Peritonitis

D/D, Assess, MNX (*) 4/M

Primary
- Spontaneous peritonitis of childhood
- Spontaneous peritonitis of adult
- Tuberculous peritonitis
- Dialysis peritonitis

Secondary
- From intra-abdominal source
  1. Hollow viscus perforation
  - Perforated duodenal ulcer
  - Enteral, enteric

2. Direct spread
- Ac. Appendicitis
- Ac. Cholecystitis gangrene
- Ac. Necrotising fasciitis

Penetrating injury
3. Post-operative peritonitis
4. Paracentesis peritonitis
5. Pseudomyxoma peritonitis

Assessment
- CLF, Acute Abdominal pain - cutting nature
- Persistent vomiting
- Pulse rate
- High-grade fever and chills and rigors
- Tenderness - cough, economic (Blumberg)
- Guarding, rigidity
- Absent bowel sound
- End stage - Hippocratic jaries
Investigation
- CBC - High count
- Blood sugar
- Plain x-ray Abdomen
  - Gas under diaphragm - Perforation
  - Ground glass appearance - due to fluid
  - Air in bowel wall - gangrene
  - Bowel shadow obliteration
- Abdominal USG = very useful
  - Free pus - peritonitis older than 48 hrs
  - Bile - green - duodenum, stomach, GB per-
  - faeculent - dark green - ileal perforation
  - Serous - exudative - TB, pancreatitis
- Haemorrhagic
- Food particles - hollow viscus perforati
  - probe tenderness - RIF = Ac. Appendicit
  - Anchovy sauce - Amoebic liver abscess.
- Abdominal Tap - As above.
- CECT = hollow viscus perforation
  - Ischemic changes
  - Unsuspected lesions - diverticulum
- Diagnostic laparoscopy
  - Reconfirm and 5x acoustical
  - Toilet can be given
  - TIL
  - Can detect Diaphragmatic Injuries
1. Aspiration → Ryle's tube → Secretion, Bact.load.
2. Bowel care and Blood
3. Charts → B.P.T.
4. Drugs → Gen. Cephalosporin + MTZ
   → Culture Sensitivity
5. Exploratory Laparotomy
6. Fluids → CVP
   → Ringer Lactate
7. Principles of Sx:
   → Generous Incision
   → Pus for C/S
   → Exploration and Establish Sx
   → Treat the Cause → Control of sepsis
     → Peritoneal toilet → Saline (Not antiseptic)
   → Drain → Subhepatic space and pelvic cavity
   → Closure → Tension sutures
   → Nonabsorbable sutures to do an intestinal anastomosis
   → Laparotomy → open/when tension is completed
   → Close

* Abdominal Compartment Syndrome →
  → IAP → 20 mmHg
  → Close monitoring
  → Temporal Abdominal Closure → Definitive closure
  → Mesh
  → Bogota bag
  → Vacuum assisted closure
Q. I Line Antimycobacterial drugs = resistance.

Complications - Severe Shock, Hypovolemic Shock of Peritonitis - Septic Shock - Subacute Intestinal Obstruction - Pelvic Abscess - Subphrenic Abscess

* Pelvic Abscess
  
  C. T. = High grade fevers
  - Discharge of mucus per rectum in Pt. Recovered from peritonitis

  D. X. = Per rectal tenderness, boggy swelling in Ant. Wall of rectum

  - USG
  - CT

  MNX = ↓ GA → Pecoscopy - Nick in Ant. Wall of Rectum

  → Rt. Paracolic gutter above omphalocelephic loop

* Subphrenic Abscess (Common on Rt. Side)

  E. L. F. = FEVER, CUE, Deterioration of health, shoulder pain, plethora, Decline, Epigastric pain

  IM. cbc, x-ray, Fluoresced radiography to reveal absence of movement on right side

  USG, CT, Scan, Isotope imaging (IRM)

  T/t = Antibiotic, control of periton as (multiple)

  Drainage - Pigtail catheter or open drainage (Recurrent, fistula)
Special cases

1. Spontaneous Bacterial Peritonitis
   - Child: Malnutrition, Malignancy, chemotherapy
   - Adult: Cirrhosis, Nephrotic Syndrome, CRF

C/F = Classical
Irr = As usual
T/t = Conservative

- >250 PM cells in Ascitic fluid.
- Albumin (In cirrhosis)
- MRI gen. cephalo + MTR.
- Norfloxacin & Incidence S/F is vaccineable
- Instillation of antibiotic solution
- Laparotomy as last resort => wash.

