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1. Introduction

What is Urology?

Urology is a surgical specialty which deals with diseases of the male and female urinary tract and the male reproductive organs. Although urology is classified as a surgical specialty, knowledge of internal medicine, pediatrics, gynecology, and other specialties is required by the urologist because of the wide variety of clinical problems encountered. In recognition of the wide scope of urology, the American Urological Association has identified seven subspecialty areas:

1. Pediatric Urology
2. Urologic Oncology (cancer)
3. Renal Transplantation
4. Male Infertility
5. Calculi (urinary tract stones)
6. Female Urology (urinary incontinence and pelvic outlet relaxation disorders)
7. Neurourology (voiding disorders, urodynamic evaluation of patients and erectile dysfunction or impotence).
2. Organization

2.1. Teaching activities

Daily departmental activities are outlined in table below.

<table>
<thead>
<tr>
<th>Day</th>
<th>AM</th>
<th>PM</th>
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<tbody>
<tr>
<td></td>
<td>8-9</td>
<td>9-10</td>
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<tr>
<td>Saturday</td>
<td>Ward (A)</td>
<td>OT (B)</td>
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<td>Sunday</td>
<td>Ward (B)</td>
<td>OPD (A)</td>
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<tr>
<td>Monday</td>
<td>Ward (B)</td>
<td>OT (A)</td>
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<tr>
<td>Tuesday</td>
<td>Grand rounds (A+B)</td>
<td>Teaching</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Ward (A)</td>
<td>OPD (B)</td>
</tr>
</tbody>
</table>

A: team A; B: team B

2.2. What to do during urology rotation

The student should benefit from the different departmental activities. You should use your time as following:

- On Tuesday, attend the grand rounds, then the formal bedside teaching, then the presentation
- Attend the afternoon seminars and lectures according to the time table
- On your free time you are welcome to attend the operating theatre, clinic, ward rounds, ESWL and urodynamic rooms.
- Use the library to read about urology topics and read interesting articles in the urology journals like
  - Journal of urology
  - European urology
  - Urology
  - British journal of urology
• See the internet for urology sites like
  
  www.auanet.org
  www.uroweb.org
  www.uroportal.net/international/index.php
  www.emedicine.com/urology

• Go to the urology museum to see surgical instruments and catheters, interesting pathology specimens and train on models
• Spend time with patients in the ward and try to know all the tubes and catheters connected to them
• Do not hesitate to ask any member of staff for any help
• Think about a research topic and discuss it with a member of staff

2.3. Examinations

For the examination guidelines refer to the departmental manuals. However, questions will include:

• MCQ paper
  o Test the general knowledge in urology and the material presented in the lectures, seminars and student notes.

• OSCE
  o Test clinical knowledge including short clinical case to examine or take short history, instruments, tubes, ward patient care, x-rays, photographs and pathological specimens
3. Topics (curriculum)

The curriculum of the topics to be covered in urology includes the following:

- History and clinical examination
  - History taking in urological patient
  - Examination concentrates on abdomen including genitalia and PR
- Surgical anatomy of urology
- Emergencies in urology
  - Trauma
  - Renal colic
  - Urinary obstruction
    - Upper urinary obstruction (Acute renal failure)
    - Lower urinary obstruction (Acute urinary retention)
  - Hematuria
  - Torsion of testis (acute scrotum)
- Tumors
  - Malignant: kidney, bladder, prostate and testis
  - Benign: BPH
- Urinary stones
- UTI in adults and children
- Incontinence
- Erectile dysfunction
- Principles of renal transplantation
- Male infertility
- Scrotal swellings
- Pediatric urology
  - Undescended testis
  - Vesicoureteral reflux
4. Urology Notes

The following topics will be covered:

- Symptomatology
- Anuria
- Retention of Urine
- Haematuria
- Undescended testis (UDT)
- Testicular Torsion
- Testicular Tumours
- Congenital Anomalies of UT
- Urolithiasis
- Urological Trauma
- UTI
- Pyonephrosis
- Vesico-Ureteric Reflux
- Renal Tumours
- Neuroblastoma
- Upper Tract Urothelial Tumours
- Bladder Cancer
- Urinary Diversion
- Benign Prostatic Hyperplasia (BPH)
- Prostate Cancer
- Erectile dysfunction
- Endoscopy
- Renal Transplantation
- Uroradiography
- Laparoscopy
Symptomatology

(1) Pain

Analysis of pain includes:

- Site.  
- Character.  
- Reference (Radiation).

- Severity.  
- What ↑&↓.  
- Associated symptoms.

Q: What is the difference between Referred pain & Radiated pain?

- Referred pain: Pain felt in certain area as well as felt in another part supplied by the same dermatomal nerve supply with area of freedom in ( ) e.g. renal pain → testis
- Radiated pain: Pain felt in certain area as well as felt in another area supplied by the same dermatomal nerve supply without area of freedom in ( ) e.g. renal pain → epigastrium, Appendicitis → around umbilicus

*Site of pain:*

- Renal pain.
- Ureteric pain.
- Bladder pain.
- Prostatic pain.
- Testicular pain.
- Epididymal pain.

(A) Renal pain:

All types of pain can occur in kidney but the commonest are:

- Colicky pain (most common) (MCQ)
- Dull aching pain.

1- Dull aching pain:

due to distension of renal capsule.

_ e.g. _

- Acute inflammation of the kidney.
  
  - Bleeding in a cyst.
  
  - Peripheral renal tumour.
  
  - Renal abscess.
  
  - Acute hydrenephrosis.
Character:

Site: renal angle. - Refers to: hypochondrium.

- ↑ with: exercise. - ↓ with: analgesics (NSAID) & antispasmodics (Buscopan)

2- Renal colic:

Most common cause is stone. (MCQ)

Definition of colic:

spasmodic pain which occur in hollow viscous or tubular structure lined by smooth muscle due to contraction of these muscles in an attempt to get rid of an obstructing agent.

Character:

1) colicky pain in renal angle.
2) may radiate to epigastrium.
3) not related to posture (MCQ)
4) may be relieved by NSAIDs. (MCQ)
5) may be associated with nausea, vomiting & diaphoresis.
6) DD from pain in loin which is mostly due to radiculitis (post. nerve root) → in female (short & obese), related to posture. (MCQ)

(B) Ureteric pain:

1- Upper third: (T11 - L1 symp.)

   colicky pain similar to that of renal colic.

2- Middle third:

   should be differentiated from appendicitis on Rt side & diverticulitis on Lt side.

3- Lower third: (T12 - L2 symp.) (S2,3,4 parasymp.)

   most common causes are stones & stricture.

Criteria: As renal colic +

1) Referred to scrotal skin in male & labia major in female.
2) may be referred to tip of penis.
3) pain usually associated with irritative voiding symptoms (frequency, urgency)

(C) Urinary bladder Pain:
**Common causes**

1) full bladder (most important) (MCQ)  
2) cystitis.  
3) stones  
4) Malignancy

**Criteria:**

- Character: dull aching or discomfort.  
- Site: supra-pubic region.  
- Referred to: tip of penis.  
- Relieved by: evacuation of bladder in full bladder.

**(D) Prostatic Pain:**

may be acute or chronic.

**Acute pain:** - severe pain in the perineum.  
- associated with: 1) dyschasia (rectal dysentery)  
2) high grade fever.  
3) urine retention.

MCQ: Triad of acute prostatic pain?  
- e.g. acute prostatitis, prostatic abscess.

**Chronic pain:** - pain in perineum, lower abdomen, around anus, tip of penis.  
- age around 20-40 y.  
- due to chronic prostatitis.

(only complication is repeated UTI & is not perfectly treated medically)

**(E) Urethral Pain:**

- Causes: stone or inflammation.  
- Character: burning pain in urethra.

**(F) Testicular Pain:**

- Cause testicular sensation in syphilis; malignancy.

**(G) Epididymal Pain:**

- most common cause is epididymo-orchitis. (MCQ)
(2) Symptoms related to act of micturation

Include:

(A) Obstructive voiding symptoms:

Causes: - infra-vesical obstruction.
         - the commonest → elderly ♂ with BPH. (MCQ)

Criteria: (MCQ)
1) weak & narrow urinary stream.
2) difficulty → to initiate (Hesitancy)
         → to maintain (Intermittency)
         → to terminate (Post-micturition dribbling)
3) sense of incomplete voiding.
4) retention of urine (acute or chronic)

(B) Irritative voiding symptoms:

due to bladder & urethral irritation (Malignancy, cystitis, stone)

Criteria:
1) frequency → by day (Diurnal) "N. 3-5 times"
         → by night (nocturia) "N. 0 - 1 times"
2) burning micturition. (Scolding)
3) urgency: strong desire to micturate which can't be postponed, can't hold urine
         whenever desire develops.
4) urge incontinence: strong desire to micturate which can't be postponed and if
         postponed → involuntary escape of urine drops.

(C) Day & Night Incontinence:

e.g. 1) stress incontinence.
         2) urge incontinence (neurogenic, stone, cystitis, malignancy)
         3) Total incontinence as in → VVF (vesico-vaginal fistula)
4) Paradoxical incontinence (false): retention with overflow as in BPH & urethral stricture.

**Change in physical character of urine**

**(A) Volume:**
Normally — 0.5 - 1 ml / kg / h (800 - 1600 ml / day)

↓↓ volume (MCQ)
- $< 400$ cc / 24 h → oliguria (least volume to excrete toxic metabolite from the body)
- No urine / 12 h (with empty bladder) → anuria

**(B) Colour:**
- Normally → golden or amber yellow.
- Red urine → blood
  → haemoglobinuria, myoglobinuria, drugs (Rifampicin)

**(C) Aspect:**
- Normally → clear.
- Turbid urine → pyuria, proteinuria, chyluria, crystalluria
- Pneumaturia (air in urine) → UTI by gas forming organism, vesico-colonic or iliac fistula?

**(4) C.R.F symptoms:** (3A)

- Anemia (pallor) → Asthenia (weakness).
- Anorexia. → Headache.

**(5) GIT symptoms:**

e.g.renal colic with nausea & vomiting.
- pyelitis in newborn with gastroenteritis.
due to: - reno-intestinal reflex. - peritoneal irritation. - organ relationship.

(6) Metastasis symptoms:
- Brain  - Bone.  - liver  - lung.  - other kidney.  - others.

(7) Masses:
a) renal mass.
b) bladder mass
- full bladder is a cystic pelvi-abdominal swelling which you can't get below.
- palpation & percussion of the mass lead to desire for micturition.
- mass disappear after voiding.

(8) Sexual dysfunction:
- ♂ & ♀
- libido, erection, ejaculation, orgasm, infertility.

Anuria
* Def.: No urine excretion for 12 h. (MCQ)
       OR excretion of < 400 cc / 24 h (with empty bladder) = oliguria.
* Types: (Aetiology)
(1) Pre-renal causes:
       - shock (hypovolemic, septicemic, cardiogenic, neurogenic)
       - heart failure.
       - hemorrhage (hge).
N.B: MAP = DBP + ⅓ pulse pressure = 95 mmHg.
(2) **Renal causes:**

- due to bilateral renal disease (dse).

a) **Diseases:** - acute glomerulonephritis (AGN)
   - SLE.
   - PCK (polycystic kidney)

b) **Toxic:** - endogenous, (bile)
   - exogenous: NSAIDs, aminoglycosides (streptomycin), anti. TB (INH)

(3) **Post-renal causes:**

- obstruction → bilateral.
  → unilateral with solitary kidney.

- infiltration of both ureter by Mg. e.g cancer Cx. (MCQ)

- accidental ligation of both ureter e.g. during hysterectomy.

- stricture.

*Diagnosis:

**History:** of urinary stone. SLE, drugs.

**Symptoms:** - renal colic.
  - anuria.
  - uraemic symptoms: headache, drowsiness, lassitude, nausea, hiccough, constipation.
  - lastly, subnormal temperature, irregular breathing, muscle twitches → coma & death.

**Examination:**

- 1st exclude retention by percussion of bladder & catheter.

- uraemia (earthy look with acidotic breathing)

- palpation of kidney → ↑size of kidney.
  → tender → obstruction.

- P.V or PR to find Mg. Which is common cause of post-renal anuria.

- DD: from urine retention.
Investigations:

1) Laboratory:  
   - ↑ S. urea & ↑ creatinine (1st) (MCQ)
   - K & Na.
   - ABG → PH, O₂ saturation & HCO₃

2) Radiology:  
   - U/S → most important. 50 % of Diagnosis (MCQ)
   - Plain X-ray → stones.
   - C.T (±)

*Treatment:*

1- Pre-renal:  
   - tgt of the cause.
   - replacement therapy.

2- Renal:  
   - tgt of the cause.

3- Post-renal:  
   - Cystoscopic catheterization of both ureters.
   - PCN (Percutaneous Nephrostomy) if obstruction.
   - tgt of the cause.

4- Indications of haemodialysis:
   - HCO₃ < 12mEq/L.
   - Pulmonary oedema.
   - K > 7 mEq / L.
   - ECG changes.

**Retention of Urine**

*Def.:* inability to evacuate full bladder. (MCQ)

*Types:*

1- Acute retention: acute onset, complete retention & painful.

2- Chronic retention: gradual onset, may be with overflow & painless.

3- Acute on top of chronic.
(A) Acute retention

* Def.: sudden failure to pass urine although the bladder is full.

* AE: 1- Obstructive (mechanical):

  - bladder: BNO, stone & Tumors.
  - prostate: BPH (old age), abscess & carcinoma.
  - urethra: stone (adolescence), stricture, PUV (child)
  - pelvis: Tumors.

2- Functional (Neurogenic)

  a- spastic (sphincter) as in spinal anaesthesia.
  b- atonic (bladder) as in senility, spinal cord lesion, atropine.

3- Hysterical: common in females.

* C/P: - sever desire to micturate but he can't do.
  - severe suprapubic bursting pain which may be periodic.
  - full bladder on percussion.

(B) Chronic retention

* Def.: it's gradual distention of bladder with increasing the residual urine.

* AE: 1- Obstructive:

  - BPH, -BNO.
  - Cancer prostate.
  - stricture urethra.
  - ureterocele (common cause of urine retention in girls)

2- Neurogenic: spinal cord lesion.

* C/P: - history of the cause.

  - painless.
  - huge UB
  - no tenderness.
  - dribbling of urine (retention with overflow)
*Investigations:*

- Acute retention: endoscopy.
- Chronic retention: urodynamic study.

*Treatment:*

1- Hospitalization.
2- Conservative: - sedation with morphine.
   - hot fermentation on suprapubic region.
   - psychological help.
3- Catheterization:
   - Foley's catheter → If failed → Nelaton's cather → If failed → Percutaneous suprapubic puncture.
   - Catheter size → child (6 - 12 french)
     → adult (16-20 french)

**N.B:** Cancer Cx in female usually associated with retention of urine and not anuria.

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**Haematuria**

*Def.*: presence of > 3-5 RBCs / H.P.F in concentrated urine.

*Types:*

1- **According to the severity:**
   a) gross haematuria.
   b) microscopic haematuria (< 5 / H.P.F)

2- **According to the relation to the urinary system: (MCQ)**
   - initial → urethra.
   - terminal → bladder & post. urethra (Bilharz.)
   - total → kidney, ureter or bladder.

3- **According to the associated pain:**
- painful (e.g. stones)
- painless (e.g. renal & UB tumours)

4- True or false.

5- Factitious haematuria.

6- According to the origin.
- urologic: from peripheral calyces to external meatus.
- nephrologic: glomerular in origin.

* Aetiology:

1 - Urologic:  
  - trauma.
  - stones.
  - infection.
  - neoplasm.
  - BPH
  - iatrogenic.

2- Nephrologic:  
  - PSGN.
  - SLE.
  - Exercise haematuria.

3- Haematologic:  
  - hemophilia.
  - ITP.
  - DIC
  - sickle cell anemia.
  - V.W dse.

4- Exercise haematuria: e.g. long distance runner.

5- Factitious: vaginal bleeding.

6- Idiopathic: 20%

* Diagnosis:

A) History:

1- Age: a- child  → most common nephrologic cause → PSGN (MCQ)
  → most common urologic cause → UTI (MCQ)

  b- adult  → most common causes → stones & tumours. (MCQ)

  c- old age male → B.P.H. & cancer bladder (MCQ)

2- Sex: female → ask about menstruation.
- most common in female → cystitis. (MCQ)

3- Analysis of haematuria:

   a- Colour of haematuria:
      - smoky urine (coca cola colour) → PSGN

   b- Time of haematuria: (MCQ)
      - initial → urethral causes.
      - terminal → bladder causes.
      - total → kidney, ureter or bladder causes,

   c- Shape of blood clots:
      - discoid → vesical causes.
      - worm like → supra-vesical cause,

   d- Other symptoms:
      - frequency → diurnal → stone bladder.
        → nocturnal → BPH.
        → diurnal & nocturnal → cystitis.
      - pain → colicky → stone.
        → dull aching → inflammation.

   e- Past history of: - trauma. - drugs e.g. rifampicin - passage of stone

II) Examination:

A- General: - vital parameters: - Temp → infection.
                      - Hypertension → oedema LL.
                      - oedema LL: nephrotic syndrome.
                      - purpuric rash: ITP.

B- Abdominal:

      - renal masses: renal causes or hydronephrosis due to lower causes
      - full bladder: BPH.
      - cirrhotic liver: bleeding tendency.
**C- PR or PV:**

- bladder mass.
- BPH.
- cancer prostate.

**III) Investigations:**

**a- Laboratory:**

1- urine:
- urine analysis.
- urine cytology.
- urine culture.
- Zeihl Neelsen.

2- Blood:
- CBC.
- ASO titre.
- haematologic tests (Bleeding & clotting times)

**b- Imaging:**
- KUB X-ray.
- IVU
- Ascending cystography.
- Angiography.
- Abdominal U/S.
- CT

c- Endoscopy: cysto-urethroscope.

d- Renal biopsy.

**IV) DD:**

**a- Causes of red urine:**

- haemoglobinuria.
- myoglobinuria.
- food e.g. beet root

- Drugs e.g. rifampiein, adriamycin, metronidazole.

_N.B:_ Cyclophosphamide → haemorrhgic cystitis → haematuria.

**b- Causes of urethral bleeding.**

***TTT:**

1 - General measures: for shocked patient

→ IV fluids, blood transfusion, continues blood irrigation, ...

2- Definitive ttt of the cause.
Undescended testis (UDT)

*Embryology:
- seminefrous tubules → spermatogenesis.
  - sertoli cells → support.
  - interstitial cells of Leydig → Testosterone
- originate from the genital ridge.
- descends from the retroperitoneal space to scrotum guided by the
gubernaculum through the inguinal canal & takes 3 sheaths from it
- levels of descent of testis during intrauterine life:
  → int. inguinal ring → 7th month
  → inguinal canal → 8th month
  → scrotum → end of 8th month
- blood supply: (MCQ)
  Arterial: → testicular artery from aorta.
  → cremastric artery from inf. epigastric artery.
  → artery of the vas (inf. vesical from int. iliac)
  Venous: Pampiniform plexus → testicular vein.
    - Rt → IVC
    - Lt → Lt renal vein

* Incidence: - preterm → 30-38%
  - full term → 3-4%
  - at 1 year & adult → 0.8% (so it's surgically corrected at 1 y)
  - Familial → 4%

* AE:
- Causes of descent:
  1) gubernaculum contraction.
  2) ↑ growth of upper ½ of the body > lower ½
3) hormonal (FSH / LH)

4) ↑ intra-abdominal pressure.

