RENAL MEDICINE H+E:

1. History of presenting complaint

[FUNDWISE-**QFS**]
[PO**R**N HA**W**CS]

F requency	**How often? How much** – ***polyuria*** → ***oliguria*** *(<400mL)* → ***anuria*** *(<40mL)* ? [possible UTI] • Small void – BPH? • Clear urine = Renal failure?
U rgency	• **Sudden/gradual urge**? ➔ **(**stress, urge, overflow incontinence)
N octuria	Excessive urination at night ➔ **benign prostatic hyperplasia (BPH)**
D ysuria	**Any pain when urinating?** ➔ Flank / Back Pain? ➔ Does it radiate? [**renal colic** – STONES?] • Infection? • Pain syndrome? • Storage/trigonal/ureteric pathology?
W eak stream	Does it flow out slowly? ➔ (hesitancy)
I ntermittency	Flow that stops and starts
S training/Strangury	"**Do you need to strain to urinate**?" (**prostate issue**) | Or **strangury = bloody urine + dysuria**
E mptying incomplete	**Dribbling** ➔ ***Pis-en-deux*** → double-voiding (incomplete bladder emptying)
Quality	• **Smell & Colour (Heamaturia**, pale, dark yellow), • **Consistency (***foamy = proteinemia | microscopic deposits in urine = casts)* *(e.g.* ***RBC casts/clumps = haemorrhage*** *,* ***WBC casts = infection/inflammation****)*
Fever	• Night Sweats [**clear differential that it is NOT CKD] ➔ UTI or stones**
Sexual Health	**Common** • **Protective sex | Libido | Vaginal/Penile Discharge | Genital rash** • **Infertility | Urethral discharge (STIs)** **Men** • **Pre-ejaculation |Erectile dysfunction** (Full Erection) ➔ **diabetes or HF** • **Retrograde ejaculation** **Women** • **# of Pregnancies |** Orgasm (MS?, spinal cord disease) • LAST **menses cycle (regularity – 28-35 days)** • **Oligomenorrhea** (regular menses) • **Amenorrhea** (primary = menopause or ovarian failure, Oral contraceptives) • **Menorrhagia** (heavy menstrual flow) • **Dysmenorrhea** (pain with menstruation)

General symptom screen especially for CKD (eGFR < 60 mL/min/1.73m²):

- **Pruritus**
- **Oliguria (**< 400mL = LATE stage CKD)
- **REST** ➔ *insomnia* \| ***Fatigue/lethargy***
  Malaise (discomfort)
- **Nausea & Vomiting**
  (accumulation of ureamic toxins)
- **Hiccups \| Anorexia (***reduced appetite* + metallic taste)
  (accumulation of ureamic toxins)
- **Weight gain/loss (Unexplained)**
- **Confusion**
- **Swelling/Oedema (weight gain)** ➔ extremity swelling, pleural effusions, pulmonary oedema ➔exertional SOB
- *polydipsia (excessive thirst)*

2. Organ Focus (kidneys, ureter, bladder, genitals, urethra)

Kidneys	Ureter	Bladder	Prostate	Urethra/Gynae/Teste
• Sepsis • Loin-groin pain • Heamaturia	• Sepsis • Loin-groin pain • Heamaturia	• Sepsis • Cystitis [FUND] • Incontinence • Heamaturia	• Sepsis • Cystitis [FUND] • Incontinence • Obstruction [WISE]	• Sepsis • Obstruction [WISE] • Mass • Burning/pain at tip
• Vitals, febrile • Ballotable kidney • +ve dipstick	• Vitals, febrile • +ve dipstick	• Vitals, febrile • Palpate Bladder • +ve dipstick	• Vitals, febrile • Percuss Bladder • DRE (size, tender)	• Vitals, febrile • Pelvic exam (Females) • Testicular mass

3. Past MHx [CHOMV STAVE] "compliance about medication?"

- **Conditions** = **Previous UTI** \| **diabetes** (gestational, obese) ➔ hypoglycemic episodes \| **HT** \| **Gout** \| **Enuresis**
- **Medications**:
  1. **oral hypoglycemics \| PDE5i (Viagra) = erectile dysfunction**
  2. **Nephrotoxins: IV contrasts** (lithium), **NSAIDs (**aspirin) \| **Alpha-blockers (**prostatic enlargement)
  3. **Diuretics** ➔ adds to nocturia / incontinence / stones \| **Antibiotics** (UTI prophylaxis + strep infections)
  4. **ACEi/ARBs** ➔ **elevated creatinine**

4. Social Hx [SHIELDOM]

- **Home life/accommodation** + **family** support (esp. prostate cancer predisposes children)
- **Independence**: **mobility care/needs [CKD patients have social problems –** *How are you coping?]*
- **Lifestyle + Hobbies** ➔ **DIET + EXERCISE (Esp. dietician advice)**
- **Alcohol** (CAGE questions) \| **Smoking** (pack years) + when did they quit \|
- **Drugs** (opioids, benzodiazepines, hallucinogens, cannabinoids – how long, how administered)

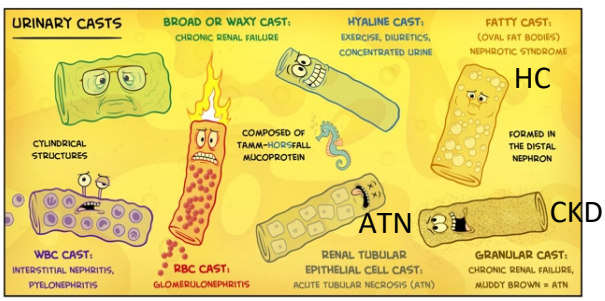
5. Family Hx

"important for young child with diabetes"

- **FHx of renal disease**: *Autosomal dominant polycystic kidney disease or glomerulonphritidies (e.g. IgA neuropathy)*
- **Family Hx of CV risk factors** (e.g. diabetes and HT)
- **Family Hx of deafness and renal impairment** (Alport's syndrome ➔ inherited nephritis)

Biochemical examination [DIPSTICK]

Urinalysis	Indication	Interpretation
Colour	Heamaturia	
Turbidity	Proteinuria or bacteria	
pH	acidity of urine	↓pH in systemic acidosis = More suggestive of infection
Specific gravity	amount of solute dissolved in	↓ in DI, polydipsia
Blood	RBC in urine	Infection, inflammation, cancer, obstruction?
Protein	level of protein in the urine	↑ nephrotic syndrome
Leukocyte esterase	enzyme produced by neutrophils	• **High sensitivity** • *low specificity* for infection as can be due to STI, renal calculi, IDC, recent surgery, chemo
Nitrites	breakdown products caused by Gram -ve organisms	• **Higher specificity** (more likely to be infection) • *low sensitivity* as some bacteria do not produce nitrites
Ketones	breakdown product of fatty acid metabolism	↑ starvation / ↑DKA
Glucose	↑ hyperglycaemia	poorly controlled diabetes
Bilirubin	↑ conjugated bilirubin	↑ biliary tract obstruction
Urobilinogen	↑ bilirubin turnover	↑haemolytic anaemia



MICROSCOPIC examination of Urine sediments (RBC, WBC, bacteria, casts)

Feature	Indication
RBC	haematuria, haemoglobinuria or myoglobinuria
WBC	**confirmed by + positive leukocyte esterase)** UTI or urinary tract inflammation
Casts	• **cylindrical structures** formed in the lumen of renal tubules and collecting ducts by **precipitation of mucoproteins** secreted by cells in the kidney • WAXY CASTS = CKD

Urological Key Features

Diseases = Possible causes [VITAMINS D]

- **V**= vascular issues
- **I** = Infection/inflammation
- **T** = traumatic causes
- **A** = auto-immune conditions
- **M** = malignant tumour (or benign)
- **I** = iatrogenic (caused by physician/surgery)
- **N/M** = Neoplasms or metabolic abnormality
- **S** = Stones + strictures/stenosis +cysts
- **D** = Drugs

Failure Type	Description
• **Acute (AKI)**	rapid severe loss in renal function ➔ waste accumulation + oliguria
• **Chronic**	Persistent > 3 months
• **Acute on chronic**	Worsening of kidney function when patient has CKD