2. Postoperative Peritonitis
   - Causes - Leakage from anastomotic line
   - Iatrogenic visceral trauma
   - Foreign bodies

How to suspect postoperative peritonitis
- Deleteriation after 3-5 days of operation
- Delay in recovery
- Evidence of toxacemia
- Free drainage of bile and fecal matter from drain site
- Odour

P/I = 1. Prevention of mop letting
     2. Specific treatment
- Reoperate
- Confirm leak or abscess
- Exploration
- Drainage
- Antibiotics
- Peritoneal lavage
- Delayed closure of skin.

Biliary peritonitis

C/I: As usual. biliary leak, Excavation

T/l:
- Most of fistula heal within 2-3 weeks
  with conservative line of mnx
- If does not heal, re-explore

Feeding jejunostomy is useful in
Reperfusion of sutured duodenal ulcers
of difficult duodenal ulcers closure.
Causes of Hematuria

1. UTI
2. Pyelonephritis
3. Kidney, Weeleeic or Bladder Stone
4. Enlarged prostate
5. Kidney disease, Glomerulonephritis, Vasculitis, IgA Nephropathy, HSP, SLE, PKD

= Trauma, Tumour, Infection, Stone

Kidney \rightarrow Weelee \rightarrow Bladder \rightarrow Weethra.
History
1. Age and sex: Young child: vesicle calculus
    - Young adults: Renal stones, TB
    - Elderly: RCC

2. Occupation: Anilin dye: Ca Bladder

3. Hematuria:
   - Beigel seed: Lower tract
   - Acleese: Kidney
   - Profuse: Papilloma
   - Small quantity: RCC, TB, Stones

   Begin
   - Eng

   Threat: Geometric origin, Painless: Papilloma or casealloba
   Painful: Renal stones, bladder stones.

4. GPE:
   - Pallor: Anemia, Blood loss or Ca
   - HN: Polycystic kidney disease
   - Bone pain: Ca Prostate

   Per abdomen:
   - Palpable kidney: WT, Polycystic, RCC
   - Distended bladder: Ca Prostate, BPY
   - Suprapubic tenderness: Bladder, stones, cystitis
   - Craygy epididymis: Genital TB
   - Rectal exam: Enlarged prostate - BPY
   - Hard irregular - Ca Prostate
   - Hard, thickened Seminaires: TB
1. Weir casts: 
- Lucernite growth
- Flat disc - Weethra
- Pieces of tumour - Papilloma bladder

2. Weire microscopy
- RBC
- Dysmorphic (x)
- Pyuria - UTI
- Bacteriuria - Acid Pyuria - TB
- Malignant cells.

3. Plain x-ray KUB
- Enlarged Kidney - Polycystic kidney, RCC
- Radio opaque - Renal stones, Wecleric stones, bladder stones

4. Cystoscopy:
- Growth in bladder - Papilloma / TCC
- Inflammation - Cystitis
- Ulcer, Golf hole ulcer - TB

5. Intra venous Pyelography
- Spider leg calyces - Polycystic kidney ails.
- Irregular calyces - RCC
- Missing calyces - TB

6. USG = RCC, PCKS, WP
- Fatty - Nephrotic Syn.
- Granular - Kidney
- Hyaline - Dehydrated
- Epithelial cell cast - Tubular orphan
Hematuria

