URINARY STONES DISEASE

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Lecture Outline

- ✔ Definition
- ✔ Epidemiology
- ✔ Pathophysiology
- ✔ Classification
- ✔ Approach
- ✔ Management

Definition

- Presence of a solid, crystal material anywhere from the nephrons to the distal urinary tract
- (Nephrolithiasis, ureterolithiasis, cystolithiasis, urethrolithiasis)

Epidemiology

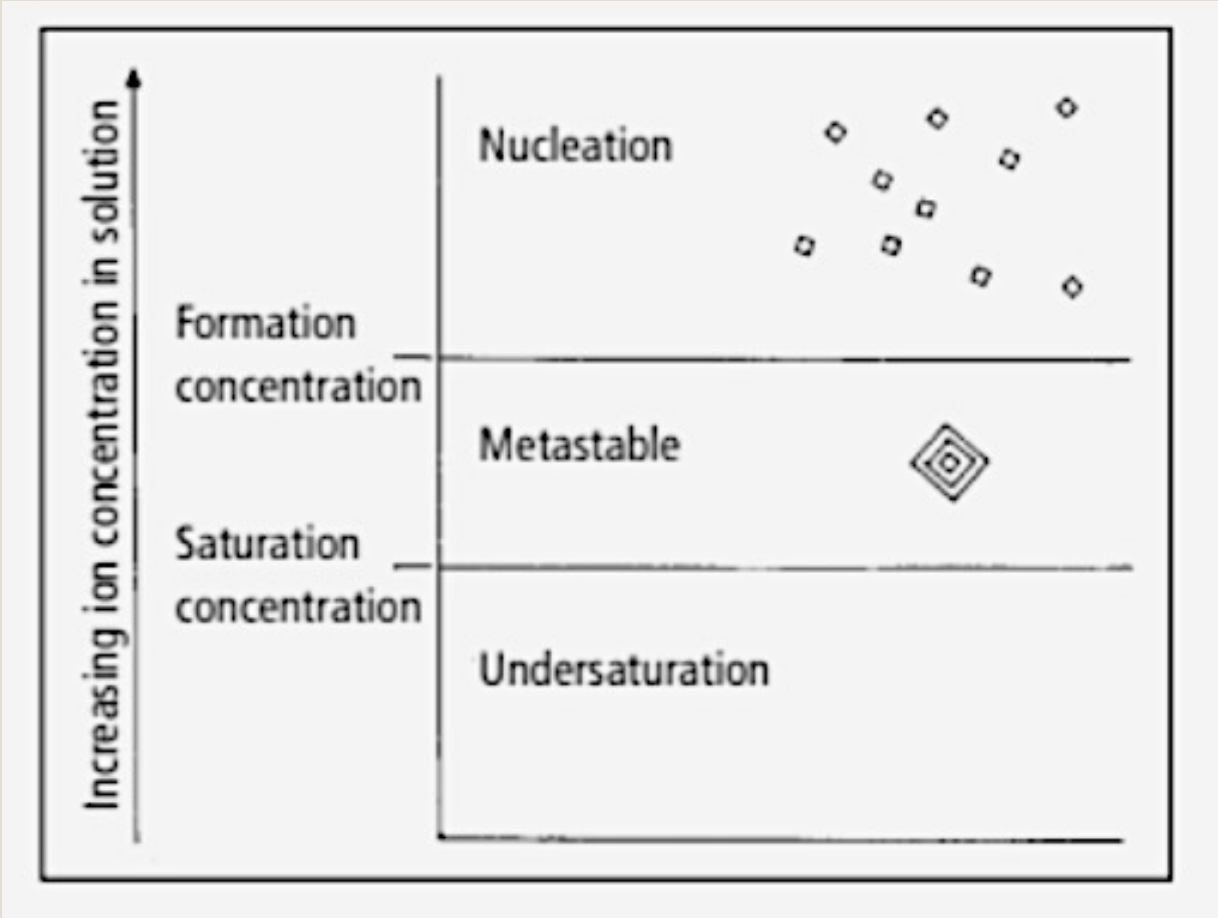
- The lifetime risk of renal calculi is approximately 12%.
- Male : Female is 3:1; due to discrete metabolic/ hormonal influences.
- The peak age of stone-related clinical episode in men is in the third decade. In women the peak incidence is in post-menopausal years.
- The incidence also varies in different populations.