Urine Issue	
Dysuria	• **Urological:** *cystitis, urethritis, pyelonephritis, BPH* • **Other:** anxiety, prostatitis, pregnancy, bladder or lower urethral calculi, drugs (e.g. diuretics)
Polyuria	• **Endocrine: (***T2DM, diabetes insipidus, cushings***)** • **Urological:** *CKD, UTI,*
Oliguria (<400mL/day**)/ Anuria (<**50mL/day**)**	• **Late stage CKD, urethral stricture, BPH, UTI (+ dysuria), bladder neck obstruction (i.e. tumour, calculi)** • **Other:** *Phimosis, MS, SCI, anticholinergic drugs, constipation (common), SIADH*

Colour of urine	Underlying cause
Very pale/colourless	• overhydration, recent colourless excessive beer consumption, • diabetes insipidus,* post-obstructive diuresis
Yellow-orange	• Concentrated urine (e.g. dehydration), Bilirubin • **Drugs**: Tetracycline, anthracene, sulfasalazine, riboflavin, rifampacin
Brown	• Brown Bilirubin, Nitrofurantoin, phenothiazines; chloroquine, senna, rhubarb (yellow to brown or red)
Pink	• Beetroot consumption • **Drugs"** Phenindione, phenolphthalein (laxatives),
Red / heamaturia	• bladder transitional cell carcinoma (painless hamaturia) • renal cell carcinoma | urethral trauma (e.g. catheter) | UTI | Urethitis • **Other Urological**: glomerulonephritis, PKD, BPH, urinary tract TB • **Miscellaneous**: coagulopathy, sickle cell, IE, menstruation, rhabdomyolysis
Green	• Methylene blue, triamterene, myoglobinuria when mild
Black	• Severe haemoglobinuria • Melanoma, ochronosis; porphyrins, alkaptonuria (red to black on standing) • **Drugs:** Methyldopa, metronidazole, unipenem
White/milky	• Chyluria (Pus, chyle (lymphatic fluid) or blood can cause a more turbid appearance)
Cloudiness	• Phosphate or urate deposits can occur normally and produce white (phosphate) or pink (urate) cloudiness • Fainter cloudiness may be due to bacteria

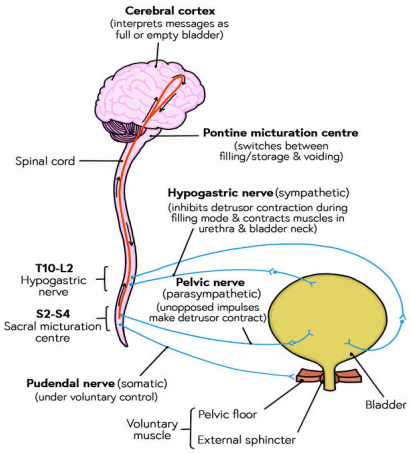
Smell of urine	Underlying cause
mild ammoniacal smell	• normal
fishy smell	• urinary tract infection (UTI)
Asparagus smell	• antibiotics

Types Of Incontinence [cannot hold urine]

	Stress incontinence (*outlet incompetence*)	Urge Incontinence (*detrusor overactivity*)	Overflow incontinence
Issue	**Inability of sphincters to hold urine** = Involuntary urine leakage (esp. on ↑intra-abdo pressure = cough /sneeze / exercise)	Sudden contraction of detrusor muscle when bladder **only partially filled** → **[large volume – sudden urge]** ➢ Dry = reaches toilet in time ➢ Wet = cannot make to toilet	Underactive bladder causing urine to leak out (incomplete emptying) **[low volume]**
RF	1) **Weak abdo muscles** (multipregnancy) 2) **+++ intra-abdo pressure** > closing pressure of urethral sphincter = obesity, heavy lifting, chronic cough 3) **Sphincter tone failure** = childbirth trauma 4) **Loss of urethral support** = post-meno E2 def.	1) UTI 2) Overactive bladder syndrome 3) Bladder Stone/clot/tumour 4) Neuro = T2DM, SCI – stroke, Alzheimer, PD, *Key notes:* 5) Triggers = Advanced age, Smoking 6) URODYNAMIC studies needed	➢ **MAIN = Chronic urinary retention** (e.g. opioid usage) ➢ **Obstruction** = Urethral stricture, Stones, UTI ➢ **Weak bladder muscles** = NMD, diabetic cystopathy
Exam + Ix	➢ **Prolapse Sx** = fullness, dragging, back ache ➢ **Sexual Sx** = dyspareunia ➢ **Pelvic pain** = bladder, pudendal neuralgia (worse on sitting) → if relieved with pudendal block (= NANTES) ➢ **+ve Cough/stress test** = stress leak ➢ **DRE** = assess anal sphincter tone + rectocele ➢ **Neuro exam (L1-S4)** = perineum sensation + sacral reflex (anal wink)		***Basic Investigations*** ➢ UA MSU + M/C/S ➢ Pelvic USS (post and pre-void residue) ➢ Uroflowmetry ➢ Intake-void diary (3-5 days)
Conservative	➢ **Reduce BMI < 25** o NEAT regime ➢ **PT = Kegel exercise** (If no hip #) especially post-pregnancy for prevention	➢ **↓↓fluid intake** (esp. ↓caffeine, ↓EtOH, soda) ➢ **Timed voiding** (bladder retraining) ➢ **Manage constipation** ➢ **Vaginal pessary** (1st line for prolapses)	➢ **Timed voiding** (bladder retraining)
Medical	➢ + metformin (if DM) ➢ Topical estrogen	➢ ***Oxybutynin*** (anti-chol -**M3** to ↓ACh – ANTI-SLUDGE) ➢ **Mirabegron** (**B3** agonist – less A/E) ➢ ***Duloxetine*** = **SNRI** → ↑ contract internal urethral sphincter	➢ Local E2 → manage post-meno atrophy *Flomax (tamsulosin) in men for both urge and overflow
Surgical	➢ **Mid-urethral sling - tension free vaginal tape (TVT)** ➢ **Colposuspensions** (laparscopically) **Rarely used = urethral injections (bulking agents e.g. silicon)*	➢ **Botulinum toxin** → blocks ACH release → injected directly into bladder via cystoscopy (*Pt must self-catheterize as botox can lead to urinary retention)* ➢ **Neuromodulation** → posterior tibial or sacral nerve → inhibit reflex contraction of bladder	➢ IDC (self-catheterise) ➢ Continuous bladder drain

INNERVATION TO URINATE

- **PSNS** ➔ ACh ➔ detrusor relax [PROPULSION]
- **SNS** ➔ NA ➔ sphincter contracts [STORAGE]
- **Somatic pudendal** ➔ external urethral sphincter (voluntary control)



IMPORTANT DIFFERENTIAL FOR "LEAKY URINE"

- **UTI – "***burning, stinging sensation + frequency***"**
- **PROLAPSE -** *fullness*
- **HERNIA –** *reducible (DDx: incarcerated)*
- **NEURO** – MS, DM, Cauda Equina

Transient incontinence [DIAPPERS]

- *Delirium,*
- *infection,*
- *atrophic urethritis,*
- *pharm, psych,*
- *XS urine (caffeine, EtOH),*
- *restricted mobility,*
- *stool incontinence*

Other types of incontinence)

- ***Mixed***
- ***True/continuous (? Fistula, ectopic ureter)***
- ***Nocturnal uresis***
- ***Situations (coital/giggle)***

Genito-urinary Examination

Lying flat

1. General inspection

- Note: *some patients with **kidney failure** = **fluid overload or a heart failure** → cannot lie flat comfortably [**ASK FIRST**]*
  - patient's mental state (confusion? = CKD?) | **VITAL SIGNS + RESPONSIVENESS**
  - **hyperventilation** or **hiccupping**? (acidosis)
  - Presence of a sallow complexion ('uraemic tinge')
  - **Patient appears properly hydrated**?
  - subcutaneous nodules (calcium phosphate deposits)
  - (on dialysis – AV fistula in forearm)

2.Nail / Hands/ Wrist

Nails	Observation	Condition
Muehrcke's nails (Leukonychia)	paired white transverse lines near end of nails	hypoalbuminaemia (e.g. nephrotic syndrome)
Mees' lines (Leukonychia)	single transverse white band	arsenic poisoning or CKD
Koilonychia	Sppon-shaped nails	Fe def. in nephrotic ysndrome
Half-and-half nails	distal nail brown or red, proximal nail pink or white	CKD

- **Palmar crease pallor** → Poor nutrition (esp. folate deficiency), EPO deficiency, heamolysis or blood loss
- **Vascular access fistula**.
- **Asterexis** (flap of extended wrist) (**ureamic** OR **hepatic encephalopathy** OR **terminal CKD** OR **CO_2 retention**)