Microscopic

Dysmorphic RBCs

+ Pus cells

Culture

D. RBCs + Pus cells

S+/1 glomerular balls

Microbiological Causes

USG/IVU/CT

+ Weine cytology

+ Cystoscopy

Stones

Multiple R/L

Cystine = Rare, due to abnormal excess, Hard, Radioopaque

Uric acid = In Acids, Weine, well response to Lithotripsy

Tripe phosphate = Alkaline, Injection = Stagnation

Oxalate = Irregular, (all others smooth), infected weine

Alternate layers of Calcium and bacterial vegetations

C/F = Pain, Colicky, Hematuria, Recurred UTI, Gout, Uric
**EXPLANATIONS**

**RENAL AND URETERIC CALCULI**

1. Ans. b. Triple phosphate (Ref: Smith 17/e p249-254; Campbell 10/e p1296-1302; Bailey 25/e p1295-1300)

   - Calcium oxalate
     - MC type of kidney stone (85%) Q
     - Risk factors are hypercalciuria, hypercalcemia, hyperoxaluria
     - Have hard, small and jagged surface
   - Uric acid stones
     - 5-10% of all kidney stones, MC radiolucent urinary calculi Q, formed in acidic urine
     - Patients with uric acid stones may have gout, myeloproliferative disorders or Lesch-Nehan syndrome (hyperuricemia)

<table>
<thead>
<tr>
<th>Types of Renal Calculi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uric Acid Stones Management</strong></td>
</tr>
<tr>
<td>- Cornerstone of treatment: Low purine diet, hydration and alkalinization of urine Q</td>
</tr>
<tr>
<td>- Allopurinol Q (Inhibits conversion of hypoxanthine and xanthine to uric acid)</td>
</tr>
<tr>
<td>- Acetazolamide Q (may be added if urine pH is &lt;6.5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Struvite Stones (Infection stones)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Composed of calcium, ammonium, magnesium phosphate (Triple phosphate stones Q)</td>
</tr>
<tr>
<td>- Tend to grow in alkaline urine Q, especially with Proteus infection and fill whole of the PCS, forming staghorn calculi Q</td>
</tr>
<tr>
<td>- Formed in high urinary concentration of ammonia</td>
</tr>
<tr>
<td>- More common in women Q (increased susceptibility for UTI)</td>
</tr>
<tr>
<td>- Most of the staghorn calculi are silent Q and cause progressive destruction of renal parenchyma Q</td>
</tr>
<tr>
<td>- Increased tendency to form struvite calculus is seen in: Foreign body in the urinary tract (Foley's catheter) and Neurogenic bladder Q/Bladder dysfunction/Bladder outlet obstruction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Struvite Stones Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Complete stone removal + Treatment of a metabolic abnormality + Correction of any anatomic abnormalities contributing to stasis</td>
</tr>
<tr>
<td>- PCNL + ESWL (best treatment option) Q</td>
</tr>
<tr>
<td>- Antibiotics to prevent stone recurrences or growth after operative procedure</td>
</tr>
<tr>
<td>- Acetohydroxamic acid (irreversible inhibitor of urease) Q increases likelihood of precipitation</td>
</tr>
<tr>
<td>- Low calcium, low phosphorus diet</td>
</tr>
<tr>
<td>- Upto 50% of patient have stone recurrences or UTI over 10 years follow up</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cystine</th>
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<tbody>
<tr>
<td>- Extremely hard stone, formed in acidic urine</td>
</tr>
<tr>
<td>- Relatively resistant to fragmentation by ESWL</td>
</tr>
<tr>
<td>- Occur in cystinuria with typical &quot;ground glass&quot; appearance with a round smooth outline Q</td>
</tr>
<tr>
<td>- Typical benzene or hexagonal cystine crystals Q in urine</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cystine Stones Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Stone removal PCNL</td>
</tr>
<tr>
<td>- To lower cystine concentration in urine (Low methionine diet and alkalinization Q)</td>
</tr>
<tr>
<td>- Cystine complexing agents: D-Penicillamine Q and Alpha-mercapto propionylglycine (MPG Q)</td>
</tr>
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<table>
<thead>
<tr>
<th>Xanthine</th>
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<tbody>
<tr>
<td>- Seen in xanthinuria, radiolucent Q</td>
</tr>
<tr>
<td>- Stones are smooth, brick red colored, round and show lamination on cross section Q</td>
</tr>
<tr>
<td>- Management High fluid intake (most effective therapy) and Allopurinol Q</td>
</tr>
</tbody>
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<thead>
<tr>
<th>Indinavir</th>
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<tbody>
<tr>
<td>- A protease inhibitor used in AIDS patients, resulting in radiolucent calculi Q in 6% patients</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silicate</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Associated with long term use of antacids containing silicate Q</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Triacontane</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Antihypertensive medication, leading to radiolucent Q stones</td>
</tr>
</tbody>
</table>
2. Ans. c. Indinavir
3. Ans. d. Usually seen in acidic urine
4. Ans. b. Urinary stones (Ref: Campbell 10/e p1202-1203)

