Renal & Genitourinary

Acute Renal Failure

Renal failure = rapid decline in GFR → **50% increase from baseline in serum creatinine (Cr)** or 50% decline in Cr clearance

Prerenal Failure

- Results from renal hypoperfusion, e.g. due to vomiting/diarrhea, blood loss, diuretics, skin loss (burns)
- Prerenal failure = shock
- Decreased effective blood volume
    - remember sepsis, anaphylaxis, low albumin states, decreased cardiac output

Intrinsic Renal Failure

- Actual kidney pathology, usually of renal tubule
- Newer term is Acute Kidney Injury (AKI)
- Intrinsic damage to the kidney/renal tubule (i.e. cortical necrosis, infection, anything anatomical to the kidney, such as renal artery stenosis or thrombosis, that does not fall into prerenal category)

Acute Tubular Necrosis (ATN)

- Accounts for 90% of AKI
- Often due to prolonged prerenal injury, e.g., ischemia, hypoperfusion, hemorrhage/sepsis
- Can also occur primarily with nephrotoxins, e.g. myoglobin in rhabdomyolysis.
- Other causes of AKI: glomerular disease, interstitial renal disease, renal artery/vein disease, vascular disease (hypertension, vasculitis)

Rhabdomyolysis

- Myoglobin injures renal tubules, especially in an acidic environment
- Bicarbonate important for exam (but clinically not that useful)
- Aggressive hydration
- **Hypo**kalemia can cause rhabdo, which can then cause **hyper**kalemia
- **Very sharp spike in serum Cr** through combination of kidney injury with breakdown of myoglobin itself to creatinine

Post-Renal Failure

- Obstruction to urine flow (stone/clot in ureter; cancer in bladder; stricture/prostatic hypertrophy in urethra)
- Ultrasound important in evaluation
- Symptoms may be absent, or may have dyspnea, malaise, weight gain, decreased urine output, edema, hypertension

Diagnosis of Renal Failure

- History and physical key (e.g. inciting event explaining what's happening)
- Place Foley early to rule out post-renal

- Renal ultrasound for hydronephrosis, stone, intrinsic renal disease
- Urine studies: myoglobin, eosinophils (suggest drug-related), sodium (high in intrinsic disease because injured tubules can't hold onto sodium)

Acute Renal Failure Workup

- UA: sodium in the 100s suggests AKI (tubular damage = loss of sodium)
- UA usually normal in pre and post-renal
- ***BUN:Cr ratio > 20 suggests prerenal
- Other studies as indicated: electrolytes, chest X-ray, CT for stones
- Urine osmolality (AKI causes loss of concentrating ability = dilute)
- FENa shows up on tests.
    - Injured kidneys can't hold onto sodium. <1% means prerenal; >2% means post-renal or intrinsic.

Treatment

- Fluid resuscitation: use caution if nephrotic (already edematous).
- Rule out obstruction with Foley or ultrasound
- Remove offending meds
- Hemodialysis (HD) for emergencies

Complications of AKI

- Most important for emergency physician is hyperkalemia
    - this can be an indication for emergent HD
- Hypermagnesemia (usually after HD)
    - can cause hypotension
- Hypocalcemia
- Severe anion gap metabolic acidosis
- Volume overload

In code situation, especially on exams, suspect hyperkalemia in known HD pt or anyone with unexplained bradycardia or wide complex tachycardia. **Treat with lots and lots of calcium.** Pre-HD, think hyperkalemia. Post-HD, think hypokalemia or bleeding complications.

