

# Urology

## ❖ Anatomy

- Kidney: lies retroperitoneally on the posterior abdominal wall.
  - Superior: diaphragm, which separates it from the pleura and the 11th and 12th ribs.
  - Inferior: lies on the psoas, quadratus lumborum and transversus abdominis muscles from medial to lateral.
  - Anteriorly: Rt kidney covered by the liver, 2nd duodenum and ascending colon. Lt kidney by spleen, stomach, tail of pancreas, left colon and small bowel.
- ★ Stones tend to impact at the three points where the ureter narrows: namely, the pelviureteric junction (PUJ), pelvic brim and ureteric orifice.
- Bladder: In children up to 4 y, it lies in abdomen; adults in pelvis.
  - Superior: The bladder is covered with peritoneum.
  - Posterior: rectum, vas deferens and seminal vesicles (male). vagina and supravaginal cervix (female).
  - Inferior: the neck of the bladder transmits the urethra and fuses with the prostate in the male and with the pelvic fascia in the female.<sup>1</sup>

## ❖ Physiology:

- Neurological control of micturition:
  - Detrusor contraction is mediated through cholinergic parasympathetic nerves. **a-adrenergic** receptors found in the smooth muscle of the bladder neck and proximal urethra. Receptors respond to NE by stimulating contraction (maintaining continence).
- The micturition cycle has two phases.
  - Storage (or filling) phase: Bladder fills steadily without a rise in intravesical pressure, due to the elasticity of detrusor muscles.<sup>2</sup>
  - Emptying (or micturition) phase: Micturition is initiated first by voluntary and then by reflex relaxation of the pelvic floor and distal sphincter mechanisms, followed by reflex detrusor contraction (controlled by pontine micturition center).<sup>3</sup>

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<sup>1</sup> - The bladder is composed of whorls of detrusor muscle, which in the male become circular at the bladder neck. They are richly supplied with sympathetic nerves that cause contractions during ejaculation, thereby preventing semen from entering the bladder (retrograde ejaculation). There is no such sphincter in the female.

- The bladder is lined with specialised waterproof epithelium, the urothelium. This is thrown into folds over most of the bladder, except the trigone where it is smooth.

<sup>2</sup> Stretch receptors in the bladder wall are stimulated, resulting in reflex bladder relaxation and reflex increased sphincter tone to maintain continence till suitable to void.

<sup>3</sup> Intravesical pressure remains greater than urethral pressure until the bladder is empty. These responses depend on normal anatomical structures and normal innervation. There are thus two main types of disorders of micturition: **structural** and **neurogenic**. Examples are extensive carcinoma of the prostate that has damaged the sphincter mechanism (structural), and spinal cord injury that has damaged the innervation (neurogenic).

## ❖ Assessment

- Urinary tract symptoms:
  - Pain:
    - Renal pain (in the angle b/w 12th rib and sacrospinalis). Ureteric pain/colic (radiates forward and downward towards groin, testis or labia. Acute bladder obstruction (central lower AP). Chronic bladder obstruction (asymptomatic). Enlarged prostate can cause rectal Sx (tenesmus).
  - Disorders of micturition:
    - Distinguish b/w Obstruction (Poor stream), storage problems (urgency), Infection (Frequency, dysuria), Malignancy (Dark, discoloured, or brown, red, pink urine). Hesitancy, poor stream and dribbling are characteristics of bladder outflow obstruction (BOO).
  - Hematuria:
    - May be Gross or Microscopic, may be intermittent or persistent, may present throughout the act of micturition or only during a particular phase (initial, midstream, terminal). May be painful or painless.
  - Dysuria:
    - Usually localised to urethra and associated w/ acute inflammatory condition. May be associated w/ frequency, urgency.
  - Frequency, Nocturia, Urgency:
    - All are the result of the inability to hold urine by bladder.
  - Incontinence:
    - True incontinence is w/o precipitating factors. Stress happens w/ increased intravesical pressure <sup>4</sup> (coughing, laughing). Urge is associated w/ urgency and seen in acute inflammatory conditions. Overflow incontinence seen w/ chronic urinary retention.
  - Oliguria, Anuria:
    - Oliguria (decreased), Anuria (absence). <400 mL/day
  - ★ Obstructive (voiding) Sx: **WISE** - **W**Weak stream, **I**ntermittent flow, **S**training to urinate, **E**mpying incomplete.
  - ★ Irritative (storage) Sx: **FUN** - **F**requency, **U**rgency, **N**octuria.
- Examination: Multi-systems, ballootment, speculum, pelvic, PR.