**RANDALL'S PLAQUES**
- Randall's plaques are soft tissue calcifications found in the deep renal medulla skirting the surface of the epithelium of the papilla, where they act as nucleating elements for renal calculi or stones.

5. Ans. a. Phosphate
6. Ans. a. Ethylene glycol (Ref: Smith 17/e p248)

**CALCIUM OXALATE CRYSTALS**
- Calcium oxalate crystals in the urine are the most common constituent of human kidney stones, and calcium oxalate crystal formation is also one of the toxic effects of ethylene glycol poisoning.
- Excessive oxalate may occur secondary to the accidental or deliberate ingestion of ethylene glycol (partial oxidation to oxalate). This may result in diffuse and massive deposition of calcium oxalate crystals and may occasionally lead to renal failure.

7. Ans. b. Phosphate

**RENA L AND URETERIC CALCULI CLINICAL FEATURES**

8. Ans. a. At pelvic brim (Ref: Smith 17/e p260-270; Campbell 10/e p1287-1288, 1371-1373; Bailey 26/e p1293, 25/e p1274, 1295-1300)

**RENAL CALCULI**
- Peak incidence 20-40 years, more common in males.
- Infectious stones are more common in females.
- For formation of stones, a period of abnormal crystalluria is required. Urine must be supersaturated with salt of the stone forming crystal (Supersaturation and crystallization).

**Clinical Features**
- MC symptom is pain.
- The severity of pain is not related to the size of the stone.
  - Stone in upper ureter or renal pelvis → pain referred to testis.
  - Stone in mid ureter → referred along iliohypogastric nerve to iliac fossa, mimicking appendicitis.
  - Stone in lower ureter → referred along ilioinguinal nerve to thigh, scrotum and perineum.
- Stone approaching bladder → bladder symptoms (frequency, urgency and dysuria).
- Stone in the intramural ureter → strangury.
- Drug of choice for ureteric colic is diclofenac (voveran).

9. Ans. b. At pelvic brim

10. Ans. c. Dietl's crisis (Ref: Bailey 26/e p1293, 25/e p1293)

**DIETL'S CRISIS**
- Intermittent hydronephrosis (Dietl's crisis): A swelling in the loin is associated with acute renal pain. Some hours later the pain is relieved and the swelling disappears when a large volume of urine is passed.

11. Ans. b. Increased peristalsis of ureter to overcome the obstruction (Ref: Smith's urology 17/e p31)
- The severity and colicky nature of ureteric colic pain are caused by the hyperperistalsis and spasm of smooth muscles of the ureter as it attempts to rid itself of a foreign body or to overcome obstruction.
# Pain from Acute Obstruction of Ureter (Stone or Blood clot)

- Ureteral pain is typically stimulated by acute obstruction (passage of a stone or a blood clot)\(^9\).
- Back pain from renal capsular distention\(^9\) combined with severe colicky pain (due to renal pelvic and ureteral muscle spasm)\(^9\) that radiates from the costovertebral angle down toward the lower anterior abdominal quadrant, along the course of the ureter.
- The severity and colicky nature of this pain are caused by the hyperperistalsis\(^8\) and spasm\(^8\) of this smooth muscle organ as it attempts to rid itself of a foreign body or to overcome obstruction.

