Renal Stones: Diagnosis and Management

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Pathogenesis of Renal Stones

- All urinary stones are composed of 98% crystalline material and 2% mucoprotein.
- The crystalline component(s) may be found “pure” or in combination with each other.
- The common characteristic that all crystalline components share, is that they have a very limited solubility in urine.
99% of renal stones (in western hemisphere) are composed of:

- Calcium oxalate 75% (mono or di hydrate)
- Calcium hydroxyl phosphate (15%)(apatite)
- Magnesium ammonium phosphate 10% (struvite)
- Uric acid 5%
- Cystine 1%
Pathogenesis of Renal Stones (cont.)

- Investigations show that the formation of a stone is similar to the development of a crystalline mass in vitro.
- Given that stone formation is an example of crystallization, one could predict:
  - the necessity for a **supersaturated** state in urine
  - the occurrence of **spontaneous crystallization**
  - the need for the earliest polycrystalline state to be arrested in the urinary tract allowing time for growth.
Spontaneous Crystallization

- Normal urine has crystals (at times)
- Normal urine is extremely effective in maintaining a stable supersaturated state
- There are certain components of urine that
  - enhance ability to maintain ss state
  - inhibit development of crystals
**Site of Stone Development**

**Question:** Where in the UT does urine reach its maximal concentration while still in a microscopic sized lumen so that crystalline particles that may form can get “stuck” in the lumen?

**Answer:** The collecting duct which runs through the renal papilla. Any part of the UT distal to this point has a large lumen and small particles would easily pass.
Clinical Risk Factors

- occupation
- family history
- diet
- hydration
- small bowel disease (i.b.d.)
- medical conditions causing hypercalcuria
- medical conditions causing aciduria
Clinical Features

- **Acute obstruction of ureter** --- severe colic
- Flank pain referred to genitalia
- Nausea, vomiting may mislead and look like GI problem
- Microhемaturia

- **Chronic stone dis.** tends to be associated with large or multiple stones
- Can be little or no pain
- May have impaired renal function, anemia, weight loss etc.
- Concomitant infection more likely
**Evaluation**

Exam - costovertebral angle (cva) tenderness, no peritoneal signs

Urine analysis (expect to see hematuria) - need to know if there is concurrent infection

KUB (expect to see a calcification but 5% of stones are radiolucent)

CT Scan will show exact location and size of stone and associated hydrenephrosis

Ultrasound can show hydro will not show ureteral stones
Treatment

- **Small ureteral stones** with good chance of passage (<7 mms)
  - allow time to pass (2-4 weeks)
  - lower ureter-ureteroscopic stone removal
  - mid-upper ureter eswl

- **Large ureteral stones (>7mms)**
  - eswl
  - ureteroscopic stone fragmentation
  - open surgery???
Ureteral stents are commonly used to accomplish the following:
- drain obstructed kidney thereby alleviating pain
- dilate ureter perhaps facilitate passage of stone
- facilitate performance of ESWL and ureteroscopic procedures
- avoid problems from “steinstrasse” in the post treatment period
Treatment Renal Stones

- < 2 cm ESWL
- > 2 cm or multiple stones, percutaneous nephrolithotomy (PCNL)
- Large branched stones “staghorn” may require PCNL and ESWL
- Cystine stones may require PCNL or open nephrolithotomy
The first stone or infrequent (no problem for 10 years) no work up needed.

More than one isolated stone event:
- 24 hr urine for total volume, pH, calcium, oxalate, sodium, uric acid, citrate, phosphate, magnesium, sulfate, creatinine, quantitative cystine (optional)
- Serum calcium, phosphorus, uric acid, HCO3, BUN, creatinine, albumin, alkaline phosphate, intact PTH (optional), 1,25-di-OH-vitamin D2 (optional)
- Stone composition analysis
Monitor stone burden with periodic KUB

Instruct patient on adequate water consumption
  (enough to produce 2.5L of urine in 24 hrs.)

Instruct in low oxalate and modified calcium diet

If hypercalcuric treat with hydrochlorothiazide
  (monitor urinary Ca)
Principles of Medical Management (2)

- If hyperuricosuric
  - allopurinol if serum uric acid elevated
  - alkalinize urine if serum level is normal
- If active Ca stone former not aided by diet and hctz: add K citrate
- If magnesium ammonium phosphate stone: treat aggressively with antibiotics after reduction of burden.
Anatomic Evaluation

- Necessary to decide on how to best treat
  - size and location of stone
  - number of stones
  - anatomy of kidney, ureter
  - is stone overlying bone
  - “condition” of involved kidney
Principles of Stone Prevention

- Prevent supersaturation
  - Water! Water and more Water: enough to make 2.5L of urine per day
  - Prevent solute overload by low oxalate and moderate Ca intake and treatment of hypercalcuria
  - Replace “solubilizers” i.e... citrate
  - Manipulate pH in case of uric acid and cystine

- Flush! Forced water intake after any dehydration
Resources

- www.auanet.org
- www.urologycp.com
- www.niddk.nih.gov