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<sup>4</sup> Which leads to loss of urine due to weakness of the sphincter mechanism.

- Investigations:
  - Urine:
    - Dipstick:
      - ✓ Proteinuria: In the absence of infection urine is protein free.
      - ✓ Glycosuria: Suggests DM.
      - ✓ Leukocytes and nitrites: suggests UTI.
      - ✓ Specific gravity: conditions affecting renal medulla such as chronic renal failure cause loss of concentration ability and presents with fixed low specific gravity.
    - Microscopy: Detects casts or tubular epithelial cells (renal parenchymal dis.), crystals (renal calculi pts), Ova (schistosomiasis).
    - Cytology/urinary cellular markers: Dx and F/U of bladder and urothelial cancers.
    - Mid-stream specimen of urine (MSSU): microbiology assessment.
  - Blood tests: electrolytes, BUN, Creatinine clearance estimates GFR.<sup>5</sup> Normocytic normochromic anemia (chronic renal failure). ESR rises in idiopathic retroperitoneal fibrosis. B-HCG, A-fetoprotein, Prostate-specific antigen.
  - Ultrasonography: First line approach. Information about renal parenchyma but less about collecting system. Helpful in evaluating bladder, tests. Prostate, epididymis. For prostate Tranrectal is better (TRUS).
  - Plain X-ray films: KUB. shows calcification in urinary tract.
  - Intravenous Urography (IVU): IV iodine+serial x-rays= demonstrates renal pelvis, calyces, rate of renal emptying, caliber of ureters, bladder outline.
  - Computed tomography urography (CTU): detects renal and ureteric calculi.
  - Retrograde pyelography: special investigation used to outline the collecting system and the ureters. Invasive. Risk of introducing an infection. Ureter is cannulated under cystoscopic vision in a retrograde fashion using fine catheters. Radiopaque dye is injected under fluoroscopic screening to outline collecting system.

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<sup>5</sup> Creatinine is a breakdown product of skeletal muscle and serum level do not begin to rise until the GFR is halved.

## ❖ Urolithiasis:

- Mechanism of stone formation<sup>6</sup>: Supersaturated urine → Crystal growth → Aggregation of crystals → Stone formation.
- Risk factors: poor fluid intake, IBD, hypercalcemia, Renal tubular acidosis and bowel bypass, genetic (cystine, tubular acidosis).
- Types:
  - Radiopaque: Calcium oxalate (85% most common, caused by hypercalciuria, hypercalcemia, hyperoxaluria, hypocitraturia - associated w/ IBD/bowl bypass), Struvite (associated w/ UTIs) **S**truvite = **S**epsis (UTIs).
  - Radiolucent calculi: **U**ric acid (**U**nseen), cystine, indinavir (radiolucent even on CT), triamterene and matrix calculi are not visualised on plain film. A noncontrast CT KUB is the modality of choice for these.
- Clinical features
  - **S** (flank/groin) **O** (sudden) **C** (colicky) **R** (testis/iliac fossa/lower abdomen) **A** (analgesics/movement) **T** (intermittent) **E** (nothing) **S** (very severe).
  - Renal calculi: **flank pain**, which may be **colicky** (arising from the renal pelvis) or a noncolicky dull ache (arising from the renal capsule).
  - Ureteric calculi: colicky pain and the site of the stone in the ureter determines the site of the pain: upper ureteric calculi (costovertebral angle or flank pain), mid-ureteric calculi (pain radiating from loin to groin), and lower ureteric calculi (pain radiating to the testicles and labia majora). All are unilateral.
  - Vesical calculus: lead to suprapubic pain, recurrent UTIs, intermittent urinary stream or urgency.
  - Any stone may also cause **haematuria**.<sup>7</sup>
  - Urethral calculi: **dysuria** and pain radiating to the tip of penis may be secondary (passing down from the bladder) or primary (stricture or diverticulum in the urethra).
  - Increased HR and BP (pain), fever (UTI, Pyelonephritis), N/V, diarrhea.

### → Investigations

- **Pregnancy test (excluding pregnancy), MSU (Hematuria), U&E (if unilateral stone it will be normal), BUN+Cr (assess renal function) UA (RBCs, WBCs, Crystals, Bacteria).**
- **CT KUB W/O contrast (position and size). Gold standard**
- **US: renal and vesical calculus disease (preferred in children, women of childbearing age and pregnant females).**

<sup>6</sup> Imbalance between Inhibitors (Citrate, Mg, pyrophosphate, and urinary proteins) and promoters (: Oxalate, uric acid, hypercalciuria).