3. Arms

- **Bruising (nitrogen retention → abnormal platelet aggregation in CKD), Pigmentation** (cannot excrete pigments)
  1. **DDx: cushing's**
- **Scratch marks/excoriations** (**Ureamic pruritis due to urea accumulation + hyperphosphatemia**)
- **Gouty tophi** (large, visible bumps made of **urate crystals**→ in joints, bone or cartilage)
- **Myopathy / bone tenderness**
- **AV Fistula in arms** (slight thrill/vibration + bruit → **for haemodialysis access**)

Blood Pressure

- **Elevated BP** due to **hypertension** or **chronic kidney disease** or **steroids** used for renal transplant immunosuppression
- *RARE: pulsus paradoxus (change in BP >10mmHg during breathing) can occur due to **uraemic cardiac tamponade** (associated with low JVP)*

4. Face

- **Eyes**—conjunctival pallor (anaemia ➔ due to chronic renal failure) | jaundice (yellow skin - chronic renal failure)| band keratopathy (cornea calcification - hyperPTH) hypertensive retinopathy (diabetic changes → fundoscopy)
- **Mouth**—dryness, **mucosal ulcers** (thrush = nitrogen retention = reduced acute inflammatory response), **ureamic fetor** (end-stage kidney disease), **gingival hypertrophy** (immunosuppressants for renal transplant), pregnancy, scurvy
- **Rash** (**SLE** – butterfly rash, vasculitis, etc.) [**SLE → kidneys -→ proteinuria**]

5. Neck

- **JVP with the patient at 45°** → if not present → distended pulsating external jugular vein (hypervolemia) or if flat
  - *Fluid overload in nephrotic syndrome*
- **Carotid bruits →** vascular disease (underlying cause for kidney disease)
- **Scars from previous vascath insertion (***in jugular or subclavian vein for haemodialysis***) → central line scar**
- **surgical scars** (e.g. Parathyroidectomy scars → results of CKD)

6. Chest (also inspect for excoriations)

Heart	• **Heaving apex, ureamic pericarditis [***frictional rub***], cardiac failure [***fluid overload***], pacemakers**
Lungs	• **Percuss for pleural effusion [***stony dull vocal resonance***], pulmonary oedema [***fluid overload***] |** • **Auscultate for crackles**

7. Abdomen

- **Inspect abdomen for scars /Ascites**
  - Tenckhoff catheter (drain fluid from lung) → **peritoneal dialysis**
  - peritoneal dialysis **[***fluid overload***] → umbilical scar**
  - operations, including renal transplants → **nephrectomy scar on flank**
- **Palpate the liver and spleen** → for abdominal aortic aneurysm.
- **Palpate + ballot for the kidneys** (palpable ONLY if very slim or masses or enlarged kidney)
  - Kidney vs spleen (strictly inferior or inferior-medial movement)
  - Renal angle tenderness
  - Renal masses
- **Percuss for ascites ➔ shifting dullness**
- **Auscultate kidney = renal bruits** (5CM superior + lateral to umbilicus bilaterally) (**renal artery stenosis, chronic vascular disease**)

Unilateral palpable kidney	Bilateral palpable kidneys
• **Renal cell carcinoma** (can be bilateral) • **Hydronephrosis** (can be bilateral) • **Acute renal vein thrombosis** • **Renal abscess** • **Compensatory hypertrophy** of single functioning kidney (Acute pyelo)	• **Polycystic kidney (ADPKD)** • **Early diabetic nephropathy** • **Infiltrative diseases** (e.g. lymphoma, amyloidosis) • **Bilateral renal vein thrombosis** • **Acromegaly** (Nephrotic syn – minimal change disease)

- **Bladder:**
  - **Inspect (gross distension)**
  - **Palpate** (over supra-pubic region) → volume in bladder
  - **over the bladder** (for ascites + shifting dullness), and **auscultate (listen)** for renal bruits or hepatic hums
- **Palpate for inguinal lymph nodes**

***MUST MENTION Per-Rectal, and pelvic examination** to detect prostatomegaly, frozen pelvis or bleeding (with finger)*

8. Back

- **Nephrectomy scar** (kidney removal)
- **Tenderness** (at flanks)
- **Sacral Oedema**

9. Legs

- **Oedema** = nephrotic syndrome, cardiac failure
- **Bruising & pigmentation**
- **Scratch marks/excoriations** (**uraemia**) or the presence of gout
- **Examine for peripheral** and **uraemic** neuropathy (decreased sensation, loss of the more distal reflexes)
- **Rash**, livedo reticularis (SLE)

10. Urine Analysis (dipstick)

- **pH** (acidic = pain ➔ need urinaric alkalisers)
- **Glucose**—diabetes mellitus
- **Blood (leucocytes)**—'glomerulonephritis', infection, stone
- **Protein**—'nephritis', diabetes (microalbumin), multiple myeloma
- **M/C/S** – UTI? Nephrotic vs nephritic?

GOOD SIGNS GUIDE 19.1
Urinalysis and chronic kidney disease

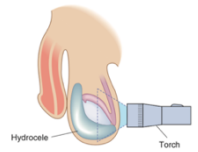
Sign	LR+	LR–
Blood on urine dipstick	1.55	0.89
Protein on urine dipstick	3.0	0.61
Blood or protein on urine dipstick	1.4	0.56
Red blood cells on urine microscopy	1.3	0.78
Casts on urine microscopy	4.1	0.22
Microalbuminuria	3.4	0.76

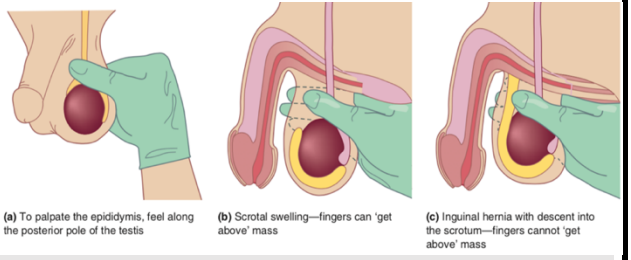
Other

- **Vitals ➔ Blood pressure**—lying and standing (for orthostatic hypotension)
- **Bloods** = FBC, EUC, CMP,
- **KUB USS +/-** CT KUB (anatomical changes)
- **Genital examination + DRE (prostate exam)**
- **ECG + ECHO of heart +/- fundoscopy (Diabetic retinopathy)**

TESTICULAR EXAMINATION

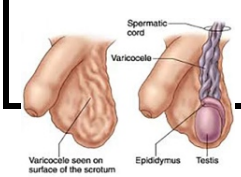
Consent	Explain examination and offer **chaperone [clinically trained!] – what is the indication?** • **Put on gloves**

Inspect [standing]	• **Skin** = "use sheet to move penis out of the way" → scabies [angry rash = mites], cysts, tinea, oedema
	• **Scrotum/Testes** = left testes lower than right (normal)
	  ○ Both testis higher and more transverse than normal = **testicular torsion (< 6 hrs = salvageable)**
	• **Penis & retract foreskin:**
	  ○ **Phimosis** (uncircumcised males → foreskin cannot be pulled over penis tip = urethral obstruction)
	  ○ **Adhesions**
	  ○ **Glan abnormalities** (e.g. discharge "try to milk it", hypospadias, peyronie's concave penis deformity due to repeated trauma)
	 
	Transillumination of the scrotum

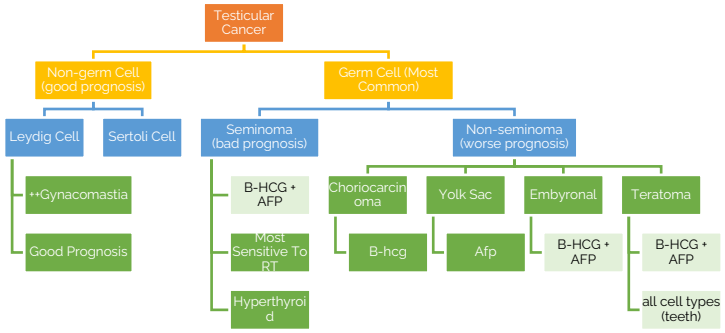
Palpate [supine]	**Support penis with non-dominant hand and palpate with index finger and thumb of abdominal hand**
	• **Testes [SSS > CCC > TTT]** → *feel inferior, middle and superior parts of testes*
	• **Epididymis** → feel posterior aspect of each testes
	  a. **Tenderness = epididymitis**
	• **Spermatic cord** → with thumb anteriorly and index finger posteriorly, feel neck of scrotum for spermatic cord (feels like string)
	• **Inguinal LN (infection/inflammation)**
	  a. **Separate from testes (feel for single or many (varicocele)**
	• **Reflexes**
	  a. **Prehn's test** = PAIN Relief when elevating testes ➔ epididymitis or testicular torsion
	  b. **Cremasteric reflex** = stroke inside of leg and watch scrotal skin tighten (no response = testicular torsion)
	• **Supraclavicular LN** (**common site of metastasis for testicular cancer, rather than superficial LN**)
	 