- Causes of non-descent:
  1) defective gubernaculum.
  2) hormonal imbalance e.g. 1ry testicular dysfunction, gonadotrophic defect (usually bilateral UDT)
  3) short testicular artery.
  4) Inadequacy of inguinal canal.

*Types:

(A) Cryptoid:

true UDT → arrest of the descend of the testis at any station of its normal pathway of descent. (MCQ)

  most common → - external inguinal ring, (most common) (MCQ)
  - inguinal canal.
  - abdominal

(B) Ectopic:

presence of the testis at any site outside the normal pathway of descent.

Common in - superficial inguinal pouch (lat. to pubic tubercle)

  - base of the penis.
  - at other side of scrotum.
  - behind the bladder in pelvis.
  - in the thigh.

(C) Retractile:

  - it change its position in & out the scrotum.

  - descend when the body is worm & ascend with stress or cold weather due to stimulation of adrenaline & contraction of cremastric muscle.

*Diagnosis:

(I) Clinical: empty scrotum (unilateral or bilateral)
(II) Investigations:

a) Radiological:

- U/S → diagnose it in inguinal canal.
  → can't diagnose intra-abdominal testis due to gases in the intestine which
  obscure it.

- CT & MRI

- Laparoscopic.

b) Laboratory:

- FSH / LH

- to differentiate ( ) 1ry testicular dysfunction & gonadotrophic effect especially if
  bilateral UDT.

*Fate of UDT:*

(1) Deposition of collagen & fibrous tissue into the UDT → destruction of its
  parenchyma.

(2) Till the age of 4 years this leads to:

  a) ↓blood supply.

  b) impaired spermatogenesis.

  c) defect of testicular function.

  This will lead to complete destruction of testis at age of 10 years.

(3) Complicated by:

  a) Precancerous → cancer.

  b) Infertility → if bilateral UDT.

  c) Torsion.

*N.B: (MCQ)*

- Any acute abdomen with empty scrotum is considered as testicular torsion until proved
  otherwise.

- Any abdominal mass with empty scrotum is considered as testicular tumour until
  proved otherwise.
**TTT:**

(1) **Hormonal:**

→ pregnyl (gonadotrophin extracted from placenta)

→ good till 20% of cases esp. in bilateral UDT.

(2) **Surgical:**

Aim → descend of the testis.

→ dissect the vas.

If the testis are palpable:

→ one stage orchiopexy.

(± incision of post, wall of inguinal canal clipping the inf. epigastric artery)

If the testis are non-palpable (abdomen):

→ one stage orchiopexy. OR → 2 stage orchiopexy.

If the age of the patient is more than 10 years:

→ orchiectomy is a must, (to avoid cancer)

**N.B:** lymphatic drainage of the testis: (MCQ)

\[
\begin{align*}
\text{Rt testis} & \rightarrow \text{paracaval LN} \\
\text{Lt testis} & \rightarrow \text{paraaortic LN}
\end{align*}
\]

\[\rightarrow \text{interaorto-caval LN}\]

---

**Testicular Torsion**

(Surgical emergency)

* **Incidence:** - 1 / 4000.

- Age: commonest around 12 - 14 y. (MCQ)

* **Types:**

\[\text{(A) Neonatal Torsion}\]

- rare (axial torsion of testis over spermatic cord)
- **Diagnosis** → acute scrotal swelling.
  - DD → haematocele with birth trauma.
    → reducible hernia.

- **Prognosis**: very bad due to:
  - over-diagnosed
  - the affected testis dies within 6 hrs.
  - the other testis will be destroyed by the formed (Ab) due to recognition of the (Ag) of the ideal testis by immune system.

- **Incidence**:
  - At age of 12 - 14 y. due to ↑ size & wt of testis at adolescence with the presence of:
    a) narrow mesentery.
    b) capacious tunica vaginalis.
  - Common problem: if any acute scrotal swelling, after exclusion of acute epididymoorchitis (absence of fever, urinary symptoms) → testicular torsion should be suspected → surgery.

- **Mechanism**:
  Torsion of the testis within the tunica vaginalis either horizontal or vertical.

- **C/P**:
  - sever testicular pain with scrotal swelling.
    - Normal body temperature. → DD of epididymo-orchitis.
    - No urinary symptoms → DD of epididymo-orchitis.
    (orchitis usually start as UTI)

- **DD**: (Testicular swelling) (MCQ)
  - Acute epididymo-orchitis.
  - Haematocoele.
  - Scrotal hernia.
  - Hydrocele.
  - Varicocele.
- Trauma / insect bite.

- **Investigations:**
  1) urine analysis $\rightarrow$ ? pus.
  2) transillumination.
  3) Radio-isotope scan.

* TTT:

A) **Early:** (MCQ)
   1) Neonatal: Detorsion then orchiopexy on both sides.
   2) Pubertal: Manual detorsion while preparing the patient for surgery then orchipexy of both sides.

B) **Late:**
  Gangrenous testis $\rightarrow$ removed then orchiopexy on the other healthy side.

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**Testicular Tumours**

* **Etiology:** Unknown but there is predisposing factors:
  1) Congenital: undescended testis.
  2) Traumatic: horse riding trauma $\rightarrow$ so usually occur in high socioeconomic level.
  3) Inflammatory: viral orchitis (mumps)
  4) Hormonal: foetal exposure to maternal estrogen
  5) Racial: white Caucasians > blacks (may be HLA association)

* **Classification:**
  (A) Primary: $\rightarrow$ Germ cell tumours, (spermatogonia)
    $\rightarrow$ Non-germ cell tumours, (sertoli cell & interstitial cell of Leydig)
  (B) Secondary: $\rightarrow$ Leukemia.
    $\rightarrow$ Lymphoma.
    $\rightarrow$ Metastasis (prostate, GIT)
Germ cell Tumours

* Incidence: 90-95%

* Types: - Seminoma. 60 %
  - Non Seminoma 40 %

**Seminoma**

*Site:* - arise from seminiferous tubules in the mediastinum of testis. - it is adenocarcinoma.

*Characters:* - highly radiosensitive & chemosensitive.
  - it may secrete HCG (B-HCG).
  - age: 30 - 40 y.
  - seminoma metastases → 15 - 20 %

*Types:* 1- classic seminoma (85 %)'
  - 2-anaplastic seminoma (10 %)
  - 3- spermatocystic seminoma (5 %)

**Non Seminoma**

Characters: - resistant to radiotherapy but sensitive to chemotherapy.
  - Aggressive Tumour.
  - secrete HCG & α-feto protein.
  - age: 10-30y.
  - Non seminoma metastases → 70 - 75 %

Types: 1- Embryonal carcinoma 20 %
  2- Teratoma 5 %: - arise from embryonic totipotent cell in rete testis.
    - adult type (Mg) - children (Bg)
  3- Choricarcinoma: - 1 % - secretes HCG.
    - aggressive. - hematological spread.
  4 - Yolk sac tumour: - 1 % - secretes α-feto protein.
  5- mixed cell type: - 40 %
    - teratocarcinoma 25 %
**Diagnosis:**

(A) C/P:

a- symptoms: Asymptomatic (10 %) (painless swelling)

- symptomatic → dull aching pain. → acute pain (hge)
- metastasis symptoms → headache & blurring of vision.
  → cough, haemoptysis.
  → spontaneous fracture of bone.
- gynecomastia.

b- Signs:
- regular non tender swelling in scrotum.
- abdominal mass → retroperitoneal L.N.
  → Tumour in undescended testis.
- 2ry hydrocele.

(B) Complications:

1- Fungation & ulceration.
2- Infection & Hge.
3- 2ry haematocele.
4- Distant metastasis
5- Gynecomastia.
6- Cachexia.

(C) DD:

from other causes of testicular & scrotal swelling (hydrocele, haematocele, varicocele, hernia...... ect)

(D) Investigations:

1- For Diagnosis:

a- Laboratory: Tumour markers

  Def.: these are markers measured by radio-immune assay & are essential to monitor response to ttt. e.g. α-fetoprotein, β-HCG, LDH.

b- Radiology: - U/S -X-ray - CT

c- Pathological: open biopsy.

2- For Distant metastasis:

- Chest: plain X-ray. - Liver: abdominal U/S.

3- Pre-operative investigations:
- CBC. - ECG. - Kidney function. - liver function.

(E) Spread:
1- Direct: - rare.
   - epididymis, spermatic cord & scrotum.
2- Blood: LBLB (lung, bone, liver, brain)

3- Lymphatic:
- retroperitoneal L.N. → para-aortic L.Ns. → cysterna chyli → thoracic duct Virchow's gland.
- if epididymis is involved → internal iliac L.N.
- if scrotum is involved → superficial inguinal L.N.

(F) Staging:
Stage I: Tumour is confined to testis.
Stage II: retro-peritoneal L.N.
   IIa → L.N mass < 5 cm in diameter.
   IIb → L.N mass 5 - 10 cm in diameter.
   IIc → L.N mass > 10 cm in diameter.
Stage III: IIIa → L.N above diaphragm.
   IIIb → distant metastasis.

-TTT:
- Main operation is high inguinal orchietomy.
   (through inguinal incision → cord is ligated & divided at level of deep ring)

A) Seminoma: (Highly radio-sensitive)
- Stage I & IIa → orchietomy + Radiotherapy (2500 - 3000 rads)
- Stage IIb & IIc → orchietomy + Chemotherapy with 2 cycles of BEP
   (Bleomycin, Etopside & Paraplatine) or Radiotherapy.
- Stage III → orchietomy + * chemotherapy with 4 cycles of BEP.
OR * Radiotherapy.
OR * Rotroperitoneal L.N dissection.

B) Non Seminoma: orchiectomy +
- Stage I → surveillance (follow up) OR retro-peritoneal L.N dissection.
- Stage II a & b → chemotherapy (2 cycles BEP)
- Stage IIc & III → chemotherapy (4 cycles BEP)

N.B: Follow up by Tumour markers & C.T

-Prognosis: 5 year survival rate is:

<table>
<thead>
<tr>
<th></th>
<th>Seminoma</th>
<th>Non Seminoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I &amp; II</td>
<td>95%</td>
<td>90%</td>
</tr>
<tr>
<td>Stage III</td>
<td>80%</td>
<td>60%</td>
</tr>
</tbody>
</table>

N.B: Despite relatively early age of onset of cancer testis, this disease remains one of the most curable cancers in human.

Congenital Anomalies of UT

(1) Congenital anomalies of the kidney

1) Anomalies of No.:
   - unilateral renal aplasia. (renal agenesis)
   - bilateral renal aplasia. (incompatible with life)
   - super-numery kidney.

2) Anomalies of shape:
   - Lobulated kidney (persistent fetal lobulation).

3) Anomalies due to abnormal fusion:
   - S-shaped kidney.
   - L-shaped kidney.
   - Discoid shaped kidney.
   - Horse-shoe kidney (commonest)

4) Anomalies due to failure of communication:
- solitary renal cyst. - polycystic kidney.

5) Anomalies due to failure of migration:
- ectopic kidney

6) Anomalies in size:
- hypo‐plastic kidney. - hypertrophied kidney.

7) Anomalies of the renal pelvis:
- bifid pelvis. - double pelvis.

8) Anomalies of renal vessels:
- renal artery stenosis → renal HTN
- aberrant renal artery → hydronephrosis.

(II) Congenital anomalies of ureter:
- single ureter. - double ureter (common) (MCQ)
- post‐caval ureter. - congenital mega‐ureter.
- ureterocele.

(III) Congenital anomalies of urinary bladder:
1- Ectopia vesica (exstrophy)
2- Congenital anomalies of urachus: (MCQ)
   - urachal diverticulum.
   - urachal cyst.
   - urachal sinus.
   - patent urachus (fistula)
3- Congenital conatrure of bladder neck (Marrion's disease).
4- Congenital diverticulum.
5- Septate, Bipartite & Lobulated urinary bladder.

(IV) Congenital anomalies of urethra:
- Phimosis. - Paraphimosis.
- Meatal stenosis. - Urethral values.
- Congenital urethral diverticulum. - Hypospadius.
- Epispadius.

**Def.:** Congenital bilateral cystic changes of the kidney.

**AE:**
- It's due to lack of communication ( ) the ureteric bud & the metanephric mass resulting in fluid accumulation & cyst formation.
- It's a hereditary disease: (MCQ) → A.D: adult type (40 y)
  → A.R: infantile type

**Diagnosis:**
- Pain (dull aching or colicky)
- Bilateral renal mass.
- Anuria.
- Investigations: - IVU.
  → U/S → multiple cysts.

**Complications:**
- Haematuria → due to rupture of cyst.
- Polyuria → failure of kidney to concentrate the urine.
- Renal HTN → renal ischaemia → renin.
- Renal failure.
- Stone formation due to stasis & recurrent infection. (MCQ)
  → Malignant transformation.

**DD:** → from other renal swellings.
  1- Hydronephrosis. (Bilateral or unilateral)
  2- Renal tumour. (Wilm's tumour) (Bilateral)
  3-Multi-cystic kidney (Unilateral)

**TTT:** (MCQ) (moderation of life.)
I- Conservative:

- Control of HTN by salt restriction & antihypertensive.
- Urinary antiseptics to guard against infection.
- Correction of anemia.
- Dialysis → if renal failure occur.

II- Surgical ttt:

1- Rovsing operation:
By puncture of superficial cysts to minimize pressure atrophy.

2- Renal transplantation → if renal failure proves.

Bladder Exstrophy (Ectopic Vesica)

*Basic anatomy:

- No ant. Abdominal wall.
- No skeletal system development with pubic diastasis.
- Superficial bladder (not deep in pelvis)

*Incidence:

- 1 : 30000
- ♂ > ♀

*TTT:

Surgical Reconstruction of bladder.
- Proper age: 1st 3 days after birth. (MCQ)
- Extremely difficult.
So → many children tttd by urinary diversion.

Phimosis

*Def.: The contracted foreskin can't be retracted over the glans due to chronic infection. (MCQ)

*TTT
- Antibiotic (after taking swab)
- Slit incision.
- Later on → Circumcision.

**Para-phimosis**

*Def.:* Foreskin once retracted over the glans can't be placed again in its normal position.

(MCQ)

a- Early. - squeezing of glans.
- slit incision.
- circumcision.

b- Late: - dorsal slit incision at the constricting ring.
- antibiotic
- circumcision.

**Hypospadius**

*Def.:* (MCQ)

It's a common congenital anomaly in which the urethra open on the ventral aspect of the penis instead of the tip of penis.

*Incidence:* 1/300 ♂ children

*Aetiology:*

1- Glandular: due to failure of canalization of the glans.
2- Other types: due to failure of fusion of 2 urethral folds

*Pathology:*

Types:

1- glandular.
2- coronal.
3- distal, mid & proximal penile hypo.
4- peno-scrotal.
5- scrotal
6- perineal (severest type) (MCQ)

**N.B:** most common type → anterior type (distal)

**Pathological changes:**

- The ectopic meatus lies on the ventral aspect of the penis.
- The prepuce is not complete on the ventral aspect like a hood over glans (hooded prepuce)

**Complications:**

1- stenosed meatus.
2- ventral curving of the penis.
3- Infertility.
4- psychological problem.

**TTT:**

*age of repair* → most suitable time for repair is 6 m - 2 y
   (before the memory is formed) (MCQ)

**Types of operations:**

a) **Glandular hypospadius:**
   - MAGPI → Meatal Advancement & Glanuloplasty Incorporated.

b) **Other types:**
   - Snodgrass.
   - Mathieu (flip flap)

- **Elements of Repair:** (MCQ)
  1- Orthoplasty (straightening) of significant curvature of penis (30°)
  2- Meatoplasty & glanuloplasty.
  3- Urethroplasty.
  4- Skin cover.
  5- Scroto-plasty.
- Complications of Repair: (MCQ)

1- Bleeding.  
2- Haematoma.  
3- Infection.  
4- Fistula (commonest) (MCQ)  
5- Meatal retraction.  
6- Stenosis.  
7- Glanular breakdown.  
8- Residual curvature.

N.B (MCQ): The commonest congenital anomaly associated with hypospadius:

- UDT (9 %)
- Hernia (9 %)

**Epispadius**

*Def*: abnormal opening of urethra on the dorsum of the penis.

*Incidence*: rare anomaly → 1 : 30 000 ♂

*TTT*: Plastic construction.

**Posterior Urethral Value**

*(PUV)*

*Def*: congenital abnormal valve ( ) the post. & ant. Urethra.

*In* ♂ only

*Pathology :*

1- Hydronephrosis.

2- Vesico-ureteric reflux.

3- Bladder dysfunction.

4- ↓ renal function

*Investigation*

Voiding "micturating" Cysto-Urethrogram MCUG (Best Diagnosis) (MCQ)

*TTT:*
Endoscopic value ablation. 

**N.B:** (MCQ)

1- Definition of phimosis ........
2- Definition of paraphimosis ........
3- Commonest type of hypospadius is ......... (Distal)
4- Commonest associated anomalies with hypospadius are ........
   (UDT "9 %", Hernia "9 %")
5- The most common cancer associated with bladder exstrophy is ..... (adenocarcinoma)

**Renal Agenesis**

*Def.*: complete absence of one kidney.

*AE*: failed development or arrested ureteric bud.

*Usually* unilateral and associated with pulmonary hypoplasia.

**Diagnosis:**  - Routine pre-natal U/S.
   - Renal angiography (the only diagnostic method) (MCQ)

**Renal Hypoplasia**

*Def.*: small sized one kidney while the other is normal.

*AE*: unequal division of the meta-nephric mass.

*The only* presentation is Hypertension (MCQ)

*TTT*: Nephrectomy. (MCQ)

**Renal Dysplasia**

Multi-cystic changes of the kidney

*It's* the most common congenital disorder of the kidney. (MCQ)

*Def.*: Normal sized kidney but with impaired function. (MCQ)

*AE*: Failed communication of the renal tubules.
* Usually unilateral but if bilateral is called → polycystic kidney (MCQ)

*C/P: Renal mass.

*D.D: → from renal tumour by: 1- U/S.
2- C.T (more accurate) (MCQ)
3- Post-operative pathological study (the best)

*TTT: Nephrectomy. (MCQ)

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Ectopic Ureteric Orifice

*Normally: it opens at the posterior surface of the trigone 2.5 cm from the bladder neck.

*Complicated by: urine incontinence. (MCQ)

*It's associated with: kidney hypoplasia, So → its ttt is that of hypoplasia → Nephrectomy. (MCQ)

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Intra-mural ureter disorders

1- Congenital stricture:
Resulting in mega-ureter (dilated ureter due to stenotic lower end) → copra-head appearance. (MCQ)

2- Ureterocele:
- The commonest cause of urine retention in females. (MCQ)
- ♂:♀ = 1 : 4
- It's a cystic dilatation of the lower part of the ureter.