Risk Factors

- A prior history of nephrolithiasis
- Family history of stones
- Stone disease is more common in individuals with diabetes, obesity, gout, and hypertension
- Low fluid intake and diet
- Malabsorption (gastric bypass, short bowel syndrome)
- Frequent upper urinary tract infections
- Use of medications that crystalize in urine (acyclovir, triamterene)

Pathophysiology

- Supersaturation
- Crystallization
- Growth


Increasing ion concentration in solution
Nucleation
Formation concentration
Metastable
Saturation concentration
Undersaturation

Promoters of stone formation

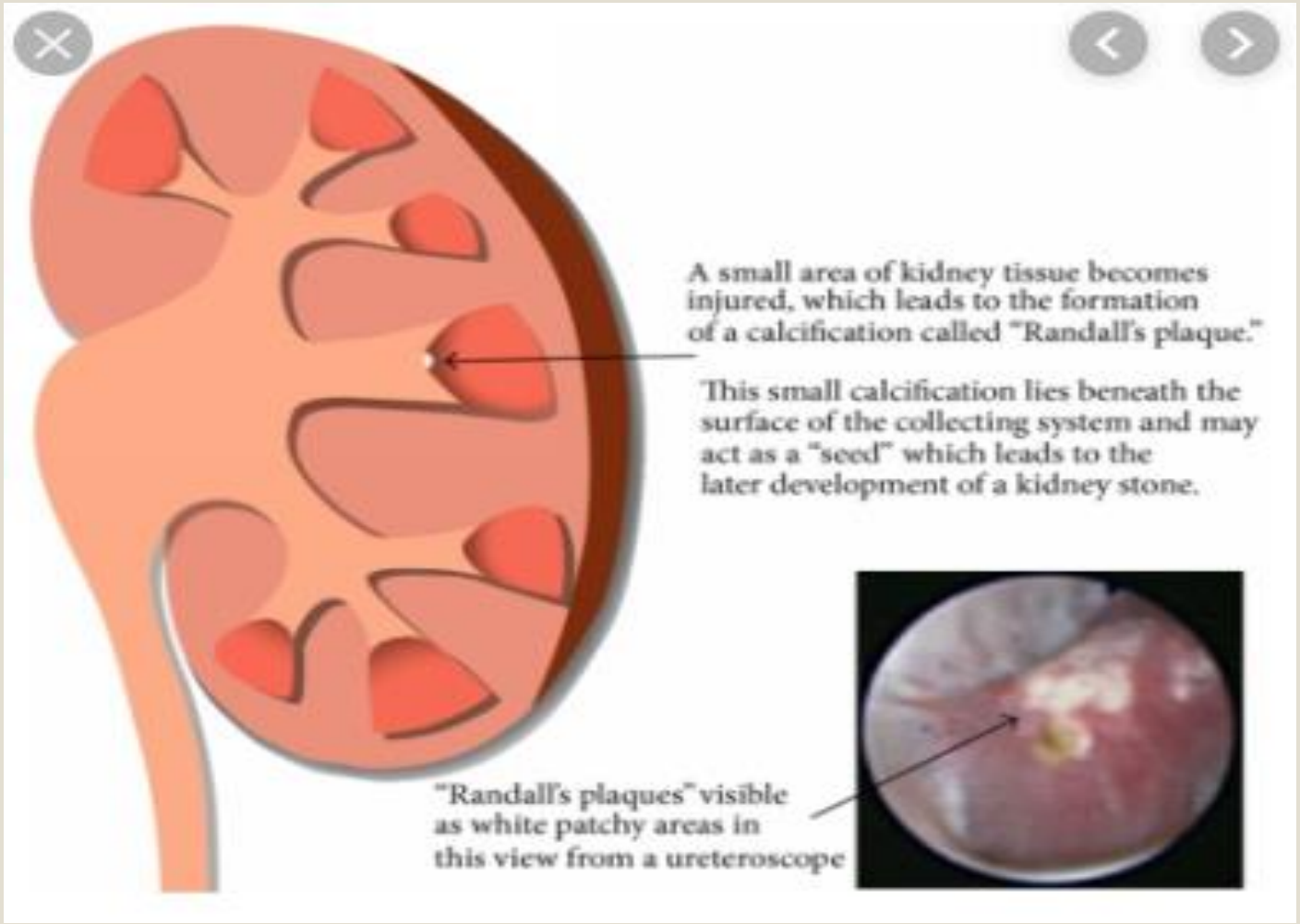
- Urine pH
- Metabolic disorders
- Rate of flow of urine and volume
- Anatomical (PUJ obstruction, horseshoe kidney, medullary sponge kidney, calyceal diverrticula)
- Dead papillae, necrotic carcinoma, non-absorbable suture, previous fragment of stone

- Citrate
- Magnesium

Inhibitors of stone formation

Randall's Plaques

- The first step in stone formation is the deposition of a plaque of calcium apatite on the beasement membrane of a renal tubule .
- The plaque grows within the renal parenchyma and erodes through the urothelium of renal papilla to act as a stable surface for the nucleation of superstaurated compounds in the urine.