<table>
<thead>
<tr>
<th>Stone in the upper ureter</th>
<th>Pain radiates to the testicle(^8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone in the middle ureter</td>
<td>Pain is referred to McBurney's point(^8) and simulate appendicitis on right side</td>
</tr>
<tr>
<td>Stone in the lower ureter</td>
<td>Pain is referred to inner side of thigh or groin (L1, L2)(^8)</td>
</tr>
<tr>
<td>Stones at the level of orifice</td>
<td>Symptoms of vesical irritability such as frequency and urgency(^8) may occur.</td>
</tr>
</tbody>
</table>

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## Oxalate Stones

- Oxalate stones are irregular in shape and covered with sharp projections, which tend to cause bleeding\(^8\).
- The surface of the calculus is discolored by altered blood\(^8\).
- A calcium oxalate monohydrate stone is hard and radiodense\(^8\).

---

## Renal and Ureteric Calculi Diagnosis and Treatment

**19.** Ans. a. PCNL (Ref: Smith 17/e p260-270; Campbell 10/e p1287-1283; 1371-1373; Bailey 26/e p1293, 25/e p1274, 1295-1300)

**Laboratory Investigations**

- Urine: pH, microscopic examination (RBCs, pus cells and crystalluria) and culture for splitting organisms
  - Acidic urine: CCU (Calcium oxalate, Cystine, Uric acid)\(^9\)
  - Alkaline urine: Calcium Phosphate, Struvite\(^9\)

<table>
<thead>
<tr>
<th>Crystal</th>
<th>Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium oxalate monohydrate</td>
<td>Dumbbell or hourglass(^9)</td>
</tr>
<tr>
<td>Calcium oxalate dehydrate</td>
<td>Enveloped or bipyramidal(^9)</td>
</tr>
<tr>
<td>Calcium phosphate (apatite)</td>
<td>Amorphous(^9)</td>
</tr>
<tr>
<td>Brushite</td>
<td>Needle shaped(^9)</td>
</tr>
<tr>
<td>Struvite</td>
<td>Coffin lid(^9)</td>
</tr>
<tr>
<td>Uric acid</td>
<td>Multifaceted, irregular plates or rosettes(^9)</td>
</tr>
<tr>
<td>Cystine</td>
<td>Hexagonal or benzene ring(^9)</td>
</tr>
</tbody>
</table>
Surgery Essence

Radiographic Investigations
- X-ray KUB:
  - 90% are radiopaque
  - Radiolucent stones (TITXU): Triamterene, indinavir, xanthine and uric acid
  - IVP:
    - Early films (AT 1 and 5 min for promptness of contrast excretion and any obstruction along urinary tract)
    - Delayed films (Identifies cause of delayed contrast excretion)

- Non-contrast spiral CT is the most sensitive investigation for renal/ureteric calculus.
- Retrograde pyelogram (RGP):
  - Better delineation of anatomy. Especially useful if distal ureter not visualized well.
  - Excludes unsuspected additional ureteric calculi and allows assessment of coexistent ureteric disease such as stricture, which may complicate the operative and post operative course.

Radionuclide Evaluation
- DMSA (Dimercaptosuccinic acid): Renal morphology (scar)
- DTPA (Diethylen Triamine Penta-acetic Acid): To assess perfusion (Effective renal plasma flow) and function (Total and differential GFR), less effective than MAG-3 for decreased renal function
- MAG-3 (Mercapto-acetyl glycine): Best for renal perfusion (Assess renal plasma flow)

- Metabolic workup should be done in young patients, with recurrent calculi, multiple calculi and in nephrocalcinosis, struvite stones, uric acid stones and cystine stones.

20. Ans. b. Uric acid

21. Ans. a. ESWL (Ref: Campbell 10/e p1302-1309; Bailey 26/e p1294-1296, 25/e p1297-1300)

The best treatment in this situation is PCNL. Since PCNL is not mentioned in the option, the best option is ESWL despite of size 2.5 cm, as it is preferred over other three for the management of renal stones.

Management of Renal and Ureteric Calculi

Indications of Conservative Treatment (for 4-6 weeks)
- Feature of stone likely to pass spontaneously
  - Single stone ≤ 5 mm
  - Stone in lower third of ureter
  - Ureter is undilated
  - Evidence of downward movement

Surgical Intervention
- ESWL (Extracorporeal shock wave lithotripsy)
- PCNL (Percutaneous nephrolithotomy)
- URS (Ureteroscopy)
- Laparoscopic stone surgery
- OSS (Open stone surgery)
- The majority (80-85%) of simple renal calculi are treated satisfactorily with ESWL.
- Rests are managed by PCNL/URS
- OSS is the least common treatment modality now days.

