

# Nephrolithiasis cases

Primary Care Internal Medicine  
October 2015

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A Teaching Affiliate  
of Harvard Medical School



MASSACHUSETTS  
GENERAL HOSPITAL

- 45 year old male, otherwise healthy, acute onset right flank pain + nausea presents to your office for evaluation.
- PMH: none
- PE: T 98.9, BP 130/80, Pulse 90
- abdomen soft, non-tender. Mild right CVA tenderness



Labs: WBC 12.5, Cr 1.2

Urinalysis: 2+ RBCs, 2+ WBCs, negative nitrites,  
negative bacteria

Imaging studies: KUB? RUS? CT?



# CASE 1

- CT scan shows 6 mm right upper ureteral stone with hydronephrosis.



What determines the  
next steps?

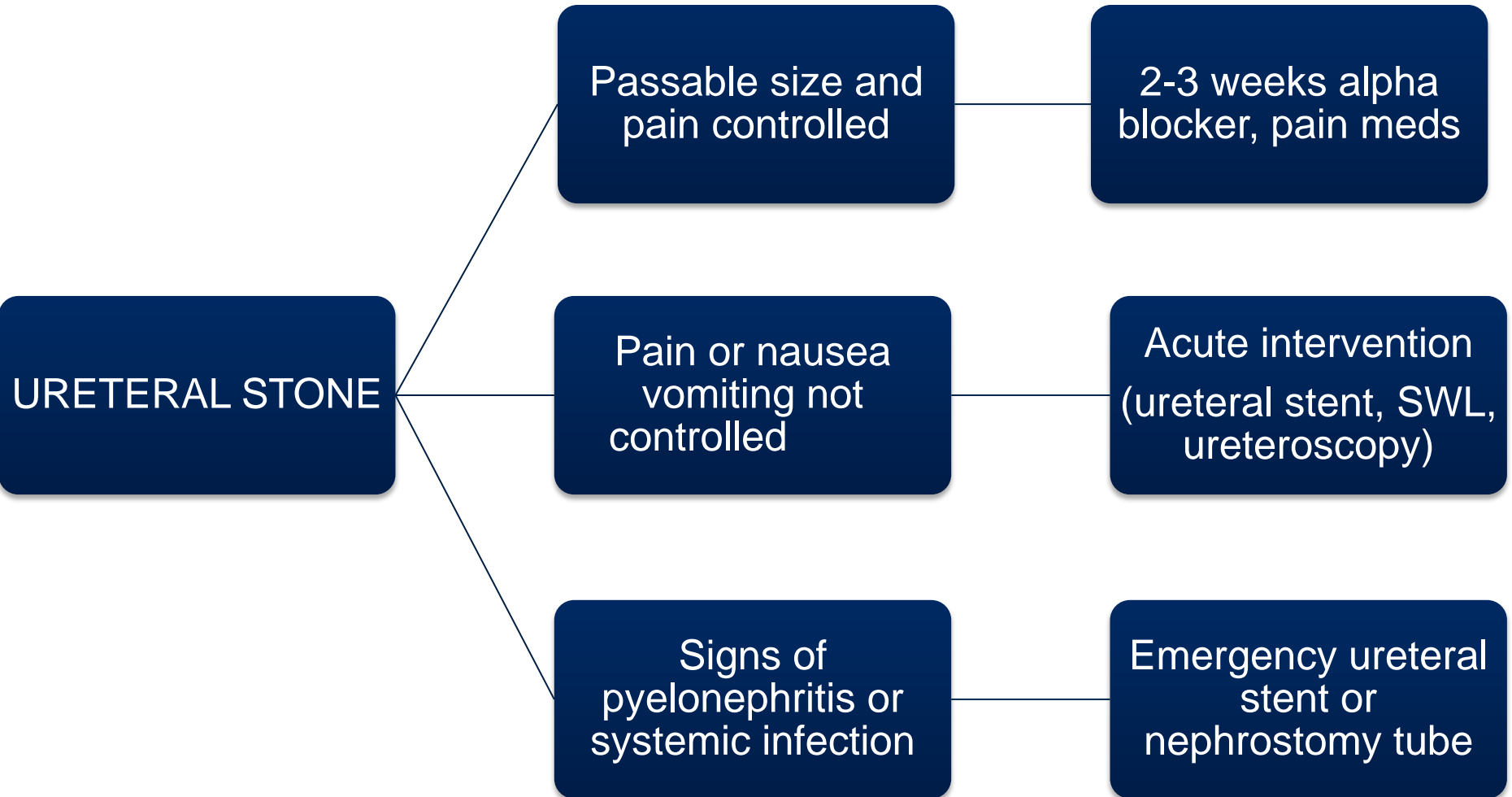


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- A 6 mm stone has a 50-60% chance of passing spontaneously
  - Alpha blocker significantly increases passage rate
  
