

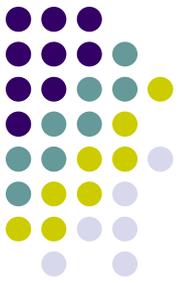


From Rocks to Dust: Nephrolithiasis & the Kidney Stone Diet



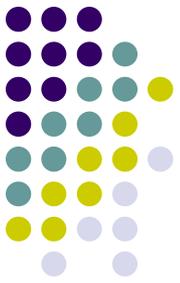
Presented by:
Dr. Caroline Stigant, Nephrologist
Ruby Bassi, Dietitian

Who is our Audience Today?

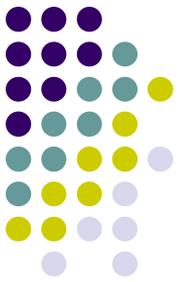


- Dietitians
- Nurses
- Pharmacists
- Physicians
- Social Workers

Do you care for individuals with nephrolithiasis...

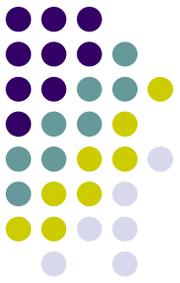


- Daily
- Weekly
- Monthly
- <Monthly
- Never



Pre-test 1

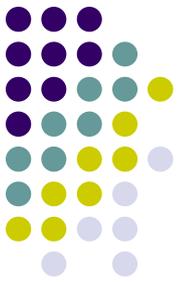
- All of the following are effective treatments for kidney stone except:
 - Low animal protein diet
 - Low sodium diet
 - Citrate supplementation
 - Dietary calcium restriction
 - Increased fluid intake



Pre-test 2

- What is the most common type of kidney stone?
 - Calcium oxalate
 - Uric acid
 - Drug
 - Struvite
 - Cystine

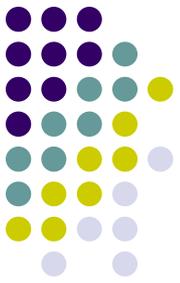
NEPHROLITHIASIS – A PAINFUL PROBLEM!



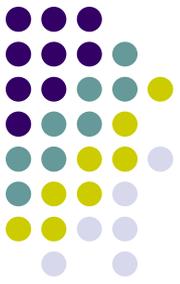
- Affects approx 10% of adults
 - Slight male predominance
- Incidence varies geographically
- Approx 50% have one or more recurrence at 10 years
 - Detailed evaluation generally performed for recurrent stone formers
- Can cause significant morbidity
- Rare cause of end-stage kidney failure

Pathophysiology

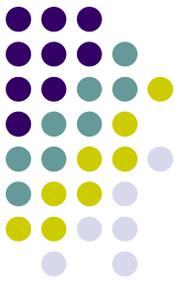
- Supersaturation
- Stasis
- Structural abnormality



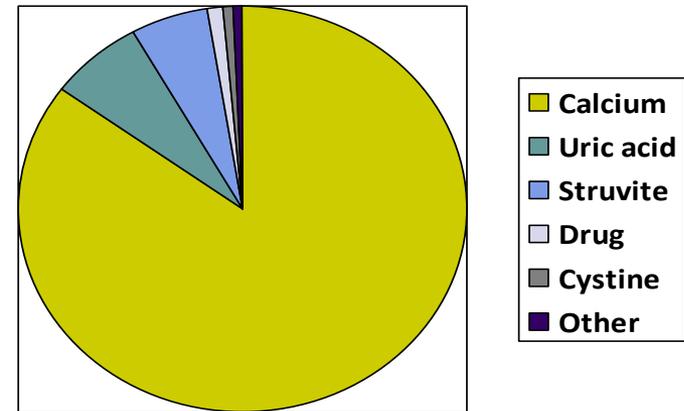
Medullary Sponge Kidney

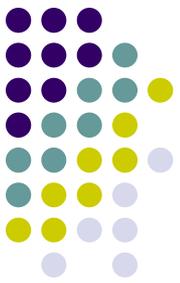


Types of Stones



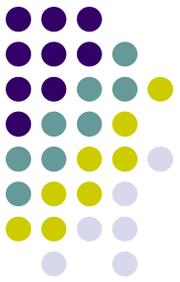
- **Calcium**
 - Calcium oxalate
 - Calcium phosphate
- **Uric acid**
- **Struvite 'staghorn'**
 - Magnesium ammonium phosphate
- **Drug-related**
 - Creation of metabolic environment favouring stone formation
 - Crystallization of drug itself when supersaturated in urine
- **Rare Stone Disorders:**
 - APRT Deficiency, Dent Disease, **Cystinuria**, Primary hyperoxaluria





How Can I Tell What Type of Stone My Patient Has?