(Ref: Smith 17/e p269; Campbell 10/e p1595, 1645; Bailey 26/e p1294, 25/e p1299)

Indications of Open Stone Surgery

- Anatomic abnormality requiring open operative intervention (e.g. PUJO)
- Nonfunctioning kidney with stone (nephrectomy)
22. Ans. a. Calcium oxalate monohydrate (Ref: Smith 17/e p264-268; Campbell 10/e p1380-1381; Bailey 26/e p1294, 25/e p1298-1299)

- **ESWL (EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY)**

  - High energy shock waves are produced outside the patient's body, which are focused on stones with the help of fluoroscopy or ultrasound.
  - The change in density between the soft renal tissue and hard stone causes release of energy at the stone surface which causes compression induced tensile cracking of stones.
  - Incoming shock wave result in fragmentation of stones from erosion and shattering.
  - The stone fragments into small pieces and may pass down the ureter.
  - Strongest or Gold standard lithotripter for ESWL: Dornier unmodified HM-3.

- **Difficult (hard) stones for ESWL:** Brushite, Hydroxyapatite, Cystine, Calcium oxalate monohydrate (BHC-2)

**Factors responsible for decreasing the chances of stone free status**

Stone burden: Multiple stones >2 cm and staghorn calculi

(ESWL is best suited for stone <2 cm in renal pelvis or calyces with no distal obstruction)

Reduced clearance: Lower calyceal location, marked hydronephrosis or scarring, calyceal diverticulum or horseshoe kidney.

**Stone composition:**
- Difficult: Brushite, Hydroxyapatite, Cystine, Calcium oxalate monohydrate (BHC-2)
- Breakable: Uric acid, struvite, Calcium oxalate dihydrate

**Contraindications of ESWL**

<table>
<thead>
<tr>
<th>Absolute</th>
<th>Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnancy</td>
<td>UUT</td>
</tr>
<tr>
<td>Bleeding disorder</td>
<td>Unrelieved distal obstruction</td>
</tr>
<tr>
<td></td>
<td>Cardiac pacemaker</td>
</tr>
<tr>
<td></td>
<td>Severe orthopaedic deformity</td>
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<tr>
<td></td>
<td>Uncontrolled hypertension</td>
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<tr>
<td></td>
<td>Weight &gt;300 pounds</td>
</tr>
<tr>
<td></td>
<td>Severe renal failure</td>
</tr>
<tr>
<td></td>
<td>Aneurysm</td>
</tr>
</tbody>
</table>
- Prompt drainage of hydroureter is the single best option to manage uremia in this patient with bilateral renal calculi, to allow recovery of renal function at the earliest.
- Hemodialysis may be used afterwards if renal recovery is prolonged necessitating removal of waste products.
- Prompt drainage of hydroureter is the procedure of choice for hydroureter complicated with renal failure in the setting of urinary obstruction.
- Prompt drainage of hydroureter is indicated in renal function is compromised or urinary infection (UTI) is suspected, to preserve/salvage renal function.
- Prompt drainage can be achieved by placement of a ureteral stent or through percutaneous nephrostomy.
- The drainage procedure of choice in emergent situations is cystoscopy with placement of internalized double J ureteral stent. This procedure has the advantage of being a completely internal drainage system.
- Percutaneous nephrostomy may be used to allow urinary drainage if the stone is too impacted to allow passage of a guide wire for stent placement.

24. Ans. a. Hydrothorax (Ref: Smith 17/e p264-268; Campbell 10/e p1298-1299; Bailey 26/e p1294, 25/e p1298-1299; Schwartz 9th /1472)
- PCNL done through the 11th intercostal space traverses the lower aspect of pleura and can result in significant hydrothorax from large amount of irrigative fluid.