- My practice:
  - 2-3 weeks alpha blocker (e.g. flomax) if patient meets following criteria:
    - Pain controlled on PO regimen
    - No evidence of infection (fever, nitrites, leukocytosis)
      - WBCs in the urine are okay (reflect inflammation from stone)
  - KUB and renal ultrasound in 2-3 weeks to assess stone passage



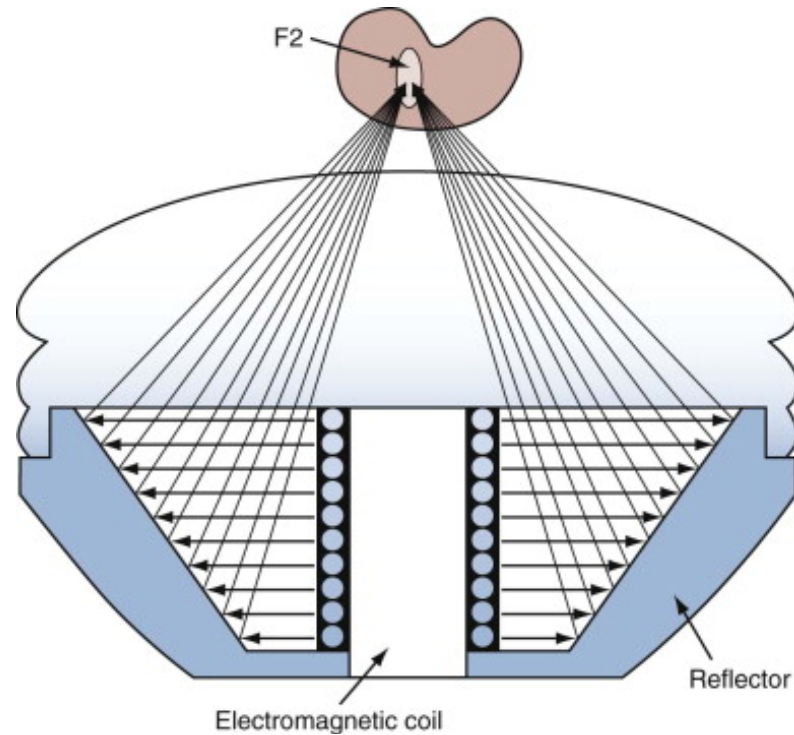
- EMERGENCY – if signs of pyelonephritis or systemic infection, this may be a LIFE-THREATENING SITUATION
- Decompression of the urinary system must be done emergently
  - Ureteral stent or nephrostomy tube
  - Choices vary by urologist
  - My practice: stent when possible to avoid external drainage of nephrostomy tube
  - Treat stone after patient has stabilized
    - 2-3 weeks of abx



- Shockwave lithotripsy (SWL)
- Truly minimally invasive – shockwaves delivered externally with imaging to confirm
- Sedation
- ~50-60% success rate
- Limited by BMI
- Cannot be done in patients on anticoagulation

- Ureteroscopy (URS)
- Flexible or semirigid endoscope passed into urethra and stones fragmented w/ laser and extracted
- General anesthesia
- 90-95% success rate for stone < 1 cm
- Often requires ureteral stent for ~ 1 week
- No issues w/ BMI
- Safe in patients on anti-coagulation