Indications for HD

- Remember that these are relative; e.g., dialyze for hyperkalemia **if refractory to medical management**
- Hyperkalemia
- Fluid overload
- Uremic symptoms (really only reversible by HD, so in a sense more emergent than, e.g., hyperkalemia)
- Acidosis
- Toxins

Complications of Vascular Access

Grafts

- Hemorrhage
- Aneurysm (risk of bleeding, rupture)

- Thrombosis (erythematous, no bruit/thrill)
- Infection
- If bleeding, treat locally and with IV DDAVP (causes von Willebrand factor release and increased platelet adhesion)

Catheters

- Thrombosis
- Superior vena cava syndrome (may be chronic, partially occlusive)
- Internal jugular thrombosis
- Bleeding
- Infection

Pearls

- There are 3 kinds of renal failure: prerenal, intrinsic, and postrenal
- Hyperkalemia is the most immediately dangerous sequelae of acute kidney injury; treat aggressively with calcium
- Dialysis is for complications of AKI that fail to respond to more conservative measures

Chronic Renal Failure

- Severity based on GFR
- Severe = <5% GFR
- At risk for: hypercalcemia (due to hyperparathyroidism); glucose intolerance; uremic encephalopathy; dialysis dementia; GI bleed; infection

Nephrolithiasis

- Age 20-50
- **Stones <5mm: 90% will pass**
- Recurrence is common
- Familial and hereditary
- Most common sites of impaction: **Ureterovesical Junction (UVJ**); Ureteropelvic Junction (UPJ); Pelvic brim
- Sx: Unilateral colicky flank pain; diaphoresis; nausea & vomiting; GU symptoms
- ****Caution** can mimic Abdominal Aortic Aneurysm**
- More common in: hypercalcemic states: sarcoid; multiple myeloma; hyperthyroid/hyperparathyroid; cancer; Crohn's disease
- Most common composition of kidney stones: **Calcium Oxalate** (75%)

Stone Types

- Struvite: Chronic UTI's; urease splitting organisms (Proteus); **Staghorn calculi;** pneumoturia (urinating air)
- Uric Acid: **Radiolucent;** gout; Leukemia and myeloproliferative disorders; acute tumor lysis

Diagnosis

- **CT scan** without contrast
- May see elevated WBC

- UA shows **hematuria** (80%)
- Renal function labs
- Elevated Ca, Phos, Uric acid may provide clues as to stone composition
- Refer for stone analysis and metabolic workup
- KUB: poor diagnostic study
- Intravenous pyelogram: identifies stones as well provides information about kidney function, less commonly used

Treatment

- IV fluids and **analgesia**
- +/- Flomax

Admission Criteria

- Infected stone (requires more than just elevated WBC: need fever, SIRS criteria, etc.)
- Intractable pain
- Renal failure
- Single kidney
- Obstruction

Pearls

- Severe chronic renal failure = GFR <5%
- 90% of stones ≤ 5mm will pass
- Most stones get stuck at the UVJ
- Struvite stones cause staghorn calculi; Uric Acid stones are radiolucent
- Most stones cause hematuria and are diagnosed with CT scan
- Treat with analgesia and IVF
- OK to discharge the otherwise healthy, uncomplicated kidney stone

Glomerular Disease

- Afferent arteries deliver blood to glomerulus
- Efferent arteries take blood away from the glomerulus
- Ace Inhibitors (ACE-I) dilate efferent arterioles reducing glomerular pressure, thus reducing the amount of protein that is pushed into the urine

Glomerulonephritis and Nephritic Syndrome

- For ED docs = any disease affecting glomerulus
- Important only to recognize the syndrome and initiate treatment
- Causes include: systemic disease, infection, drugs, intrinsic renal disease, autoimmune
- Sx: proteinuria; hematuria; edema; hypertension, renal failure (AKI)
- Dx: workup goes beyond the ED and includes labs, urine (**Red cell casts**), Complement (C3, C4), autoimmune markers
- Tx: **largely supportive**; treat edema; search for underlying cause; dialysis
- **Post-Streptococcal Glomerulonephritis = common cause of glomerulonephritis**

Nephrotic Syndrome

- Primary renal or systemic etiology
- Sx: edema (especially **periorbital edema** that is worse in morning); hyperlipidemia; hypertension
- Findings: proteinuria; low albumin
- Increased risk of thromboembolism (due to loss of anticoagulant proteins in urine, therefore the worse the nephrotic syndrome, the higher the risk)
- Most common cause of Nephrotic Syndrome: **Focal Segmental Glomerulosclerosis (adults); Minimal Change Disease (kids)**
- Tx: IVF if volume depleted; sodium restriction; steroids; ACE-I; thromboembolism prevention
- Complications: renal vein thrombosis; DVT; **PE**

Pearls

- Ace-I's improve proteinuria by reducing glomerular pressure by dilating the efferent artery
- Red Cell Casts = Glomerulonephritis
- Most common types of nephrotic syndrome are: Focal Segmental Glomerulosclerosis (adults) and Minimal Change Disease (kids)
- Patient with Nephrotic Syndrome and sudden shortness of breath: Think PE!