A small area of kidney tissue becomes injured, which leads to the formation of a calcification called "Randall's plaque."
This small calcification lies beneath the surface of the collecting system and may act as a "seed" which leads to the later development of a kidney stone.
"Randall's plaques" visible as white patchy areas in this view from a ureteroscope

Classification

- Calcium Stones
- Oxalate Stones
- Uric Acid Stones
- Cystine Stones
- Struvite Stones

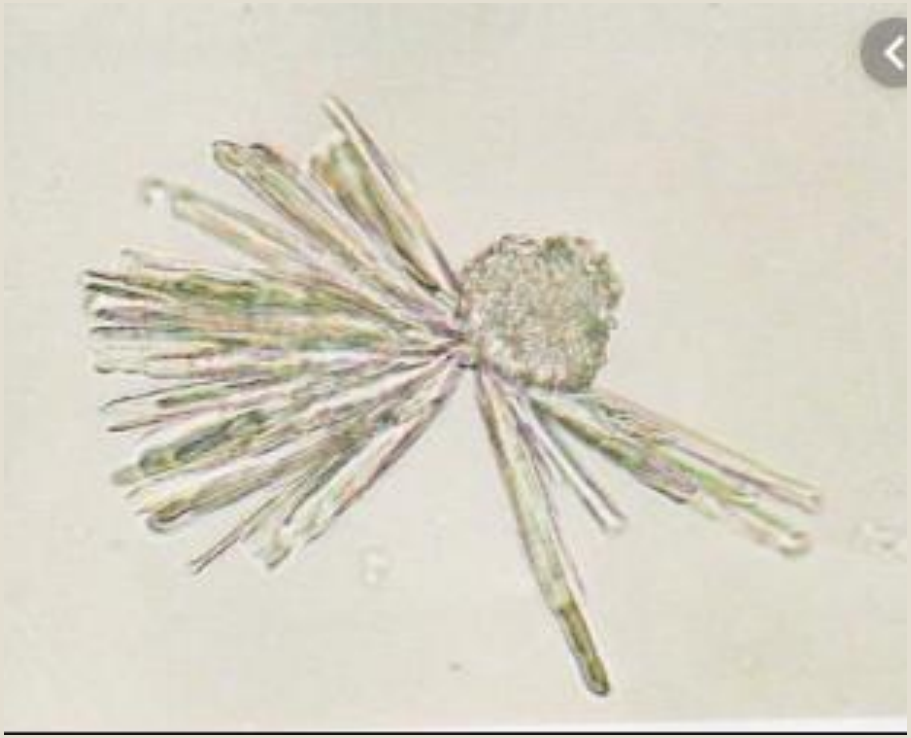
Calcium Stones

- Absorptive hypercalciuria
- Renal hypercalciuria
- Resorptive hypercalciuria

Calcium phosphate stones

- Distal renal tubular acidosis, failure to excrete excess acid in urine
- Metabolic acidosis with bone demineralization and secondary hyperparathyroidism.
- Hypercalciuria and hypocitaturia
- Raised urine pH and hyperparathyroidism reduces renal phosphate reabsorption.

- Wedge-shaped



Oxalate Stones

- Is the most common type of urinary tract stones.

-It may due to :

- Hepatic Oxaluria

  Rare, autosomal recessive disorder of metabolism

- Enteric Oxaluria

  Most common, chronic diarrhea and fat malabsorption

- Dietary Oxaluria

Calcium oxalate crystals

- Biconcave dumbbells or bipyramidal envelopes
- Develop in acidic urine.
- 70%

Uric Acid Stones

- Low urine pH

  Metabolic syndrome, insulin resistance and diet rich in animal protein

- Hyperuricemia

  Increased tissue breakdown and protein catabolism in association with chemotherapy for certain malignancies

- Pure uric acid stones are radiolucent. Commonly, they act as a nidus for calcium oxalate and calcium phosphate precipitation in which ase they become radio-opaque.

- Rhomboid shape

Cystine Stones

- Cystinuria

  Autosomal recessive disorder characterized by defective intestinal or renal tubular transport of dibasic amino acids (COAL – cystine, ornithine, arginine, lysine)

- Most frequent cause of stones in children

- Hexagon shaped crystals

Struvite Stones

- Recurrent urinary tract infection

  Elderly, women, diabetics, urinary tract abnormalities and spinal cord injury.