- Shockwave lithotripsy (SWL)
  - Schematic of an electromagnetic lithotripter

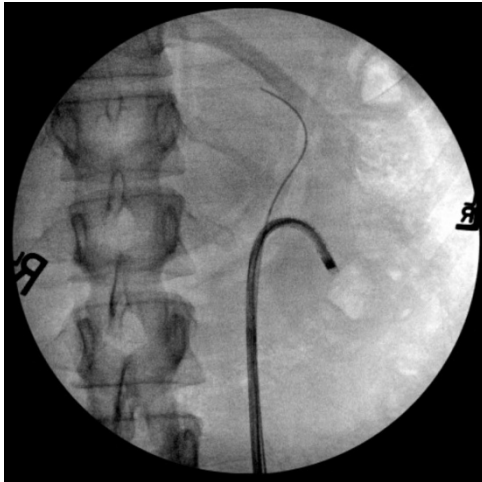


# CASE 1

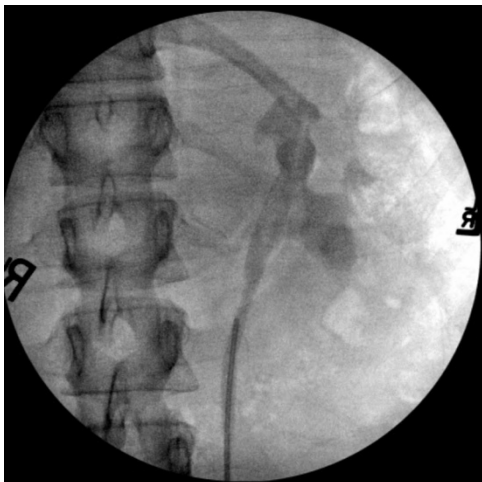
## ■ Ureteroscopy (URS)

- Fluoroscopic images from laser fragmentation of stone

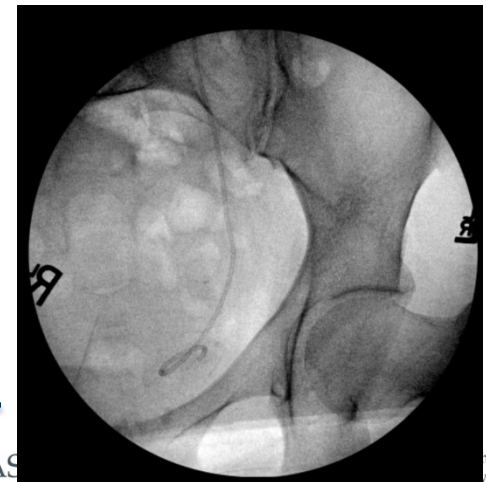
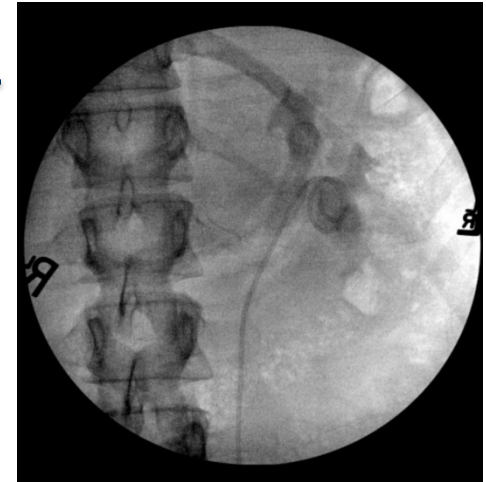
Flexible ureteroscope in lower pole of kidney



Retrograde pyelogram



Ureteral stent (coil in kidney and bladder)



# CASE 1

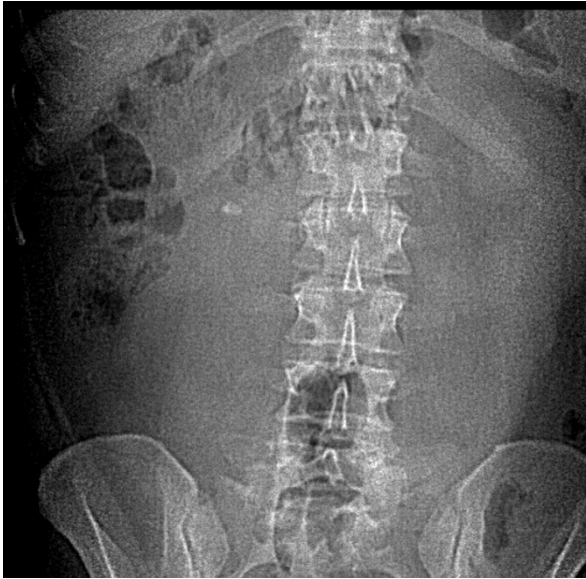
- Distal stones pass more frequently than proximal stones
- Most common place for stone to lodge is distal ureter or ureterovesical junction (~60%)
- Alpha blockers recommended to aid passage for all stones < 1 cm in diameter
- Passage rate is not increased after a single 2 week course of alpha blocker