• Complications: - urine retention (→ ↑ cyst size)
  - stasis → infection & stone formation.
  - neurogenic bladder.

- TTT: Endoscopic transverse incision. (MCQ)
Pelvi-Ureteral Junction obstruction  
(PUJO)

*AE:*

1- From outside: abnormal blood vessel crossing over (commonest) (MCQ)
2- From inside: polyps or stones.
3- From the wall: stricture.

*Complications :* Hydronephrosis.

*Investigations:*
- U/S.
- IVP
- MRU (the best) (MCQ)
- Pre-operative retrograde imaging.

*TTT:* 1- Excision + Pyeloplasty. (MCQ) 
2- Re-anastomosis of the ureter to the renal pelvis.

Urolithiasis  
(Urinary stones)

*Mechanism of formation: *Unknown but theories:

1) Saturation of urine by salts:
- It depends on: - type of solute (concentration).
- PH of urine.
- Temperature.
- It's important to ↓ recurrence of stone by control of PH & solute.

2) Super-saturation:
   - Above saturation level.
   - due to absence of :
     - Inhibitors → inhibit stone formation (organic nephrocalcin, inorganic → Mg citrate)
- Complexing agents e.g. 
\[ \text{Ca} \] citrate
- Without nucleus formation.

3) Nucleation:
   - e.g. epithelial cells, urinary crystals, RBCs, WBCs, ......... .

4) Crystal formation:
   - PPT of additional salts on the nucleus.
   - 90 days \( \rightarrow \) 15 years to form significant stone

5) Crystal aggregation \( \rightarrow \) fragile.

6) Crystal retention:
   - factor \( \rightarrow \)↑ this retention.
   - due to:
     - pelvi-ureteric junction obstruction (PUJO)
     - medullary sponge kidney
     - UT obstruction.
     - Crystals & epithelial adhesion.

* Aetiology: (Predisposing factors)

(I) Pre-renal Causes:

1) Hypercalcemia
due to:
   - a- Idiopathic hypercalciuria (60%):
     - excess absorption of Ca from GIT (commonest)
     - excess excretion of Ca in urine
   - b- Hypercalciuric state (40%)
     - e.g. hyper-parathyroidism
     - hyperthyroidism (↑ bone catabolism)
     - Cushing syndrome
     - Paraneoplastic syndrome (PTH like) (Bronchogenic carcinoma, Renal cell carcinoma)
     - Multiple Myeloma \( \rightarrow \)↑Adrenalin (pheochromocytoma)
- Vit. D toxicity.

2) Hyper-oxaluria:

due to: 1. 1ry hyper-oxaluria (oxalosis): due to enzyme deficiency in liver →

↑ oxalate formation.

2. 2ry hyper-oxaluria (dietary): - ↑ intake

- ↑ absorption (in short bowel syndrome)

3) Hyperphosphaturia: - ↑ intake of proteins.

4) Hyper-uricosuria : in

- Gout & during ttt of leukemia.

- ↑ purine intake → Red meat liver

(adenine & guanine → xanthine oxidase → uric acid)

- lead to uric acid nucleus upon which oxalate will ppt.

5) Cystinuria: due to ↑ absorption.

6) Low citrate level: acidosis → ↓ serum citrate → hypocitraturia as citrate → ppt of ca as ca oxalate (MCQ)

(II) Renal Causes:

due to renal tubular necrosis → kidney fails to excrete H⁺ ions → alkalosis of urine (ppt of Ca phosphate) & acidosis of blood. (MCQ)

(III) Post-renal Causes:

- Infection. - Stasis of urine.

*Types of Stones

(1) Ca Oxalate stone:

- Commonest type. (60 %)

- Oxalate stone is hereditary. (MCQ)

N.B.: (MCQ) Character of stone in hyper-parathyroidism:

1-Radio-opaque. 2-Multiple. 3-Bilateral.
4- May be staghorn. 5- Recurrence.

(2) Ca Phosphate stone (10%):

- Usually in association with Ca oxalate. (10%)
- Pure phosphate stone are rare.(5%) due to renal tubular acidosis.

(3) Struvite stone (5-10%)

- Triple phosphate stone = Ammonium, Mg, Phosphate, Carbonate "CO₃"
- Infection stone (Mg, PO₄, NH₄ + CO₃) (MCQ)
- Formed by urea splitting organism: Proteus Mirabilis, Pseudomonas, Klebsiella. (MCQ)
- Mechanism: Urea → organism by urease enzyme in bacteria → ammonium (NH₄) + H₂O → alkaline urine → ppt of Mg, NH₄ & PO₄.

N.B. (MCQ): E-coli is the commonest organism of UTI but not form stone.

(4) Uric acid stone. (5-10%) Metabolic stone

(5) Cystine stone. (1%) Metabolic stone

(6) Xanthine stone → Radiolucent

(7) Matrix stone → soft gelatinous material in urine

N.B: (MCQ)

1- Most common stone is Ca oxalate.

2- Most opaque stone is Ca phosphate (as composition of bone)

3- Radiopaque stones (90%) → Ca phosphate, Ca oxalate, other Ca stone, Cystine (ground glass → least radio-opaque), Struvite.

4- Radiolucent stones (10%) → Uric acid stone (most radiolucent), Matrix stone, Xanthine.
**Pathology:**

* Composition of stone:

<table>
<thead>
<tr>
<th>1-No.:</th>
<th>Ca Oxalate stone</th>
<th>Phosphate stone</th>
<th>Uric acid stone</th>
<th>Cystine stone</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Single</td>
<td>- Single or Multiple.</td>
<td>- Multiple</td>
<td>- Multiple</td>
<td></td>
</tr>
<tr>
<td>2- Size:</td>
<td>- Moderate</td>
<td>- large</td>
<td>- Small</td>
<td>- small</td>
</tr>
<tr>
<td>3- Shape:</td>
<td>- Irregular</td>
<td>- Oval or stagehorn</td>
<td>- Oval faceted</td>
<td>-Oval</td>
</tr>
<tr>
<td>4- Surface:</td>
<td>- Spiky</td>
<td>- Smooth</td>
<td>-Smooth</td>
<td>- Smooth</td>
</tr>
<tr>
<td>5- Composition:</td>
<td>- Ca oxalate</td>
<td>- Ca phosphate</td>
<td>- Pure uric acid</td>
<td>- Cystine (sulphur containing)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Triple $\text{PO}_4$ → $\text{PO}_4$, $\text{Mg},\text{NH}_4$, $\text{HCO}_3$</td>
<td>- $\text{Ca}^{+2}$ urate</td>
<td></td>
</tr>
<tr>
<td>6- Colour:</td>
<td>- White</td>
<td>- Dirty white</td>
<td>- Yellow</td>
<td>-Yellow</td>
</tr>
<tr>
<td>7- Consistency:</td>
<td>- Hard</td>
<td>- Chaky friable</td>
<td>-Hard</td>
<td>-Hard</td>
</tr>
<tr>
<td>8- Cross section:</td>
<td>- Amorphous</td>
<td>- Laminated</td>
<td>- Amorphous</td>
<td>-Amorphous</td>
</tr>
<tr>
<td>9- X-ray</td>
<td>- Radio-opaque</td>
<td>- Radio-opaque.</td>
<td>- Pure → radio-lucent.</td>
<td>-Radio opaque due to sulphur</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Ca urate → Radio-opaque.</td>
<td></td>
</tr>
</tbody>
</table>


Site of impaction:

<table>
<thead>
<tr>
<th>Kidney</th>
<th>Ureter</th>
<th>U.B</th>
<th>Urethra</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- major &amp; minor</td>
<td>At site of normal constrictions.</td>
<td>- usually trigone.</td>
<td>1- post. urethra:</td>
</tr>
<tr>
<td>calyceal system.</td>
<td>1- pelvi-ureteric Junction.</td>
<td>- abnormal sites:</td>
<td>- prostatic.</td>
</tr>
<tr>
<td>2- pelvi-ureteric</td>
<td>2- where it is crossed by bifurcation of common iliac</td>
<td>1- diverticulum.</td>
<td>- membranous,</td>
</tr>
<tr>
<td>junction.</td>
<td>vessels.</td>
<td>2- over tumour.</td>
<td>2- penile urethra</td>
</tr>
<tr>
<td></td>
<td>3- vas d. (♂) &amp; broad lig. (♀)</td>
<td>3- intramural part</td>
<td>- intrabulbar fossa</td>
</tr>
<tr>
<td></td>
<td>4- where it enter wall of U.B.</td>
<td>of ureter.</td>
<td>3- glandula urethra</td>
</tr>
<tr>
<td></td>
<td>5- ureteric orifices.</td>
<td>4- over suture</td>
<td>- fossa navicularis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>material adherent to</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>wall.</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical picture:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Asymptomatic.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Symptomatic:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kidney</th>
<th>Ureter</th>
<th>Urinary bladder</th>
<th>Urethra</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Pain (renal colic)</td>
<td>- Pain (ureteric colic) radiate to labia majora or scrotum.</td>
<td>-Pain (dull aching or discomfort), supra-pubic &amp; refer to tip of penis.</td>
<td>- Pain (burning)</td>
</tr>
<tr>
<td>in loin &amp; may radiate to</td>
<td>- Haematuria.</td>
<td>- Haematuria.</td>
<td>- Haematuria.</td>
</tr>
<tr>
<td>epigastrium.</td>
<td>- Infection.</td>
<td>- Infection,</td>
<td>- Infection,</td>
</tr>
<tr>
<td>- Haematuria (common)</td>
<td></td>
<td>- Urgency &amp; Frequency.</td>
<td></td>
</tr>
<tr>
<td>- Infection → fever,</td>
<td></td>
<td>- Strangury.</td>
<td></td>
</tr>
<tr>
<td>headache, malaise &amp;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>anorexia.</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
*Complications: (HIMOM+R.F)

1- Haematuria: due to injury to mucosa.
2- Infection: pyonephrosis, pyelonephritis, pyelitis, cystitis.
3- Migration, repeated attack of colic.
4- Obstruction: hydronephrosis, retention or anuria.
5- Malignancy: due to chronic irritation.
6- Renal Failure.

*Differential Diagnosis:

a) Kidney stone: from radio-opaque shadow in Rt hypochondrium:
   - G.B stone.
   - F.B in intestine.
   - Calcified L.N.

b) Ureter stone:
   - Upper 1/3 : radio-opaque shadow in Rt hypochondrium.
   - Middle 1/3 : acute appendicitis(Rt), diverticulitis (Lt).
   - Lower 1/3 : other causes of stones.

*investigations :

A) Laboratory: 
   - urine analysis for: crystals (Struvite, Cystine), pus cells, RBCs, PH.
   - Kidney function test (creatinine)

B) Imaging: 
   - Plain X-ray: 90% of stone are radio-opaque.
   - U/S. - C.T

C. Endoscopy:
   - Cystoscope.
   - Urethroscope.
- Uretero-Pyelo scope.

*Treatment:

→ Medical (conservative)

→ ESWL.

→ Endoscopy.

→ Open Surgery.

*N.B*: Indication of interference:

1- Pain   2- Obstruction.  3- Infection.  4- Functional loss.

(I) Medical (conservative):

Aim:  - Spontaneous passage.

   - ↓ metabolic activity → ↓ stone recurrence.

Include:

1) Antispasmodic: e.g. buscopan.

2) Analgesic: up to morphia.

3) Antiseptic: to guard against infection.

4) ↑ fluid intake: esp. H₂O (3-4 litre / day)

5) Diet:

   - Ca containing stone → ↓ use of milk & milk products.

   - Oxalate stone → ↓ Tomato, Spanish, Mango, Strawberry, Coffee

   - Uric acid → ↓ Red meat, Liver, Coffee, Tea, Coca, Soup.

6) Drugs:

   - Ca oxalate stone → Vit. B₆ (pyridoxine)

   - Phosphate stone → Aceto hydroxamic acid (urease inhibitor)

   - Uric acid stone → Xanthine oxidase inhibitors (Allopurinol)

   - Cystine stone → D-penicillamine, Mercapto-propionyl glycine (Best), Acetyl cystein.

7) PH of urine:
1- Dilution of urine: slight alkalinization of urine.

2- Alkalinization of urine: in uric acid & cystein stone by potassium citrate

3- Acidification of urine: in Ca & PO₄ stone by vit.C.

_N.B.:_ Orange & Lemon (Citric acid) → produce alkalanization and not acidification as citric acid enters Kreb's cycle → HCO₃.

8) Chemolysis of stone:

1- Irrigation of the cavity for repeated time by drugs:
   a- Uric acid stone → - alkalinization of Urine. - Allopurinol.
   b- Cystine stone → - alkalinization. - MPG.
   c- Sturvite stone → -acidification, -antibiotic, -urease inhibitor (acetohydroxamic acid)

2- Only used to ↓ size & so spontaneous passage.

3- Indication → - bed ridden ptn. - unfit for surgery.

4- Not used in Ca oxalate.

(II) ESWL (Extra-corporeal Shock Wave Lithotripsy)

*_Def._ (Principle):

Non invasive disintegration of stone into small particles → for spontaneous passage.

**Indications:**

- site → ureteric (upper → 80-90%, lower → 60-80%) & renal stones (90%)
- size→ <1.5 cm.
- non impacted.

**Contraindications:**

Absolute: - distal obstruction. (MCQ)

Relative: - Bleeding tendency - HTN.
- Infection. - Pregnancy.

*Shock wave:

- Generator (Electro-hydrolytic, Electro-magnetic, Peizo elective US)
- Focusing.
- Coupling.
- Localization.

(III) Endoscopy (Intra-corporeal lithotripsy) (instrumental)

*Aim* : Stone extraction.

- Entoto = Mechanical.
- After disintegration → lithotripsy → compression.

   → lithotripsy = impaction by:
   - U/S waves.
   - Electro-hydrolytic.
   - Laser.
   - Pneumatic, (lithoclast)

**Indications:**

(A) Ureter:

1) Ureteroscopy:

Indication:

- distal ureteric stone.
- <2 cm.

C.I:

- absolute → bleeding tendency.
- big stone.
- associated dse e.g. BPH

Complication → Trauma

2) Ureteric catheterization.

3) Stone extraction by Dormia basket.

(B) Bladder:

1) Litholapaxy: (Trans-urethral)
mechanical compression of the stone using lithotrate then removal of the fragments.

2) Electro-hydrolytic lithotripsy.

(C) Kidney:

Nephroscope (PCNL) → Percutaneous nephrolithotomy.

- puncture under general anaesthesia.
- dilatation.
- Nephroscope stone extraction:  -  < 1 cm: mechanical by forceps or basket.
-    > 1 cm: disintegration.

(D) Urethra:

1) Posterior urethra: - push it back into U.B by any sound or catheter.
   - manage as bladder stone

2) Penile urethra: lubricated crocodile forceps.

3) Glandular urethra: lubricated artery forceps.

(IV) Surgical:

(A) Kidney:

Indications:  - Failure of previous lines of ttt.
  - Large staghorn stone.
  - stricture.
  - hydronephrosis.

Incision: flank incision

Technique:  - Nephrolithotomy.
  - Pyelolithotomy.
  - Partial nephrectomy.
  - Simple nephrectomy.

(B) Ureter:

Technique: Uretrolithotomy & Pyelolithotomy.

Incision:  - stone upper 1/3 → flank incision
( stone is best extracted by pyelolithotomy)
- stone middle 1/3 → Gibson incision (low subcostal)
- stone lower 1/3 → midline supra-pubic incision.

(C) Urinary bladder:

Technique: Cystolithotomy

Indications: (= C.I. of instrumental ttt)
- distal obstruction → BPH.
- infection → urethritis, cystitis.
- large stone > 3 cm. → multiple stones.
- too hard stone. → too soft stone.
- failure of crushing. → in children.

(E) Urethra:

Posterior urethra:

Supra-pubic cystolithotomy for stone firmly impacted supported by urethral dilator & removed trans-vesical.

Penile urethra: External urethrotomy

Glandular urethra: External meatotomy.

N.B.: (MCQ)
- Ca oxalate stone is ppt in neutral PH.
- Ca phosphate & Struvite stones are ppt in alkaline PH.
- Cystine & Uric acid stones are ppt in acidic PH.
- Citrate inhibit ppt of Ca.
- Mg inhibit ppt of oxalate.
- Pyrophosphate inhibit ppt of phosphate.
- Hper-oxaluria is an inborn error of metabolism of glycine.
- Hard stones: - Ca oxalate monohydrate stone.
  - Cystine stone.
  - Some types of uric acid stone.
Urological Trauma
(Injuries)

(I) Renal injury

N.B. Kidney is protected by thoracic cage.

*Aetiology:

a- Predisposing factors:

1- enlarged kidney (hydronephrosis)
2- Fracture ribs / vertebrae.
3- ptosed kidney.

b- Precipitating factors:

1- blunt trauma: (commonest 85%)
   e.g. motor vehicle accident, falling from height.
2- penetrating renal trauma: e.g. Gunshot, stab wound.
3- spontaneous rupture due to minor unnoticed trauma.

Grading of renal injury: (MCQ)

G. I: Minor trauma → contusion → subcapsular haematoma with no parenchymal laceration (may produce haematuria)

G. II: Renal haematoma + parenchymal laceration < 1cm.

G. III: Parenchymal laceration > 1cm but not reaching pelvicaliceal system.

G. IV: laceration reaching pelvicaliceal system → urinoma around the kidney + thrombosis of the main renal vessels.

G. V: Multiple renal injuries (shuttered kidney) or avulsion of renal vessels.

N.B.: GI,II → minor trauma.

GIll, IV, V → major trauma

*C/P:

I- History of Trauma.
II- General Examination:

1- shock (hemorrhagic or neurogenic)
2- haematuria (95%)
3- anuria. (in severe cases)

III- Local Exam-

1- marked tenderness & rigidity in the hypochondrium & lion
2- Swelling in the lion due to pseudo haemato-hydronephrosis
3- shifting dullness in cases of int. hge.

IV- Picture of complications. ,

*Complications: (MCQ)

I- General: 1- shock. 2- injury to other organ.

II-Local:

1- pseudo haemato-hydronephrosis. 2- 2ry hge
3- infection → peri-nephric abscess. 4- renal failure
5- hypertension. 6- renal atrophy
7- renal artery stenosis. 8- renal calculi

Investigations:

1- urine analysis (1st) (MCQ)
2- Plain X-ray: show →
   - Fracture lower ribs.
   - Scoliosis of vertebra .towards injured side.
   - Blurring of psoas shadow by the perinephric haematoma
3- I.V.P: it can show urine extravasation but can't show extent of haematoma & laceration.
4- U/S: It can detect injury, its type & extent.
5- C.T scanning: (the best) (MCQ),
   show → - parenchymal lesion.
   - urine extravasation, (indicate IV & V)
- lack of contrast uptake suggest renal artery injury.
- associated injury of other organs.

6- Arteriography:

can detect any renal vessel injury & localize the arterial bleeding which can be controlled by embolization.