- **History**
 - Age, comorbidities, medications, family history, occupation / environment, prior kidney or GI surgery
- **Physical**
 - Urinalysis
 - presence of crystals
- **Lab testing**
 - Serum: creatinine, bicarbonate, calcium, PTH, glucose/HgA1c, uric acid
 - Urine (24 hr): calcium, uric acid, oxalate, sodium, citrate
 - Urine pH: uric acid crystals form in acidic uric, calcium phosphate crystals form in alkaline urine, urine is alkaline with struvite stones
- **Imaging:**
 - Radiolucent (uric acid stones) vs opaque (most other stones)
 - ? Nephrocalcinosis
- **Stone Analysis**



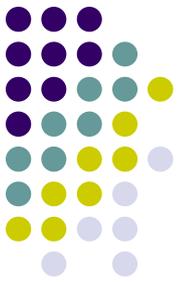
Selected Medications

- Change urine pH or composition:
 - Vitamin C
 - Vitamin D
 - Calcium (ie. CaCO_3)
 - Diuretics: carbonic anhydrase inhibitors, loop diuretics
- Drug precipitates:
 - Antimicrobials: acyclovir, amoxicillin, ampicillin, ceftriaxone, ciprofloxacin, sulfamethoxazole
 - Protease inhibitors: indinavir
 - Guaifenesin
 - Triamterene
 - Methotrexate

Calcium Oxalate

- Most common (80-85%)
- Presumed diagnosis unless atypical features
- Higher incidence:
 - Post (partial) bowel resection
 - High dose Vitamin C
 - Family history
- Hypercalciuria not necessary
- Hyperoxaluria not necessary





Uric Acid Stones

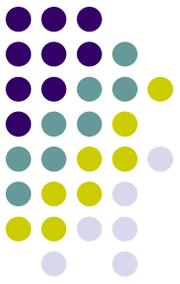
- Reasonably common
- Risk factors:
 - Gout
 - Chronic diarrhea
 - Obesity
 - Metabolic syndrome / DM
 - Malignancy
- Not seen on plain X-ray
- Hyperuricosuria common

Struvite Stones

- Magnesium ammonium phosphate + calcium carbonate
- Formed in infected upper urinary tract:
 - Females, neurogenic bladder, urinary diversion
 - Can grow quickly so often present late
 - UTI symptoms, flank pain, gross hematuria
 - pH > 7
- Antibiotics and surgical removal required



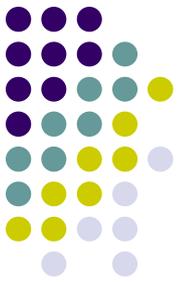
Cystine Stones



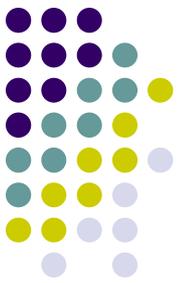
- Cystinuria 1/7000 live births
 - Reduced renal absorption cystine (plus ornithine, lysine, arginine)
- +/- Family history
- Often presents in childhood
- Can form staghorn calculi
- Less radiopaque than calcium stones



What proven treatments are there?

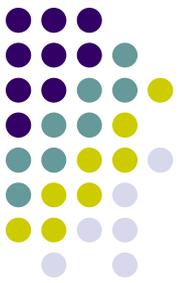


- Increasing fluid intake
- Thiazide diuretic (reduces urine calcium)
- Allopurinol (reduces urine uric acid)
- Citrate (raises urine citrate / raises urine pH)



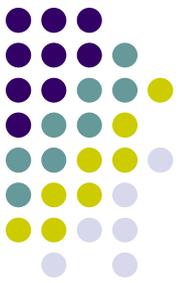
Other Treatments

- Diet
- Oral calcium (oxalate binding)
- Disease-specific
 - ie. captopril or penicillamine for cystinuria
- Analgesia
- Alpha blockers (relax smooth muscle tone of ureters to help stone pass / relieve colic)
- Lithotripsy
- Surgical
 - Endoscopic
 - Percutaneous
 - Open
- **MEDICAL THERAPY DOES NOT DISSOLVE STONES**