- MY PRACTICE
  
- Pain management
  - Acute: IV ketorolac (toradol), IV narcotics
  - For Discharge: diclofenac, percocet or vicodin, colace, alpha blocker
  
  - Others
    - Antibiotics? – if cystitis or infection, should have stent placed; if no infection, no abx
    - Pyridium – for dysuria
    - Anti-cholinergics (ditropan) – for frequency

- IMAGING
- CT is gold standard
  - Most efficient and accurate
  - Risks = ionizing radiation (but remember, non-contrast CT scan is far lower dose than contrast enhanced)
  - CT more costly than other modalities
- KUB (plain radiography) + ultrasound (RUS)
  - Will pick up a majority of stones
  - Sufficient in many cases (maybe not for *obese* patients)
  - Less detail than CT
  - Less radiation than CT
  - Less \$\$\$ than CT

# CASE 1



**KUB showing right renal stone**



**RUS showing right hydronephrosis and left renal stone**

- 53 year old female. First stone age 44. She has passed 4 stones (1 every other year) and has had 2 procedures (ureteroscopy) by local urologist. “I need a drug to make these go away!!!!”
- PMH: nephrolithiasis (CaOx), DM, HTN, hypothyroid
- PE: BMI 33, otherwise unremarkable





- Nephrolithiasis – 10% lifetime prevalence worldwide
- Men > women, but female #s are increasing at faster pace
- 50% recurrence within 10 years of first stone event



- Stone composition
  - Calcium oxalate (most common); CaP (increasing); Calcium based stones ~ 80%
  - Uric acid (diabetic, overweight) ~ 5-10%
  - Cystine (genetic disorder, may present in childhood) ~1%
  - Struvite (recurrent infection) ~3%
  - Miscellaneous others (protease inhibitors, other rx)

- **Absolute indications for metabolic evaluation**
  - multiple/recurrent stones
  - solitary kidney
  - GU anatomy abnormalities which may make surgery difficult
    - diversion, horseshoe kidney
  
- **Relative indications for metabolic evaluation**
  - young age
  - single stone, particularly difficult episode for patient (i.e. sepsis, surgery)
  - patient preference

## ■ Workup

- chem 7, calcium, PTH, uric acid (if PTH is elevated, check vitamin D!!!)
- 24-hour urine
  - 2 collections standard, but many obtain only 1

## ■ Maintenance/monitoring

- Recent guidelines published by the AUA
- My practice – recheck 24-hour urine 3-4 months after starting a new therapy (e.g. thiazide, allopurinol, k citrate) then yearly x 1-2 years
- My practice – stop checking yearly 24-hour urines once patient's stone disease is stabilized



- Pharmacotherapy for **calcium oxalate** stones – the basics
- Hypercalciuria – thiazide diuretic (**level 1 evidence**)
- Hyperoxaluria – no standard of care
  - Magnesium oxide, magnesium hydroxide, calcium carbonate with meals
- Hypocitraturia – potassium citrate (**level 1 evidence**)
- Hyperuricosuria – allopurinol (**level 1 evidence**)

- Pharmacotherapy for uric acid stones – the basics
- Potassium citrate or sodium bicarbonate
- Can dissolve stones at higher doses
- Lower doses for maintenance
- Usually *do not need allopurinol* unless potassium citrate fails or if patient has hyperuricemia

- 21 year old male, passed 1 stone this year. KUB shows a 5 mm stone in left kidney.
- PMH: nephrolithiasis
- PE: BMI 30, otherwise unremarkable
- “How can I change my diet??? I don’t want a pill.”