*Treatment:

(A) **Conservative ttt:** (98% of cases) (MCQ)

1- Hospitalization (if with haematuria)
2- Bed rest.
3- Antibiotic.
4- I.V fluids.
5- follow up by (U/S, Hb %, HCV)

(B) **Operative ttt (surgical):**

**Indications:**

A).Absolute: (MCQ)

Persistent renal bleeding → expanding perirenal haematoma.
→ pulsatile perirenal haematoma.

B) Relative: - non viable tissue.
- incomplete staging (by imaging)
- segmental artery injury.
- extensive urine extravasation.

**Technique:** It depend on type of injury

- Tear → suture.
- Destruction amputation of one pole → partial nephrectomy.
- Pulped kidney or Avulsion of the renal pedicle (vessels) → nephrectomy.
*Aetiology:*

1- External penetrating trauma. (Rare)

2- Surgical (operative) trauma (iatrogenic) "Commonest" (MCQ) esp. → hysterectomy, CS, colorectal injury.

3- Instrumental injury → Endoscopic stone extraction.

4- Radiation injury.

*C/P:.

- History of trauma.   - Renal pain & fever.
- Haematuria.    - Anuria if bilateral.

*Investigations:*

1-U/S.   2- IVU.     3- Ureteric catheterization

4- Retrograde / Antegrade urography             5- CT.

*TTT:*

(A) Early recognition:

at operation room or within 7 days of injury →

- Exploration.
- Remove ligature.

(B) Late recognition: (MCQ)

- PCN. (Percutaneous nephrostomy)
- Retrograde Catheterization.

1 - Upper ⅔ :  - < 1 cm → end to end anastomosis.

   - > 1 cm →  - Transuretero-ureterostomy.

   - Ileal seg. Replacement.

   - Auto-transplantation.

2- Lower ⅓:  - < 1 cm → Re-implantation of ureter in bladder with psoas hitch.

   - > 1 cm —> - Bladder flap & attached to ureter.

   - Ileal seg. Replacement.
**Aetiology:**

1- Blunt trauma:
   
a- Direct: blow or kicks in the suprapubic region.

   b- Indirect: fracture pelvis, (most common in extra-peritoneal type) (MCQ)

2- Penetrating trauma: stab, gun shots & instrumentation.

3- Spontaneous rupture of diseased U.B.

**Pathology:**

There are 3 types of rupture:

1- Extra-peritoneal rupture (65%) → urine leakage to inferior & lateral side to UB

2- Intra-peritoneal rupture (25%) → urine leakage above bladder.

3- Combined. (10%)

**C/P:**

<table>
<thead>
<tr>
<th>Extra-peritoneal type</th>
<th>Intra-peritoneal type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- History of trauma.</td>
<td>- Severe trauma (run over accident)</td>
</tr>
<tr>
<td>2- Shock.</td>
<td>- Marked.</td>
</tr>
<tr>
<td>3- Pain &amp; tenderness.</td>
<td>- Pain &amp; tenderness is suprapubic which remain localized for long time then spreads up to the abd. wall.</td>
</tr>
<tr>
<td>4- Desire of micturation.</td>
<td>- There's intense desire for micturation but the ptn can't void urine.</td>
</tr>
<tr>
<td>5- PR</td>
<td>- Soft swelling around the prostate &amp; bladder.</td>
</tr>
<tr>
<td>6- Catheterization.</td>
<td>- Show small amount of urine &amp; blood.</td>
</tr>
<tr>
<td></td>
<td>- Abdominal trauma.</td>
</tr>
<tr>
<td></td>
<td>- Mild.</td>
</tr>
<tr>
<td></td>
<td>-Suprapubic pain &amp;tenderness which soon become generalized in the abdomen (peritonitis)</td>
</tr>
<tr>
<td></td>
<td>- No desire for micturation</td>
</tr>
<tr>
<td></td>
<td>- Feel extra-vasated urine as fullness in the recto-vesical pouch.</td>
</tr>
<tr>
<td></td>
<td>- Show small amount of urine &amp; blood.</td>
</tr>
</tbody>
</table>
**Complications**

1- Shock & Hge.
2- Peritonitis in the intra-peritoneal type.
3- Pelvic abscess in extra-peritoneal type.
4- Associated injuries e.g. rupture urethra.

**Investigations:**

1- Plain X-ray show fracture pelvis.
2- Abdominal U/S.
3- IVU → show leakage of dye from the bladder. called tear drop sign
4- Static cystography → 100% accurate D. (MCQ)
5- C.T cystography → 100% accurate.

**TTT:**

I) **Emergency ttt:** correct hge & shock.

II) **Extra-peritoneal rupture:**

   (1) Urethral catheter drainage → 'Tear will close within 10 - 14 days.

   (2) Open surgery & Injury repair:

      **Indications:**

      1- failed conservative ttt (no healing > 10 days)
      2- Bone fragment projecting in the bladder.
      3- Extension of tear to bladder neck (Incontinence)
      4- Rectal perforation.

      **Technique:** Trans-vesical approach.

III) **Intra-peritoneal & combined injury:**

   - No conservative ttt because the urine in peritoneal cavity can lead to peritonitis
   - line of ttt → Exploration & Repair.

IV) **Fracture pelvis: External fixation.**

V) **Post-injury management:**
1- Prophylactic antibiotic.
2- Follow up by cystography.

**Posterior Urethral injury**

*The tear at the junction ( ) prostatic & membranous urethra.

**Aetiology:**
1- Direct trauma: - kick or falling astride on hard object.
   - Instrumental injury.
2- Indirect trauma: Fracture pelvis (most important) (MCQ)

**C/P:**
- History of trauma/ pelvic fracture.
- Classical triad (50% of cases):
  1- Blood at urethral meatus (most common) (MCQ)
  2- full bladder.
  3- Inability to void.
- Inability to pass a urethral catheter.
- DRE → - pelvic haematoma.
   - highly riding prostate.

**Investigations:**
1- KUB → fracture pelvis.
2- Retrograde urethrography (MCQ) → contrast dye from fossa navicularis.

**Types of rupture:**
1- Complete → no dye to the U.B.
2- Partial → dye reaches U.B.
   But it is difficult to differentiate both on urethrography.

**TTT:**
1- Emergency ttt → for shock & hge.
(2) **Conservative:**

- Supra-pubic cystostomy tube + delayed reconstruction.
- It's the 1st step management with post, urethral injury.

(3) **Immediate realignment:** (Not done now)

- means insertion of a stent for suturing of the ends.
  
a) **Direct (open) suture realignment:**
  
  but is complicated (in 50 - 80 %) by:
  
  - bleeding.  
  - impotence.  
  - incontinence.

b) **Indirect (endoscopic) realignment:**

  either → try to pass a catheter (16 F.)

  if failed → endoscopic & catheter insertion either antegrade or retrograde.

(4) **Delayed reconstruction:**

**Timing:**  
3-12 month after injury for:

- chance for associated injury to heal.
- scar tissue is mature.
- ptn is ambulatory & can be placed in lithotomy.

**Preoperative evaluation:**

combined study cystography & urethrography to show the tear.

**Management options:**

A) **Endoscopic:**

- visual internal urethrotomy.

- if short stricture → guide wire can pass.

B) **Surgical:**

- If long stricture → no guide wire pass.

  - By → Resection re-anastomosis.

  - Staged repair.

**Complications:**

- Impotence → 15- 30%

- Incontinence → < 5%
- Stricture → 50 - 65% (commonest)

### (VI) Anterior urethral injury

*Rare* → only 10% of lower UT injury & almost always isolated (no other lesion)

**Aetiology:**

1. Straddle injury (fall down with abducted legs over sharp object) common (MCQ)
2. Direct blunt trauma to penis.
3. Penetrating trauma e.g. gunshot, stab wound

*C/P:*

- History of trauma.
- Classical triad, (as before)
- Haematoma in penis, scrotum, perineum.
- Bleeding per urethra.
- Acute retention of urine for short duration due to sphincter spasm.

**Complications:** (< 5%)

- Impotence  
- Incontinence.
- Stricture. → common → visual urethrotomy.

**Investigations:**

- Retrograde urethrography.

**TTT:**

2. Conservative: suprapubic cystostomy + delayed reconstruction.

**N.B.** (MCQ)

1- Diagnostic sign of pelvic fracture & urinary bladder injury is Haematuria.
2- Definitive diagnosis of bladder rupture is Cystography.

3- Appropriate therapy for intraperitoneal bladder rupture is formal surgical repair + Catheter.

4- Extra-peritoneal rupture bladder is treated by urethral catheter drainage.

5- Diagnosis of rupture urethra best made by Retrograde urethroscopy.

6- Ptn with complete anterior urethral injury + extensive perineal haematoma is best treated by suprapubic cystostomy + delayed repair.

---

Suspected Urological Trauma / injury

No Blood at urethral meatus  Blood at urethral meatus

↓

pass urethral catheter  Retrograde urethrography

↓

No haematuria  Haematuria (gross or M/E)

↓

Observation  CT or IVP to exclude upper U.T trauma (Kidney or ureter)

→ 2 films cystography:

↓

Urethral rupture  Suprapublic cystostomy tube + delayed reconstruction

No Extravasation  Extravasation

↓

Observation

Extraperitoneal  intraperitoneal

↓  ↓

- Catheter drainage  - Surgical repair

- Surgery
UTI
(Non specific UTI)

*Incidence:
- It's a very, important problem as it's very common.
- Sex: more common in females than males due to:
  1) Short urethra.
  2) Multiple events of infection which include:
     - sexual act.
     - menstruation.
     - labour & puerperium.
  3) Commensal:
     Bacteria on perineum which may lead to infection in cases of defective local immunity & change of mucous membrane of urinary tract.

-Age: Peaks of UTI in ♀ life:
- Neonatal. - at school entry.
- puepertal.
- pregnancy.
- marriage (honey moon cystitis)

Aetiology:
I- Causative organism:
- Escherichia coli (the commonest) (MCQ)
- Pseudomonas, strept. faecalis, staph. aureus & chlamydia.
- Parasites:  - S. haematobium & sometimes mansoni.
- entrobius vermicularis (oxyrius) (pin worm)
- trichomonas vaginalis.

II- Rout of spread:
- Ascending infection → the commonest (MCQ)
- Haematogenous spread.
- Lymphatic spread from colon.

**III- Predisposing factors:**

1- General factors: D.M

2- Local factors: - stasis - stone or F.B
    - excess coitus - catheterization

**Pathology:**

There's diffuse oedema & congestion of the pelvi-calyceal system, renal parenchyma, urinary bladder & urethra.

**C/P:**

1- Acute Pyelonephritis:

   a- General: (FHMA)

   Fever (with rigors), Headache, Malaise & Anorexia,

   b- Local:

   - Pain in the lion & hypochondrium. (dull aching pain)
   - Marked tenderness in renal angles.
   - Rigidity in hypochondrium.
   - Pyuria → passage of turbid urine.

2- Cystitis:

   - Pain → suprapubic, burning & referred to the tip of the penis.
   - Frequency: marked day & night.
   - Strangury (bladder tenesmus) → sense of incomplete evacuation.
   - Pyuria : passage of turbid urine.
   - Haematuria.

3- Urethritis:

   - Urethral discharge without micturation & without sexual excitation.
   - Usually sexual transmitted except:

     - urethral diverticulum (retained urine → infection)
- Reiter's syndrome → conjunctivitis, urethritis, knee joint synovitis.

- It may be:
  - Acute with copious secretion & needs no investigation to diagnose it
  - Chronic → morning drop with squeezing the urethra → culture.

**N.B: Prostatorrhea:**
- Not an infection.
- It means secretion with the urine after straining esp. with constipation.
- Needs no ttt.

**Complications:**
1. Chronicity → chronic pyelonephritis, chronic cystitis, chronic urethritis.
2. Toxaemia, septicemia, pyaemia.
3. Irty pyonephrosis.
4. Perinephric abscess.

**DD:**
From other causes of fever with rigors e.g. cholangitis, breast abscess, malaria.

**Investigations:**
a- Laboratory: - CBC
  - Urine analysis, culture & sensitivity test, (most accurate) (MCQ)

b- Radiology: - IVP - U/S

c- Endoscopy: cystoscopy.

**TTT:**
1. High water intake.
2. Change of PH of urine:
   - Mg citrate to alkalize acidic urine & Vit.C to acidify alkaline urine.
   - OR → in acidic PH e.g. E-coli → alkanization by NaHCO₃
      → in alkaline PH e.g. staph & proteus (urea splitting organisms) → acidification by Vit.C (ascorbic acid)
3- **Broad spectrum antibiotics:**

- Co-trimoxazole (septrin) \(\rightarrow\) E-coli.
- Metronidazole \(\rightarrow\) trichomonas vaginalis.
- Doxycyclin \(\rightarrow\) chlamydia.
- Praziquantel \(\rightarrow\) Bilharzia.
- Penicillin \(\rightarrow\) Gonorrhoea.

4- **TTT of ppt factors.**

**N.B:**

Defensive mechanisms against infection are:

a- unidirectional patency of urinary tract.

b- continues (unobstructed) flow of urine (regular act of micturation)

c- secretory IgA.

d- PH of urine.

e- high osmolarity of urine.

f- urothelium: - thick & difficult to penetrate.

- difficult of adherence of bacteria.
- uromucoid particle.

---

**Pyonephrosis**

*Definition:*

- Septic dilatation of the pelvicalyceal system due to obstruction & infection.

- Lastly, the kidney is transformed into a bag of pus.
**Aetiology & Pathology:**

<table>
<thead>
<tr>
<th></th>
<th>1ry pyonephrosis</th>
<th>2ry pyonephrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1-AE:</strong></td>
<td>coincidental infection &amp; obstruction.</td>
<td>infection of hydronephrosis.</td>
</tr>
<tr>
<td><strong>2- Size:</strong></td>
<td>doesn't reach big size due to fibrosis.</td>
<td>huge size</td>
</tr>
<tr>
<td><strong>3- Pelvis:</strong></td>
<td>not dilated &amp; thick wall.</td>
<td>dilated &amp; thin wall.</td>
</tr>
<tr>
<td><strong>4- Prognosis:</strong></td>
<td>bad.</td>
<td>good when obstruction is relived.</td>
</tr>
</tbody>
</table>

**C/P**

1- **General:** FHMA → fever, headache, malaise & anorexia.

2- **Local:**
   - Mass → in 2ry pyonephrosis
   - Pain & tenderness → loin & hypochondrium
   - Rigidity → in hypochondrium
   - Pyuria → intermittent
   - PR → to exclude BPH

**Complications:**

1- Toxaemia, septicemia & pyaemia.  
2- Descending infection

3- Stone formation.  
4- RF if bilateral.

**Investigations:**

1- Urine analysis.  
2- Kidney function test.  
3- Plain X-ray.

4- U/S.  
5- IVU.  
6- Cystoscopy

7- Renal isotope scan.

**DD:** From other renal swellings.

**TTT:**

1- **Unilateral cases:**
   a- If the diseased kidney is still functioning → ttt the cause
   b- If the diseased kidney is non-functioning → nephrectomy.

2- **Bilateral cases:** Nephrostomy →
- If the function improves → ttt the cause.
- If the function doesn't improve → dialysis till renal transplantation is available.

Hydronephrosis

*Definition:

Aseptic dilatation of the pelvicalyceal system due to obstruction at or distal to the pelvi-ureteric junction.

*Aetiology:

A) Acute hydronephrosis: Ureteric obstruction due to:

- stone.
- blood clot.
- ligature (iatrogenic).
- fungus ball.

B) Chronic hydronephrosis:

1) At the level of the kidney:

- Congenital: pelvi-ureteric junction obstruction (PUJO).
- Inflammatory: urinary TB.
- Calcular: stone in the renal pelvis.

2) At the level of the ureter:

- Congenital: PUJ, vesico-ureteric reflux (VUR), ureterocele, ectopic ureter orifice.
- Inflammatory: TB, Bilharzia.
- Neoplastic: - Internal → ureteric tumour.
  - External → retroperitoneal fibrosis.
- Calcular: the most common.

3) At the level of the bladder:

- Congenital: bladder neck obstruction (BNO), neurogenic bladder.
- Inflammatory: T.B, Bilharzia.
- Neoplastic: bladder tumour.
- Calcular: stones.

4) **At the level of the urethra:**

- Congenital: post. urethral value, meatal stenosis.
- Inflammatory: gonorrhoea & T.B
- Neoplastic: tumours.
- Calcular: stones.
- Traumatic: stricture urethra.

*Pathologysiology of chronic obstruction:*

Kidney: - RBF:

- U.P: transient ↑ then return to normal once equilibrium has been reached.

Ureter & Bladder: - Stage of compression: muscle hypertrophy.
- Stage of de-compensation: atony.

*Diagnosis:*

(A) **Acute obstruction: (as D of renal stones)**

- History.
- Clinical examination: (Renal colic)
- Investigations: Laboratory: 1-urine analysis. 2-serum creatinine.
  Radiological: 1- KUB 2-U/S 3-IVP 4 Spiral C.T

(B) **Chronic obstruction:**

- History.
- Clinical examination: (Renal mass)
  - mass in hypochondrium & lumbar region,
  - cystic. - firm.
  - move up & down with respiration. - ballotable.
  - available insinuation of the hand. - no notch
  - Complaint: - dull aching pain. - renal mass.

- Investigations:
1-KUB  2-U/S  3-IVP
4- C.T  5- MRI  6- Diuretic renogram.
7- Ante & Retrograde pyelography.

**Complications:**

- Infection.
- Hypertension.
- Renal failure.

**1TTT**

**1- Unilateral cases:**
- If the kidney is still functioning → ttt the cause.
- If the kidney not functioning → do nephrectomy.

**2- Bilateral cases:**
Do → nephrostomy till the kidney function improves:
- If the function improves → ttt of the cause.
- If the function doesn't improve → maintain nephrostomy & prepare for renal transplant.

**N.B.:** Hydronephrosis is the most common abd. mass in children

---

**Vesico-Ureteric Reflux (VUR)**

*In child with UTI:*  
- 2 - 6 % → have VUR.
- 5 - 10 % → obstructive lesion:
  - mega ureter.
  - post. urethral valve
  - PUJO.

**N.B.:** Reflux doesn't cause infection but it complicates the infection.

*♀ > ♂*

*Types:*  
- Iry: short submucosal ureter.
- 2ry: due to ↑bladder pressure e.g. in neurogenic bladder & PUV

*Grades of Reflux:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>ureter</td>
</tr>
<tr>
<td>II</td>
<td>pelvi-calyceal system</td>
</tr>
<tr>
<td>III</td>
<td>flat calyces</td>
</tr>
<tr>
<td>IV</td>
<td>clubbing of calyces</td>
</tr>
<tr>
<td>V</td>
<td>tortuous ureter</td>
</tr>
</tbody>
</table>

_N.B:_
- G1, G2, G3 are low grades, while G4, G5 are high grades
- DMSA Scan → best study to detect renal scarring (can be caused by recent infection)

*TTT of VUR:*

A) Prophylactic:
- prophylactic antimicrobial → Nitrofurantoin, septrin.
- dose → 50% of suitable dose.