- Magnesium ammonium phosphate
- Urease producing bacteria (proteus, pseudomonas, staphylococcus)
- Urease hydrolyses urinary urea into ammonium with resultant alkalinisation of urine.

- rectangular prisms (coffin lid-appearance)

Patient History

- **Symptoms**: pain, hematuria, N/V
- **Past medical & surgical history:** stones, UTI, gout, hyperparathyroidism ...
- **Family history**
- **Drug history:** chemotherapy, Ca++, diuretics ...
- **Social history:** fluid intake, diet

Physical Examination

- Vital signs
- General
- Abdominal exam: costophrenic angle tenderness

Kidney Stones

- Asymptomatic
- Flank pain, non radiating
- Hematuria (microscopic or occasionally macroscopic)
- Recurrent UTI
- Malaise, weakness, loss of appetite, N/V

Ureteral Stones

- Sudden onset of severe colicky flank pain.
- Pain radiates to groin, testicles or labia majora
- Hematuria (microscopic or gross)
- N/V, pallor, sweating

Bladder Stone

- Asymptomatic (and incidentally found on KUB X-ray, bladder ultrasound or cystoscopy)
- Suprapubic or perineal pain
- Hematuria
- Urgency
- Recurrent UTI
- Poor flow
- Hesitancy

Investigation

- Urine analysis and culture
- Metabolic workup (calcium, uric acid, creatinine, urea)
- Any stone should be analyzed by x-ray crystallograhy.
- CBC
- KFT

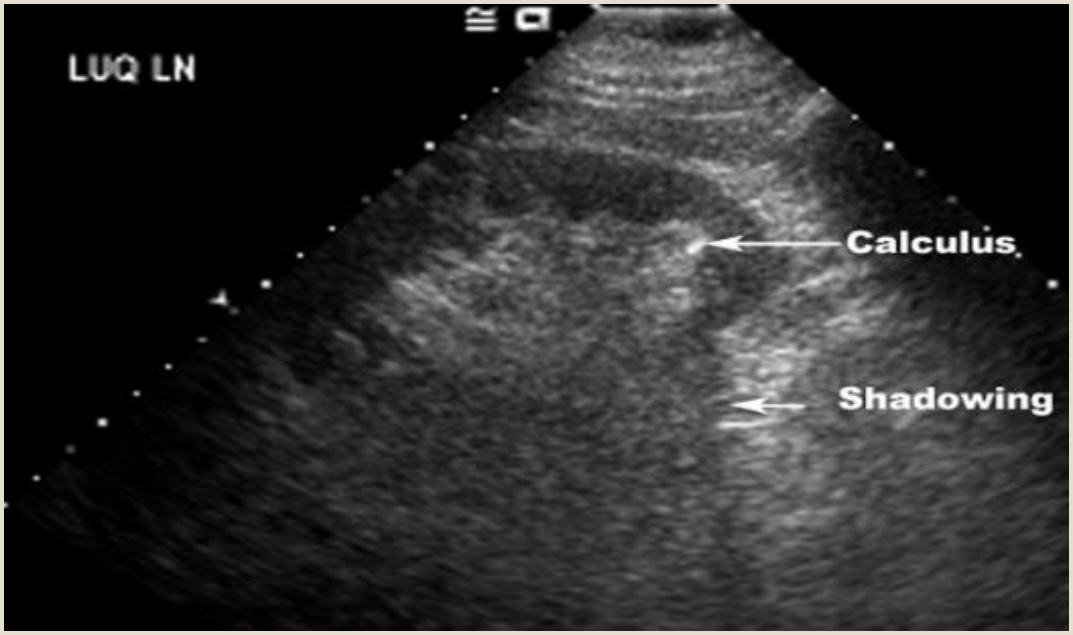
Imaging Studies

- **KUBx-ray**:(initial imaging for follow up and to know if its radiolucent or opaque)
- **Radio-opaque**: calcium containing(Ca oxalate, Ca phosphate)
- **Relatively Radiolucent**: struvite and cysteine
- **Completely radiolucent:** uric acid

This is a K. U. B x Ray showing stone at the middle of the left ureter

Imaging Studies

- **Ultrasound**: (hydronephrosis, misses30% of stones)
- Stones appear only in kidney,
- Stones do not appear if they are in ureter



