"I didn’t think getting stoned would be so painful."

Nephrolithiasis – modern diagnosis and management

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Pathophysiology

- **Calcium oxalate:** 70%
  - Hypercalciuria
    - most are from jejunal hyperabsorption
    - Hyperparathyroidism
  - Hyperoxaluria
    - tea, coffee, sodas, plums, rhubarb, cranberries, citrus, green leafy veggies
    - Can occur with small bowel disease
Pathophysiology

- **Calcium phosphate:** 10%
  - a/w defects in urine acidification (RTA)

- **Struvite** (Magnesium-Ammonium-Phosphate): 10%
  - a/w infections with urea splitting bacteria (Klebsiella, Serratia, Enterobacter, Pseudomonas, Proteus and Staph)

- **Uric acid:** 10%
  - Hyperuricosuria
    - meat, fish, poultry
    - a/w acid urine and hyperuricemia

- **Cystine:** 1%  
  - a/w inborn disorder in reabsorption of cystine

Radiolucent?
Epidemiology

- Incidence up to 12%
- 3 times more common in males
- 70% occur between age 20 and 50
- Recurrence after 1st episode:
  - 15-30% @ 1 yr
  - 50% @ 5-10 yrs
Risk Factors

- 20-50 years old
- Male
- Family history
- Hot, arid climates
- Sedentary
Fat men between 20 & 50 who live in Arizona.
Anatomy

- UPJ: 3 mm
- Pelvic Brim: 4 mm
- UVJ: 2 mm
- <5% of stones > 8mm will pass
- 15% of stones 5-8 mm will pass
- 90% of stones < 5 mm will pass
Classic Hx:

- Sudden onset of severe pain
  - Pelvis/calyx
    - deep flank ache
  - Ureter
    - severe colicky pain in flank, abdomen, groin
  - Distal ureter / Bladder
    - dysuria, frequency, urgency, retention
- N/V
Classic PE:

- Writhing
- Non-tender or mildly tender over impaction
- Normal genital exam
DDx: Be sure to check:

- **fever**
  - infection (pyonephrosis, perinephric abscess)
- **hypotension**
  - AAA
- **abdominal distension, pulsatile masses, bruits, peritoneal signs**
  - AAA, SBO, appendicitis, PID, renal artery stenosis ........
DDx: Be sure to check:

- CVA tenderness
  - pyelo, shingles, back strain
- genitals/pelvic
  - hernias, torsion, PID, epididymitis
- lungs
  - lobar pneumonia
- skin
  - Zoster
- lower extremity pulses
  - AAA
Labs:

- Urine dip & Urinalysis
  - RBCs (absent in 15-20%)
  - WBCs or bacteria
  - pH < 5.0 suggests uric acid stone
  - pH > 7.6 suggests struvite stone

- Pregnancy test (just for the females)
Labs:

- Others not routinely indicated:
  - Electrolytes
    - prolonged symptoms, or renal insufficiency
  - CBC
  - Serum calcium, phosphorus, uric acid
Imaging

- What are our options?
Imaging:

- **KUB:**
  - 90% of stones are radio-opaque
  - low sensitivity and specificity
    - Sensitivity: <50 % when read by EPs
    - Specificity: 70%
  - may be useful to monitor passage of a known opaque stone

- **Pros:** easy
- **Cons:** low sensitivity and specificity
Imaging

- **US:**
  - sensitivity: 66-93% (70%)
  - specificity: 83-100%
  - look for:
    - stone, hydroureter, perirenal urinoma
- **Pros:** no radiation (pregnancy), no contrast
- **Cons:** low sensitivity compared to IVP and CT
Imaging:

- KUB and US (either positive):
  - sensitivity of 95%
  - specificity of 67%
- Pros: minimal radiation, good sensitivity
- Cons: 2 studies, sensitivity/specificity not as good as other modalities
Imaging

- IVP:
  - sensitivity: 64-97%
  - specificity: 94-100%
- Pros: sensitive and specific, can tell structural and functional information
- Cons: IV contrast, radiation, time, most techs have never done one.
Imaging

- IVP signs of obstruction
  - delayed nephrogram (earliest & most reliable)
  - hydronephrosis
  - hydroureter
  - standing column
  - distension of renal pelvis
  - calyceal distortion
  - dye extravasation
Imaging

- CT scan
  - sensitivity 94-100%
  - specificity 96-100%
- Pros: quick, no contrast, can see other pathology
- Cons: radiation, cost, no functional information
  - Cost at MCL: CT $1012
    - IVP $472
Imaging

- Renal stone CT signs:
  - Calcification
  - Hydroureter
  - Perinephric stranding
  - Dilation of the kidney / collecting system
Left hydronephrosis
Stone at left UPJ
So Who Needs to be Imaged?