<sup>7</sup> However, a stone in the kidney may remain silent, even one large enough to fill the pelvis and calyces ('staghorn' calculus).

- Urine culture will determine if there is infection. (admit pt if fever and order blood & urine culture).
  - Common sites of obstruction: UreteroPelvic Junction (UPJ), UreteroVesicular Junction (UVJ), Intersection of the ureter and iliac vessels.
- Management
    - Sx Tx as soon as confirmed Dx, IM diclofenac; pethidine is an alternative.
    - Stone size and smoothness determines the likelihood of spontaneous passage.<sup>8</sup>
    - Indications of admission: Fever/pyelonephritis, Refractory pain (not controlled with oral analgesia), Renal failure, Persistent nausea and vomiting.
    - If Fever is present: order blood & urine culture & CXR “ARDS” (u r suspecting sepsis), then start antibiotics and drain the kidney. (treat/prevent sepsis first then stone).<sup>9</sup>
- Medical Management:
- **Pain relief:** NSAIDs. - +/- Opiate analgesics (pethidine or morphine).<sup>10</sup>
  - **Hyper hydration** (IV fluids and drinking water).
- Surgical Management:
- Indications for Intervention:
    - To Relieve Obstruction and/or Remove the stone.
    - Pain that fails to respond to analgesics.
    - Association with fever.<sup>11</sup>
    - Renal function impairment caused by stone, which may cause uremia.<sup>12</sup>
    - Obstruction unrelieved (not to exceed 4 weeks).<sup>13</sup>
    - Personal or occupational reasons: doctors or pilots.
  - **Temporary** relief of the obstruction:
    - Insertion of a double coil or **JJ stent**.
    - percutaneous nephrostomy **tube**.
  - **Definitive** :
    - Extracorporeal Shock Waves Lithotripsy (**ESWL**).<sup>14</sup>
    - Percutaneous Nephrolithotomy (**PCNL**).<sup>15</sup>

<sup>8</sup> A stone less than 5 mm in diameter should pass easily. The location of the stone in the ureter also determines the ease with which it will pass: small lower ureteric stones having a higher likelihood compared with larger upper or mid-ureteric calculus. Immediate treatment should be considered in cases of ongoing pain, renal obstruction or, more importantly, where there are signs of sepsis (infected obstructed kidney).

<sup>9</sup> In this case, if you do shock wave or ureteroscopy to remove the stone, patient might go into sepsis and die. Also, if you leave this patient on antibiotics only, patient might go into sepsis and die. Therefore, you have to give antibiotics and drain the patient renal system then 2-3 weeks later after the infection resolves, place either a nephrostomy tube or a double J stent to treat the stone.

<sup>10</sup> may cause vomiting, So we give antiemetic.

<sup>11</sup> (fever highly suggests pyelonephritis which requires drainage because it may cause septicemia).

<sup>12</sup> And how do we assess renal functioning? = increase creatinine

<sup>13</sup> After 4 weeks obstruction will cause necrosis.

<sup>14</sup> renal and ureteric stones. Stones visualised on x-ray or US can be treated by ESWL, especially those that are single and up to 2 cm.

<sup>15</sup> Direct puncture of the kidney, insertion of a sheath and removal under vision with a nephroscope w/ or w/o ultrasonic disaggregation (stones in the kidney that are unlikely to pass even if broken up).

- Ureterorenoscopy (URS): usually the lower 2/3 of the ureter is accessible by this procedure.<sup>16</sup>
- Laparoscopic extraction if combined pathology (rare).
- Open Surgery.
- Vesical calculi: Endoscopically like ureteric calculi. pneumatic lithotrite or holmium laser.<sup>17</sup>
- Urethral calculi: Primary are treated along with the inciting cause. Secondary may be removed intact endoscopically if small, or may have to be crushed and removed.

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<sup>16</sup> stones broken up using a holmium **laser** or removed intact using a Dormia wire basket.