To complete	***To complete the exam I would perform***: • Full abdominal exam and examine hernial orifices • Further investigations after full history may include Urinalysis, testicular US

Differential Dx of a scrotal mass

Mass	Hx features (symptoms)	Examination features (signs)	Ix	Mx
 **Hydrocele** Fluid accumulation around testes (tunica vaginalis) ➢ **idiopathic**	• **Painless (usually)** • *increased secretion or poor reabsorption of peritoneal fluid between parietal and visceral layers of the tunica vaginalis*	• Soft + bouncy (mobile) • **Transilluminated Mass** • **Unilateral or bilateral diffuse swelling** • **Cannot feel scrotum (may hide testicular cancer → need USS)**	DDx causes: ➢ Teste cancer ➢ Torsion ➢ Orchitis ➢ trauma	• Conservative • Aspiration • Sclerotherapy • Surgery
 **Testicular Tumour [RARE]** Most common solid mass derived from germ cells	• **Painless mass** BUT scrotal pain • **Young males** (15-35yo) • **RF: undescended testes, FHx, increased height, male infertility**	• Hard irregular, **nontender mass** • **DOES NOT** transilluminate **DDx: lymphoma, SCC, granulomatous orchitis**	• scrotal USS • Tumour markers (AFP, B-HCG, LDH) • Staging + PET-CT – **lymphatics, lungs, liver, brain**	• Urology referral • Chemo + RT • Surgery (radical orchidectomy) • Sperm banking • F/U = tumour marker, CT, CXR
 **Cyst of the epididymis**	• asymptomatic • Male offspring of mothers who used diethylstilbestrol during pregnancy (1940-1970s)	• Soft round mass at head of epididymis (**SUPERIOR POLE**) • Mass = [**separate from testis]** and **transilluminates** • *Difficult to differentiate epididymal cyst with spermatocele even with US* • Often bilateral	• Scrotal USS	• Supportive – harmless (30% of men and asymptomatic)
 **Spermatocele [cyst]**	• Cysts: containing fluid + sperm [epididymal cyst > 2 cm]		• Scrotal USS	• Supportive – harmless
 **Cyst of hydatid of morgagni** [appendix testis]	• predisposed to torsion due to pedunculated shape	• 0.3 cm embryologic remnant of the Müllerian duct system → anterosuperior aspect of the testis	•	•
Epididymo-orchitis • RF: males < 35yo • ++ Sexual partners	• **Insidious onset of pain + hot swollen epididymis behind testes** • **Fevers + rigors** • Dragging/heavy sensation • **Relevant sexual history** (*C + G*)	• Urethral discharge (C+G) or E.coli, MUMPS • **DOES NOT** transilluminate • **Hardened, tender** testis • **Positive** Prehn's sign • **Intact** cremasteric reflex	• Urine M/C/S • C+G NAAT PCR • Charcoal Swab (gonorrhea M/C/S) • Saliva swab (PCR for mumps) +/- serum antibodies • Scrotal USS	**Refer to local guidelines for Abx** • Quinolones for 10-14 days (or co-amoxiclav if contraindicated) **If STI suspected** – refer to guidelines: • IM ceftriaxone + • 100mg Doxy PO 7 days
 **Testicular torsion** *Twisting of spermatic cord with rotation of testicle mainly due to **bell clapper deformity*** 	• **Sudden onset** Severe pain • N + V • "**bell-clapper deformity**" = no fixation b/w testicular and tunica vaginalis → testes hangs in horizontal position rather than vertical (more likely to twist)	• Asymmetric, high-riding testis • Firm, swollen testicular • **Negative** Prehn's sign • **Absent** cremasteric reflex	• **Scrotal USS** – Whirlpool sound (spiral appearance to speramtic cord and BVs)	• Urgent urology referral • NBM + Analgesia *Scrotal surgical exploration* • **orchiopexy** (correct position and fix testes in place) • orchidectomy (if surgery delayed)
Torsion of appendix testis [CHILDREN]	• **Gradual onset of** Moderate to severe pain • Assoc. N + V	• Painful High riding testes with horizontal line • **'Blue dot' sign [tender nodule with blue discoloration on the upper pole of the testis]**	•	•
Varicocele (*dilated pampiniform venous plexus in scrotum*)	• **Throbbing, aching, scrotal** pain **worse on standing** • **Atrophy of left testicle** • **Dragging sensation** • **Infertility** • **DDx**: *retroperitoneal tumour (when varicocele **DOES NOT** disappear when lying down)*	➢ Usually **Left-sided mass** (90%) + affected testes horizontal ➢ ***bag of worms + asymmetry*** ➢ ***do not disappear when lying down*** **Cause:** ➢ **incompetent valves in PPV** ➢ **SMA compression** ➢ **RCC**	• Doppler imaging • Semen analysis (if fertility concerns) • Hormonal test (FSH and TT)	• **Conservative** • **Surgery** – endovascular embolization indicated for pain, testicular atrophy or infertility

TESTICULAR CANCER



DDx:
- Lymphoma
- Sarcoma
- Leukaemia
- Fibroma

Tumour markers:
- **LDH** = Prognosis + tumour volume (non-specific)
- **AFP** = track response of chemo in non-seminoma
- **B-HCG** = tumour marker to check response to Rx

Testicular cancer is staged with the **Royal Marsden staging system**:
- **Stage 1** – isolated to the testicle
- **Stage 2** – spread to the retroperitoneal lymph nodes
- **Stage 3** – spread to the lymph nodes above the diaphragm
- **Stage 4** – metastasised to other organs (usu. LN, lungs, liver, brain)

Long term side effects of treatment are particularly significant, as most patients are young and expected to live many years after treatment of testicular cancer. Infertility
- Hypogonadism (testosterone replacement may be required)
- Peripheral neuropathy
- Hearing loss
- Lasting kidney, liver or heart damage
- Increased risk of cancer in the future