B) Surgery:
- Ureteral re-implant (↑ length of submucosal ureters)
- Indications: - Break through UTI.
  - No compliance with medical ttt.
  - Grade IV & V with pyelonephritic changes.
  - Deteriorated renal function.
**Genito-Urinary TB**

**Aetiology:**

I- **Causative organism:** Mycobacterium T.B human type (75%)

II- **Route of infection:**

- Haematogenous (mainly): from T.B focus (mediastinal or mesenteric)
- Ascending infection (sometimes): from T.B prostatitis, seminal vesiculitis or cystitis

III- **PPT factors:** low resistance of the patient

**Pathology:**

1- **Renal T.B:** (Bilateral in 40 %)
   a) T.B bacilluria: passage of T.B bacilli in urine with no gross pathology in the kidney.
   b) Caseo-cavernous type: T.B follicle in the cortex coalesce → cold abscess.
   c) Ulcero-cavernous T.B: spread to medulla → caseating → ulcers & infection of the pelvis.

2- **Ureter T.B:** ureter → thickened, fibrosed & shortened.

3- **Bladder T.B:** bladder → thickened, fibrosed & contracted (thimble bladder)

4- **Genital organs:** prostate, seminal vesicles, epididymis may be affected.

**incidence:**

- young adult (20 - 40 y)
- more common in♀ (♀:♂ → 2 : 1)

**C/P:**

A) **General:** (T.B toxaemia) → Loss of wt, night fever & sweats.

B) **Local:**

1. Frequency of micturation → earliest manifestation.
2. Pain in the loin → due to congestion of kidney. Dull aching or colicky.
3. Haematuria.
* Complications :

1- Kidney :
   - T.B pyonephrosis
   - T.B hydronephrosis
   - stones
   - T.B perinephric abscess
   - military T.B
   - R.F

2- Ureter :
   - stricture ureter

3- U.B :
   - Haematuria
   - Contractered bladder

4- Genital organs :
   - infertility

* Investigations :

1- Urine analysis
2- Bacterial exam : Zeihl Neelsen stain
3- Kidney function test
4- Plain X-ray
5- U/S
6- IVU → early → Moth eaten appearance of the calyces
7- Renal isotope scanning
8- Cystoscope → schow :
   - T.B lesion in the bladder
   - Golf-hole appearance of the ureteric orifice
9- Tuberculin test, ESR, Chest X-ray

* TTT :

(1) Medical ttt :
   a. Sanatorium admission
   b. Diet : good diet, vitamins & minerals
   c. Anti T.B drugs : e.g. Rifampicin, INH, Streptomycin, Pyrizinamide

(II) Surgical ttt:
Indication :
- Failure of medical ttt
   - Presence of stricture or obstruction
   - Development of complications e.g. pyonephrosis

Operations :

1- Renal Cavernotomy :
   - For caseating cavities - the abscess is aspirated 1st

2- Nephro-Ureterectomy :
   - for damaged non-functioning kidney
3- Ileo-Cystoplasty : - for contracted bladder

**Renal Tumours**

(A) Iry tumours:

1 - Benign tumours:

**adenoma** (most common benign tumour) (MCQ), papilloma, fibroma, lipoma, haemangioma, oncocytoma.

2- Malignant tumours:

a) Parenchymal: (90%)

   1. **Renal cell carcinoma** (hypernephroma, clear cell carcinoma, renal adenocarcinoma, Grawitz tumour) (75%)
   2. Wilm's tumour (nephroblastoma) (10%)
   3. leiomyosarcoma, haemangiosarcoma (5%)

b) Urothelial: (10%)

   1. transitional cell carcinoma. (TCC)
   2. Sq. cell carcinoma. (SCC)

(B) 2ry tumours:

1. lung cancer  2. breast cancer  3. stomach cancer
4. leukemia.  5. lymphoma.

* Comparison between RCC and Wilm's tumour:

<table>
<thead>
<tr>
<th></th>
<th>RCC</th>
<th>Wilm's tumour</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Incidence:</strong></td>
<td>-75% of Mg. renal tumour (commonest renal tumour) (MCQ)</td>
<td>- 10% of Mg. renal tumour</td>
</tr>
<tr>
<td></td>
<td>- 3% of adult cancer</td>
<td>- Commonest urological tumour in children</td>
</tr>
<tr>
<td></td>
<td>- Age → around 60 y</td>
<td>- Age → around 3.5y</td>
</tr>
<tr>
<td><strong>2. AE:</strong></td>
<td>- Unknown but PPF is:</td>
<td>- Unknown but theories:</td>
</tr>
<tr>
<td></td>
<td>1) smoking. (↑ by 2 folds)</td>
<td>1) abnormal proliferation of mesonephric blastoma (old theory)</td>
</tr>
<tr>
<td></td>
<td>2) occupational (Asbestos &amp;</td>
<td></td>
</tr>
</tbody>
</table>
| Cadmium) | 3) diet (fat) | 4) hormone (estrogen) | 5) hereditary Von Hippel-lindau disease $\rightarrow$
| (cerebellar haemangioblastoma, retinal haemangioma & bilateral RCC) | 2) primitive embryological cells persistent after age of 36 wks gestation | **N.B.**: Kidney is developed from' mesonephric blastoma & completed by 36 wks gestation |
| 3) Associated lesion's: | (see later) |

| 3. Pathology: | Adenocarcinoma |
| a- Cell of origin: | Adenocarcinoma -PCT(MCQ) |
| b- Site: | Arise from one pole of the kidney usually upper pole. |
| c- N/E: | bilateral (2 - 3%) |
| d- M/E: | - variable in size & yellow in colour (high fat content) |
| | - pseudo capsule (compressed surrounding tissue) |
| | - C/S $\rightarrow$ area of hge & necrosis (mosaic app.) |
| | -infiltrate renal pelvis early |
| 1-cellular typing: | - clear cell adenocarcinoma. |
| | - granular cell adenocarcinoma. |
| | - mixed adenocarcinoma. |
| 2-tissue pattern: | - tubular. |
| | - papillar. |
| | - sarcomatoid. |
| - Totipotent cells | - arise from one pole of the kidney usually upper pole. |
| | - bilateral (5%) |
| | - huge, pinkish or grayish white incolour. |
| | - pseudo capsule |
| | - C/S$\rightarrow$ area of hge & necrosis (Mosaic app ) |
| | -infiltrate Renal pelvis late |
| 2 types of tissue: | - 2 types of tissue: |
| 2. C.T elements: ms fibers cartilage & even bone. | 2. C.T elements: ms fibers cartilage & even bone. |
| Histological types: | Histological types: |
| -favourable (90%) $\rightarrow$ multilocular cysts, congenital mesoblastic nephroma, rhabdomyosarcoma. | -favourable (90%) $\rightarrow$ multilocular cysts, congenital mesoblastic nephroma, rhabdomyosarcoma. |
| -unfavourable (10%) $\rightarrow$ anaplasia, rhabdoid tr. of kidney (RTK), clear cell sarcoma. | -unfavourable (10%) $\rightarrow$ anaplasia, rhabdoid tr. of kidney (RTK), clear cell sarcoma. |
### e- Spread:

- **Direct:**
  - Intrinsic → renal pelvis (early) → haematuria.
  - Extrinsic → capsule → perinephric fat → surrounding tissue.

- **Lymphatic:**
  - Embolization: lung, bone, liver, brain (LBLB)
  - Hilar L.N → para-aortic L.N. → thoracic duct → virchow L.N.

- **Blood:** (main route) (MCQ)
  - Permeation: renal vein → IVC → R.A

- **TNM & ROBSON staging (see later)**

### f- Staging

- **Hilar & lumbar L.N.
  - LBLB (main)

### 4. C/P:

1- Haematuria (65%) → painless, periodic, profuse, panhaematuria.
2- Pain (60%) → dull aching pain or colicky.
3- Mass (15%) → irregular, hard.
4- Paraneoplastic syndrome → HTN, anemia, erythrocytosis, hypercalcemia (PTH)
5- Symptoms of metastasis → cough, haemoptysis, bone pain, ...

### 5. Complications:

1- Cachexia
2- Weight loss
3- Haematuria
4- Fever
5- HTN
6- Distant metastasis

### 6. Investigations:

a) For Diagnosis:

#### Laboratory:

1- Urine analysis.
2- S. Creatinine.
3- Tr. markers:
- In RCC → PTH, PG, CEA, Renin, Angiotensin
- In Wilm's tr. → catecholamine to differentiate it from neuroblastoma.

**II- Radiological:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1</td>
<td>U/S (cyst or mass) &quot;85% D&quot;</td>
</tr>
<tr>
<td>2</td>
<td>IVU</td>
</tr>
<tr>
<td>3</td>
<td>C.T (98% D)</td>
</tr>
<tr>
<td>4</td>
<td>MRI</td>
</tr>
<tr>
<td>5</td>
<td>Renal angiography.</td>
</tr>
<tr>
<td>6</td>
<td>X-ray:</td>
</tr>
<tr>
<td></td>
<td>- In RCC' → diffuse calcification.</td>
</tr>
<tr>
<td></td>
<td>- In Wilm's → focal calcification.</td>
</tr>
</tbody>
</table>

b) Metastatic work up:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1</td>
<td>Brain scan.</td>
</tr>
<tr>
<td>2</td>
<td>Chest X-ray</td>
</tr>
<tr>
<td>3</td>
<td>Abdominal U/S.</td>
</tr>
<tr>
<td>4</td>
<td>Bone survey</td>
</tr>
<tr>
<td>1</td>
<td>CBC</td>
</tr>
<tr>
<td>2</td>
<td>ECG</td>
</tr>
<tr>
<td>3</td>
<td>Kidney functions</td>
</tr>
<tr>
<td>4</td>
<td>Liver function</td>
</tr>
</tbody>
</table>

**7. DD:**

1. From other causes of haematuria
2. From other causes of renal mass

1. From huge.abd. distension (spindle shape infant):
   a. cong. megacolon.
   b. neuroblastoma.
2. From other renal swellings in children:
   a. infantile PCK.
   b. multicystic kidneys
   c. bilateral hydronephrosis

**8. TTT**

I- Localized disease:

A) Radical nephrectomy
   (open or laparoscopic)
- it's the standard ttt.

Multi-modal

(1). Surgery:
   → Radical nephrectomy:
   -upper transverse incision.
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>- Indications:</td>
<td>- Through exploration of the abdomen.</td>
</tr>
<tr>
<td>1- Solitary kidney.</td>
<td>- Random L.N sampling.</td>
</tr>
<tr>
<td>2- Bilateral dse.</td>
<td>- Exploration of other kidney.</td>
</tr>
<tr>
<td>3- Tr. &lt; 4 cm.</td>
<td>(2) Chemotherapy: post-operative in all cases as surgery alone is not curative for Wilm's tr.</td>
</tr>
<tr>
<td>4-CRI.</td>
<td>(3) Radiotherapy: in pre-operative to ↓size.</td>
</tr>
<tr>
<td>C) New modalities:</td>
<td>- Metastases (palliative)</td>
</tr>
<tr>
<td>- Cryoablation.</td>
<td>N.B.: Ideal ttt of Wilm's Tr. is Radical nephrectomy + Post-operative chemotherapy.</td>
</tr>
<tr>
<td>- High intensity focused U/S.</td>
<td></td>
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<tr>
<td>- Radio-frequency ablation.</td>
<td></td>
</tr>
<tr>
<td>2- Locally advanced Tr.:</td>
<td></td>
</tr>
<tr>
<td>1. Radical nephrectomy.</td>
<td></td>
</tr>
<tr>
<td>2. Remove of extensions of tr.</td>
<td></td>
</tr>
<tr>
<td>3. Radiotherapy.</td>
<td></td>
</tr>
<tr>
<td>3-MetastaticTr.:</td>
<td></td>
</tr>
<tr>
<td>1. palliative nephrectomy.</td>
<td></td>
</tr>
<tr>
<td>2. palliative radiotherapy (for metastasis)</td>
<td></td>
</tr>
<tr>
<td>3. biologic response modifiers:</td>
<td></td>
</tr>
<tr>
<td>- Interferon-α.</td>
<td></td>
</tr>
<tr>
<td>- Interleukin-2.</td>
<td></td>
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<tr>
<td>N.B.: RCC is chemoresistant.</td>
<td></td>
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<thead>
<tr>
<th>9. Prognosis:</th>
<th>5 years survival rate:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Organ-confined T1</td>
<td>90-100%</td>
</tr>
<tr>
<td>T2</td>
<td>60-95%</td>
</tr>
<tr>
<td>5 years survival rate:</td>
<td></td>
</tr>
<tr>
<td>- Infant: 80%</td>
<td></td>
</tr>
<tr>
<td>- Older child: worse</td>
<td></td>
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</tbody>
</table>

M S Al-Marhoon | Page 77
- Capsular/adrenal  T3a 60-70%
- Renal vein or IVC thrombus  T3b/c 50-80% (25% with IVC wall invasion)
- Visceral/N+  T4  5-30%
- Distant M+  M+  5-30%

* Staging :

(A) Renal tumours→ROBSON (1969)

stage I: confined to renal parenchyma.

stage II: extend to perinephric fat but with intact fascia

stage III:  
a → Renal vein & / or IVC.
b → Regional L.N.
c → a+b

stage IV:  
a → surrounding tissue.
b → distant metastases.

(B) Renal cell carcinoma 2002 TNM classification

T - Primary tumour

- T1 Tumour < 7 cm in greatest dimension, limited to the kidney
  - T1a Tumour < 4 cm in greatest dimension, limited to the kidney
  - T1b Tumour > 4 cm but < 7 cm in greatest dimension, but not more than 7 cm
- T2 Tumour > 7 cm in greatest dimension, limited to the kidney
- T3 Tumour extends into major veins or directly invades adrenal gland or perinephric tissues but not beyond Gerota’s fascia
  - T3a Tumour directly invades adrenal gland or perinephric tissues but not beyond Gerota’s fascia
  - T3b Tumour grossly extends into renal vein(s) or its segmental branches, or the vena cava below the diaphragm
  - T3c Tumour grossly extends into vena cava or its wall above diaphragm
- T4 Tumour directly invades beyond Gerota’s fascia

N - Regional lymph nodes
• N0 No regional lymph node metastasis
• N1 Metastasis in a single regional lymph node
• N2 Metastasis in more than 1 regional lymph node

M - Distant metastasis
• M0 No distant metastasis
• M1 Distant metastasis

TNM stage grouping
• Stage I T1 N0 M0
• Stage II T2 N0 M0
• Stage III
  o T3 N0 M0
  o T1, T2, T3 N1 M0
• Stage IV
  o T4 N0,N1 M0
  o Any T N2 M0
  o Any T Any N M1

(C) Wilm's Tumour → It's post-nephrectomy staging

(National Wilm's Tumour staging system) (NWTSS)

Stage I: Tr. is confined to the kidney & was completely excised

Stage II: Tr. extend beyond the kidney but capsule still intact, completely excised without residue.

Stage III: Tr. resectable but with residue &/or L.N &/or biopsied Tr. & /or rupture.

Stage IV: Distant haematogenous spread. (MCQ)

Stage V: Bilateral renal involvement. (MCQ)

* Associated Anomalies with Wilm's tumour:

1) WAGR syndrome:
   1- Wilm's tumour (50%).   2-Aniridia.   3-Mental Retardation
   4- Genito-urinary anomalies (hypospadius, cryptochidism, duplication of collected system).
   5- Deletion of chromosome 11 P13

2) Beckwith-Weidemann syndrome:
   microcephaly, macroglossia, macrosomia, hemihypertrophy, Wilm's Tt. (4 – 10%)
3) Drash syndrome: Wilm's Tr., nephropathy, Gut anomalies
4) Isolated aniridia (30%)
5) Isolated hemihypertrophy.
6) Isolated Gut anomalies.

**Neuroblastoma**

*Def.*: 
Mg. Tr. of the neural crest (supra-renal gland, sympathetic chain)

*incidence*: < 2 years.

*C/P*: - It is the most common abdominal tumour in children

- Abdominal mass:
  - irregular
  - may cross the midline.

*Investigations:*

**a- Laboratory:**
- Urine analysis.
- VMA (Venyl Mandelic Acid) HVA (Homo-Valinic Acid) (MCQ)

**b- Imaging:**
- U/S. - C.T
- MRI. - X-ray → diffuse calcification.

**c- Metastatic:**
- Chest X-ray.
- Bone Survey.
- Bone marrow aspiration.
- Brain Scan.

*TTR*: Multi-modal → Surgery + Chemotherapy + Radiotherapy
Upper Tract Urothelial Tumours
(Carcinoma of the renal pelvis & ureter)

*Epidemiology:
- 10% of renal Tr. & 5% of all urothelial Tr.
- ♂:♀ → 3 : 1 - Age: at 7th decade.

*AE
Risk factors for TCC:
1- Smoking. 2- Occupational.
3- Long history of analgesic abuse. 4- Balkan nephropathy.

Risk factor for SCC:
- Chronic inflammation. 2- Calculous dse.

* Pathology:
1- M/E: - TCC (commonest 90 - 97%) (MCQ)
   - SCC (rare < 10%) - Adenocarcinoma (very rare)

2- Staging:

TNM
Ta, Tis → confined to mucosa.
T1 → invasion of lamina.
T2 → invasion of muscularis.
T3 → extension to peripelvic at or renal parenchyma.
T4 → spread to adjacent organ.
N+ → L.N metastasis.
M+ → distant metastasis.

* C/P:
1- Gross haematuria (70 - 90%) 2- Flank pain due to ureteric obstruction.
3- Irritative voiding symptoms. 4- Symptoms of metastasis.

**Signs:**

1- Flank mass. 2- Flank tenderness.
3- Supra-clavicular or inguinal-L.N enlargement.

* **Investigation:**

**Laboratory:**

1- Haematuria. 2- Pyuria & Bacteruria. 3- Elevated liver Enzymes.

**Cytology:**

detection of Mg. cells in urine sample aspirate from ureter or pelvis of the affected side.

**Imaging:**

1- IVU(Intraluminal filling defect) 2- U/S, CT & MRI
3- Retrograde uretero-pyelography. 4- Uretero-pyeloscopy.

* **DD:**

1) Filling defect in the pelvicalyceal system:

1- lucent stone. 2- blood clot. 3- fungus ball. 4- T.B granuloma.

2) Renal parenchymal tumour.

* **TTT**

(1) **Nephro-ureterectomy with excision of bladder cuff:**

- Tr. in renal pelvis or upper ureter.
- It's the standard ttt.(MCQ)

(2) **Segmental ureterectomy & uretero-vesical re-implant:**

for distal ureter tumour.

(3) **Renal sparing procedure:**

**Indication:**

1- Solitary kidney. 2- Bilateral disease.
3- low grade, non invasive tr. 4- CRI
**Types:** 1 - Tumour resection.  2-Fulguration.  3-Laser ablation.

Then local chemotherapy (mitomycine) or BCG.

Long term follow up with images & ureteropyeloscope is mandatory.

(4) **TTT of metastatic tumours:**

chemotherapy → platin-based regimens.