<sup>17</sup> open suprapubic cystolithotomy, or by suprapubic insertion of a nephroscope and the use of ultrasonic shattering (large stones)

## ❖ Benign prostatic hyperplasia (BPH):

- Clinical features:
  - Lower urinary tract symptoms (Irritative “storage” and/or Obstructive “voiding”)<sup>18</sup>.
  - Poor bladder emptying.
  - Urinary retention.
  - Urinary tract infection (UTI).
  - Hematuria.
  - Renal insufficiency.
  - Ask about: FHx of prostatic cancer (it’s familial but BPH is not) - Urethral/transurethral surgeries, prolonged catheterization and urethritis (R/O stricture) - Suprapubic pain, hematuria, burning micturition, dysuria and change in the smell of urine and turbid (R/O cystitis) - Total painless hematuria (bladder cancer) - Previous stones (R/O stones) -
- Physical examinations:
  - DRE (Digital rectal Examination): rubbery, symmetrical and smooth prostatic enlargement, with a median groove between the two lateral 'lobes'. Asymmetry or a hard consistency raises the suspicion of malignancy “if suspicious TRUS Bx is indicated”.
  - Look for Prostate and Rectal Cancers
  - Focused neurologic exam: Anal tone, Neurological examination<sup>19</sup>.
  - Abdomen: Distended bladder
- Investigations:
  - Urinalysis, Culture (UTI, Hematuria).
  - Serum Creatinine +BUN (blood tests for renal function).
  - Serum Prostate-Specific Antigen (PSA)<sup>20</sup>.
  - Flow rate. (Post Residual Volume is high)
  - US → (kidney, bladder and prostate).
- Management: Mild to moderate symptoms and not bothered by the symptoms → watchful waiting.
  - **Medical** therapy:
    - **Selective  $\alpha_1$ -Adrenergic Blockers**: Act by opening the bladder neck and relaxing the prostatic capsule to void easily (Tamsulosin, Alfuzosin, Terazosin). Has rapid effect and used for smaller size.
    - **5 $\alpha$  reductase inhibitor** (androgen suppression): Shrinks the prostate (Finasteride). Takes 4-6 months and used for >30 gm in size.

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<sup>18</sup> Sometimes obstructive symptoms and causes lead to irritative symptoms because when there is an obstruction the bladder hypertrophies which increase as the obstruction increases and starts having overflow incontinence and acts like neurogenic bladder which causes the irritative symptoms.

<sup>19</sup> some neurological disorders may cause bladder dysfunction (There is micturition center in the pons).

<sup>20</sup> Causes of increased PSA: increased age, prostatic Bx, prostatitis, ejaculation, catheterization, cystoscopy, transurethral procedures, large BPH. - causes for decreased PSA is 5- $\alpha$  reductase inhibitors.

- **Surgical** Rx : prostatectomy (removal of the whole or a part of prostate) - Indications (urinary retention, hydronephrosis, UTIs, bladder stones and severe symptoms)
  - **Endoscopic** (e.g. Transurethral resection of the prostate (**TURP**)<sup>2122</sup>, transurethral incision of the prostate (**TUIP**), laser ablation, prostatic stent); Cut adenoma that blocks the passage.
  - **Open** prostatectomy.<sup>23</sup>
- **Complication:**
  - BPH may lead to obstruction → stasis → UTIs, bladder stones, tumor, or obstructive uraemia<sup>24</sup>.

#### ❖ **Cystitis:**

- Ascending infection from the urethra to the bladder.
- S&S: Suprapubic pain, frequency, urgency, burning micturition, dysuria +/- hematuria, change in the smell of urine and becomes turbid. No fever.
- Dx: Dipstick (+ve nitrite indicates infection), Urinalysis, urine culture (gold standard, start empirically).
- Tx:
  - Nitrofurantoin is secreted in the urine, but don't give it to a pt that has fever because it has poor tissue penetration.
  - Bactrim for 3 days (3 female, 10 male) and education (wipe front to back not back to front, drink more water, don't delay emptying of bladder, empty bladder after sexual intercourse).

#### ❖ **UTIs (urethritis):**

- S&S: Urethral discharge, Dysuria, Burning on urination, Asymptomatic (25% especially in women).
- Dx: urethral swab & culture.
- Rx: Abx
  - It is either gonococcal (*Neisseria gonorrhoeae*) or non-gonococcal (*Chlamydia trachomatis*).
  - If gonococcal give ceftriaxone (+azithro or clinda), if chlamydia give azithromycin or clindamycin (+ceftriaxone).

<sup>21</sup>Complications: Failure to void, Bleeding, Clot retention, UTI, Incontinence.

