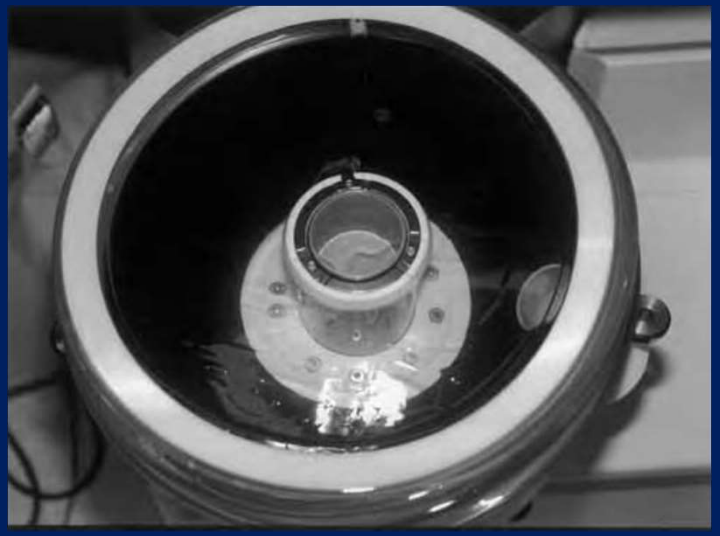
ESWL machine

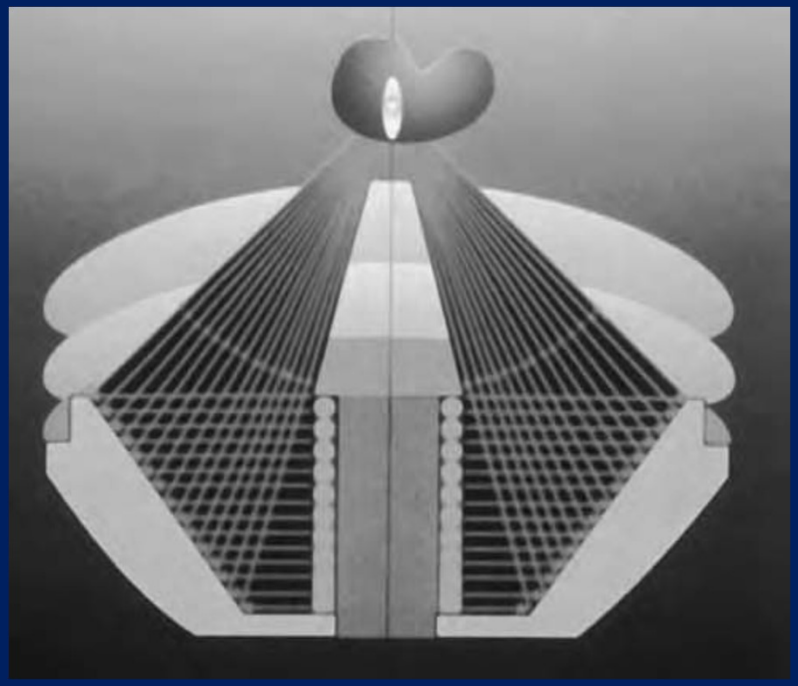
ESWL

Shock wave generator

Electromagnetic, Piezoelectric.