	LUT infection	Interstitial Cystitis	Pyelonephritis
	➢ Infection in bladder (cystitis) than can spread to the kidneys	➢ Chronic inflammation of bladder causing LUTS and suprapubic pain ➢ "bladder pain syndrome and hypersensitive bladder syndrome"	Inflammation of kidneys due to bacterial infection
Cause	➢ Female ➢ Incontinence ➢ Poor hygiene ➢ Instrumentation (IDC)	Multifactorial: ➢ Dysfunctional BVs, nerves, immune system ➢ More common in women	➢ Female ➢ Structural urological anomalies ➢ Vesico-ureteric reflux (child) ➢ T2DM
Sx	➢ Dysuria (stinging sensation) ➢ Suprapubic pain ➢ Incontinence ➢ Haematuria ➢ LUTS – frequency and urgency ➢ Cloudy / smelly urine ➢ Confusion / delirium (elderly)	➢ LUTS – frequency and urgency ➢ Suprapubic pain ➢ Worse during menstruation	➢ Fever ➢ Loin/back pain ➢ N + V ➢ LoA ➢ Haematuria ➢ Renal angle tenderness on exam
Comp	Cystitis Pyelonephritis	Pyelonephritis	Bacteraemia – sepsis
Ix	**Urine dipstick:** ➢ Nitrites (highly specific for gram -ve e.g. E. coli) ➢ Leucocytes (sensitive for infection) ➢ Haematuria (DDx: bladder cancer, nephritis) **Urine MSU M/C/S** ➢ Pregnant patients ➢ Patient with recurrent UTI ➢ Atypical Sx ➢ Unresponsive to Abx **Criteria to start Abx for UTI:** 1) Nitrites positive 2) Leucocytes + haematuria	**Prostate exam** ➢ Prostatitis ➢ BPH ➢ Cancer **Urine dipstick:** ➢ UTI **Urethral swabs** ➢ 1st pass urine PCR **Cystoscopy** ➢ **Hunner's lesions** (5-20% of patients) – red, inflamed patches of bladder mucosa containing small BV ➢ **Granulations (**tiny haemorrhages on bladder wall)	Same as LUT infection: • **Urine dipstick:** • **Urine MSU M/C/S** • **Bloods = FBC, EUC, CRP** • **KUB USS and CT –** exclude abscess, kidney stones Causative Organisms • E. coli (most common – gram-ve rod) • ***Klebsiella pneumoniae*** (gram-negative anaerobic rod) • ***Enterococcus*** • ***Pseudomonas aeruginosa*** • ***Staphylococcus saprophyticus*** • ***Candida albicans*** (fungal)
Mx	**Antibiotics – check local guidelines**: ➢ **Trimethoprim** (high rate of bacterial resistance) ➢ **Nitrofurantoin** (CI in patients with eGFR < 45) ➢ Other: o Amoxicillin o Cefalexin **How long?** ➢ 3 days for simple UTI in women ➢ 5-10 days in immunosuppressed, abnormal anatomy or impaired kidney function ➢ 7 days for men, pregnant, or catheter related UTI **UTIs in pregnancy:** ➢ Increased risk of pyelonephritis, PPROM, pre-term labour ➢ ALL required urine MSU M/C/S ➢ 7 days of Abx of either: o Nitrofurantoin (NOT in 3rd trimester – risk of neonatal haemolysis) o Amoxicillin (only after sensitivities known) o Cefalexin *AVOID trimethoprim (esp. 1st trimester) = folate antagonist = neural tube defects and congenital malformations	**Most symptoms resistant to Rx (HARD TO TREAT)** ***Supportive management*** is used initially: • Diet changes such as avoiding alcohol, caffeine and tomatoes • Stopping smoking • Pelvic floor exercises • Bladder retraining • Cognitive behavioural therapy • Transcutaneous electrical nerve stimulation (TENS) ***Oral medications*** may be helpful, including; • Analgesia • **Anticholinergic medications** (e.g., solifenacin or oxybutynin) • Mirebegron (beta-3-adrenergic-receptor agonist) • Cimetidine (histamine-2-receptor antagonist) ***Intravesical medication*** may be helpful, given directly into the bladder: • Lidocaine • Pentosan polysulfate sodium • Hyaluronic acid • Chondroitin sulphate ***Surgical procedures*** may be used, including: • Cauterisation of Hunner lesions during cystoscopy • Botulinum toxin injections during cystoscopy • Neuromodulation (implanted electrical nerve stimulator) • Cystectomy (removal of the bladder) • **Hydrodistention** (fill bladder w/ high pressure during cystoscopy)	**Antibiotics –7-10 days in community** ➢ *Cefalexin,* ➢ Co-amoxiclav, trimethoprim (if culture results available) ➢ Ciprofloxacin (A/E = tendon damage and lowers seizure threshold) **If they look unwell and unsafe to be managed at home ➔ admit (SEPSIS 6)** • Blood culture • Urine output (IDC) • Empirical ABx • O2 (94-98%) • IVF resus • VBG – lactate **What if unresponsive to Abx?** .Consider an: ➢ abscess, or ➢ kidney stones obstructing ureter **Mx of chronic pyelonephritis:** ➢ Recurrent pyelonephritis ➢ Causes scarring of renal parenchyma ➢ CKD → end-stage renal failure ➢ Assess renal damage using **radio-labelled DMSA** which builds up in healthy kidney tissue

ACUTE KIDNEY INJURY & CKD

Acute Kidney Injury

Define

Sudden onset kidney damage seen by (KDIGO staging)

1. elevated Cr
2. oliguria

	Serum Cr Level	Urine Output
Stage 1 AKI	• **>1.5x baseline** OR ≥ 0.3 mg/dL	< 0.5 mL/kg/h **for 6-12 hours**
Stage 2 AKI	• **>2.0x baseline**	< 0.5 mL/kg/h for **≥ 12 hours**
Stage 3 AKI	• **>3.0x baseline** OR ≥ 4.0 mg/dL	< 0.3 mL/kg/h **for ≥ 24 h OR** anuria ≥ 12 hours

RF

- **Hypovolaemic shock** (haemorrhage, diarrhoea, vomiting) → Ischaemia, shock
- **CKD,**
- **T2DM**
- **Liver disease**
- **Nephrotoxic drugs (***NSAID, ACEi)*
- **Contrast medium usage**

- **Older age (>65 yo)**
- **Cognitive impairment**
- ****BEWARE*: Body builders, African americans, drug-drug interaction (cimetidine – competing with Cr) → normal eGFR even when oliguric

S+S / Exam

- Extreme malaise
- Anorexia
- N/V
- Confusion
- Recent IVDU, infections
- Fluid imbalances

- Dehydrated signs (dry MM, reduced skin turgor, oliguria, tachycardia, hypoTN)
- Flank or abdominal pain

Factors besides CKD causing ↑↑ urine albumin excretion:

1. UTI
2. High dietary protein intake
3. CCF
4. Acute febrile Illness
5. Heavy exercise within 24 hr
6. Menstruation
7. Genital discharge or infection

DDX

Pre-renal	Renal	Post-renal

• **Hypoperfusion**
  ○ Blood loss, volume loss, dehydration
  ○ Heart or liver failure
• **HTN** (essential or secondary)
• **Ischemia** (ACEi, NSAIDs, renal infarciton)
	• **Infection** (cystitis vs pyelonephritis)
	• **GN** (nephrotic vs nephritic)
	• **Acute interstitial nephritis** (nephrotoxins – amino, diuretics)
	• **ATN** (most common) → ischaemia, sepsis, post-op
	• Microvascular – DM,
		• **Obstructive** (renal stones, renal clots, abdominal masses
		• **Strictures** (BPH, prostate cancer, pregnancy, strictures)

Comp.

- Seizures → Coma
- Hypovolaemic shock
- Fluid-overload → Heart failure

Ix

1. **Vitals** = BP, HR
2. **Bloods** = **FBC** (*anaemia*), **EUC** (*eGFR, hyperK*), **LFT** (albumin - nephrotic), **fasting lipids** (*nephrotic*) **and BSL & HbA1C** (*DM*), **CRP** (*UTI*)
   1) Repeat (within 1 week)
3. **Urine ACR** (best if 1st AM void to *reduce* postural effects on albumin excretion)

OTHER:

4. **CXR= pulmonary venous congestion (fluid overload)**
5. **(1) KUB USS or (2) CT KUB or (3) X-ray Pyelogram (check urinary collecting system)**
   1) small echogenic kidney in CKD
   2) Anatomical issues – strictures, stones,
6. **MRI angiogram → renal artery stenosis, MR venogram → tumour of AKI**
   (use 0.9% NS IV infusion before procedure to reduce contrast-induced nephropathy)
7. **Renal Biopsy –** ONLY for intrinsic AKI (if suspected)
8. **Urine electrolytes**

Urine electrolytes	Pre-Renal	Intrinsic
FeNa	< 1%	> 2%
FeUrea	<35%	>50%

9. **Urine M/C/S (UTI) + cytology**
   1) **WCC (pyuria)** (UTI – bacterial or atypical?) or **STERILE WCC** → Interstitial nephritis
   2) **Granular (muddy brown) Epithelial cells** = contaminated, ATN, ischaemic or nephrotoxic
   3) **Dysmorphic red cells** = nephritic or ANCA vasculitis
   4) **Fatty/waxy casts** = nephrotic, DM, amyloid and FSGS
   5) **Crystal casts** = drug-induced
   6) **Bence-Jones protein (free light chains) –** multiple myeloma

Systemic signs (e.g. *rash, CT disease*)	• **Anti-GBM (Goodpasture's)** • **ANCA, ANA + ENA** • **Complement studies (c3,c4)**
BBV risks	• HBV, HCV, HIV serology
Age > 40 + MM suspected	• Serum and urine protein EPG

Mx

Pre-renal	• **Rehydrate**= IVF (isotonic crystalloid) + ECG + BP (HTN) • **Diuretics** (if fluid overload) +/- vasopressor support • **Cardiology + nephrology consult**
Renal	• **Stop nephrotoxins** (e.g. NSAID, aminoglycosides, IV contrasts) • Fluid balance • RENAL Biopsy + nephrology consult
Post-renal	• Renal USS → surgical cause • Urology consult • **relieve obstruction** (IDC or ureteric stents)

Beware of complications:

- Hyperkaleamia
- Fluid overload – HF, APO
- Metabolic acidosis
- Ureamia – encephalopathy and pericarditis

Refer + FU

Yellow Zone	Orange Zone	Red Zone	Nephrologist Referral Indications
Blood Test every **12 months** • Identify cause + stop nephrotoxins • Reduce eGFR decline (SGLT2i +ACEi) • Abs. CV risk • Maintain normal fluid status	Blood test every **3-6 months** **PLUS:** • Early detection • Minimise complications	Blood Test every **1-3 months PLUS**: • Prepare for RRT OR non-dialysis support • Should be under care of nephrologist • Prepare kidney transplant + keep on dialysis (3x/week)	• **eGFR < 30** OR Sustained reducing eGFR (>20% in past 12 months) • **Persistent** urine ACR ≥ 30 mg/mM OR any haematuria • CKD w/ **unresponsive HTN** (using ≥3 Anti-HTN)

Med-legal + Px

Preventative (for both)	• **IUTD** (flu, pneumococcal, COVID, shingles) • 2-**yearly total CVD risk assessment** from 45-75 yo or 30-75 yo (ATSI)
Medico-legal	• **Fitness to drive** (vision/neuropathy – DM) • **General Screen esp. if young** (ADPKD, Fabry, Alport, Liddle, Bartler, Gittleman)

Chronic Kidney Disease
(NOT a diagnosis – always an underlying cause)

A SILENT chronic deterioration in kidney function evidenced by either:

1. Declining eGFR < 60 for > 3/12
2. Irreversible kidney damage for >3/21)
   - ACR > 30
   - Electrolyte disturbance
   - Urinary sediment issue
   - Abnormal histology / imaging
   - Hx of renal transplant

Hyperfiltration ↓ Albuminuria ↓ ↓ eGFR ↓ Loss of nephrons

1. T2DM (MOST COMMON)
2. HTN
3. GN
4. ADPKD (FHx of kidney failure)
5. Nephrotoxins (NSAID, PPI, Lithium)

Other risk factors:

- Known CVD
- ATSI
- ≥60 yo
- Obese (BMI ≥30)
- Smoking + FHx

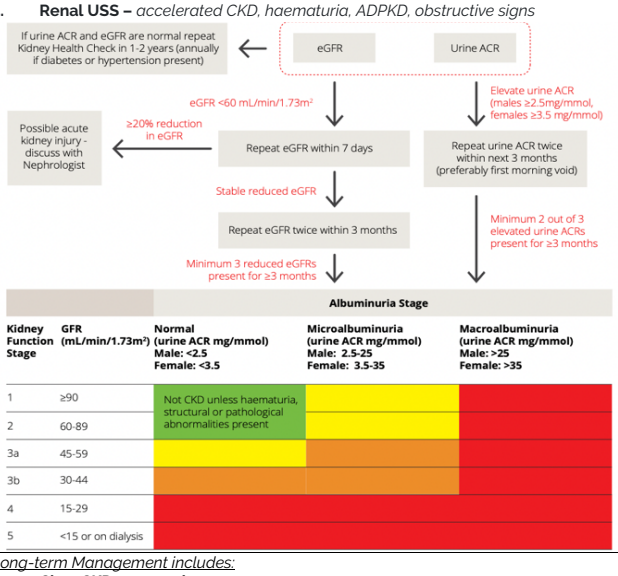
- Nocturia +/- Haematuria
- *Anaemia signs* = Restless legs + fatigue + pruritus + insomnia
- SOB +/- chest pain

- Sallow appearance (uraemic tinge) = ANAEMIA + hyperpigmentation
- **Pruritus** = Scratch marks and excoriations
- Rash (malar – SLE?)
- Conjunctival pallor
- Muscle cramps
- Peripheral neuropathy
- **Ballotable kidney** (unilateral vs bilateral) + **ascites** (shifting dull – hypoalbumin)
- Fluid overload = Elevated JVP, Bilateral Peripheral and sacral **Oedema**

- Seizures → Coma
- Hypovolaemic shock
- Fluid-overload → Heart failure, oedema, raised JVP

If urine ACR and EGFR normal →check every 1-2 years the following:
[Check annually if DM or HTN present]

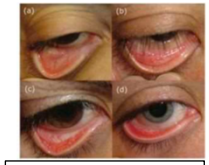
1. **Vitals** = **BP** (multiple -sitting vs standing)
2. **Elevated Urine ACR more than 2x over 3 months** → best if AM void to reduce postural effects on albumin excretion)
3. **EUC (check eGFR < 60)**
4. **Renal USS –** *accelerated CKD, haematuria, ADPKD, obstructive signs*



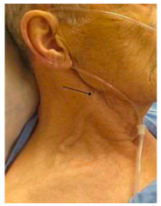
Long-term Management includes:

1. ***Slow CKD progression***
   - Exercise – maintain healthy weight, stop smoking
   - Dietary advice – low PO4, low Na, low K
   - Statin = primary prevention of CVD
2. ***Reduce risk of cardiovascular disease***
   - Optimise diabetic and HTN control → metformin, ACEi, SGLT2i
     - Aim : <140/90 or (<130/80 if ACR > 70)
     - Monitor for hyperK
   - Treat glomerulonephritis
3. ***Reduce risk of complications and treat***
   - ***Oral NaHCO3 –*** *metabolic acidosis*
   - ***Fe supp + EPO –*** *Anaemia*
   - ***Vitamin D + bisphosphonates–*** *renal bone disease (osteomalacia, OP, osteosclerosis, secondary HPTH)*
   - ***Dialysis –*** *end-stage renal failure*
   - ***Renal transplant*** *-end-stage renal failure*

ACUTE KIDNEY INJURY CAUSES

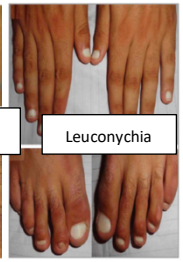


Conjunctival pallor



Raised JVP

DRY MM



Leuconychia

AV fistula

Pitting ankle oedema

KDIGO criteria:
- Cr > 1.5x baseline (48hrs) + ↓ eGFR
- Oliguria (< 0.5mL/kg/hr)

Investigations:

Bedside: Urine dipstick → proteins, Hb, WCC, glucose
- Urine M/C/S → ?dysmorphic RBC
- Spot urine ACR – Glomerular injury

Bloods:
- FBC (Hb – anaemia, HCT-dehydration, WCC -infection)
- EUC (urea > Cr = pre-renal), CMP, CRP
- LFT (hepatorenal syndrome)
- Serum osmolarity + Urine Osmolarity + Urine Na

Imaging
- KUB USS (size, hydronephrosis, postrenal obstruction, or persistent AKI)
- CT abdo

Special tests
- IDC trial (rule out bladder obstruction)
- Fluid challenge (rule out pre-renal causes) – Pre vs post void residual
- Renal biopsy (if uncertain dx or persistent >2 day oliguria)

ACUTE KIDNEY INJURY (AKI)

Pre-renal (60%)

Urea : Cr > 20
↓Urine Na < 30 (FeNa < 1%) AND ↑ SG
↑Urine osmo

What is patient is on diuretics?
➢ **Use Fe(urea)**

Disorder autoregulation
- **NSAID** (afferent vasoconstrict)
- **ACEi/ARB** (efferent vasodilitation)
- **Calcineurin inhibitors** (tacrolimus (tremor), cyclosporin - gum hypertrophy)
- **HyperCa** (HPTH, cancer, FHH, vit D intake)

Hypovolemia (Hypoperfusion)

Absolute Loss
- **Haemorrhage** (GI bleed, AAA trauma)
- **GI Loss** (vomit/ diarrhoea)
- **Skin Loss**
- **Renal Loss** (DI, diuretics)

Effective Loss
- **Low CO / ischaemia** (MI, renal infarct, embolus, dissection)
- **Cirrhosis** hepatorenal syndrome
- **Urosepsis**
- **3rd spacing**

Renal

Urea : Cr > 10
↑ Urine Na > 30 (FeNa < 1%)
↓Urine osmo < 280
Muddy brown epithelial casts = ATN

Glomerular

Nephrotic Syndrome
- **Npehrotic range Proteinuria** >3.5g/day --> **hypoalbuminemia** --> peripheral oedema **HC --> Hypercoagulable** (VTE)
- Minimal change FSGS Membranous nephropathy