---

**Bladder Cancer**

*Incidence:*

- Commonest urological cancer in Egypt. (MCQ)
- More common in: - Farmers. (Bilharz.)
- > 20 y - ♂> ♀ (4 : 1)

*Aetiology:*

A) predisposing Factors:

1- End product of aniline dye or tryptophane. (Nitrosamine)
2- Smoking.  3- Fertilizer.
4- Bilharziasis.  5- Squamous metaplasia
6- long standing cystitis.

B) Pre-cancerous lesion:

1- Villious papilloma  2- Cellular dysplasia  3- Leukoplakia
5- long standing stone.  4- Ectopia vesica.

**Pathology:**

1. **N/E (Gross appearance)**

There are 2 types of cancer bladder which are:

1) on top of bilharziasis. (B)
2) Non-bilharziatic (Non B)
<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Non B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Nodular (cauliflower)</td>
<td>++ (commonest) (MCQ)</td>
<td>+</td>
</tr>
<tr>
<td>2- Infiltrating.</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3- Papillary.</td>
<td>+</td>
<td>++ (commonest) (MCQ)</td>
</tr>
<tr>
<td>4- Ulcerative.</td>
<td>+</td>
<td>+</td>
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2. M/E (Microscopic appearance):

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Non B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- S.C.C</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>2- T.C.C</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>3- Adenocarcinoma</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

3. Site:
- B cancer: lateral wall & posterior wall, (most common site)
- Non B cancer: trigone (most serious) → due to:
  1- infiltration of ureteral orifices → hydroureter, hydronephrosis & R.F.
  2- BNO.

4. Grading:
- GI → highly differentiated (good prognosis)
- GII → moderately differentiated
- GIII → poorly differentiated (anaplastic)

5. Spread:
1) Direct spread:
- Intrinsic → to the wall of U.B.
- Extrinsic → to rectum, vagina, uterus, prostate, pelvic wall
2) Blood spread: LLBB
3) Lymphatic spread:

→ obturator L.N → internal iliac L.N → common iliac L.N → presacral L.N → para-aortic L.N.

**N.B:**
- Below bifurcation of common iliac → regional L.N
- Above bifurcation of common iliac → juxta regional L.N

6. Staging: (TNM classification)

**Tx** → Tumour can't be assessed.

**T0** → No evidence of tumour.

**Tis** → Flat lesion (not invade BM) → No palpable mass

**Ta** → Papillary lesion (not invade BM) → No palpable mass

**T1** → invade lamina propria (mucosa musculosa) → mouse of U.B (palpable mobile mass without induration of wall "move within U.B")

**T2:**

- a → invade superficial 1/2 of ms layer.
- b → invade deep ms layer.

**T3:** invade the pelvesical fat.

- a → microscopic
- b → macroscopic

**T4:**

- a → invade adjacent organ.
- b → invade side wall of pelvis.

**Nx** → L.N can't be assessed.

**N0** → No nodal metastasis.

**N1** → Single ipsilateral (< 2 cm)

**N2** → Single or multiple (2 - 5 cm)

**N3** → Single or multiple (> 5 cm)
Mx→ metastases can't be assessed.
M0 → No evidence of metastasis.
M1 → Disatant metastasis including juxta-regional L.N.

MCQ: Which of the following has best prognosis:

Tis , Ta , Tl → Ta (as in Tis the course is unpredictable)

*C/P:

a) Symptoms:

1- Malignant cystitis = Exaggerated cystitis syndrome + modification + addition

Exaggerated cystitis syndrome: - Frequency "Ptn. Always in W.C
- Urgency "Ptn always wet."
- Dysuria "Painfull micturition"

Modification: - not respond to usual ttt.
- Frequency "diurnal & nocturnal"

- Necroturia. "S.C.C > T.C.C"
- Pyuria.
- Pain.

2- Symptoms of metastasis:

Liver → Rt hypochondrium pain. Lung → Haemoptysis, chest pain.
Rectum → Tenesmus.

b) Signs:

General: search for distant metastasis.
Local: - Bimanual exam.: (P.V or P.R + abd. hand) → for ant. bladder mass.
- DRE (P.R): for staging.
- EUA → Examination under anaesthesia.

Complications:

- Cachexia. - Haematuria. - Metastasis,
- Renal failure → if bilateral ureteric obstruction.

**Investigations:**

A) Laboratory:  
1- Urine analysis.  
2- Urine cytology.  
3-CBC.  
4- Liver & kidney functions.

B) Radiological:  
1- KUB (Plain X-ray) show:  
- Soft shadow (mass)  
- Calcification in B.  
2- U/S: bladder mass.  
3- IVP: not done now.  
4- C.T scan & MRI → for staging.  
5- Cystoscopy → visualize the bladder & show the lesion.  
6- Cystoscopy guided biopsy:  
7- Metastatic work up:  
   - Abdominal U/S.  
   - Brain scan  
   - Bone survey.  
   - Chest X-ray.

*DD*: from other U.B masses.

**Treatment:**

(A) **TTT of superficial bladder Tr.: (T.C.C)**

**N.B.:** - 75% of TCC are superficial.  
- Generally S.C.C / adenocarcinoma are ms invasive.

1) **TURBT (Endoscopic Resection) → "Ta"**  
   Trans-urethral resection of bladder tumour.

2) **Adjuvant intravesical Chemotherapy & immunotherapy → "Tis"**  
   - Chemotherapy → Adriamycin, Mitomycin, Thiopeta.  
   - Immunotherapy → BCG → only line of ttt in CIS as chemotherapy has poor effect on CIS. (MCQ).

3) **follow up:**  
   - By regular cystoscopy + urine cytology.  
   - For early detection of Recurrence.
(B) **TTT of muscle invasive tumour: (S.C.C & T.C.C)**

Radical cystectomy + urinary diversion $\rightarrow$ T2, T3

**We remove:**

1- Bladder & its peritoneal cover.  
2- Distal ureter.  
3- In $\varnothing$ $\rightarrow$ distal vas deferens, seminal vesicle, whole prostate & prostatic urethra. In $\varphi$ $\rightarrow$ tubes, uterus, upper 1/3 of vagina)  
4- Regional L.N (Ext. & Int. iliac L.N)  
5- Urethra if involved.

**Survival after cystectomy: 5 years survival is 50 %**.

(C) **TTT of advanced Tumour** (Locally advanced T4, N+ and metastatic M+)

according to the type of cells: ' 

1) T.C.C: - Radiotherapy.  
2) S.C.C or Adenocarcinoma:  
   - it is radio & chemoresistant.  
   - ttt is palliative:  
     - palliative of Tr.  
     - palliative of symptoms.

**Urinary Diversion**

*Definition:*

- Replacement of U.B.  
- Diversion of the ureter & urine flow away from the bladder (diseased or resected)

*Indications:*

1- Congenital: ectopia vesica with failed repair.  
2- Traumatic: vesico-uretero-vaginal fistula.  
3-Infection: Bilharzia, TB.  
4- Malignancy: muscles invasive cancer bladder.  
5- Functional: neurogenic bladder.

*Methods:*
(1) Non continent:

Ileal loop conduit:
- Ileal segment connected to lower ends of ureter & then to skin by stoma.
- Urine collecting bag attached to skin to collect / evacuate bladder.
- indicated in: - Ptn with liver impairment.
               - Ptn with renal impairment.
               - unfit for continent diversion.

(2) Continent:

1- Rectal diversion: (e.g. ureterosigmoidostomy)
   - Urine collects in colon & controlled by anal sphincter.
   - Very high incidence for complication (esp. hyperchloremic acidosis (MCQ)

2- Ileocaecal bladder (continent cutaneous diversion)
   - Caecum & terminal ileum are isolated.
   - Caecum is closed & the 2 ureters are impacted into it.
   - The terminal ileum is opened to the skin.
   - Controlled by ileocaecal valve which open only when ptn pass a catheter.

3- orthotopic or neobladder diversion, (Best) (MCQ)
   - Ileal segment is implanted in the same site of removed UB & depend on the external urethral sphincter.
   - It's better as it simulates normal bladder.

*Complications:

(1) General (Metabolic) :

1- ↑ loss of K.

2- Hyperchloremic metabolic acidosis → due to digestion of urea by bacteria into NH₄ → (↑ H⁺ → metabolic acidosis), CL → absorbed (hyperchloremic)

(2) GIT complications:

1- Ileum resection → nutritional deficiency esp. vit B₁₂.

2- Multi Vit. deficiency.
3- Activation of pro-carcinogens → active carcinogen → cancer intestine (adenocarcinoma)

e.g. Nitrite / Nitrate → colonic bacteria → Nitrosamine (active carcinogen)

(3) UT complications:

1- Incontinence of continent diversion.
2- Obstruction → hydrenephrosis.
3- Infection (pyelonephritis)
4- Stone formation.
5- Renal failure (if bilateral).

Benign Prostatic Hyperplasia (BPH)

* Definition:
Benign condition associated with symptom complex (syndrome) of what's called LUTS (lower urinary tract symptoms)

* Incidence:
- most common Bg neoplasm in adult ♂. (MCQ)
- ↑ by aging → 20 % in men at 40 years → 40 % in men at 50 years
  → 50 % in men at 60 years → 60 % in men at 70 years
  → 75 % in men at 80 years

* Etiology: Unknown but theories:

(1) Hormonal dependent theory: (Role of Androgen)
  
  testosterone → 5 α-reductase enzyme → 5 DHT → ↑ growth factors → enlargement.

(2) Role of estrogen: (Hormonal imbalance)
  
  there's associated ↑ of serum estrogen. (↑ E / T Ratio)

(3) Programmed cell death regulation: (Apoptosis)
↓ apoptosis (↑ cell growth )

(4) Neoplastic theory:

BPH is considered as Bg tumor.

(5) Inflammatory theory: (not accepted)

based on appearance of chronic infl. cells e.g. lymphocytes in stroma.

N.B: - Prostate becomes palpable at puberty.
- Prostate is crossed by urethra & ejaculatory duct.
- Remain constant size (3 x 3 x 3 cm) (20 gm) & may regress.

*Pathology:

- Hyperplasia of the glandular tissue → enlarged prostate.
- Fibrosis (↑ fibromuscular component) → retraction (small size but cause obstruction)"

- Site: periurethral zone (transitional zone)

*C/P:

a) Symptoms: (Prostatism) (LUTS)

1- difficulty to → initiate (hesitancy)

→ maintain (intermittancy)

→ terminate (post. mict. Dribbling)

2- weak & narrow urinary stream.

3- sense of incomplete voiding.

4- complicated LUTS → - frequent UTI → burning & urgency.

- Haematuria. - Retention.

b) Signs :

- Neurological examination for overall sensory & motor deficit.

- DRE (Digital Rectal Examination): Prostate size & contour can be assessed (5S)
→ Symmetrically enlarged, Smooth surface, Soft to firm, preserved Sulci, Sliding rectal mucosa over it)

N.B.: - Clinically presenting BPH is called BPO (Bladder prostatic obstruction)
- SPE (Senile prostatic enlargement) old name of BPH.
- old name of LUTS was prostatism.
- BNO → bladder neck obstruction.
- BOO → Bladder outlet obstruction.

**Complication.**

1- Acute & chronic retention of urine.
2- Infection
3- Overflow incontinence.
4- U.B stones
5- Hydro-ureter & hydronephrosis.
6- Haematuria.
7- Renal failure.

**Investigations:**

(a) Laboratory:
- Urine analysis.
- Urine culture.
- liver & kidney function.
- PSA (prostate specific Ag)

(b) Urodynamic study (Uroflowmetry)
- Q max (peak) = normal > 15 ml/sec (MCQ)
- < 10 ml/sec means obstruction to bladder outflow.

(c) Imaging:
- TRUS. (Trans-rectal ultrasound)
- MRI.
- IVU: to show back pressure on the kidney.

**Treatment:**

(A) Prophylaxis:

avoid ppt factor e.g. Excess work, worry, weather (cold), wine, women, withholding urine in bladder, spices, constipation.

(B) Medical therapy:

1- α-blockers: e.g. Tamsulosin, Alfuzosin. block α-receptors in the urethra → ↓ its tone.
2- 5α-reductase inhibitors: e.g. Finasteride (proscar)
3- Phytotherapy.
(C) Minimal Invasive therapy:
1- Intra-prostatic stent. 2- Trans-urethral needle ablation. 3- Balloon dilatation.

(D) Surgical TURP (Trans-Urethral Resection of Prostate)
- main tt. (MCQ) - Wt from 25 - 60 gm.
- Resection of the prostate & examined by excision biopsy then cauterization of the bed.

Complications:
- blockage (main)
- recurrence
- perforation
- extravasation

(E) Trans-urethral vaporization.

(F) Trans-urethral Incision.

(G) Open prostatectomy: (> 80 gm) site: - supra-pubic. - retro-pubic.


N.B.: MCQ
1- Prostate weighting 80 gm with large bladder stone is best treated by Open prostatectomy & suprapubic cystolithotomy.
2- Fibrous prostate is treated by TURP.
3- PSA is measured before DRE as squeezing the prostate → ↑PSA level.

Prostate Cancer

*Incidence
- most common cancer among elderly♂. (MCQ)
- 2nd common cause of death in ♂ after cancer lung (MCQ)
- 85% of cases between 45-89y.
- peak incidence in the 8th decade.
- 50 % develops metastasis.

* Risk Factors:
1- Age: - Elderly ♂ esp. 8th decade. - Rare before 45 y.
2- **Familial tendency:** +ve family Hx (father or brother)

3- **Race:** -↑ in Scandinavian, Europe, America. - Least incidence in Japan.

4- **Diet:** ↑fat intake → ↑incidence.

5- **Hormonal:**
   
   Androgen (Testosterone) → non carcinogenic but it's necessary for maintenance & growth in most of cases.

6- **Pre-cancerous lesion:**

1- Prostatic intraepithelial (intracellular) neoplasia. (PIN) (MCQ)

2- BPH (It never turn mg. but TURP leave post. capsule which my turn mg.)

*Pathology:*

1. **Histological type of cancer prostate:**
   
   a- Glandular (70%): - Adenocarcinoma (95%) (MCQ)
      - TCC (5%) → from prostatic duct and urethra

   b- Stromal (30%): - Rhabdomyosarcoma.
      - Leiomyosarcoma.
      - Fibrosarcoma.

2. **M/E:**

Malignant criteria of tissue & cells:

   **Cells:** - Hyperchromatosis - ↑N/C ratio
      - prominent nuclei - ↑mitotic figures

   **Tissue:**

   - acini or packed to each other with no stroma in between
   - complete loss of differentiation in the form of sheets of mg. cells with no arrangement into acini.

3. **Site:** (of adenocarcinoma)

   - Peripheral zone (70%) (MCQ)
   - Transitional zone (20%)
   - Central zone (10%)
4. Spread:

A) Direct:  
- Intrinsic: involve the rest of prostate.
- Extrinsic: upward → UB, ureter.
- Downward → urethra.
- Laterally → sciatic nerve & iliac blood vessels.
- Forward → pubic bone.
- Backward → rectum "but very late & rare due to presence of Denonvillier's fascia ( ) prostate & rectum.

B) Lymphatic:

Obturator L.N → internal iliac L.N → common iliac L.N → pre-sacral L.N → para-aortic L.N.

C) Haematogenous: LBLB

Bone is the commonest site of metastasis in cancer prostate (MCQ):
1- lumbar vertebra. 2- pelvic bone. 3- head of femur.
4- thoracic spine, sternum, skull & head of humerus.
5- Ribs.

N.B.: Tumours which prefer bone metastasis are:

- Cancer thyroid → skull.
- Cancer breast → lumbar vertebrae.
- Cancer prostate → above 5 bony sites

5. Staging: Prostate 2002 TNM classification

T - Primary tumour

T1 Clinically inapparent tumour not palpable or visible by imaging
  T1a Tumour incidental histological finding in 5% or less of tissue resected
  T1b Tumour incidental histological finding in more than 5% of tissue resected
  T1c Tumour identified by needle biopsy (e.g. because of elevated prostate-specific antigen, PSA, level)

T2 Tumour confined within the prostate
  T2a Tumour involves one half of one lobe or less
  T2b Tumour involves more than half of one lobe, but not both lobes
  T2c Tumour involves both lobes
T3 Tumour extends through the prostatic capsule
   T3a Extracapsular extension (unilateral or bilateral)
   T3b Tumour invades seminal vesicle(s)
T4 Tumour is fixed or invades adjacent structures other than seminal vesicles: bladder neck, external sphincter, rectum, levator muscles, or pelvic wall

N - Regional lymph nodes
   N0 No regional lymph node metastasis
   N1 Regional lymph node metastasis

M - Distant metastasis
   M0 No distant metastasis
   M1 Distant metastasis
      M1a Non-regional lymph node(s)
      M1b Bone(s)
      M1c Other site(s)

6. Grading: According to Gleason score (0-10)
   2 – 4 → well differentiated tumour
   5 – 7 → moderately differentiated
   8 – 10 → undifferentiated tumour

*C/P:*

a) Symptoms:

1- Metastatic manifestations:
   - 50% of cases
   - e.g. back pain, haemoptysis, pathological fracture of bone, ..

2- Invasive manifestations:
   due to infiltration of surrounding tissue e.g. sciatica, rectal obstruction, uraemia.

3- Obstructive manifestations:
   symptoms of bladder neck obstruction (difficulty in micturation, retention of urine, suprapubic pain)

4- Complications:
   - haematuria.
   - infection.
   - obstruction.
   - metastasis.
- Renal failure. - infiltration of surroundings.

b) Signs:

1- General: signs of distant metastasis.

2- Local: DRE → - Enlarged prostate (stony hard, irregular surface, obliteration of post. Sulci, rectal wall may be fixed to tr.)

- Enlarged hard pelvic L.N.

Investigations:

(A) Laboratory:

1- Urine analysis. 2- K.F.T.

3- Tumour markers:

- Serum acid phosphatase.
- Serum alkaline phosphatase. (↑ in bone metastasis)

- Serum prostatic specific Ag.: (PSA) → most sensitive (MCQ)

  - Normally → 0 - 4 ng / ml.
  - ↑ in: - BPH. - Cystoscopy.
  - prostatic biopsy. - DRE or marriage.
  - prostatitis. - cancer prostate, (very high)

- Value of PSA: - Screening.

  - Staging.

  - Prognostic value.

(B) Radiological:

- KUB. - Chest X-ray. - Bone scan.
- TRUS (Trans-rectal U/S) - C.T & MRI.

(C) Biopsy:

- most important tool of Diagnosis. (MCQ)

- Done in: - cancer prostate. - T.B prostatitis.

(D) Screening by:

1- PSA. 2- DRE. 3- TRUS guided biopsy.
**DD:** 1-BPH

2- Other causes of nodular prostate:
   - T.B prostatitis.  - Cancer prostate.
   - B prostatitis.   - Calcification.

3- From other causes of retention & haematuria.

