

Evaluation and Management of the Patient with Kidney Stones

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Nephrolithiasis-Epidemiology

- 12% men 6% women
- 5.2% prevalence
- 1% of hospital admissions
- \$2.1 billion
- Increased risk HTN, DM, ASHD, ESRD



Stone Recurrence

- Greater risk in men
- 10-20% in 1-2 years
- 35% within 5 years
- 60% within 10 years



Types of Stones

- Calcium oxalate or phosphate 75-90%
- Uric Acid 10-15%
- Struvite 5%
- Others (e.g. cystine) < 1%



Calcium Stones-Risk Factors

1. Low urine volume
2. Hypercalciuria
3. Hyperoxaluria
4. Reduced inhibitors- citrate
5. High urine pH- calcium phosphate
6. Structural abnormalities- medullary sponge



Hypercalciuria

- 33% incidence- urinary Ca 33-38% higher in stone formers on same Ca diet
- Men>250 mg/day Women>200 mg/day
- Most are idiopathic- 35% in first degree relatives- renal leak
- Consider secondary causes
- Glucose loading
- Sodium loading
- Protein loading




Hyperoxaluria

- 20% incidence in stone formers
- Genetic component- glyoxalate metabolism
- Inversely correlated with calcium intake
- Associated with increased BMI and DM
- Increased in malabsorptive states
- Diet usually not major factor
- Oxalobacter formigenes



Hypocitraturia

- Ingested and produced endogenously
- Lowers urinary ionized Ca- prevents crystallization
- Mean 640mg/day. <500 is low
- 33% incidence in stone formers
- Determined by tubular reabsorption- depends on total body acid-base balance
 - Increased by acid load- buffer
 - Decreased by alkali



Hypocitraturia- Risk Factors

- Acidosis promotes mitochondrial citrate use
- High protein diet- increased acid load
- Hypokalemia causes intracellular acidosis
- Renal Tubular Acidosis
- Chronic diarrhea- IBD
- Strenuous physical exercise- lactic acidosis
- High Na⁺ diet
- Idiopathic



Medullary Sponge Kidney

- Urinary stasis
- Hypercalciuria
- Hypocitraturia



Iatrogenic Stones

- Stone-forming Drugs
 - triamterene
 - anti-HIV agents: Indinavir
 - Melamine Milk (China)



Iatrogenic Stones

- Drugs that inhibit carbonic anhydrase
 - acetazolamide (Diamox)
 - topiramate (Topamax)
 - cause profound hypocitraturia (RTA)
- Bariatric Surgery
 - Hyperoxaluria
 - Hypocitraturia



Calcium Stones- Treatment

I. WATER, WATER, WATER

- avoid high glucose intake
- avoid fructose

II. Hypercalciuria

A. Diet

1. DASH- fruit, vegetables, low Na⁺, moderate low-fat dairy, low animal protein.

B. Thiazide Diuretics



Calcium Stones- Traeatment

III. Hyperoxaluria

A. High oxalate foods- black tea, chocolate, soy milk, nuts, berries, beans, beets, carrots, celery.

B. Calcium with meals.

C. Avoid high dose Vitamin C.

IV. Hypocitraturia

A. Diet- DASH

B. Potassium citrate.



Uric Acid Stones

A. Risk Factors

1. Low urine volume.
2. Low urine pH- associated with metabolic syndrome.
3. Hyperuricosuria.

B. Treatment

1. WATER, WATER, WATER.
2. DASH diet.
3. NaHCO₃ or Kcitrate- urine pH>6-6.5.
4. Allopurinol.

Patient Results Report

PATIENT

██████████

DATE OF BIRTH

██████████

PHYSICIAN

Miner, David J.

Values larger, bolder and more towards red indicate increasing risk for kidney stone formation. See reverse for further details.

Stone Risk Factors / Cystine Screening: Negative (09/19/2007)

| DATE | SAMPLE ID | Vol 24 | SS CaOx | Ca 24 | Ox 24 | Cit 24 | SS CaP | pH | SS UA | UA 24 |
|--------------|-----------|----------|---------|--------------------------|---------|--------------------------|---------|-----------|-------|------------------------------|
| 06/13/11 | S879850 | 3.51 | 5.61 | 209 | 77 | 720 | 0.16 | 5.517 | 0.92 | 0.712 |
| 01/10/11 | S791157 | 2.02 | 10.05 | 174 | 103 | 933 | 1.28 | 6.299 | 0.45 | 0.831 |
| 06/14/10 | S674380 | 3.42 | 3.79 | 170 | 66 | 1017 | 0.59 | 6.379 | 0.18 | 0.638 |
| 03/01/10 | S625423 | 3.04 | 6.30 | 232 | 69 | 573 | 0.21 | 5.433 | 0.83 | 0.502 |
| 09/17/07 | S292858 | 2.96 | 7.54 | 341 | 71 | 827 | 0.48 | 5.640 | 0.93 | 0.738 |
| NORMAL RANGE | | 0.5 - 4L | 6 - 10 | male <250 female <200 | 20 - 40 | male >450 female >550 | 0.5 - 2 | 5.8 - 6.2 | 0 - 1 | male <0.800 female <0.750 |

Dietary Factors

| DATE | SAMPLE ID | Na 24 | K 24 | Mg 24 | P 24 | Nh4 24 | Cl 24 | Sul 24 | UUN 24 | PCR |
|--------------|-----------|----------|----------|----------|-----------|---------|----------|---------|--------|-----------|
| 06/13/11 | S879850 | 239 | 71 | 144 | 1.260 | 63 | 232 | 62 | 17.13 | 1.3 |
| 01/10/11 | S791157 | 258 | 115 | 162 | 1.457 | 46 | 240 | 53 | 17.79 | 1.4 |
| 06/14/10 | S674380 | 262 | 102 | 158 | 1.201 | 43 | 244 | 56 | 15.08 | 1.2 |
| 03/01/10 | S625423 | 211 | 65 | 179 | 1.350 | 54 | 201 | 57 | 14.36 | 1.1 |
| 09/17/07 | S292858 | 266 | 61 | 240 | 1.474 | 79 | 237 | 75 | 17.26 | 1.4 |
| NORMAL RANGE | | 50 - 150 | 20 - 100 | 30 - 120 | 0.6 - 1.2 | 15 - 60 | 70 - 250 | 20 - 80 | 6 - 14 | 0.8 - 1.4 |

Renal Function Normalized Values

| DATE | SAMPLE ID | WEIGHT | Cr 24 | Cr 24/Kg | C Cr | Ca 24/Kg | Ca 24/Cr 24 |
|----------|-----------|--------|-------|----------|------|----------|-------------|
| 06/13/11 | S879850 | 97.5 | 2118 | 21.7 | | 2.1 | 98 |
| 01/10/11 | S791157 | 94.4 | 2139 | 22.7 | | 1.8 | 81 |
| 06/14/10 | S674380 | 95.3 | 1814 | 19.0 | | 1.8 | 94 |