Nephritic syndrome
- **HTN** (Na retention) + **Oliguria** **VTE** **Haematuria (coca-cola)** (Dysmorphic RBC casts)
- C1, C3 nephropathies Berger's vs PSGN Anti-GBM vs Good Pasture Lupus ANCA +ve (Wegener, MPA,Churg Strauss)

Interstitial (AIN)
- **Hyper-sensitvity reaction** *(e.g. penicillin, NSAID, PPI, allopurinol, diuretic, rifampin)*
- ***AKI + HTN*** *TRIAD = Rash + Fever ,+ Eosinophilia* ***Rx: steroids***
- ***chronic tubulo-interistial nephritis*** cause = autoimmune, infection, iatrogenic, granulomatous disease **Rx: steroids**

Tubular

Acute Tubular Necrosis *MOST COMMON*
- **Ischaemia** **Sepsis** **Haemorrhage/ dehydration** **Post-surgery** **Nephrotoxin** (contrast, aminoglycoside, NSAID)
- *RF = advanced age, DM, ACEi*
- Rx: supportive + IVF + stop nephrotoxins + Rx complications

Renal Tubular Acidosis
- Type 1 = DCT issue (alkalilne urine + low k)
- Type 2 = PCT issue = impaired HCO3 reabsorption +low K, PO4
- Type 4 = aldosterone resistance = acidic urine + hyperK

Vascular

Large
- **Malignant HTN** (acute onset HTN causing end-organ dysfn)
- **Renal infarct**
- **Atherosclerosis**
- **Fat emboli**

Small
- **Thombotic micro-angiopathy** (HUS, TTP, APS)
- **Vasculitis (ANCA)**
- **Diabetes Nephropathy** *glomerulosclerosis, proteinuria, CKD Rx: BSl and BP control (START ACEi even if normal BP)*

Post-Renal

Neurogenic / Functional / incontinence

Anatomical *(Ureter/ bladder / urethra)*
- **Intraluminal Obstruction** (clot, stone, pyrogenic debris)
- **Extraluminal obstruction** (retroperitoneal fibrosis, pelvic tumour, uterine prolapse)
- **Malignancy** *(prostate, Urothelial ca, lymphoma, MM)*
- **Stricture** (phimosis, paraphimosis)

Pre-renal Mx: ➔ REFER TO NEPHROLOGIST
1. Rx underlying cause (*e.g. remove NSAIDs)*
2. Fluid resus (NS, albumin, blood/plasma – colloids)
3. Optimise electrolytes

Intra-renal Mx ➔ REFER TO NEPHROLOGIST
1. Rx underlying cause (*e.g. stop nephrotoxic drugs, Rx infection and optimise electrolytes)*
2. Correct ECF volume:
   a. Supportive care +/- corticosteroids or immunosuppressive therapy
   b. Renal diet = low protein, K, PO4 → regular EUC checks

Post-renal Mx: → REFER TO UROLOGY
1. Rx obstruction or functional cause
2. Foley catheter insertion
3. Nephrostomy
4. Ureteric Stents

For stones:
- Stricture pts = ureteropelvic jn, ureter crossing iliac artery, juxtaposition of vas def. or broad ligament
- < 5mm = IVF or oral + URAL (alkalinise) + analgesia
- <10mm = lithotripsy
- >10mm = percutaneous stent
- Uric acid crystals = radiolucent (cannot see under XR)

General Rx for complications
1. Fluid overload – NaCl restriction, high-dose loop diuretics (**40mg furosemide iV STAT bbolus – not if ESKD)**, hyperK, adjust drug dosages of meds excreted by kidney (e.g. amiodarone, digoxin, ABx, tacrolimus, chemo agents, Lithium, theophylline, EtOH)
2. Dialysis or RRT (AEIOU) → consult nephrology (esp. if ESKD)
3. If contrast is needed + patient has risk of CIN – contrast induced nephropathy ➔ lower contrast dosage + IVF + STOP NSAID

X-linked hypophosphatemia (rickets) OR Fanconi Syndrome

- Inappropriate release of vital substrates normally reabsorbed (triggered by heavy metal consumption)
- Muscle cramp hypoK
- DDx: rickets or osteomalacia

Straight segment of PCT

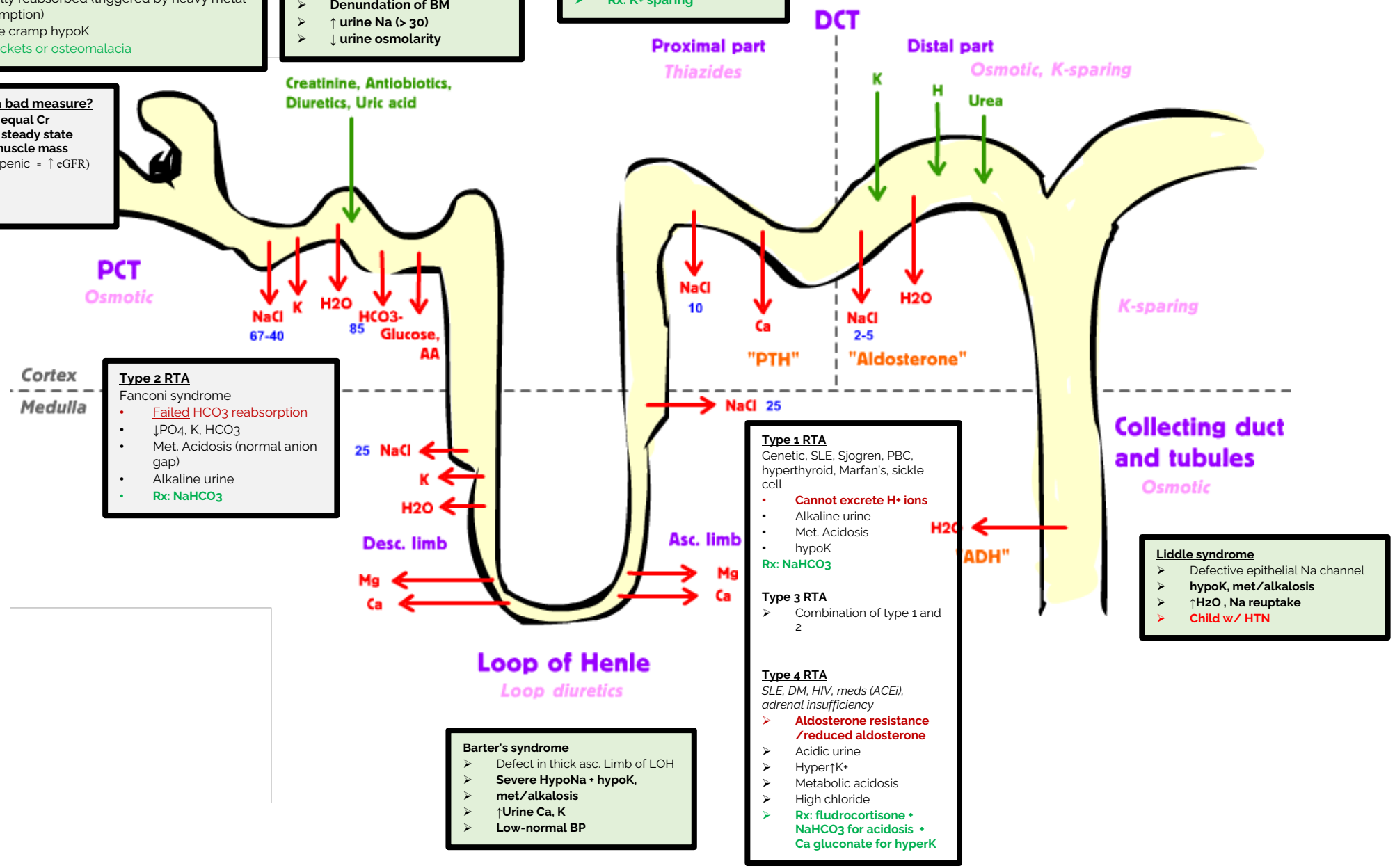
- **1ST damaged in renal hypoperfusion**
- **Denundation of BM**
- **↑ urine Na (> 30)**
- **↓ urine osmolarity**

Gitelman Syndrome

- Mutant Na/Cl transporter (proximal DCT)
- Modest hypoNa, hypoMg
- Low urine Ca
- Rx: K+ sparing

Why is eGFR a bad measure?