**N.B:**

<table>
<thead>
<tr>
<th></th>
<th>BPH</th>
<th>Cancer prostate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Site:</td>
<td>- Transitional zone.</td>
<td>- Peripheral (mainly)</td>
</tr>
<tr>
<td>2- DRE:</td>
<td>- Sliding rectal mucosa.</td>
<td>- Fixed mucosa.</td>
</tr>
<tr>
<td></td>
<td>- Smooth surface.</td>
<td>- Nodular surface.</td>
</tr>
<tr>
<td></td>
<td>- Soft-firm consistency (as</td>
<td>- Hard consistency.</td>
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<tr>
<td></td>
<td>contracted thenar eminence)</td>
<td>- Obliterated sulci.</td>
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<tr>
<td></td>
<td>- Preserved sulci.</td>
<td>+</td>
</tr>
<tr>
<td>3- Haematuria:</td>
<td>+ + +</td>
<td></td>
</tr>
<tr>
<td>4- TRUS:</td>
<td>can differentiate ( ) both .</td>
<td></td>
</tr>
<tr>
<td>5- PSA:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6- Biopsy:</td>
<td></td>
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*Treatment:*

(1) **Open prostatectomy:**

- in weak unfit ptn → follow up.
- good general condition → progress to radical prostatectomy.

(2) **Radical prostatectomy: (classic ttt)**

- in T1, T2, N0, M0 Tumour (confined to prostate)
- removal of → prostate, seminal vesicle, both vas deferens, draining L.N,
  3 fascia (capsule, endo-pelvic fascia & Denonfillier's)

(3) **Hormonal ttt:**
- in painful metastatic Tr. (MCQ)
- either: → Ablative (remove the source of hormone secretion)
  → Additive (LHRH, Estrogen, Antiandrogens)
- Total androgen blockage: → Casteration:  - Surgical → orchiectomy.
  - Chemical → LHRH analogue
    → Antiandrogen.

(4) Radiotherapy:
  a) external = 6000 – 7000 rads for 6 – 7 weeks
  b) Internl : Interstitial radiation

Erectile dysfunction
(Impotence)

*Definition:-
Inability of the male to attain & / or to maintain a penile erection sufficient for satisfactory sexual performance.

*Prevalence:-
- Common problem of considerable importance
  - 30 million in USA (1993)
  - 31 million in Europe (1995)

*Physiology of normal erectile response:
- Complex neuro-vascular response
- Neuro transmitters of erection include
  1) Cholinergic (PS) which ↑ NO (nitric oxide)
  2) Adrenergic (S) which ↓ NO
  3) Non cholinergic non adrenergic. (NO "nitric oxide")
    - Which is the main transmitter.
    - It's secreted from: - cavernous nerve
- Endothelial lining of cavernous space

- Sexual stimulus → Fore brain → Spinal cord → Sacral (S2,3,4) PS → Pelvic nerve → pelvic plexus → Cavernous nerve → ↑NO→ GTP → cGMP → Relaxation of sm. ms in lacunae → dilatation → accommodation of more blood → Erection.

*Causes of erectile dysfunction:*

(1) Psychogenic

(2) Organic (50-90%):

i) Arterial: Atherosclerosis affect small Vs (arteries & arterioles) → ↓ Blood flow to penis during erection.

ii) neurogenic:
- Sensor & Motor → head trauma → Pripheral Neuropathy.

iii) Endocrinal:
- Hypogonadism (andropause) d.t. ↓ testicular function & ↓ testosterone.
- Hyperprolactinaemia. - Thyroid dysfunction.
- Bilateral subcapsular orchietomy.

(iv) Cavernosal (peripheral organ failure)

- Tough Tunica albugina:
  d.t. loss of elasticity → no compression on cavernous space → Venous leakage (ptn complaint of failure to maintain erection).

- Fracture penis: (Rupture tunica albugina)
  - C/O → sudden pain, sudden bending of penis & angulation, Cracking sound, Haematoma, sudden loss of erection.
  - It's emergency & must be corrected with in 1st 6hr.

- Defect of cavernous space.

*Diagnosis of erectile dysfunction:*

1. History:
   → medical: - systemic dse (D.M) -Trauma -Operation
   → Onset, Course, Duration
- If psychogenic → sudden onset / intermittent course.
- If organic → gradual onset / progressive course.

→ frequency of coitus and state of erection
→ libido, orgasm, ejaculation.
→ Drugs. (Anticholinergic, antidepressent, antihypertension)

2. Examination:

General:  - 2ry sex character
   - systemic dse.   - Palpation of the artery.

Local:   - testis → small atrophic → hypogonadism.
   - Penis → fibrous non elastic tunica albugina.
   - Scrotum & prostate.

Neurological: - Saddle area (perineum)
               - Bulbo cavernous reflex.

3. Investigations:

A) Laboratory:      - lipid profile      - fasting bl. Sugar
                   - testosterone level   - Prolactin assay

B) Radiological:    - Dupplex U/S → show Bl. Flow to penis.
                   - Cavernosography & cavernosometry.
                   - Penile pharmacoarteriography.

C) Nocturnal penile tumescence & rigidity (NPTR)
   - Used to diff. ( ) psychogenic → normal test
     Organic → less frequent & less rigid erection.
   - Done now by Rigiscan.

NB: Normally during sleep, 3-4 episodes of erection occur lasting for 10 - 20 min each.

Treatment :-

1) Correctable "modifiable" cases:
   1- Stop causative drugs.
2- Replacement therapy of hormonal dse.
3- Bromocriptine in hyperprolactinaemia.
4- Life style modification.  5- Psychotherapy.

2) Management of established cases:

1st line of ttt:

A) Oral erectogenic drugs:

1) Sildenafil (viagra)
   - mechanism of action: It's PDE: (phosphodiesterase type 5E) inhibitor which destroy cGMP. Accumulation of cGMP → Better erection.
   - Half life: 4-6 hr.
   
   Need sexual stimulation to produce NO& cGMP
   - Dose: 25,50,100 mg
   -C.I:  - Coronary heart dse & on nitrate therapy ( C.I to take both drugs within 24hr → profound hypotension).
      - Recent MI - sever H.F
      - Unstable angina - Hypotension
      - Sever hepatic impairment - sever renal insufficiency

2- Tadalafil (Cialis):  
- Potent PDE5 inhibitor but more selective than sildenafil for PDE6 present in the retina.
   -Half life: 1 -2hr.
   - Dose: 10, 20 mg.

3- Vardenafil (Levitra):  
- Dose: 10, 20mg.

4- Apomorphine sulfate:  
- S.E : nausea & vomiting.
- Dose: 2 - 3 mg sublingual & effective 10 min after intake.
- Advantage: Not need sex stimulus.
- CI: Sever cardiac problem.

H) Vacumm erection device:
- Cold erection induced by -ve pressure pump around the penis.
- S.E: (S.C Hge spots, hinged erection).
- Satisfaction → 27 - 74%

2nd line of ttt:-

A) Intra cavernous injection:
- Agents: - Papaverine (V.D) - PGE₁
- Phentolamine - Tripple therapy.
- Complications:
  - Hypotension - Headache - pain
  - Prolonged penile erection (priapism) - parasthesia
  - Fibrosis - injection in urethra

B) Intra-urethral alprostadil:
- PGE₁ injection in the urethra → absorbed to corpus spongiosum → some absorbed through collateral to the cavernous body.
- Needs bid dose (500-1000 mg)
- S.E → - urethral pain - Haematuria - Hypotension

3rd line Of ttt:- (Penile prosthesis)

Indication: failure of other lines of ttt.

Types of prosthesis: - Rigid - Semirigid - Inflatable

Success rate: 95%

S.E: - very expansive - infection
- mechanical failure - Erosion

NB (MCQ):
- Priapism: prolonged, painful, aimless erection > 6hr after intercourse
- Partner has role in pathogenesis of ED.
- Highest incident of ED occur with $\beta$- Blockers.
- Lowest incident of ED occur with $\alpha$- Blockers.

**Endoscopy**

**Definition:** Tools of importance to visualize the internal surface of U.T.

**Types:**
1. Rigid endoscope: Most commonly used in urology.
2. Flexible endoscope

**Components:**
1. **Sheath (metal tube):**
   - Length & diameter of each must be appropriate to:
     - size of the organ
     - age of the pt.
   - Diameters: range from 6 - 28 ch (chairier) (French =1 ch = 0.33 mm)
   - E.g.(MCQ): - urethra:    - Adult (28 ch)
     - Infant (6 ch)
     - Ureter: 6- 10.5 ch'
     - Calices: 24-28ch
2. **Lens:**
   - $0^\circ$ → for tubes urethra, ureter (commonly used)
   - $30^\circ$ → for cavities
   - $70^\circ$ → for cavities
   - $120^\circ$ → for bladder neck

**Types of lens:**
- Rod lens:  Glass lens & in ( ) spaces (air) & the picture (image) is in the same direction.
- New system: Glass lens & in ( ) fiberoptics

**Field of vision:**
- $0^\circ$
30°

(3) **Light:**

- Source: not associated with heat as not to cause thermal injury of the tissue.
- Cable: for transmission of light.

(4) **Irrigant:** → change potential spaces to actual cavities.

- Must be sterile
- Needed to clear the field of vision → bleeding stopped by diathermy.

-Types:
  - H₂O
  - Saline
  - Glycin (1.5%)

- Complications of H₂O associated with irrigation:
  1) Hypervolaemia over load → pulm. oedema
  2) Haemolysis (as it's hypo-osmolar).
  3) Hypo Na → neurological deficit (epileptic fit) common to see this condition with TUR of prostate so know as TUR syndrome.

→ How to avoid it: by using glycin instead of H₂O.

**Indications:**

NB As we ascend up → indication of endoscopy become more therapeutic than Diagnostic.

(1) **Panendoscopy = Cystourethroscopy:**

A) **Diagnostic:**

1) Bleeding / urethra (lesion below the level of ext. sphincter)

2) Recurrent or sever cystitis: to find the cause of resistance to ttt & recurrence. e.g tumor, stone ......

3) Haematuria.

4) Filling defect of bladder or urethra in ascending uretherocystogram to find the nature.

5) Retrograde uretero pyelography if the dye in IVU is not excreted in one kidney.
6) To take biopsy from suspicious lesion.

**B) Therapeutic:**

1) **visual internal urethrotomy (VIU):** (MCQ)
   
   by visual urethrotome in cases of short segment stricture of anterior urethra (but not in large one).

2) **Crushing of bladder stone either:**
   
   Small: mechanical destruction (fragment)
   
   Large: disintegration into small fragment by
   
   → Powers: - U/S fragment, (most common).
   - Pneumatic (lithoclast) most commonly used now (Cheap, effective)
   - Electrohydrolic fragm. (EHL) → not used now.
   - Laser fragm → effective but expensive.

3) **Resectoscope for** incision or resection

   * **Incision:** in
   
   a- BNO or contracture
   
   b- Fibrous prostate: - BNI (bladder neck incision)
   - Endoscope meatotomy to extract stone from intramural ureter

   * **Resection:** in
   
   a- Superficial bladder Tr. (transurethral resection) TURBT+ chemotherapy
   
   b- Transurethral resection of prostate (TURP) for BPH with failure of medical ttt (use glycin as irrigant to avoid TUR syndrome)

**Ureteroscope:**

**A) Diagnostic:**

1) Unilateral haematuria (cystoscope shows bl. Coming from one ureteric orifice)

2) Filling defect of ureter in IVP, Ascending ureteropyelogram.

3) Abnormal cytology without apparent pathology on cystoscopy (cell may be coming from upper U.T).

**B) Therapeutic:**
1) Management of ureteric stone (most common indication esp. of lower ureter (main site).

2) Dilatation or incision of ureteric stricture.

3) Dilatation or incision of pelviureteric junction (PUJ) obstruction.

4) Resection of ureteric Tr.

(3) Nephroscopy:

A) Diagnostic (very rare)
   - Non explained haematuria.

B) Therapeutic:

1) PCN (Percutaneous nephrostomy)
   - Temporary method in case of acute renal obstruction to relieve:
     - Obstructive anuria
     - Fever & avoid septicemia. Then causal ttt is indicated.

2) PCNL (Percutaneous nephrolitholomy)
   - Through artificially created tract to reach the pelvicaliceal system (How)
     - (i) Ureteric catheter.
     - (ii) Contrast media in pelvicaliceal system.
     - (iii) Trochar & Cannula through the skin into the middle calicx.
     - (iv) Guide wire is introduced & gradual dilatation to 30 ch (1 cm)
       - if stone < 1 cm → mechanical extraction
       - if stone > 1 cm → Disintegration by U/S, lithoclast or LASER

3) Percutaneous endopyelotomy:
   - Incision → stent for wks → removed (success rate 80%)
   - Used in recurrent surgeries.

4) Resection of Tr. Of renal pelvis.
Renal Transplantation

* Options of ttt of end stage renal failure:

(1) Renal transplantation.

(2) Dialysis:  
- Haemodialysis (through A-V fistula)
- Peritoneal dialysis (by Tencoff's catheter)

→ Renal transplantation is better with the following advantage over dialysis:

1) Better quality of life: - ↓ time. - ↑ work. - ↑ sexual performance

2) more economic.

* Causes of end stage renal failure: (MCQ)

**Adult:**
1) chronic glomerulonephritis (commonest) (MCQ)
2) HTN.
3) Diabetic nephropathy.
4) Adult Polycystic kidney.

**Child:**
1) Nephropathy.
2) Obstructive uropathy (with progressive hydronephrosis, with gradual loss of function):  
   - Post. urethral valve.
   - BNO.
   - Neurogenic bladder.

*Contraindications of Renal transplantation: (MCQ)*

**Absolute:**

1) Active infection.

2) Active malignancy.

→ Only allowed after ttt / cure & complete clearance → due to Immunosuppressive drugs used after transplantation which lead to:

- ↑ extension.
- flaring of infection.

**Relative:**

1) Age: usually transplantation is done when there's life expectancy ≥ 10 y.

2) viral hepatitis: dialysis is used till the ptn either cured or converted to sero –ve

**Types of Rejection:**

<table>
<thead>
<tr>
<th></th>
<th>Hyperacute</th>
<th>Acute</th>
<th>Chronic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence</td>
<td>Very rare &lt; 1</td>
<td>25 – 50% (few weeks → months)</td>
<td>↑ by 5% every one year</td>
</tr>
<tr>
<td>Mechanism</td>
<td>Humoral immunity (Ag-Ab reaction)</td>
<td>Cell mediate (T cells)</td>
<td>Unknown &amp; may be combined humoral &amp; cellular reaction</td>
</tr>
<tr>
<td>Clinical picture</td>
<td>It lead to soft blue kidney after removal of vascular clamps</td>
<td>- Progressive ↑ in S. creatinine - Pain + tenderness at graft site - Fever - ↑ kidney size by U/S</td>
<td></td>
</tr>
<tr>
<td>Prognosis</td>
<td>Very grave</td>
<td>good</td>
<td></td>
</tr>
<tr>
<td>TTT</td>
<td>No ttt</td>
<td>High dose steroid</td>
<td>Imurane (↓ progress)</td>
</tr>
</tbody>
</table>

**Immunosuppressive drugs:**

* Any drug may be used in: - Induction.
- Maintenance.
- TTT of rejection (usually high dose steroid in acute rejection)

* Drugs include:

**(1) Azathioprine (Imuran)**

- Mech. of action: - B.M depression → pancytopenia → ↓ Th cells.
- S.E.: - ↓ leucocytic count. - anaemia.
  - ↓ platelets. - used in maintenance therapy.

(2) **Corticosteroids:**
- Mechanism: suppression (specific, non-specific) of immune response.
- used in all types (maintenance, induction, rejection)

(3) **ALG / ATG.** (Anti-leucocytic / Anti-thymocyte globulin)
- Polyclonal Ab.
- used in: - Induction.
  - Rejection (steroid resistant > 5 days)

(4) **OKT3** (mono-colonal Ab)

(5) **Cyclosporine**
- Mech: - Act on IL2 (important for Tc activation)
  - so it prevent only Tc & preserve Ts/humoral /nonspecific response
- SE: Nephrotoxic (↑ S. creatinine)

(6) **Rapamycine** (Rapamune)
- Mech: as cyclosporine
- Advantage: not nephrotoxic

*Complications of renal transplantation*

1) Vascular: - renal vein thrombosis
   - renal artery thrombosis or stenosis
2) Urological (3-5% only): - ureteric obstruction
   - urinary extravasation
3) Lymphocele: - collection of lymph in closed space (retroperitoneal) due to cutting
   of lymph vessels around the renal vessels of recipient or donor
   - usually its small sized / asymptomatic
   - It ↑ - infection
- obstruction of ureter → back pressure on the kidney
- compression on iliac vessels → LL oedema

4) Infections: most common infection → UTI, pneumonia

   - 1st month → conventional infections (chest, wound)
   - 3-6 months → opportunistic infections due to ↓ immunity

5) Cancer: - due to prolonged immunosuppression
    - usually → lymphoma, Kaposi sarcoma (of skin)

*Results of renal transplantation*

* Ptn survival after 1 y → 90%
* Graft survival: 1y → 90%; 5ys → 60%; 10ys → 40%
   → due to chronic rejection

**Uroradiography**

*Normally: *

- Kidney size 3 × 6 × 12 cm (with variation even in the same individual)
- Radiological site of kidney:
  - Up → last thoracic spine.
  - Down → 3rd lumbar spine.
  - Over the last 1 or 2 ribs.

*Radiological investigations of Urinary tract:*

(I) Plain Film "X-ray"

= KUB → Kidney Ureter Bladder.

**Characters of good KUB:**

1) Should show area of the last 2 ribs (upper level)
2) Should show symphysis pubis & part of U.B (lower level)
3) Well centralized: - 2 iliac bone are equal on both sides.
   - length of 2 ribs on both sides is equal.

4) Well prepared ptn (with enema) to lead to minimal amount of intestinal gas (its
   black shadow can obscure a pathology behind e.g. stone)

5) Psoas line should be well identified at least on one side as it's a site of lower pole
   of the kidney & whole course of ureter, so if it's disturbed → pathology around
   the kidney e.g. perinephric blood collection, abscess.

**Data gained from KUB:**

(1) **Calculi** at any level (Radio-opaque shadow)

→ DD of radio-opaque shadow at:

**Rt kidney:**
- Faecolith.  - Calcified L.N (mesenteric)
- Gall bladder stone.  - Kidney stone.

**Lt kidney:**
- Fecolith  - Splenic calcification.
- Calcified L.N.  - Kidney stone.

→ How to differentiate ( ) kidney & G.B stone?

By:  - Lateral view X-ray & distance ( ) it & vertebral column:
   - In front of Vertebral column → G.B. stone.
   - Over the vertebral column → kidney.
- U/S.
- 1VP.

→ DD of radio-opaque shadow at Lt & Rt side of the pelvis:

1) Calcified L.N.  2) Faecolith.  3) Calcified fibroid.
4) Ureteric stone.  5) Philboli (calcified pelvic bl. vs esp in ♀)

→ How to DD ( ) ureteric stone & philboli:

By: - Plain film → ureteric stone:
   - circular.
- well circumscribed.
- umblicated (calcified wall but lumen not calcified)

- IVP

(2) Fracture pelvis: which can lead to trauma of bladder or urethra.

(3) T.B spine → eaten vertebra.

(4) Fracture rib → kidney injury.