Imaging Studies

- **Non contrast CT scan:**

  gold standard for diagnosis

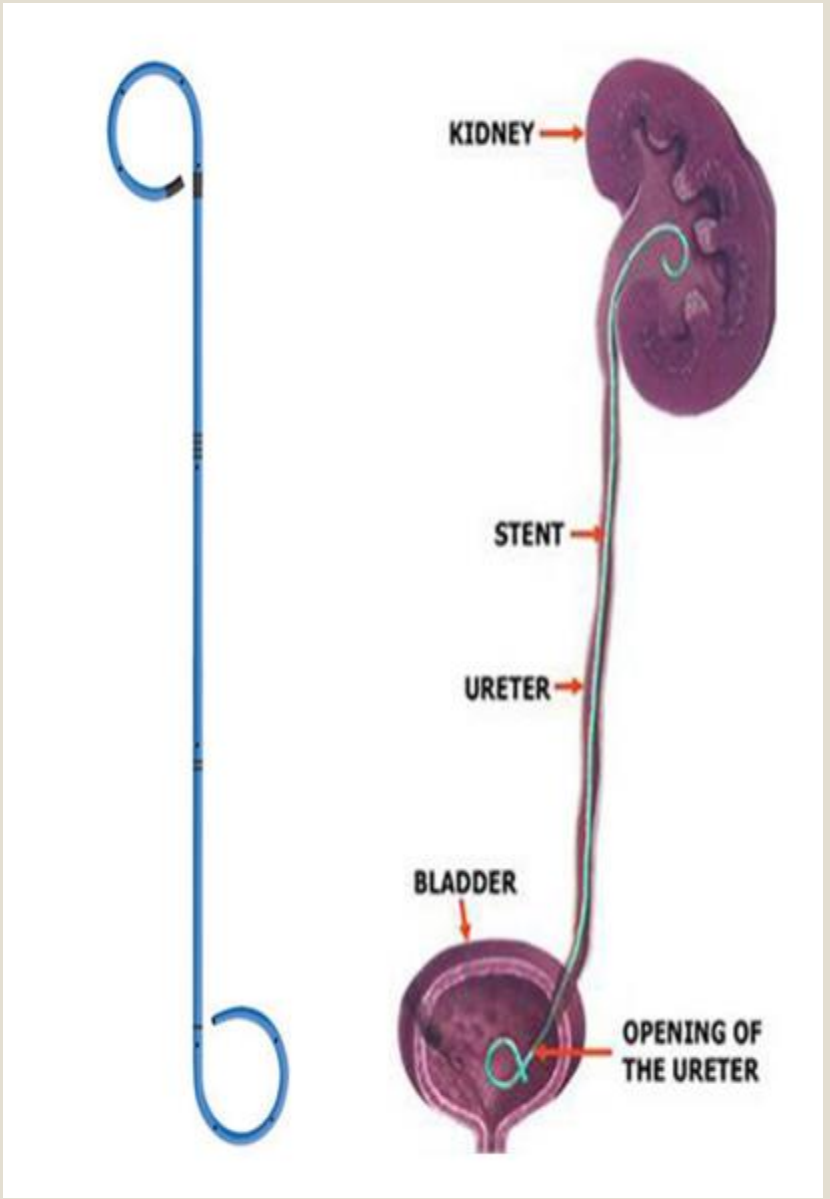
- Non contrasted CT scan showing bilateral renal pelvis stones

Management

- Analgesia
- IV fluid
- Antiemetic
- Double J-stent placement

➢ It a ureteral stent with curving ends that prevent the stent slipping into the bladder or kidney. It's placed temporarily into the ureter to reduce pain from the stone or allow drainage or to speed up healing after stone surgery.