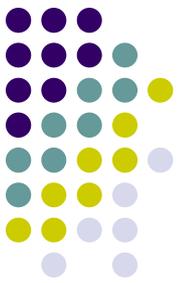
Case 1 – Patient AS

- 34 F 4 year history of recurrent nephrolithiasis, onset with renal colic at age 26 when pregnant
 - Every 6 months, then monthly severe colic
 - Stone obstruction twice (9mm, 1.2cm); bilateral ureteric obstruction with urosepsis
 - Ureteric stents placed on multiple occasions
- No family history
- CT-KUB consistent with medullary sponge kidneys; multiple bilateral calculi up to 3 mm in size



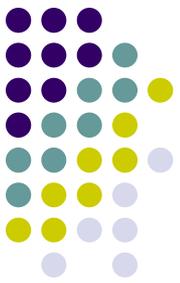
AS - continued

- Normal serum biochemistry
- Stone analysis: calcium oxalate
- Urinalysis: pH 6.5, RBC 40-100/hpf
- 24 hr urine:
 - Volume 3.7 L
 - Calcium 5.2 (2.2-6.5 mmol/d)
 - Oxalate 344 (40-340 umol/d)
 - Citrate 4.44 (0.7-4.9 mmol/d)
 - Sodium 207 (40-220 mmol/d)
 - Uric acid 3.4 (1-3.8 mmol/d)



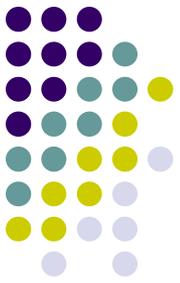
AS – follow up 3 years later...

- Therapy:
 - HCTZ 12.5 mg po BID
 - Potassium citrate 50 mEq po TID
 - Prazosin 1 mg po OD
 - Cipro 500 mg po OD
 - Endoscopic stone extraction & laser lithotripsy x2
- Urine pH 8.5
- Urine volume still high, biochemistry still normal
- Right hydronephrosis with multiple impacted ureteric stones – currently awaiting surgery



Case 2 - Patient WM

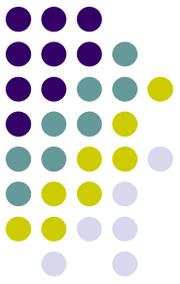
- 32 F of Chinese descent, presented with creatinine 106 on routine lab testing
 - U/S: nephrocalcinosis, bilateral hydronephrosis, cortical thinning
 - CT: staghorn calculi bilaterally, multiple intrarenal stones
- Extensive surgery / subsequent surgeries
- Pregnancy with nephrolithiasis complicating
- Urine amino acid electrophoresis: urine cystine excretion 4x normal
- Increased fluids, diet control, and K citrate



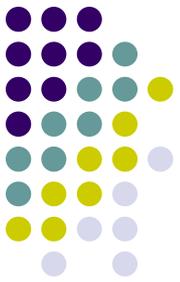
Onto nutrition therapy...



Agenda



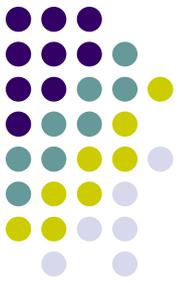
- Types of stones
- Nutritional risk factors
- Nutritional assessment
- Evidence
- Challenges
- Post test



The Stones that Roll In...

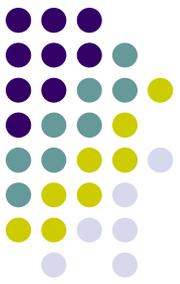
- Most common: calcium oxalate & uric acid
- Struvite stone
- Clients can have various ones over time, i.e. calcium oxalate, uric acid

Nutritional Risk Factors

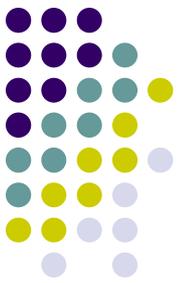


- Obesity
- Diabetes
- Gout
- Gastrointestinal complications

Nutritional Assessment

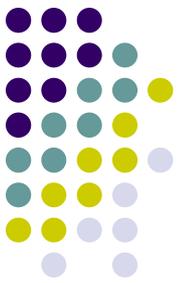


- Assess the 24 hour urinalysis
 - Urine volume, calcium, oxalate, sodium, citrate, uric acid, pH (if completed)
- Assess 3 day diet record
 - Fluid intake, salt, sugar, caffeine, protein, calcium, oxalate
- Assess vitamins/minerals/herbal remedies
 - Vitamin C dose?
 - Herbal remedies



Case Study: 55 year old female

MEAL	FOOD
Breakfast	-All-Bran cereal with 1/2C milk -Coffee -1 banana
Lunch	-1C canned soup -4 crackers with cheese
Dinner	-Frozen dinner -1C juice
Snacks:	-salted nuts, candy, chocolate, cookies
Fluid intakes:	Water: 750ml; Coffee: 2C; Juice: 1-2C

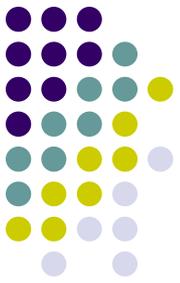


Case Study cont.