PCNL (PERCUTANEOUS NEPHROLITHOTOMY)
- Removal of kidney stone via a ‘track’ developed between the surface of the skin and the collecting system of the kidney.
- The posterior approach is most commonly used, through the posterior calyx rather than into the renal pelvis; as it avoids damage to the posterior branches of the renal artery, which are closely associated with the renal pelvis.

Indications of PCNL
- Obstructive uropathy (contraindication for ESWL)
- Large volume stone (>2 cm), staghorn calculi
- Other modalities failure (Ureteroscopic failure or ESWL failure)
- Lower pole calyceal stones
- Difficult (hard) stones for ESWL: Brushite, Hydroxyapatite, Cystine, Calcium oxalate monohydrate (BHC-2)

Complications
- Injury to other visceras like pleura, MC, colon, spleen
- Bleeding, urinary extravasation
- Retained fragments
- Sepsis

25. Ans. d. Stone in a calyceal diverticulum (Ref: Smith 17/e p264-268; Campbell 10/e p1298-1299; Bailey 25/e p1298-1299)

26. Ans. d. Ureteroscopic retrieval (Ref: Smith 17/e p268-269; Campbell 10/e p1407-1410; Bailey 26/e p1297-1298)

URETEROSCOPY
- Ureteroscopic stone extraction is highly efficacious for lower ureteric calculi.
- The use of small-caliber ureteroscopes and the advent of balloon dilatation or ureteral access sheaths have increased stone-free rates (66%-100%) dramatically.
27. Ans. a. Endoscopic removal (Ref: Campbell 10/e p1375-1379; Bailey 25/e p1295-1296, 1380-1381)

Proximal and mid-ureteral stones
- Stone ≤ 1 cm: ESWL is primary approach. Ureteroscopy is preferred in failed ESWL, distal obstruction or impacted stones.
- Stone > 1 cm: Ureteroscopy is primary approach. PCNL for large proximal stones or impacted calculi.
- Distal ureteral stones
- Stone ≤ 1 cm: ESWL and Ureteroscopy equally successful. Ureteroscopy is the primary approach.
- Stone > 1 cm: Ureteroscopy

Remember: For all ureteric stones, ureteroscopy is the primary approach except for 1cm proximal and mid-ureteral stones.

28. Ans. d. Ureteric obstruction due to fragments in ureter

29. Ans. b. Its use for uric acid stones has caused deaths due to generation of cyanide (Ref: Smith 17/e p130; Campbell 10/e p198-199, 1380-1391)

INTRACORPOREAL LITHOTRIPSY

Techniques
- Electro hydrolytic lithotripter (EHL)
  - Narrow safety margin, may damage ureteral mucosa but least expensive
  - Suitable for bladder calculi
- Successully fragments 90% of calculi
- Ultrasonic lithotripter
- Ballistic lithotripter
- Laser lithotripter (Holmium-YAG laser)
- Ho-YAG is the best laser source for intracorporeal lithotripsy, primarily through a photothermal mechanism that causes stone vaporization
- Most effective and versatile with good safety margin
- Fragments all stones regardless of composition. It can cut through the metal. So, caution must be exercised while using a basket.
- Potential side effect is production of cyanide when uric acid stones are treated. This has been reported in vitro. The clinical experience has suggested no significant cyanide toxicity
- Major disadvantage is initial high cost of the device and the laser fibers.

30. Ans. a. Cysteamine (Ref: Harrison 18/e p3221; Smith 17/e p249-254; Campbell 10/e p1296-1302; Bailey 25/e p1295-1300)

- Patient with cystinuria with multiple renal stones should be treated with increase urine volume (high fluid intake), alkalization of urine, Penicillamine and tiopronin.