Cystitis

- Infection confined to the bladder
    - most common E. coli
- Clinical: presenting symptoms are dysuria, frequency, and urgency
- Diagnosis with UA and urine culture
- Tx: short course of abx (3-5 days). Nitrofurantoin (not in elderly)

Pyelonephritis

- Ascending infection of urinary tract
    - E. coli most common
    - Staphylococcus saprophyticus
- Clinical: may initially be silent
    - flank pain, fever, toxicity/sepsis possible
- Tx: outpatient vs inpatient treatment (longer course abx 7-14 d)

Genital Lesions

Syphilis

- Painless lesion (chancre) - primary syphilis
- Tx: penicillin

Herpes Simplex Virus

- Painful lesions, low-grade fever
- Tx: antivirals (acyclovir)

Haemophilus Ducreyi

- Painful lesion (chancroid)
- Tx: doxycycline, macrolides

Hernias

Inguinal Hernia

- Indirect: going through the canal into scrotum
- Direct: through muscles on abdominal wall
- Complications include obstruction, incarceration, and strangulation of bowel
- **PEARL**: Being in jail is bad (incarceration) but being in jail and being strangulated is worse (strangulation)

Femoral Hernia

- Common in female; often missed

Other Hernias

- Umbilical, ventral, incisional, spigelian

Balanitis/Balanoposthitis

- Inflammation of the glans penis
    - involvement of foreskin referred to as posthitis
- Seen in uncircumcised men, diabetics, poor hygiene and obesity
- Clinical: penile itching, discharge, redness, and pain (clinical diagnosis)
- Tx: hygiene, warm soap/water and topical antifungal +/- antibacterial

Epididymitis/Orchitis

- Epididymitis: inflammation of epididymis
- Orchitis: testicular involvement
- Most are STD related
- Chemical epididymitis is due to reflux
    - seen in older men with BPH, stricture or cancer.
- Clinical: progressive pain, swelling, erythema, dysuria, fever, and discharge
    - Check for Phren's sign, which is relief of pain with scrotal elevation
- Clinical diagnosis with the use of ultrasound and urinalysis
- Tx: antibiotics (arbitrary division at 35 years of age); analgesics; scrotal elevation
    - Young men likely STD and infection with Chlamydia/Gonorrhea
    - Older men usually E. coli

Fournier's Gangrene

- Necrotizing infection of the scrotum and perineum
- Rapidly progressive and increased risk in diabetics.
- Tx: surgery, broad-spectrum antibiotics, **hyperbaric oxygen**

Urethritis

- Usually caused by STDs (Chlamydia, Gonorrhea, Ureaplasma urealyticum, Trichomonas, Candida, Herpes)
- Clinical: urethral discharge, dysuria, pyuria
- Diagnostics: urethral swab, urine tests
- Tx: antibiotics for Chlamydia/Gonorrhea (Azithromycin/doxycycline and Ceftriaxone IM)

Prostatitis

- Bacterial infection of the prostate
    - Acute or chronic
- Clinical: dysuria, frequency, hematospermia, **pain with defecation**, urinary retention
    - If acute present with fever, tender prostate, myalgias.
- Diagnosis based on prostate exam and urinalysis
- Treatment
    - Age categories arbitrary, but < 35yo give ceftriaxone, doxycycline and > 35yo give ciprofloxacin
    - If chronic give ciprofloxacin
    - Stool softeners and analgesics

Paraphimosis

- Foreskin of uncircumcised male can't be pulled back over the head of the penis
- CALL the PARAmedics: organ threatening
- Tx: manual reduction, if that fails dorsal slit procedure