- She presents with the following 24 hour urinalysis:

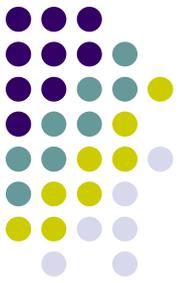
LAB	VALUE	REFERENCE RANGE
Urine volume	1500 ml	
Calcium	3.4	1.0-7.0
Oxalate	1297	40-340
Citrate	0.8	1.0-6.0
Uric acid	2.4	1.5-4.5
Sodium	254	40-220

Analyzing the 24 hour urinalysis

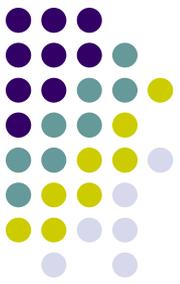


- Urine volume = low
- Oxalate = elevated
- Citrate = low
- Sodium = elevated

Nutritional Concerns

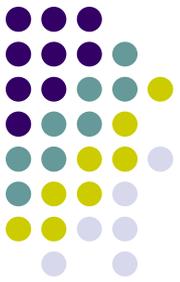


MEAL	FOOD
Breakfast	- All-Bran cereal with 1/2C milk - Coffee - 1 banana
Lunch	- 1C canned soup - 4 crackers with cheese
Dinner	- Frozen dinner - 1C juice
Snacks:	- salted nuts , candy, chocolate, cookies, fruit
Fluid intakes:	Water: 750ml ; Coffee: 2C; Juice: 1-2C



Nutritional Concerns cont.

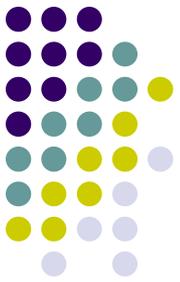
- All bran cereal, nuts, chocolate → Oxalate
- Canned soup, cheese, frozen dinner, salted nuts → Sodium
- Juice, candy → Sugar
- Low fluid intake
- Inadequate calcium intake



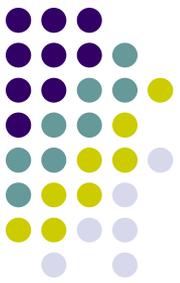
Dietary Recommendations

- Increase fluid intakes: 2.5-3L (10-12C)
 - Includes: water, milk, juice, tea, & soup
- Limit high oxalate content food
- Monitor sodium
- Reduce refined sugars
- Citrate therapy
- Meet calcium requirements for age/gender

Case Study: 41 year old male



MEAL	FOOD
Breakfast	-2 slices bacon, 1 egg, 2 slices toast -Black tea
Lunch	-2 C mixed green salad with almonds and 1 C tuna
Dinner	-5 oz. steak, ½ mashed potatoes, ½ C asparagus
Snacks:	-nuts, fruit, black tea
Fluid intakes:	Water: 1500 ml; Black tea: 2C

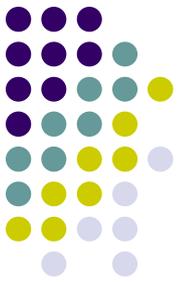


Case study cont.

- He presents with the following 24 hour urinalysis:

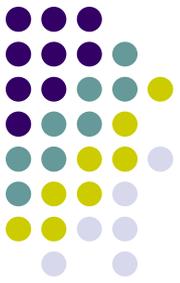
LAB	VALUE	REFERENCE RANGE
Urine volume	1800 ml	
Oxalate	303	40-340
Citrate	2.5	1.0-6.0
Uric acid	6.0	1.5-4.5
Sodium	140	40-220

Analyzing the 24 hour urinalysis

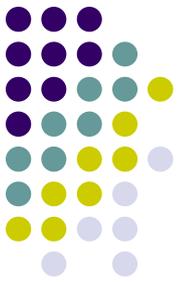


- Urine volume = Low <2L
- Uric Acid = Elevated
- Sodium

Nutritional Concerns



MEAL	FOOD
Breakfast	- 2 slices bacon, 1 egg , 2 slices toast -Black tea
Lunch	-2 C mixed green salad with almonds and 1 C tuna
Dinner	- 5 oz. steak , ½ mashed potatoes, ½ C asparagus
Snacks:	-nuts, fruit, black tea
Fluid intakes:	Water: 1500 ml; Black tea: 2C



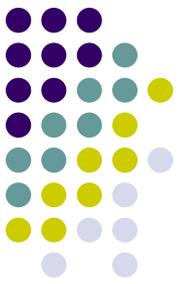
Nutritional Concerns cont.