Shock waves are focussed on the stone causing stone fragmentation





Complications of ESWL

Haematuria

Infection

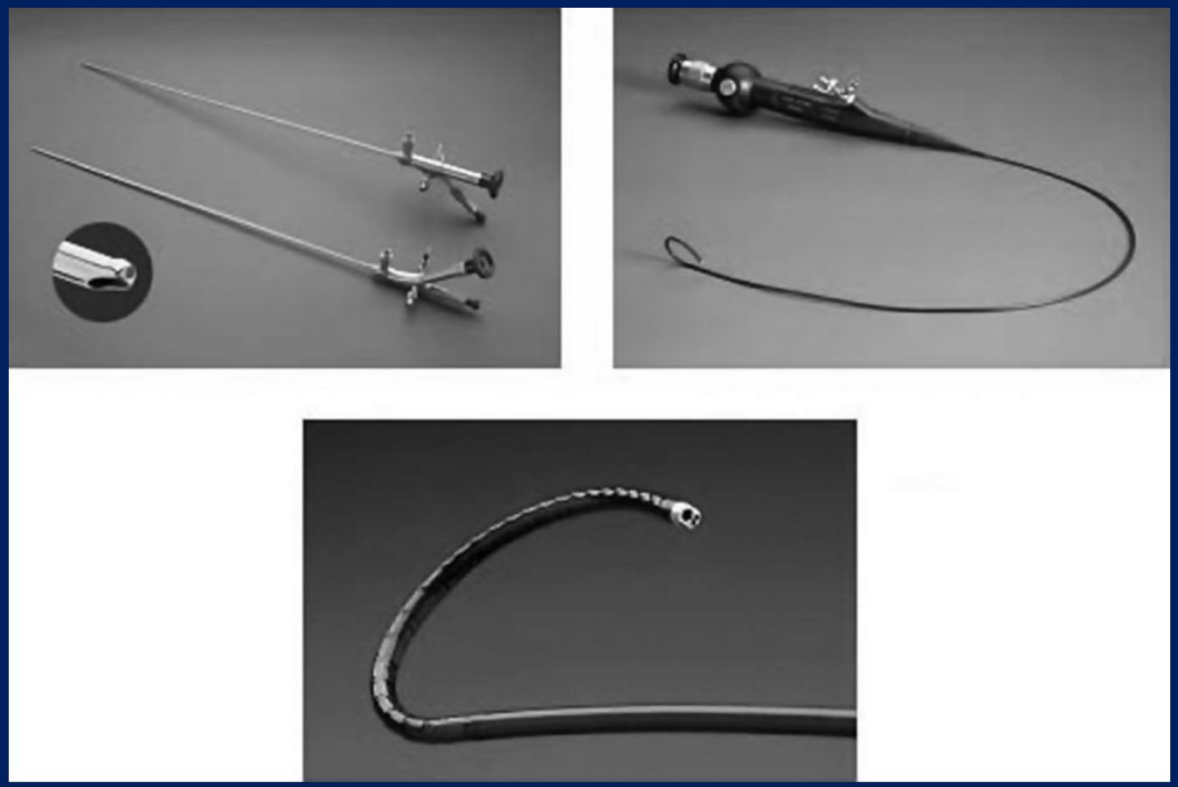
Residual stone fragments

Ureteric obstruction by stone fragments - steinstrasse

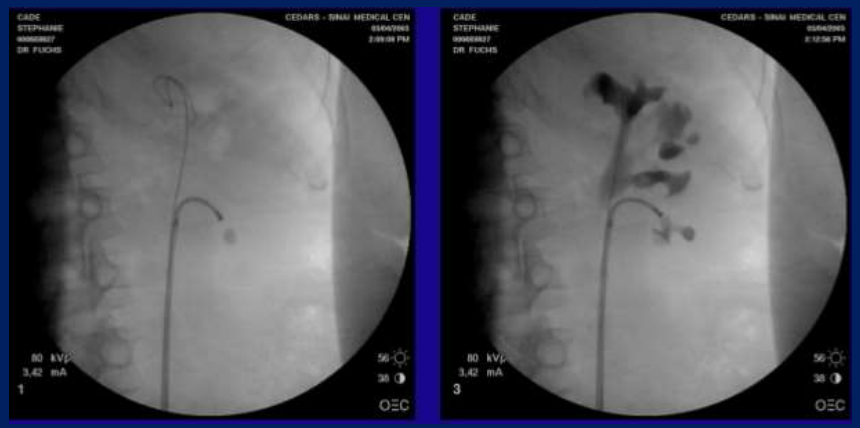
FLEXIBLE URETEROSCOPY

For Small Renal Stones

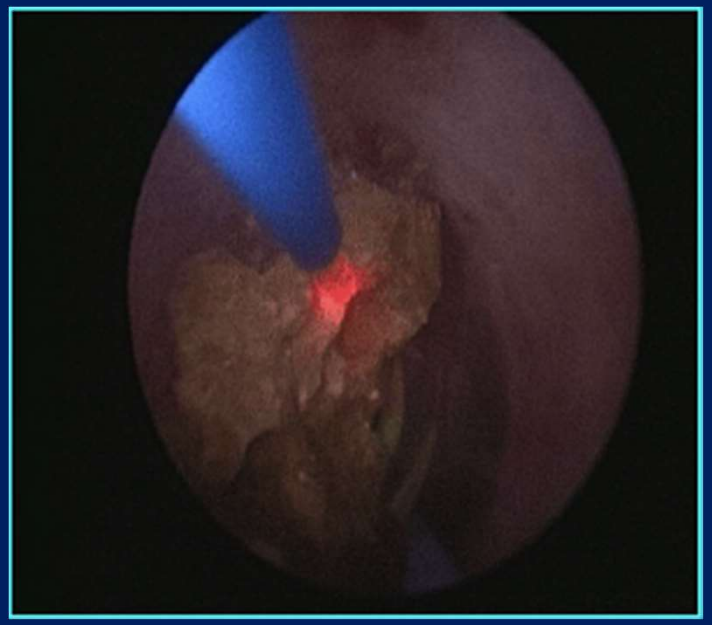
& Ureteric calculi



Retrograde Intrarenal Surgery (RIRS) for small renal stones < 1cms



Stones are fragmented using Holmium laser or pneumatic lithotripter



Percutaneous Nephrolithotomy (PCNL) for renal stones > 2cms

Complications of PCNL

Bleeding

Infection

Residual stone fragments

Damage to surrounding otgans

Open surgery for renal / ureteric stones

Uncommonly performed at present

Indications:

Very large stone

When equipment for other techniques are not available

Open surgery is performed for very large stones

Open surgery for renal / ureteric stones

Types of surgery for renal stones:

Pyelolithotomy

Nephrolithotomy

Surgery for ureteric stone:

Ureterolithotomy

Surgery for bladder stone:

Cystolithotomy

Pyelolithotomy / Nephrolithotomy

Approaches to the kidney for open stone removal:

Flank approach

- Subcostal, below 12th rib
- Trans costal (through 11th or 12th rib bed after resecting rib)
- Intercostal (above the 11th or 12th rib)

Patient Position for open stone surgery

Pyelolithotomy

Steps:

Patient placed in lateral position, subcostal skin incision made

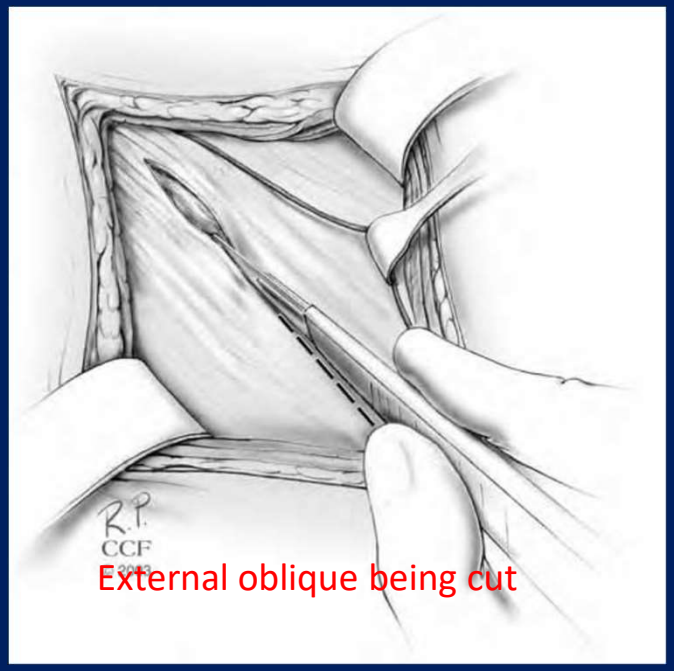
External oblique, Internal oblique and transversus abdominus muscles cut anteriorly and latissimus dorsi and serratus posterior inferior muscle cut in posterior part of incision.

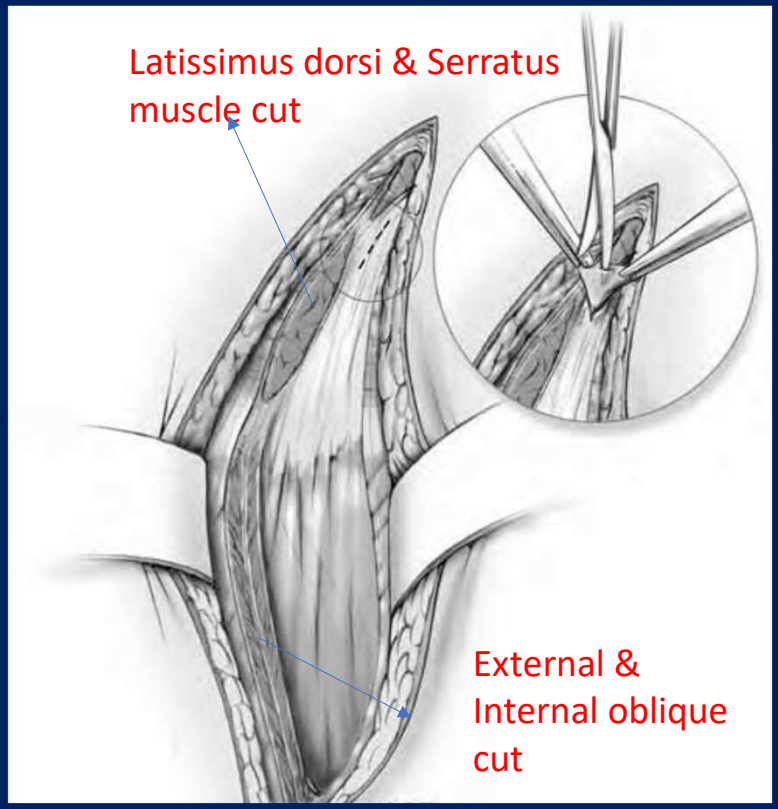
Gerotas fascia incised and kidney exposed

Renal pelvis dissected and incised on it's posterior aspect. Stone removed. Renal pelvis sutured with vicryl suture.

Cut edges of muscle sutured with vicryl or prolene suture and skin sutured with silk sutures

Pyelolithotomy: muscles being cut





Pyelolithotomy: Kidney exposure

Renal pelvis being cut open to reach stone

Complications of Open renal stone surgery

Intra operative complications:

Bleeding

Avulsion of ureter

Opening of pleura

Post operative complications:

Infection

Left over stones

Laparoscopic surgery for Renal / Ureteric stones

Laparoscopic and retroperitoneoscopic approaches can also be used for performing pyelolithotomy for renal stone and ureterolithotomy for large ureteric stone which can not be fragmented by ureteroscopy