PATHOPHYSIOLOGY OF NEPHROLITHIASIS (STONE DISEASE)

Stone Type	Etiology	Pathophysiology	Lab Findings and Diagnosis	Treatment
Indications for Hospitalizaiton Concurrent UTI with obstruction Stone diameter > 1 cm requiring surgery or ablation Bilateral obstruction and posterenal AKI Inability to ingest fluids Non-tolerance of pain **In ALL acute stone disease** Initial therapy is preventative: increase fluid intake > 2 L/d (stone clinic effect) Pain management MET: alpha antagonists (tamulosin) and CCDs (nefedipine) to dilate ureters **Resolution depends on size** < 0.5 cm: spontaneous passage 0.5 – 1.0 cm: may require intervention > 1.0 cm: intervention always necessary **Differential Diagnosis:** acute pyelonephritis, renal papillary necrosis, renal vascular occlusion **For Chronic Stone Disease** > 1 stone event, multiple concurrent stones, new stone formation or progression of established stone Obtain intact PTH, 24-hr UroRisk profile (sodium, calcium, phosphorous, uric acid, oxalate, pH, citrate)				
CALCIUM OXALATE	**60% of stones** Hypercalcuria Lack of *Oxalobacter fomigenes* Hyperoxaluria (metabolic, IBD, short bowel syndrome, gastric bypass) Decreased urinary citrate (no chelation of urinary calcium) Medullary Sponge Kidney Polycystic Kidney Disease	Supersaturation (calcium > oxalate) → (hypercalcuria) → deposition of calcium phosphate on the tubular basement membrane of LoH + interstitium → nidus for calcium oxalate deposition → growth into lumen	Microhematuria or gross hematuria Plain film: opacity alogn psoas shadow Gold standard: CT without contrast Strain urine for stone analysis (typically for 1 wk. after resolution of renal colic) r/o infection: CBC, pyuria	Thiazide diuretics: increase calcium reabsorption in the PCT Sodium, protein, and oxalate restriction Potassium citrate supplement Increases the pH of urine, so it is **contraindicated for pure calcium phosphate stones** DO NOT RESTICT dietary calcium

CALCIUM PHOSPHATE	**Brushite and Apatite stones** **9% of stones** Type I RTA Hyperparathyroidism Form in **alkaline urine**	Typically from in the tubular lumen Thus, these stones are associated with medullary fibrosis and retraction	Serum electrolytes Renal failure (AKI) is unlikely	
STRUVITE (TRIPLE PHOSPHATE)	**10 – 15% of stones** $Mg(NH_4)PO_4$ + carbonic apatite Complicated or recurrent UTI Repeated catheterization Neurogenic bladder Urologlical procedures *Proteus, Prodencia, Klebsiella, Pseudomonas, Enterococcus*	Involves sieve urine alkalinizatin due to urea splitting	Rapid growth leads to non-painful large masses (no renal colic) Urine cultures pH > 7.0 Urinalysis for signs of infection Sediment revelas coffin-lid crystals	Percutaneous nephrolithotomy ESWL Urease Inhibitor (acetohydroxamic acid) Acidify urine to pH < 7/2 Treat underlying infection
URIC ACID	**10% of stones** Metabolic Syndrome: decreased NH_4^+ excretion and abnormally acidic urine Chronic diarrhea Increased serum uric acid Decreased urine volume Form in **acidic urine**	Solubility of uric acid decreases with lower urine pH	Strain urine to collect stone OR 24-hr urine collection → increased soluble uric acid + low pH → presumptive diagnosis if no calcium stones seen on CT or plain film	Alkalinize urine: postassium citrate Low protein diet Allopurinol (lowers serum uric acid)
CYSTINE	< 1% of stones Genetic: dysfunctional dibasic amino acid transport → cystinuria SLC3A1 and SLC7A9 Typically present sin pediatric patients	Stones form within the tubular lumen	Positive FHx: AR inheritance Urine sediment: hexagonal forms Stone analysis Elevated urine cystine (CN-nitroprusside test)	Decrease urine cystien < 250 mg/L High fluid intake Alkalinize urine: pH > 7.0 Cysteine-binders: D-penicillamine, Tioprinin