- Elderly
- Signs of infection
- Refractory symptoms
- Decreased renal reserve
  - comorbidities or underlying renal disease
  - solitary kidney
- Prolonged symptoms
- Uncertain diagnosis
- First time
Treatment:

- NSAIDs
- Narcotics
- IV hydration?
- Anti-emetics
- $\alpha$-blocker (Flomax)
- CCB (nifedipine)?
When should we consult?

- Infection without obstruction
- Stone unlikely to pass spontaneously
- Moderate to severe hydronephrosis
- Solitary kidney
- Intrinsic renal disease
- IVP with extravasation
When should we admit?

- Infection with obstruction
- Refractory symptoms
- Solitary kidney with obstruction or large stone
- Renal failure
So who gets to be discharged without imaging?

- Young
- Healthy
- History of stones
- No signs of infection
- Symptoms controlled
Discharge instructions:

- po analgesia (NSAID + narcotic)
- Strain their urine / save stone
- All need to follow-up with PMD/urologist in <1wk
- po hydration
- Return for fever, chills, refractory symptoms
What Might We Be Missing?
Differential Diagnoses

- AAA
- ectopic
- incarcerated hernia
- cholecystitis
- appendicitis
- testicular torsion
- ovarian torsion
- shingles
- pyelonephritis
- intestinal obstruction
- mesenteric ischemia
- back strain
- urinary tract tumor
- renal papillary necrosis
- blood clots from upper tract hemorrhage
- fungal aggregations
- renal infarct
- endometriosis
- cervical cancer
What Might We Be Missing?

- AAA
  - 18% initially misdiagnosed as kidney stone
  - all were > 60 years old

What Might We Be Missing?

- Renal artery or vein thrombosis
  - flank pain, hematuria
  - may have bruit
  - no nephrogram
  - no hydronephrosis

- if suspected should get contrast CT or angiogram
What Might We Be Missing?

- Renal or perinephric abscess
  - Flank pain, fever, mass
  - Picked up on CT or US
What Might We Be Missing?

- Renal papillary necrosis:
  - flank pain, hematuria
  - a/w diabetes, sickle cell, NSAID abuse
  - ring shadows on IVP
  - triangular lucency on CT
What Might We Be Missing?

- Tumor:
  - filling defect on IVP (lucent stone?)
  - mass on CT
Clinical Scenarios
- Patient #1
  - Hx: 33 yo male with sudden onset of R flank pain. States he has a hx of stone once 3 years ago. No meds. No allergies.

- Patient #2
Physical Exam

- Patient #1
  - young man writhing on the bed
  - no findings on PE

- Patient #2
  - young man uncomfortable on the bed
  - only finding is CVAT
What to do?

- **Patient #1:**
  - Urine shows mod blood and no white cells

- **Patient #2:**
  - Urine dip shows mod blood and trace leuks
### Treatment

- **Patient #1:**
  - 2 L NS
  - Pain controlled with ketorolac and meperidine

- **Patient #2:**
  - 2 L NS
  - Pain controlled with ketorolac and meperidine
What now?

- Patient #1 – See ya!
  - Strainer
  - Hydration
  - Po analgesia (NSAID + narcotic)
  - ? tamsulosin
  - F/u with urology <1 wk
What now?

- Patient #2
  - UA shows 40 WBCs, 10-20 bacteria
  - CT shows 8mm stone at pelvic brim and moderate hydro on the R
What now?

- Abx in the ED
- Urology consult:
  - The urologist comes in, says thanks for caring for this patient and admits him for percutaneous drainage.
Patient #3

- 66 year old male c/o sudden onset of colicky L flank pain radiating around to the anterior abdomen
- PE shows obese male uncomfortable on stretcher. Mild LUQ tenderness. No masses palpated.
- Urine dip shows mod blood only
What now?

- Labs are all normal

- Imaging shows 7 cm aortic aneurysm just below the renal vessels.

- Vascular surgeon comes in. He says, “you guys are awesome for picking this up,” and takes him to the OR.
Pearls

- What is the most common place for impaction of a stone:

- Answer: UVJ
Pearls

- How long before a young, healthy person with complete obstruction can start to get irreversible kidney damage?
  - About 1 week
Pearls

- What percent of stones > 8mm will pass spontaneously?
  - <5% of stones > 8mm will pass
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REFERENCES