<sup>22</sup> Prolonged resection can occasionally result in excessive absorption of glycine irrigation fluid and electrolyte imbalance (TURP syndrome).

<sup>23</sup> Reserved for very large adenomas After prostatectomy, the bladder must be allowed to drain freely via a urethral catheter while the prostatic bed heals and bleeding stops.

<sup>24</sup> which is characterized by Azotemia and decreased GFR, Oliguria, Nausea and vomiting, Weight loss, Muscles cramps.



## ❖ Congenital anomalies:

### → Introduction:

- Hydronephrosis: dilation of pelvicalyceal system.
- Hydroureter: dilatation of the ureter.
- Hydroureteronephrosis: both renal pelvis + ureter.
- Antenatal hydronephrosis:
  1. Dilation of pelvicalyceal system.
  2. Detected during pregnancy.
  3. By US.
- DDX of antenatal hydronephrosis (ANH) (Commonest causes):
  1. Pelviureteric junction obstruction (PUJO).
  2. Ureterovesical junction obstruction (UVJO).
  3. Vesicoureteric reflux (VUR).
  4. Posterior urethral valve (PUV).
  5. Multicystic dysplastic kidney (MCDK).
- DDX Of Unilateral ANH (antenatal hydronephrosis):
  - UPJO (most common), VUR, UVJO, Dilatation of one unit of duplex kidney, MCDK, PUVs, Megaureter.
- DDX of Bilateral ANH:
  - **Normal transient physiologic** findings (most common), **Bilateral VUR** (most common pathologic cause of bilateral ANH), PUV, Bilateral UPJO, Bilateral primary megaureter, Prune-belly syndrome (VUR), Bilateral duplication with obstruction, Prolapsing ectopic ureterocele (causes BOO), Bilateral multicystic or AD PCKD.
- Investigations<sup>25</sup>:
  1. **Ultrasound**: to evaluate the anatomical structure of the kidney and detect any dilatation (done antenatally by obstetrician and if suspected anomaly done postnatally).
  2. Micturating/voiding cystourethrogram (**MCUG/VCUG**)<sup>26</sup>:
    - Mainly anatomical.
    - A contrast is injected through a catheter, normally the contrast remains in the bladder doesn't go upward to the kidney (normal picture: normal shape of the bladder "spherical", contrast limited to the bladder & urethra is not dilated).

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<sup>25</sup> There is anatomical and physiological obstruction these 4 investigations can be done for all patients to find cause of hydronephrosis after delivery.

<sup>26</sup> A urinary catheter must be inserted for this procedure, and the patient must void. The main role of the VCUG is to rule out vesicoureteral reflux, and in boys to evaluate the posterior urethra. It should be performed in every child with a suspected UPJO.

### 3. Nuclear scan:

- DTPA (MAG-3):
  - It's an isotope not a contrast, there is uptake by the kidney.
  - It's equivalent to IVP but it has replaced it where there is uptake + excretion by the glomeruli to the renal pelvis > drainage to the ureter and bladder.
  - Assess function and **drainage**.
- **DMSA**: dimSa=Stay "mnemonic"
  - Isotope is given > uptake in the kidney > remains in the glomeruli not excreted compared to DTPA.
  - To assess **function** "more accurate".
- Diuretic nuclear scan: if u find non-excreting kidney (dilation) → give diuretics during scan and observe, if excreted then no obstruction it is only stasis of urine.

### 4. IVP:

- X-ray exam that uses a contrast that is given in I.V route goes to the kidney > uptake > excretion > drainage but it may cause nephrotoxicity especially in exhausted kidney (obstructed one).
- **DTPA/ DMSA has replaced IVP.**

### ★ The immediate assessment after birth (postnatal) for any patient with antenatal hydronephrosis is:

- **Hx**: maternal health, maternal PMHx & FHx, course of pregnancy, DM, HTN, meds, Previous pregnancies (siblings w/ VUR, hydro), gender, voiding (make sure pt is voiding, wetting diaper, is pt straining?).
- PEx: Associated anomalies ?
- baseline **RFT** (Cr, BUN, Electrolytes).<sup>27</sup>

### ★ Prophylactic antibiotic: All patients with antenatal hydronephrosis especially if bilateral we start them on prophylactic antibiotic until we reach our diagnosis where we can decide whether to continue on Abx or stop it.