(5) Tumours: - Osteolytic lesions (↓ density) → Renal Tr.
   - Osteosclerotic lesions (↑ density) → Prostatic Tr.

(6) Soft tissue shadow: - kidney - bladder - psoas line
   1) Perinephric abscess (↑kidney size, obliteration of psoas line& sclerosis of vertebral column to the side of abscess)
   2) Calcification of related Bilharzial lesions in the bladder wall.
   3) ↑ kidney shadow in (hydronephrosis, pyonephrosis, PCK& tumours)

(II) IVP:

- Principle:
  - By: - Contrast dye IV
  - X-ray film.
  - Contrast dye is non metabolized & excreted in the kidney, (iodine containing)

- Normal IVP:
  - Ureter: - non dilated < 0.5 cm.
    - may be non visualized d.t. peristalsis.
  - Renal pelvis: triangular.
  - Calices: cupped.

- Abnormal IVP:
  1) Calices → flattened, clubbing, dilated minor /major calices. (+ve back pressure) (MCQ)
  2) Ureter → bifid ureter (doublex), dilated down to the level of pathology, non. visualized ureter below.
3) Stone → if radiolucent = filling defect.
4) Trauma → irregular shadow.
5) Bladder filling defect: either: - stone (smooth)
    - mass (irregular)

(III) U/S:
- **Principle:** It hits structure of the body then the reflected different intensities (according to H₂O content) are recorded. The same introducer receives the reflection.
- **Can detect:** 1) Solid from cystic mass.
    2) All types of stones: - Radiolucent. - Radio-opaque.

N.B.: MCQ
- D of radio-opaque stones → plain X-ray, U/S
- D of radiolucent stones → U/S, IVP (not plain X-ray)

**Laparoscopy**

*indications:*

A) Diagnostic:
   1) UDT.
   2) Renal biopsy for nephrology.
   3) Lymphadenectomy for staging (cancer bladder, prostate, ….)

B) Therapeutic: → Ablative.
    → Reconstructive.

**Ablative:**
   1) Nephrectomy (simple, partial, radical)
   2) Adrenalectomy.
   3) Nephro-ureterectomy.
   4) Cyst deroofing.
5) Radical prostatectomy.
6) Radical cystectomy.
7) Orchiectomy.
8) Lymphocelectomy (one of renal transplantation complications)

**Reconstructive:**

1) Pyeloplasty.
2) Pyelolithotomy.
3) Nephropexy (fixation of the kidney after sever regime which depletes the perinephric fat → dragging on the pedicle → sever pain)
4) Orchiopexy.
5) Augmentation.
6) Uretero-lithotomy.
7) Ureteral re-implantation.
8) Continent urinary diversion.

* Advantages of laparoscope: (MCQ)

1) Minimal access surgery.
2) Fine dissection.
3) Short convalescence.
4) Low incidence of wound related complications (pain, disfigurement, infection, hernia)
5) ↑ Safety of attending staff
   
   **No:** - Hepatitis (viral infection B,C)
   - AIDS

**Disadvantages of laparoscope: (MCQ)**

1) Take much time.
2) Needs much experience.
3) Difficult management of major arterial bleeding.

4) Lack of direct tissue handling.

*C.I of laparoscope: (MCQ)*

1) Uncorrected coagulopathy → e.g. liver cell failure &↓↓ Vit. K.

2) Sever cardiopulmonary dse → d.t. ↑ risk with pneumoperitoneum.

3) High risk pttn of bowel injury → e.g. peritonitis, multiple abdominal surgeries (d.t. adhesions & distant anastomosis)

4) Previous renal surgery.

*Complications of laparoscope:

(1) Access related:

- Emphysema (Surgical emph. Of mesentry)
- Bleeding.
- Organ injury esp. if associated with pathology.

(2) Procedure related:

- Pneumothorax.
- Pneumomediastinum.
- Organ injury.
- Bleeding.

(3) Post-operative (at puncture site):

- Pain.  - Infection.
- Hernia.  - Adhesions.
- Fistula.

*Equipment:

1) Automatic high flow insufflators (CO₂)
2) Lens system: - 0° (5 mm or 10 mm.) - 30° (10 mm) (optional)
3) Trocars: - 5mm, 10mm, 12mm. - disposal ore reusable.
4) Camera & Video equipment
5) Xenon light.
*Access:

→ Transperitoneal:  - Abdominal  - Pelvic.

→ Retroperitoneal.

(A) Transperitoneal:

- Advantages
  
  - Capacious space (3-5 liters) |
  
  - Easy anatomical landmark.
  
  - Large organ manipulation e.g. Hydronephrosis

- Disadvantages:

  1 - Long operative time.          2- possible organ injury
  
  3- possible bowel herniation      4- possible adhesion

-Access:

1) Veress needle puncture technique.

   either: - umbilical   - subcostal   - iliac   - low midline.

2) Visiport technique.

3) Open technique (Hasson Trocar)

4) Hand assisted (endohand)

- Pneumoperitoneum:

  → 13-15 mm Hg pressure by insufflation of :-

1) CO₂ → most important → inert, non inflammable, can be excreted by lung if absorbed.

2) Filtered room air.

3) Helium.

4) Argon.

5) Nitric oxide NO.

B) Retroperitoneal:

Indications:  - Adrenalectomy  - nephrectomy

- Pyeloplasty  - Nephro-ureterectomy.

- Varicocelectomy.
5. Differential Diagnosis in urology

BPH
- Prostate cancer
- Urinary obstruction (stricture, stone)
- Cystitis
- Prostatitis
- Neurogenic bladder
- Bladder cancer
- Causes of polyuria and frequency (DM, Diuretics, caffeine, alcohol)

Prostate cancer
- BPH
- Prostatitis
- Prostatic stones
- Bladder cancer
- Other sources of bone metastases: lung, kidney, thyroid, multiple myeloma

Neurogenic bladder
- Stroke
- Multiple sclerosis
- Parkinson’s disease
- Spinal cord lesion or injury
- DM
- Pelvic surgery or trauma
- Tabes dorsalis (neurosyphilis)
- Herniated lumbar disc

Bladder cancer
- Cystitis (bacterial, interstitial, chemical, radiation)
- Urinary calculi
- BPH
- RCC
- Prostate cancer

Renal cell carcinoma (RCC)
- TCC of urethra, bladder, ureter or renal pelvis
- Renal cyst
- Adrenal tumor
- Renal abscess
- Renal oncocytoma
- Renal angiomylipoma
- Metastases (contralateral kidney, lung, breast, stomach)
- Lymphoma
- Urinary calculi
- Renal infraction

**Testicular mass or swelling**
- Inguinal hernia
- Hydrocele
- Testicular cancer
- Epididymitis
- Orchitis
- Testicular torsion
- Varicocele
- Testicular cyst (epidermoid cyst)
- Lymphoma
- Lymphedema (filariasis)
- Metastases (prostate, lung, GI, melanoma, kidney)

**Cloudy urine**
- UTI
- Alkaline urinary PH
- Chyluria (lymph in urine) due to fistula with lymphatics e.g: filariasis, TB, retroperitoneal tumor

**Acute cystitis**
- Pyelonephritis
- Urethritis
- Vaginitis
- Prostatitis
- Epididymitis
- Asymptomatic bacteruria
- Interstitial cystitis
- Urethral syndrome
- Pelvic inflammatory disease
- Urinary calculi
- Radiation or chemical cystitis
- Bladder cancer
- Urinary incontinence
- Atrophic vaginitis
- In men associated with: infected renal calculi, chronic urinary retention

**Pyuria**
- Cystitis
- Urethritis
- Epididymitis
- Orchitis
- Prostatitis
- Pyelonephritis
- Perinephric abscess
- Renal TB (sterile pyuria)

**Dark urine**
- Hematuria
- Biliary tract obstruction
- Hepatitis
- Dehydration (concentrated urine)
- Hemolytic anemia
- Rhabdomyolysis
- Ingestion of beets
- Phenazopyridine
- Acute porphyria

**Hematuria**
- Cystitis
- Urinary calculi
- BPH
- RCC
- TCC
- Glomerulonephritis
- Polycystic kidney disease
- Anticoagulant use
- Prostate cancer
- Papillary necrosis (NSAID overuse, DM, sickle cell)
- Renal infraction
- Interstitial nephritis
- Medullary sponge kidney
- Radiation or chemical cystitis
- Atrophic vaginitis
- Schistosomiasis
- Menses

**Dysuria**
- Cystitis
- Urethritis (e.g. gonorrhea, Chlamydia)
- Pyelonephritis
- Vaginitis
- Epididymitis
- Balanitis
- Prostatitis
- Interstitial cystitis
- Urethral syndrome
- Genital herpes
- Atrophic vaginitis
- Reactive arthritis (Reiter’s syndrome)

**Epididymitis**
- Testicular torsion
- Inguinal hernia
- Testicular malignancy
- Torsion of appendix of testis or epididymis
- Hydrocele
- Varicocele
- Orchitis
- Acute bacterial prostatitis
- Urethritis

**Erectile dysfunction**
- DM
- Atherosclerosis (leriche syndrome: impotence and claudication)
- Hypogonadism
- Stroke
- Local trauma
- Hyperprolactinemia
- Hyperthyroidism
- Cushing’s syndrome
- Addison’s disease
- Acromegaly
- Multiple sclerosis
- Spinal cord trauma or tumor
- Psychogenic
- Drugs

**Frequency (urinary)**
- Cystitis
- Urethritis
- Pyelonephritis
- DM
- Diabetes insipidus
- Excess fluid intake
- Diuretics
- Caffeine, alcohol
- Chronic urinary retention
- Neurogenic bladder
- Interstitial cystitis
- Urethral syndrome
- Extrinsic bladder compression (pelvic tumor, radiation fibrosis)
- Urinary calculi
- Anxiety

**Urinary incontinence**
- Cystitis
- Prostatitis
- Interstitial cystitis
- Medications (diuretics, alcohol, caffeine, hypnotics)
- Polyuria (DM, DI, hypercalcemia)
- Fistula (vesicovaginal, ureterovaginal)
- Dementia
- Normal pressure hydrocephalus

**Nocturia**
- BPH
- Congestive heart failure
- DM
- Diuretic use
- Cystitis
- Urinary incontinence
- Obstructive sleep apnea

**Urgency (urinary)**
- Cystitis
- Urethritis
- Pyelonephritis
- Neurogenic bladder
- Interstitial cystitis
- Urethral syndrome
- Urinary calculi

**Testicular pain (scrotal pain, groin pain)**
- Trauma
- Epididymitis
- Testicular torsion
- Inguinal hernia
- Hydrocele
- Varicocele
- Orchitis
- Torsion of appendix testis or epididymis
- Testicular tumor
- Prostatitis
- Urinary calculi
- Renal disorder
- Hip joint arthritis
- Iliopsoas bursitis
-  Ilioinguinal, iliohypogastric, or genitofemoral neuralgia
-  Lumbar disc or cord disease

**Urinary calculi**
-  Cholecystitis
-  Appendicitis
-  Diverticulitis
-  Epididymitis
-  Pyelonephritis
-  Prostatitis
-  Pancreatitis
-  Pneumonia (lower lobe)
-  Abdominal aortic aneurysm
-  Musculoskeletal pain

**Urinary tract obstruction**
-  BPH
-  Bilateral ureteral calculi
-  Urethral structure
-  Neurogenic bladder
-  Prostate cancer
-  Bladder cancer
-  Extrinsic compression (pelvic or GI tumor)
-  Urethral carcinoma
-  Meatal stenosis

6. **Glossary of Terms in urology**

**AIDS** - acquired immune deficiency syndrome

**ANOVA** - analysis of variance

**AUA** - American Urological Association

**BAUS** - British Association of Urological Surgeons

**BCG** - bacille Calmette-Guérin

**BPH** - benign prostatic hyperplasia

**BSA** - bovine serum albumin

**BOO** - bladder outlet obstruction
CI - confidence interval
CNS - central nervous system
CT - computed tomography
DMSA - dimercapto-succinic acid
DRE - digital rectal examination
DTPA - diethylene-triamine-penta-acetic acid
EDTA - ethylenediamine tetra-acetic acid
ELISA - enzyme-linked immunosorbent assay
ESWL - extracorporeal shock wave lithotripsy
FSH - follicle-stimulating hormone
GFR - glomerular filtration rate
GnRH - gonadotrophin-releasing hormone
GP - general practitioner
hCG - human chorionic gonadotrophin
HIV - human immunodeficiency virus
HPLC - high-pressure liquid chromatography
ICS - International Continence Society
IGF - insulin-like growth factor
IgX_\text{z} - immunoglobulin (class X, subclass z)
IPSS - International Prostate Symptom Score
IVU - intravenous urography
LHRH - luteinizing hormone-releasing hormone
LUTS - lower urinary tract symptoms
MAG3 - mercapto-acetyltriglycine
MHC - major histocompatibility complex
MRI - magnetic resonance imaging
NSAIDs - nonsteroidal anti-inflammatory drugs
PAGE - polyacrylamide gel electrophoresis
PBS - phosphate buffered saline
PCR - polymerase chain reaction
PSA - prostate-specific antigen
PTFE - polytetrafluoroethylene
PUJ - pelvi-ureteric junction
PUV - posterior urethral valves
RCC - renal cell carcinoma
sd - standard deviation
SDS - sodium dodecyl sulphate
TCC - transitional cell carcinoma
TGF - transforming growth factor
TNF - tumour necrosis factor
TNM - Tumour-Node-Metastasis
TRUS - transrectal ultrasonography
TURP - transurethral resection of the prostate
TURBT - transurethral resection of bladder tumour
UTI - Urinary tract infection
VUR - vesico-ureteric reflux
WHO - World Health Organization

7. Normal Laboratory Values

Blood [B], Plasma [P], Serum [S], Urine [U].

Values may vary with method of measurement and population

**Blood, Plasma, or Serum Chemical Constituents**

**Creatinine:** [S or P] 0.7-1.5 mg/dL (62-132 μmol/L)

**Glucose:** [S or P] 65-110 mg/dL (3.6-6.1 mmol/L)

**Osmolality:** [S] 280-296 mOsm/kg water

**Prostate-specific antigen (PSA):** [S] 0-4 ng/mL

**Urea nitrogen:** [S or P] 8-25 mg/dL (2.9-8.9 mmol/L)

**Uric acid:** [S or P] Men, 3-9 mg/dL (0.18-0.54 mmol/L); women, 2.5-7.5 mg/dL (0.15-0.45 mmol/L)

**Hormones, Serum, or Plasma**

**Adrenal:**

Aldosterone: [P] Supine, normal salt intake, 2-9 ng/dL (56-250 pmol/L); increased when upright.

Cortisol: [S] 8:00 AM, < 5-20 μg/dL (0.14-0.55 μmol/L); 8:00 PM, < 10 μg/dL (0.28 μmol/L).

Deoxycortisol: [S] After metyrapone, > 7 μg/dL (> 0.2 μmol/L).

Dopamine: [P] < 135 pg/mL.

Epinephrine: [P] < 0.1 ng/mL (< 0.55 nmol/L).

Norepinephrine: [P] < 0.5 μg/L (< 3 nmol/L).

**Gonad:**
Testosterone, free: [S] Men, 10-30 ng/dL; women, 0.3-2 ng/dL. (1 ng/dL = 0.035 nmol/L).

Testosterone, total: [S] Prepubertal, < 100 ng/dL; adult men, 300-1000 ng/dL; adult women, 20-80 ng/dL; luteal phase, up to 120 ng/dL.

Estradiol (E2): [S, special handling] Men, 12-34 pg/mL; women, menstrual cycle 1-10 days, 24-68 pg/mL; 11-20 days, 50-300 pg/mL; 21-30 days, 73-149 pg/mL (by radioimmunoassay [RIA]). (1 pg/mL = 3.6 pmol/L.)

Progesterone: [S] Follicular phase, 0.2-1.5 ng/mL; luteal phase, 6-32 ng/mL; pregnancy, > 24 ng/mL; men, < 1 ng/mL (by RIA). (1 ng/mL = 3.2 nmol/L.)

Kidney:

Renin activity: [P, special handling] Normal sodium intake: Supine, 1-3 ng/mL/h; standing, 3-6 ng/mL/h. Sodium depleted: Supine, 2-6 ng/mL/h; standing, 3-20 ng/mL/h.

Parathyroid: Parathyroid hormone levels vary with method and antibody. Correlate with serum calcium.

Pituitary:

Growth hormone (GH): [S] Adults, 1-10 ng/mL (46-465 pmol/L) (by RIA).

Thyroid-stimulating hormone (TSH): [S] < 10 μU/mL.

Follicle-stimulating hormone (FSH): [S] Prepubertal, 2-12 mIU/mL; adult men, 1-15 mIU/mL; adult women, 1-30 mIU/mL; castrate or postmenopausal, 30-200 mIU/mL (by RIA).

Luteinizing hormone (LH): [S] Prepubertal, 2-12 mIU/mL; adult men, 1-15 mIU/mL; adult women, < 30 mIU/mL; castrate or postmenopausal, > 30 mIU/mL.

Corticotropin (ACTH): [P] 8:00-10:00 AM, up to 100 pg/mL (22 pmol/L).

Prolactin: [S] 1-25 ng/mL (0.4-10 nmol/L).

Somatomedin C: [P] 0.4-2 U/mL.

Antidiuretic hormone (ADH; vasopressin): [P] Serum osmolality 285 mOsm/kg, 0-2 pg/mL; > 290 mOsm/kg, 2-12+ pg/mL.

Renal Function Tests
**Creatinine clearance (ml/min):** calculation from serum creatinine:

Men = (140-age) x (wt in kg) / 72 x serum creatinine (mg/dL)

Women = calculated value x 0.85

**Creatinine clearance, endogenous (GFR):** Approximates inulin clearance (see below).

**Inulin clearance (GFR):** Men, 110-150 mL/min; women, 105-132 mL/min (corrected to 1.73 m² surface area).

**Osmolality:** On normal diet and fluid intake: Range 500-850 mOsm/kg water. Achievable range, normal kidney: Dilution 40-80 mOsm; concentration (dehydration) up to 1400 mOsm/kg water (at least 3-4 times plasma osmolality).

**Specific gravity of urine:** 1.003-1.030.

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**Miscellaneous Normal Values**

**Adrenal hormones and metabolites:**

**Aldosterone:** [U] 2-26 μg/24 h (5.5-72 nmol). Values vary with sodium and potassium intake.

**Catecholamines:** [U] Total, < 100 μg/24 h. Epinephrine, < 10 μg/24 h (< 55 nmol); norepinephrine, < 100 μg/24 h (< 591 nmol). Values vary with method used.

**Cortisol, free:** [U] 20-100 μg/24 h (0.55-2.76 mmol).

**11,17-Hydroxycorticoids:** [U] Men, 4-12 mg/24 h; women, 4-8 mg/24 h. Values vary with method used.

**Metanephrine:** [U] < 1.3 mg/24 h (< 6.6 μmol) or < 2.2 μg/mg creatinine. Values vary with method used.

**Vanillylmandelic acid (VMA):** [U] Up to 7 mg/24 h (< 35 μmol).

Thank you

End