K. U. B showing Left ureteral stent in place



Treatment

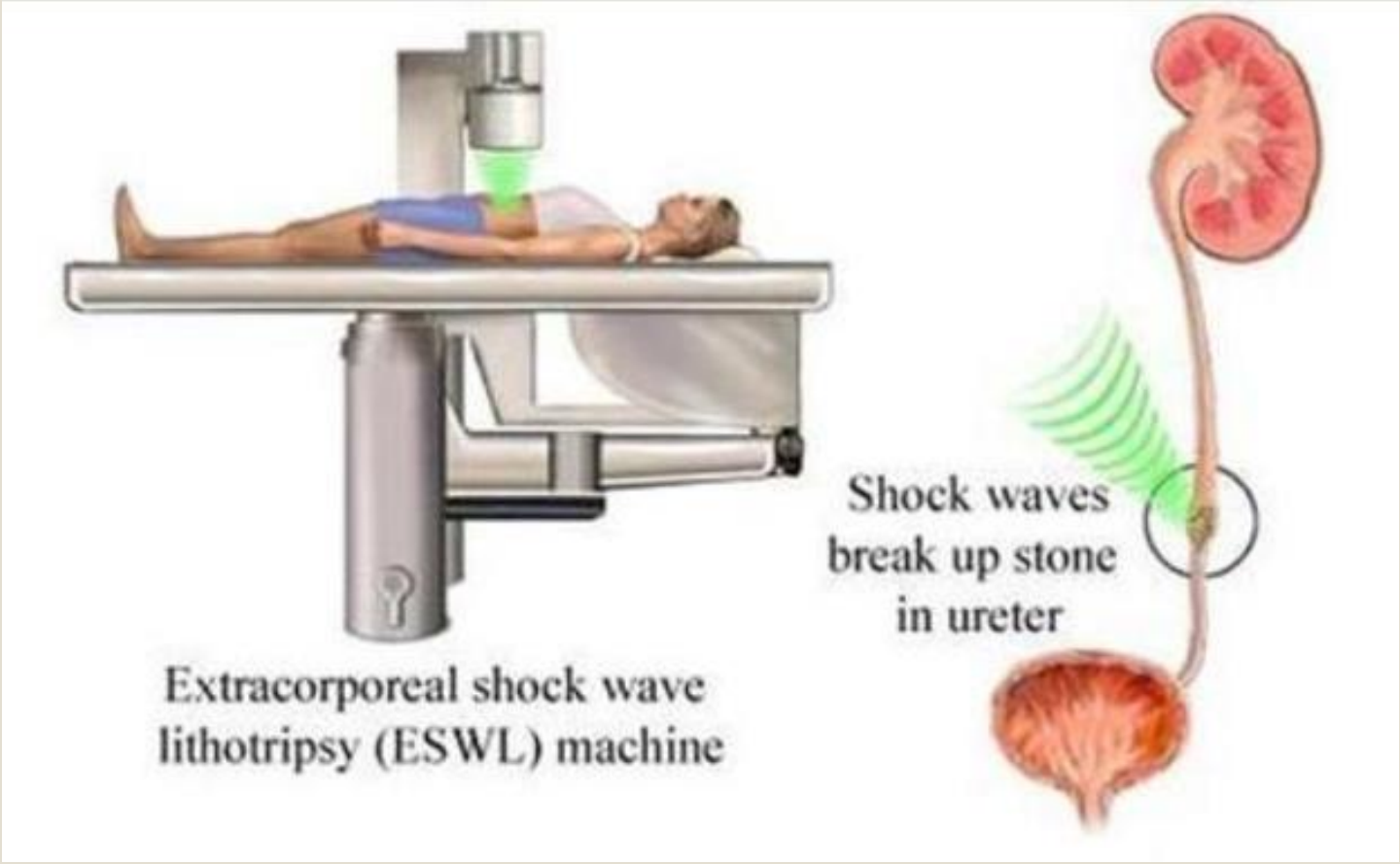
- Depends on the size and site of stone
- ESWL
- Ureteroscopy and laser treatment
- PCNL
- Open surgery

ESWL

- Extracorporeal shock wave lithotripsy
- The efficacy of ESWL depends on stone size, location, anatomy of renal collecting system, degree of obesity and stone composition.

ESWL

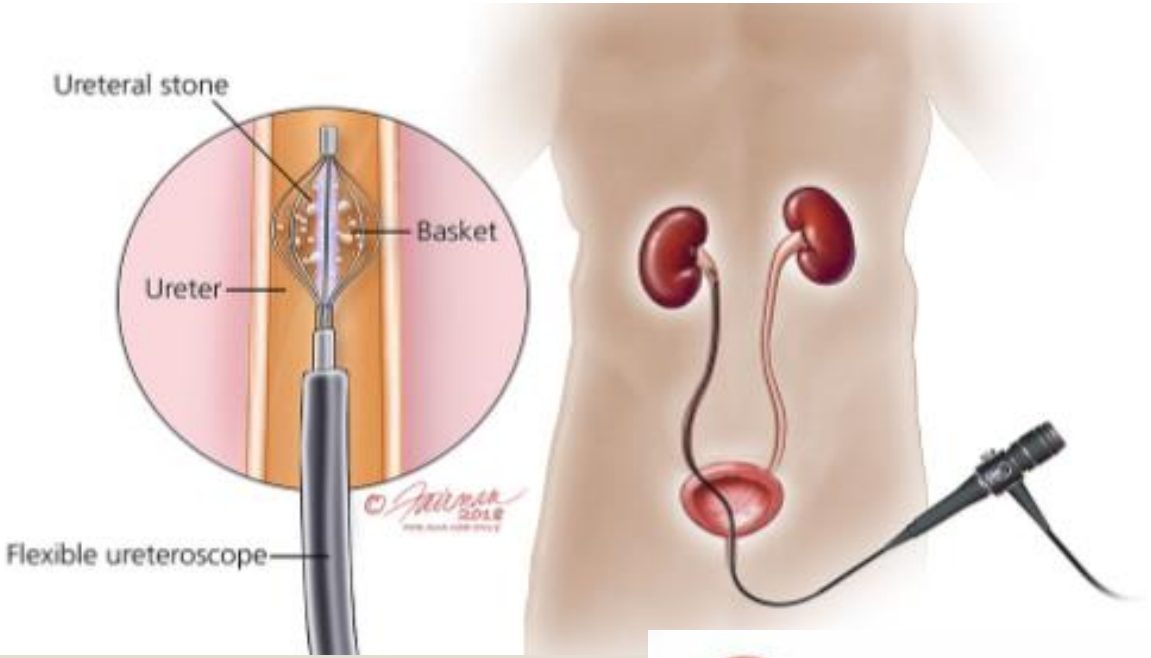
- **Side effects of ESWL:**
- structural and functional renal damage
- hematuria (macroscopic, microscopic)
- edema
- perirenal hematoma
- decreased renal plasma flow (Causing HTN)
- Acute renal injury is more likely to occur in patients with pre-existing HTN, DM, prolonged coagulation time, coronary heart disease and those with solitary kidney.
- **Contraindications: pregnancy, blood clotting disorders, morbid obesity, CKD**