- Difference between prophylactic and therapeutic antibiotics:

1. Lower doses (1/3rd of the therapeutic Abx).
2. Frequency: once daily.

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<sup>27</sup> If creatinine might be raised (normal up to 60) that's expected it's physiological. In the first 48 hours after birth the newborn reflects the creatinine level of the mother (half life of maternal Cr), so delaying the test so u can get the newborn's Cr level.

3. Choose Abx that is mainly excreted by kidney i.e. Bactrim (TMP/SMZ) is **contraindicated** in the first 3 months of life although it's the best prophylactic Abx, because it is metabolized by the liver that is not mature in this case so they will develop jaundice.

## → Kidney anomalies

- **Anomalies of form and fusion:**

1. Multicystic dysplastic kidney (**MCDK**):
  - Congenital abnormality of the connective tissue, a grape like cysts replaces the normal tissue (mass of cysts and fibrous tissue, no nephrogenic tissue).
  - Unilateral if bilateral dies in utero.
  - Detected during prenatal US (multi cysts, no pelvis, no communication b/w cysts).
  - DMSA: no function.
  - Rx: nothing unless pt started to be symptomatic (pain, infections) or increased size to the extent that it can be palpated by hand or US then managed by nephrectomy.
2. crossed renal ectopia with and without fusion:
  - a. Abnormal position of kidney but on the opposite side, ureter (insertion in the bladder) is not crossed to the opposite side. Types (crossed renal ectopia with fusion, crossed renal ectopia without fusion, solitary crossed renal ectopia, bilaterally crossed renal ectopia).
3. Horseshoe kidney<sup>28</sup>

- **Anomalies of rotation:** The most important thing to know is if the kidneys in the normal position or malpositioned.

- **Anomalies of number:**

1. renal agenesis:
  - a. unilateral renal agenesis: one kidney is absent (if compensated pt is asymptomatic and kidney hypertrophy occur - adrenal gland is present "different embryological origin")
    - i. Dx: CT abdomen, DMSA (nuclear medicine).
  - b. bilateral renal agenesis:
    - i. No compensation, amniotic fluid is formed by urine; so if there are no kidneys → no urine → no amniotic fluid → no nutrition → death (mostly due to respiratory distress).
2. supernumerary kidneys: More than 2 kidneys and all are functional (asymptomatic).

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<sup>28</sup> They are usually asymptomatic and are discovered incidentally on imaging. The fused mass usually has two collecting systems and two ureters. no intervention unless symptomatic or associated w/ other anomalies.

- **Anomalies of ascent:**

1. Simple renal ectopia: abnormal position of kidney however it is on the same side. Asymptomatic
  - a. 50% have hydronephrosis: obstruction (PUJO, UVJO), reflux (grade 3 or greater), malrotation.
2. Cephalad renal ectopia.
3. Thoracic kidney.

→ **Ureteral anomalies:**

1. Ureteropelvic junction obstruction (**UPJO**):
  - Hydronephrosis, normal ureter.
  - US: Thin parenchyma, dilated pelvis and calyces (hydronephrosis), normal bladder, check other kidney to know if bilateral or isolated.
  - MCUG: Normal filling of the bladder, no contrast going upward, normal urethra.
  - **Nuclear study (DTPA<sup>29</sup>):** Confirmatory.
  - Management:
    - No need for urgent intervention (because it is unilateral unless bilateral UPJO) unless baby develops pyelonephritis then managed by nephrostomy tube or stent.
    - **Pyeloplasty** (excise stenotic area and anastomose ureter to pelvis).
2. Ureterovesical junction obstruction (**UVJO**).
  - US: Hydroureteronephrosis either unilateral or bilateral, normal bladder.
  - MCUG: Normal smooth outline bladder since there is no reflux or obstruction, normal bladder is spherical in shape, normal urethra.
  - **DTPA<sup>30</sup>:** visible isotope at the level of ureter and pelvis (indication obstruction).
  - Rx: obstruction + decreased function = Surgery (ureteral reimplantation).
3. Vesicoureteral reflux (**VUR**)<sup>31</sup>:
  - Presentation: **antenatal hydronephrosis** or UTI.
  - Dx:
    - US: alternating hydronephrosis (if taken during voiding it shows system dilation, if empty bladder no dilation).

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<sup>29</sup> Not DMSA because I want to assess drainage.

<sup>30</sup> Normally we don't see the renal pelvis and ureter together in the same film if we saw them > there is obstruction at the distal ureter (so normally when the isotopes in the kidney, the ureter is not visible once it goes out to the ureter we can see it and it will not be seen in kidney anymore, if you see isotopes in both at the same time = distal obstruction).