- **Does not equal Cr**
- **Assumes steady state**
- **Normal muscle mass** (e.g.sarcopenic = ↑ eGFR)



Type 2 RTA

Fanconi syndrome

- Failed HCO_3 reabsorption
- ↓PO_4, K, HCO_3
- Met. Acidosis (normal anion gap)
- Alkaline urine
- Rx: $NaHCO_3$

Type 1 RTA

Genetic, SLE, Sjogren, PBC, hyperthyroid, Marfan's, sickle cell

- **Cannot excrete H+ ions**
- Alkaline urine
- Met. Acidosis
- hypoK

Rx: $NaHCO_3$

Type 3 RTA

- Combination of type 1 and 2

Type 4 RTA

SLE, DM, HIV, meds (ACEi), adrenal insufficiency

- **Aldosterone resistance /reduced aldosterone**
- Acidic urine
- Hyper↑K+
- Metabolic acidosis
- High chloride
- Rx: fludrocortisone + $NaHCO_3$ for acidosis + Ca gluconate for hyperK

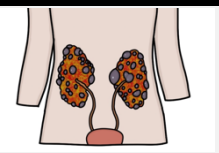
Liddle syndrome

- Defective epithelial Na channel
- **hypoK, met/alkalosis**
- **↑H2O , Na reuptake**
- **Child w/ HTN**

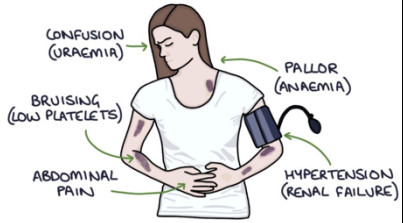
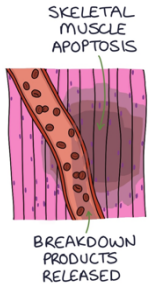
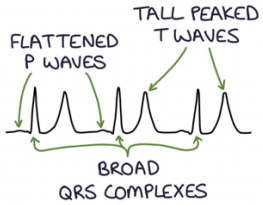
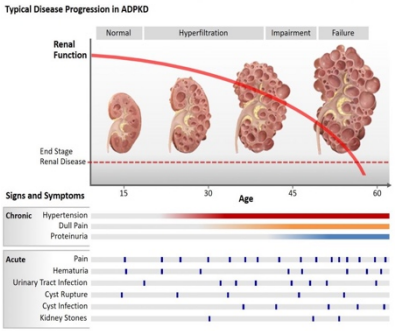
Barter's syndrome

- Defect in thick asc. Limb of LOH
- **Severe HypoNa + hypoK,**
- **met/alkalosis**
- **↑Urine Ca, K**
- **Low-normal BP**

HUS, Rhabdo, HyperK, ADPKD

	Haemolytic Ureamia Syndrome	Rhabdomyolysis	HyperKalemia	Polycystic Kidney Disease
Define	**Thrombosis of small BVs throughout body** **Triggered by shiga bacterial toxin**	**Skeletal muscle breaks down and releases breakdown products:** ➢ ***Myoglobin*** (causing ***myoglobinurea***) ➢ ***Potassium*** ➢ ***Phosphate*** ➢ ***Creatine kinase***	**High serum potassium levels**	**Genetic condition** *where kidney develop multiple fluid filled cysts → causes significant renal impairment* ➢ **AUTOSOMAL DOMINANT** type = more common 

RF /Causes	• E. coli O157
	• Shigella
	• Anti-motility meds (loperamide)
		• **XS underuse or prolonged immobility** (frail patients, long lie, seizures)
		• **XS overuse –** rigorous exercise – tirathalon, crossfit competition
		• **Traumatic or crush injury**
			• Acute kidney injury
			• Chronic kidney disease
			• Rhabdomyolysis
			• Adrenal insufficiency
			• Tumour lysis syndrome
			• Meds (ACEi/ARB, NSAID, K supp., aldosterone antag)
				• **FHx**
				  • 30-40s = kidney function deteriorates
				  • 40s-50s = more symptomatic → present to Dr
				  • 50-60s = many complications (enormous kidney)

S+S **Exam**	**Prodrome (gastroenteritis)** ➢ Reduced UO ➢ Haematuria / dark bronze urine ➢ HTN ➢ Confusion ➢ Bruising 	• Myalgia • Oedema • Fatigue • Confusion (esp. Elderly) • Red-brown urine 	 Nb: ***Haemolysis*** (breakdown of RBC) during sampling can result in a **falsely elevated potassium.** ➢ The lab might indicate that they have noticed some haemolysis and require a repeat sample to confirm the correct potassium result.	***General Sx: (RUSH MVP)*** ➢ ***UTI symptoms – Chronic loin pain →gross heamaturia*** ➢ ***Gross haematuria*** can occur with cyst rupture (this usually resolves within a few days ➢ **Fatigue + sallow complexion** ➢ **Palpable enlarged kidneys – BILATERAL**  ***Extra-renal Manifestations*** ➢ **Aneurysms** = SAH ➢ **Cardiac valve disease** (mitral regurgitation) – 25-30% ➢ **Colonic diverticula** ➢ **Aortic root dilatation** ➢ **CYSTS** = Hepatic, splenic, pancreatic, ovarian & prostatic **(***hepatomegaly, splenomegaly***)** ➢ **Abdominal wall and inguinal hernia**
Comp.	• Death	• Arrythmias • Seizures • Encephalopathy	• Arrythmias – VF → asystole • Fatal	• ***Hypertension*** + ***Cardiovascular disease*** • ***Renal stones*** are more common in patients with PKD • ***End-stage renal failure*** occurs at a mean age of 50 years

Ix	**Classic Triad**
	• Haemolytic anaemia – fatigue, haematuria
	• Acute kidney injury - confusion
	• Low platelet count (thrombocytopenia) - bruising
		Raised:
		• ***EUC = HyperK***
		• ***CMP = HyperPO4***
		• ***Creatine kinase – higher CK = increases AKI risk***
		Must also do:
		➢ ***ECG (****hyperK changes – tall tented T waves, wide QRS, QT prolonged ➔ VF****)***
		➢ ***Urine dipstick - myoglobinurea***
			Raised:
			• ***EUC = HyperK,***
			• ***Monitor urea + eGFR →*** *hemodialysis consideration?*
			ECG (hyperK changes)
			➢ *tall tented T waves*
			➢ *Flattened or absent P waves*
			➢ *wide QRS*
			➢ *QT prolonged ➔ VF)*
				➢ FBC, EUC (baseline levels)
				➢ VBG (acidosis)
				➢ URINE M/C/S
				➢ **USS KUB**
				➢ T2 MRI KUB
				➢ **Genetic testing**
				  o PKD-1: chromosome 16 (85% of cases)
				  o PKD-2: chromosome 4 (15% of cases)
				TABLE 2 ADPKD, as Defined by Standardized Ultrasonographic Diagnostic Criteria[21]
				Patient age (y) / Findings on ultrasonography
				15 – 39 / Three or more renal cysts (unilateral or bilateral)
				40 – 59 / Two or more cysts in each kidney
				> 60 / Four or more cysts in each kidney

Mx	**Medical Emergency (10% mortality)** ➢ Self-limiting -→ 70% have full recovery ➢ Supportive management ➢ Anti-HTN ➢ Blood transfusion ➢ Dialysis (AEIOU)	**Acute Mx:** **1. IVF –** encourage filtration of wastes 2. **IV NaHCO3 –** for acidosis + reduce toxicity of myoglobin 3. **IV mannitol –** increase eGFR to reduce oedema and flush out breakdown products **4. Rx hyperK →** Ca resonium, SABA, IV insulin/5% dextrose + Ca gluconate	**Check local protocols:** ➢ **Remove offending agent** ➢ Ca resonium, ➢ SABA, ➢ IV insulin/5% dextrose (SC 10U actarapid) ➢ 10% Ca gluconate = cardioprotective (ICU admission)	**Mainly supportive:** ➢ **Genetic counselling** ➢ **Avoid: Contact sports** (risk of cyst rupture) ➢ **Avoid NSAIDs and anti-coagulants** ➢ **Regular EUC and BP monitoring** ➢ **MRA brain (**diagnose possible aneurysms in symptomatic pts or those w/ FHx) **Specific Mx:** ➢ **Tolvaptan (ADH antag) –** slow cyst development and renal failure ➢ **Anti-HTN** (ACEi) ➢ **Analgesia →** renal colic, stones ➢ **ABx → for infection (**drainage may be required) ➢ **Dialysis OR renal transplant → ESKD**