Phimosis

- Foreskin cannot be retracted to expose the glans
- Can be due to recurrent balanitis, inadequate circumcision
- Treatment
    - Non-obstructive: Urology follow-up
    - Obstructive: place urinary catheter (may have to place suprapubic) and consult Urology

Priapism

- Painful, prolonged erection without sexual stimulation.
- Low flow vs high flow (trauma)
    - Low flow due to sickle cell, leukemia, polycythemia.
- Common medication causes: Viagra, trazadone
- Tx: On the board exam vs reality! TIME IS PENIS!
    - Terbutaline (0.25-0.50 mg SC) - usually doesn't work
    - Intracavernosal aspiration, injection
    - Phenylephrine, Epinephrine, Pseudoephedrine
    - Sickle Cell: exchange transfusion
    - Urology consultation

Benign Prostatic Hypertrophy (BPH)

- Clinical: Older men (50s-60s), nocturia, frequency, urgency, hesitancy, weakened stream
- Treatment
    - Digital rectal exam to diagnose and outpatient referral
    - Rule out obstructive sxs, urinary retention → if present place a foley catheter
    - May start alpha blockers (tamsulosin/Flomax)

Testicular Torsion

- Classic exam question: go with the **clinical exam, not the US**!
- True urologic emergency
- Young: 1st year of life, puberty
    - Undescended testicle is high risk
    - Bell clapper deformity is high anatomical risk.
- Clinical: acute, severe testicular pain; nausea/vomiting/abdominal pain; scrotal swelling, tenderness; absent cremasteric reflex is classic
    - Child with abdominal pain/nausea → examine the testicles!
- Tx: ultrasound; urology consultation; may try manual detorsion; surgery

Torsion of the Appendix Testis

- Blue dot sign-25%
- Can look exactly like testicular torsion so it must be taken seriously until ultrasound determines it's the appendix testis

Prostate Cancer

- Common after the age of 50; usually slow growing; can metastasize
- May be asymptomatic or have BPH symptoms
- Elevated PSA, abnormal exam

Testicular Cancer

- Most common cancer of men age 15-35
- Often **misdiagnosed as epididymitis**
- Clinical: painless, firm mass on exam
    - Can present with pulmonary metastasis (cannon-ball lesions on CXR)
- Diagnosed with ultrasound, may have elevated HCG
- Tx: urgent referral

Hemolytic Uremic Syndrome

- Usually seen in the pediatric population, age 6 months - 4 years
- History of recent diarrheal illness
- Culprits usually **E.coli O157:H7** from contaminated food/water and Shigella-toxin mediated
- Clinical: fever, GI bleeding, abdominal pain, neurologic-seizures
- Diagnostics
    - Anemia, thrombocytopenia, fever, renal dysfunction, hemolytic anemia
    - Schistocytes
    - Normal Coags and DIC panel

    - Elevated BUN and creatinine
- Tx: Supportive care, dialysis.

Obstructive Uropathy

- Mechanical obstruction, BPH, inability to void
- Tx: Foley and urologic consultation

Polycystic Kidney Disease

- Autosomal dominant, multiple kidney cysts
    - Cysts can become infected, bleed
- Associated liver cysts and cerebral aneurysm
- Clinical: flank pain, hematuria, hypertension
- Diagnostics
    - Renal insufficiency
    - Diagnosis with CT scan, renal ultrasound
    - Can be an incidental pickup
    - Tx: blood pressure control and referral to nephrology

Pearls

- Common GU infections include urethritis, cystitis, pyelonephritis and genital lesions. Additionally in males balanitis/balanoposthitis, epididymitis/orchitis, and prostatitis. Know the presentations and treatments.
- Urologic emergencies include Fournier's gangrene, paraphimosis, priapism and testicular torsion.
- Hemolytic Uremic Syndrome, usually caused by E.coli O157:H7, leads to hemolytic anemia, thrombocytopenia, fever, and renal dysfunction and is treated with symptomatic care.
- Remember to think of cerebral aneurysms in patients with PCKD.