Extracorporeal shock wave lithotripsy (ESWL) machine

Ureteroscopy and Laser Treatment

- More effective than ESWL.
- Requires general anesthesia.
- **Indications:**
  - ESWL failure
  - Lower pole stone
  - Cystine stones
  - Obesity (PCNL and ESWL are difficult)
  - Musculoskeletal deformities (stone access by PCNL or ESWL is difficult)
  - Stone in calyceal diverticulum
  - Stenosis in calyceal infundibulum
  - Horseshoe or pelvic kidney



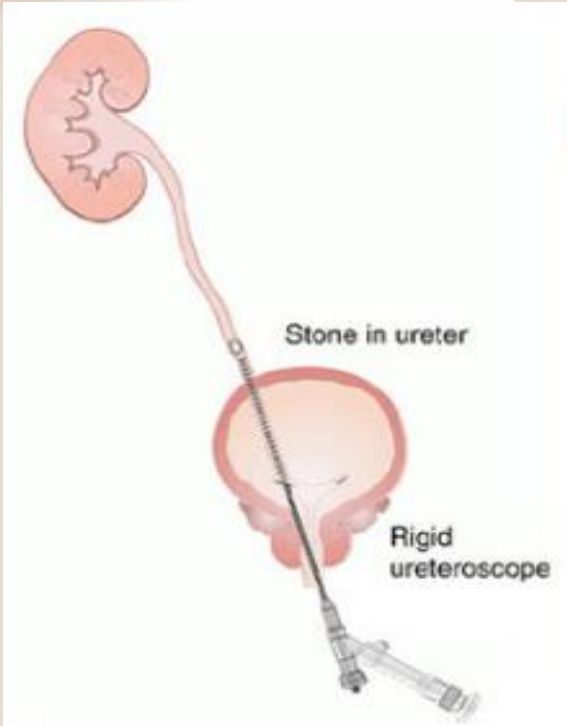


FIGURE: A

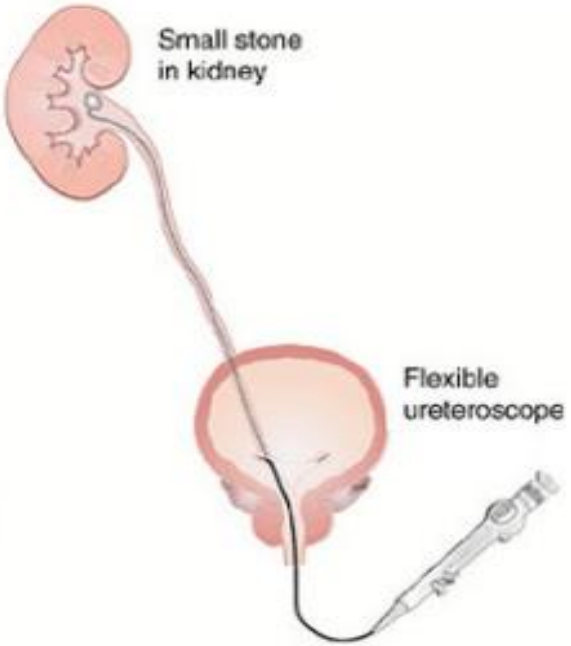
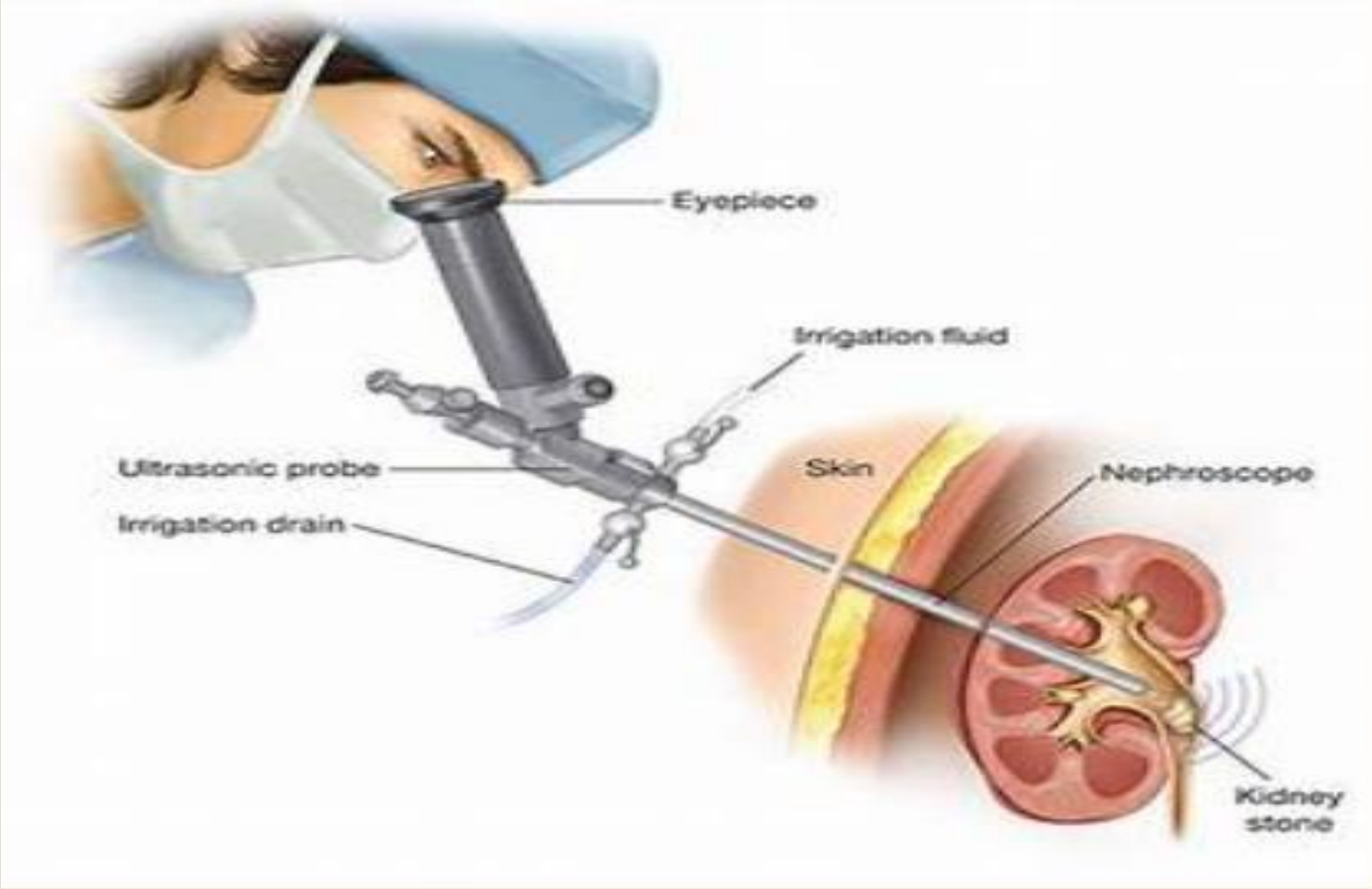


FIGURE: B

PCNL

- Percutaneous Nephrolithotomy
- PCNL is the removal of a kidney stone via a track between the surface of the skin and the collecting system of the kidney.
- PCNL gives the best chance of stone clearance with a single procedure but this is achieved at a higher risk of morbidity.
- **Indications**: 1st line option for staghorn calculi > 2cm or failed ESWL and flexible ureteroscopy
- **Contraindications:** UTI and bleeding tendency


Eyepiece
Irrigation fluid
Ultrasonic probe
Irrigation drain
Skin
Nephroscope
Kidney stone

Open Surgery

- **Open surgery :**
- Indications:

  - complex stone burden: projection of stone into multiple calyces

  - Failure of endoscopic treatment

  - Difficulty performing endoscopic treatment due to anatomic renal abnormality, obesity, kyphoscoliosis

  - Nonfunctioning kidney

Thank you