<sup>31</sup> Normal anti-reflux mechanism (**Flap valve**): 1/Oblique course as it enters the bladder. 2/ Proper muscular attachments to provide fixation. 3/Posterior support to enable its occlusion. 4/Adequate submucosal length.

- MCUG<sup>32</sup>: contrast going to upper tract.
- Nuclear study (DMSA): we don't need to r/o obstruction we just need to assess function.
- 5 grades: (By cystogram)
  - grade I: reflux limited to ureter (distal ureter dilated - **half the ureter**).
  - grade II: reflux up to the renal pelvis without dilatation (**all ureter**).
  - grade III: mild dilatation of ureter and pelvicalyceal system + **loss of cupping**.
  - grade IV: **Ballooning of calyces** tortuous ureter with moderate dilatation blunting of fornices but preserved papillary impressions.
  - Grade V: **dilated tortuous ureter** with severe dilatation of ureter and pelvicalyceal system loss of fornices and papillary impressions.
- Rx: Observation (spontaneous resolution), Prophylactic ABX<sup>33</sup>, Surgical (deflux injection<sup>34</sup>, Ureteric reimplantation).
- In general: management of VUR observational with prophylactic Abx until spontaneous resolution of reflux.
- Low grade includes grade (I,II, and 50% of III) → spontaneous resolution of reflux. IV & V surgery.
- What if you start patient on prophylactic Abx but patient developed infection (pyelonephritis=FEVER)? What do we call it? **Breakthrough infection**<sup>35</sup>
- Indications for surgical intervention:
  1. If patient developed breakthrough infection.
  2. Non compliance to prophylactic Abx.
  3. If patient start developing hydronephrosis.
  4. If during follow up DMSA showed decrease in kidney function.
- Type of surgical intervention:<sup>36</sup>
  - Open surgery: Ureteral **reimplantation**.
  - Cystoscopy: Endoscopic reflux correction (Material **injection**).
- ★ If u r given a scenario that suggests VUR, make sure neurological deficits, spina bifida, myelomeningocele, (anything that suggests neurological cause)... r not mentioned in same scenario otherwise scenario will make neurogenic bladder more probable than reflux.

<sup>32</sup> Hydronephrosis is graded by US while VUF is graded by cystogram (MCUG).

<sup>33</sup>All patients with antenatal hydronephrosis we start them on prophylactic antibiotic until we reach our diagnosis. **VUR is the only** pathology where we continue prophylactic Abx. Always say "minimal effective dose of Abx"

<sup>34</sup> The process of urine going down through ureters (antegrade) is considered an active process due to multiple mechanisms (1/pressure gradient, 2/peristalsis, 3/gravity) so when injection is made mostly there won't be an obstruction and retrograde movement is resolved.

<sup>35</sup> That is why we give minimal effective dose, so incase pyelonephritis for a pt who is already on prophylactic abx u still have other effective antibiotics.

<sup>36</sup> Usually for grade 4 & 5. normally ureter will cross oblique and pass in bladder tunnel 3 cm, in patient with primary reflux they have short tunnel (Urine normally travels in one direction (forward, or antegrade) from the kidneys to the bladder via the ureters, with a 1-way valve at the ureterovesical junction preventing backflow. The valve is formed by oblique tunneling of the distal ureter through the wall of the bladder, creating a short length of ureter that can be compressed as the bladder fills. Reflux occurs if the ureter enters the bladder without sufficient tunneling), in this case we try to make the tunnel longer to recreate normal anatomy by **ureteral reimplantation** (like UVJO the only difference that in UVJ there is stenotic area that we need excision) or we do endoscopic correction by **injection** (Deflux, Teflon, autologous fat, blood).

4. Megaureters.
5. Ectopic ureter:
  - A ureter that doesn't enter the trigone of bladder.
  - In female it can insert anywhere from neck to rectum. (continuous wetting - due to insertion distal to sphincter)
  - In male it present w/ recurrent epididymitis, epididymo-orchitis (because it always enter the urogenital system above external sphincter).
6. Ureterocele: cystic dilation of distal ureter - not treated unless causing obstruction - could be intra or extravesical.
  - Presentation: Calculus formation, urinary retention, antenatal US, infection.
  - Dx: US, MCUG.
  - Rx: if present w/ obstruction we drain the urine using a cystoscope.