- **FLUID INTAKE**
- **Level 1 evidence** – randomized trial of fluid intake of 2.5 L/day versus 1.0 L/day
  - Recurrences in 5 years decreased by > 50%
  - Time to recurrence increased from 25 to 38 months



- ANIMAL PROTEIN
- Theoretical risk of increased urine calcium and decreased urine citrate with increased protein consumption and portion size
- Data equivocal but several studies demonstrate association between protein consumption and risk of nephrolithiasis
- My practice – “Don’t eat anything bigger than your hand (palm) in a single serving.”



- **SODIUM**
- Sodium and calcium co-transported in renal proximal tubule; increased dietary sodium → increased urine sodium → increased urine calcium
- Data equivocal but several studies demonstrate association between dietary sodium and risk of nephrolithiasis
- My practice – “Moderate sodium intake.”



## ■ OXALATE

- Area of major patient concern
  - Patients can control this part of the diet
- Green vegetables, spinach, potatoes, cereal, oranges, carrots, tea, coffee, nuts, beans, chocolate, strawberries, vitamin C supplements
- Urine oxalate = ~30% from diet, 70% from endogenous production (liver)



- OXALATE (continued)
- Epidemiologic studies demonstrate that dietary oxalate
  - Is not related to kidney stone risk in younger women
  - Is “modestly” related to kidney stone risk in older women
- The only foods with enough oxalate to change urine oxalate are
  - Spinach, beets, rhubarb, vitamin C (> 1000 mg/day)



- **PHYTATE**
- Common dietary sources include cold cereals, bread, beans
- Epidemiologic evidence demonstrates that phytate is protective against incident stone disease in women

- **LEMON JUICE/LEMONADE**
- Citrate is potent inhibitor of stone disease
- Potassium-citrate shown to prevent stone recurrence
- Lemon juice and homemade lemonade preparations have been shown in some retrospective studies to significantly raise urine citrate
- My practice: Mix  $\frac{1}{2}$  cup lemon juice (concentrate) w/ 7  $\frac{1}{2}$  cups water and drink daily



- VITAMIN C
- Can be metabolized to oxalate and therefore can theoretically increase risk of calcium oxalate stone formation
- Modest increase in stone risk for consumption  
> 1000 mg/day

- My general dietary recommendations:
- > 2 L fluid/day
- Watch salt intake (< 2g), animal protein (no portion larger than palm of your hand)
- Limit spinach/beets/rhubarb to 1 serving/week
- Vitamin C < 1000 mg/day
- ½ cup lemon juice mixed in 7 ½ cups of water, sweeten w/ artificial sweetener as needed



- 67 year old female, recent admission to hospital for hip fracture. Subsequent workup reveals osteoporosis w/ osteopenia.
- PMH: osteoporosis, osteopenia, HTN, history of kidney stones (passed 4 stones since age 55)
- PE: BMI 24, otherwise unremarkable

Knowing most stones  
are made of calcium, is  
it safe to  
Supplement calcium?  
Supplement vitamin D?  
Give bisphosphonates?





## Calcium plus Vitamin D Supplementation and the Risk of Fractures

- 36,000 women randomized to calcium carbonate + vitamin D versus control
  - Mean f/u 7 years
- 17% increased risk in kidney stone formation in treatment arm
- Real #s: 2.6% of treatment versus 2.3% of placebo



- Dietary calcium is PROTECTIVE against stone disease (i.e. reduces stone risk)
  - Binds oxalate in GI tract
  
- Supplemental calcium data is equivocal
  - Metanalysis of 12 calcium supplementation trials for osteoporosis shows that calcium supplementation likely is protective against stone disease (up to 2000 mg/day)



- Vitamin D supplementation – may increase GI absorption and therefore urinary excretion of calcium
- No evidence of increased urine calcium in stone formers given 50,000 IU ergocalciferol/week x 8 weeks
- No evidence of relationship between serum vitamin D and urine calcium in stone formers

- Bisphosphonates - decrease fasting calciuria
  - Evidence that bisphosphonates decrease kidney stone formation in bed-ridden patients
  - Risedronate protective against stone formation
  - ? Ibandronate may increase stone formation



- My practice/recommendations
- Maximize DIETARY calcium
  - Take with meals
- Calcium supplementation is fine
  - Take with meals
  - Use calcium citrate
- Vitamin D supplementation – no issues
- Bisphosphonates – no issues
  - ? Ibandronate caveat



- Thank you!!!!!!!!!!!!
- Questions:
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