- Bacon, egg, tuna, steak → Uric acid
- Sodium intakes
- Calcium intakes



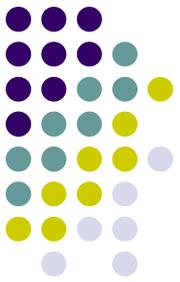
Dietary Recommendations

- Limit intake of meat & alternatives to 2-3 servings/day (1 serving=2.5oz)
- Increase fluid 2.5L
- Limit sodium intakes
- Meet calcium requirements for age/gender



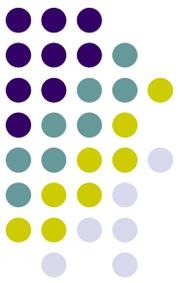
Evidence : Fluid Intake

- Low strength evidence that, compared to no treatment, **increased fluid intake** to maintain daily u/o of $>2\text{L/day}$ significantly reduces risk of stones.
- High fluid intake ($>2.5\text{L/d}$) decreases risk for kidney stones in adults with no previous history



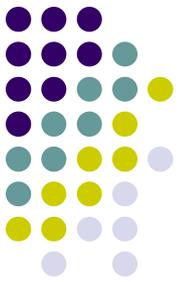
Evidence: Calcium

- Limited evidence shows that restricting calcium will increase stone formation
- Elevated calcium in urine is responsible for calcium containing stones
- Some evidence shows high intake of dietary calcium appears to decrease risk for symptomatic kidney stones



Evidence: Oxalate

- Limited evidence shows that lowering dietary oxalate will reduce risk of calcium oxalate stones
- Oxalate bioavailability varies in food – although a food may be high in oxalate, its bioavailability may be low, i.e. swiss chard



Evidence: Protein

- Protein from animal sources increases the excretion of calcium, oxalate, and uric acid in urine.
- Limited evidence supports that high urine uric acid excretion increases the risk of calcium oxalate stones

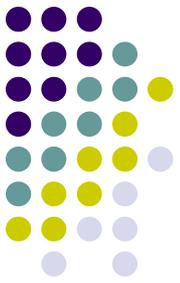
Citrate Therapy



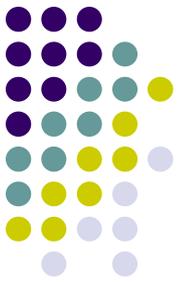
- May work to increase urinary citrate + pH, which reduces CaOx crystal formation
- Evidence does show increase of urinary citrate with citrate therapy alone
- More significant changes seen with K-Citrate
- K-Citrate + citrate therapy is more effective than citrate therapy alone

Challenges

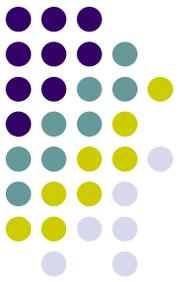
- Individuals with:
 - Heart disease
 - Diabetes



Stone Cold Recommendations

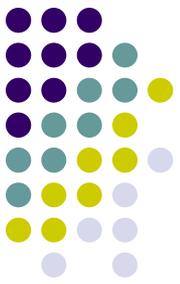


- Suggest 2.5-3L fluids/day
- Limit high oxalate content foods
- Meet recommendations for calcium
- Monitor sodium intakes
- Enjoy 2-3 servings from meats & alternatives group



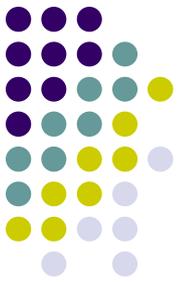
Post Test - 1

- What is the most common type of kidney stone?
 - Calcium oxalate
 - Uric acid
 - Drug
 - Struvite
 - Cystine



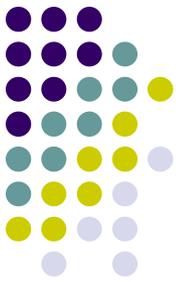
Post test - 2

- All of the following are effective treatments for kidney stone except:
 - Low protein diet
 - Low sodium diet
 - Citrate supplementation
 - Dietary calcium restriction
 - Increased fluid intake



Questions??

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