31. Ans. d. Uric acid, e. Xanthine

RENSAL STONES

- Renal stones: 90% are radiopaque
- Radiolucent stones (TIXU): Triamterene, indinavir, xanthine and uric acid
32. Ans. c. 90° (Ref: Smith 17/e p261-262)

**IMAGING OF URETIC COLIC (CALCULUS)**

- A plain film of the abdomen and renal ultrasound examination will diagnose most stones.
  - Spiral CT (Non-contrast CT) has become the study of choice in emergent situations, as the entire urinary tract can be scanned rapidly and without contrast injection.
  - Calculi can be readily identified and distinguished from clot or tumor.
  - About 90% of calculi are radiopaque (calcium, cystine).
  - Excretory urography is necessary to verify their location within the urinary tract and also affords a qualitative measure of renal function.
  - An acutely obstructed kidney may show only increasing density of renal shadow without significant radiopaque material in calices.
  - A non-opaque stone (urate acid) will be seen as a radiolucent defect in the opaque contrast media.

33. Ans. d. Lower 1/3rd of ureter
34. Ans. a. Urine is always infected, b. Should be removed immediately
35. Ans. a. Uric acid
36. Ans. a. ESWL
37. Ans. a. High average intake
38. Ans. a. Uric acid stones are resistant to ESWL
39. Ans. b. Phosphate
40. Ans. a. Endoscopic removal
41. Ans. c. Renal stones (Ref: Bailey 25/e p1297; mededconnect.com)

**X-Ray KUB**

- Kidney stones should be looked opposite to second lumbar vertebra.
- In a lateral X-ray of abdomen gallstones are anterior and renal and ureteric stones overlap the lumbar spine.

**Opacities on a plain X-ray that may be confused with renal calculi**

- Calculus mesenteric LN
- Gallstones or concretion in the appendix
- Tablets or foreign bodies in the alimentary canal (e.g. cyclophosphamide)
- Osseous tip of the 12th rib
- Phleboliths: calcification in the walls of veins, especially in the pelvis
- Calcified tuberculous lesion in the kidney
- Calcified adrenal gland

42. Ans. d. Restricted calcium intake (Ref: Harrison 18/e p 1817; Smith 17/e p271)

A source of calcium at each meal may actually help prevent oxalate stones from forming as the calcium binds with oxalate in food and thus prevents the oxalate from being absorbed into the body.

**Dietary Modification in Stone Disease**

**Increase Intake of**
- Fluid
- Dietary calcium
- Potassium and phytates
- Vitamin C

**Decrease Intake of**
- Oxalate
- Animal protein
- Sucrose
- Fructose
- Sodium
Primary Bladder Calculi (Endemic Bladder Calculi)

- Mainly seen in underdeveloped countries (North Africa, Thailand, Burma, Indonesia), in pediatric age group.
- Most common in children <10 years, with a peak incidence at 2 to 4 years of age.
- Common in boys than in girls.
- Common in Rajasthan, Andhra Pradesh and some north-eastern states of India.
- Related to chronic dehydration and low protein, low phosphate, exclusive milk and high carbohydrate diet.
- Low phosphate diet increases urinary ammonium excretion leading to ammonium urate stones.

Diagnosis
- USG bladder: Identifies the stone with its characteristic shadowing and stone moves with changing body position.

Treatment
- Small stones: Removed or crushed transurethrally (Cystolitholapexy).
- Larger stones: Disintegrated by transurethral electrohydraulic lithotripsy or Cystolithotomy.

Primary bladder calculi rarely recur after treatment.

Secondary Bladder Calculi

- Most bladder stones are secondary, more common in older males (>50 years), usually because of bladder outlet obstruction.
- MC type: Uric acid (sterile urine) > Struvite stones (Infected urine)
- Bladder stones are usually solitary, multiple in 25% patients.

Etiology
- Bladder outlet obstruction (MC cause)
- Neurogenic bladder
- Foreign body (Foley’s catheter, forgotten DJ stents)
- Bladder diverticula

Clinical Features
- Typical symptoms are intermittent, painful voiding and terminal hematuria with severe pain at the end of micturition.
- Pain may be referred to the tip of the penis or to the labia majora.

Diagnosis
- A large percentage of bladder stones are radiolucent (uric acid).
- USG bladder: Identifies the stone with its characteristic shadowing and stone moves with changing body position.

Treatment
- Small stones: Removed or crushed transurethrally (Cystolitholapexy).
- Larger stones: Disintegrated by transurethral electrohydraulic lithotripsy or Cystolithotomy.