## → Bladder anomalies

1. Urachal abnormalities
  - Dx: imaging (CT & VCUG) continuation b/w umbilicus and contrast.
  - Rx: Conservative if asymptomatic, drainage and abx followed by surgical excision (infected urachal remnants), excused due to risk of adenocarcinoma formation (nonresolved urachal remnants).
2. Bladder diverticulum: weak bladder muscles leads to outpouching of the mucosa, if filled w/ urine it cause infection or retention.
  - 1ry: congenital, at uretral hiatus, 2ry: acquired, multiple, due to infravesical obstruction.
  - Dx: VCUG (gold standard, might reveal possible VUR), prenatal US.
  - Rx: asymptomatic no rx, Sx (surgical)
3. Bladder duplication.
4. Bladder exstrophy: loss of anterior wall of the abdomen and bladder (visible urine out of ureter on examination).

## → Urethral anomalies:

1. Posterior urethral valves (**PUV**): causes obstruction so bladder and kidney r developed under high pressure and resistance. Only in males.
  - Presentation: antenatal bilateral hydronephrosis, retention, poor stream, CRF (ESRD), incontinence, UTI..
  - Associated findings: oligohydramnios, valve bladder, renal impairment, VUR, bilateral renal dilation.
  - Dx:
    - US: Suspected findings (dilated posterior urethra, irregular thickened wall<sup>37</sup> bladder, dilated kidney and ureters). Sometimes posterior urethra is dilated and bladder wall is thick so it is called **keyhole sign**.
    - MCUG<sup>38</sup>: A **valve** within posterior urethra, **christmas tree bladder**, vesicoureteral **reflux**.
  - Management:
    - initial: **Catheterization** (bladder drainage), NICU<sup>39</sup>, prophylactic abx.
    - **Treatment is surgical**<sup>40</sup>: Endoscopic valve **ablation** (urgent).
2. Others: Anterior urethral valves, Urethral duplication, Congenital urethral stricture, Urethral polyps.

## → Anomalies of external genitalia:

1. Hypospadias<sup>41</sup>:
  - There is abnormal **ventral** opening of urethral meatus, abnormal ventral curvature, abnormal distribution of foreskin
  - 2 types (distal and proximal).
  - Dx: by PEx.
  - Rx: repair<sup>42</sup> (we do repair because we want to allow 1: effective insemination, 2: sexual intercourse, 3: micturition in preferable positions, 4: cosmetic).
2. Epispadias: External urinary meatus opens on the dorsal surface of the penis.
3. Micropenis
4. Cloacal exstrophy: pt has no anus compared to bladder exstrophy.

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<sup>37</sup> Pt has narrowing not complete obstruction (atresia), so during voiding bladder detrusor muscles contracts and sphincter relaxes and due to narrowing bladder has to overcome resistance (fibers increase in muscles © مئائته تصوير معضلة).

<sup>38</sup> That's why when a MCUG pic is shown and u r asked to comment on don't mention hydronephrosis (it is already mentioned in US what u need to mention is: 1/ irregular bladder wall, 2/reflux" don't say hydronephrosis", 3/hypertrophied bladder neck, 4/ marked discrepancy b/w anterior and posterior urethra).

<sup>39</sup> Effective NICU support for issues w/ pulmonary hypoplasia and renal insufficiency (fetus gets nutrition from amniotic fluid, amniotic fluid is the fetal urine "after 20W").

<sup>40</sup> We incise not excise. Even after incision the effect on kidney is not resolved because renal system have been working against resistance for > 6 months (antenatally) so some pts develop renal failure.

<sup>41</sup> Failure of the embryonic folds to fuse results in abnormal placing of the external urinary meatus on the ventral surface of the penis.

<sup>42</sup> The prepuce, which is in the form of a hood, should never be excised, as it is an important structure used in the reconstruction of the urethra.

- Prune-belly syndrome (eagle-barret's syndrome): Triad (anomalous urinary tract, deficiency of abdominal musculature, bilateral intra-abdominal testis) +/- cardiac anomalies (TF, VSD).

★ I did not include:

- Urinary tract injuries.
- Malignancy.
- Prostatitis.

★ PR:

○ Comment on the following:

- Shape of prostate.
- Median sulcus.
- Size of prostate.
- Consistency of prostate.
- Tenderness.
- Presence of nodules, size and location of nodule.

Best wishes 🍀 😊  
Adel Alshihri