

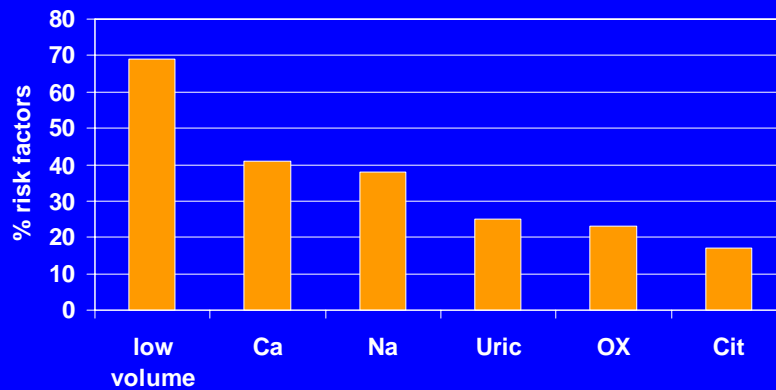
METABOLIC STONE DISEASE

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BACKGROUND

- Stones affect 12% adult population
- Lifetime recurrence approaches 90%
- 97% of patients have identifiable risk factors

CALCIUM STONES



Pak 1997, n=3473

METABOLIC MANAGEMENT

Risk	Data	Management
Low volume	< 2 L	Fluids
AH 1	UCa, ↓PTH	HCTZ, K citrate, NaCellulosePhos
AH 2	UCa	Diet, NaCellulosePhos
Hypocitraturia	U citrate, (pH)	K citrate
Hyperoxaluria	U Ox, PTH	Diet, pyridoxine, Ca
Parathyroidism	S Ca ↑PTH	Surgery
Hyperuricosuria	U UA (S UA), pH	K citrate (allop), diet
Renal hypercalciuria	UCa, ↑PTH	HCTZ, orthophosphate

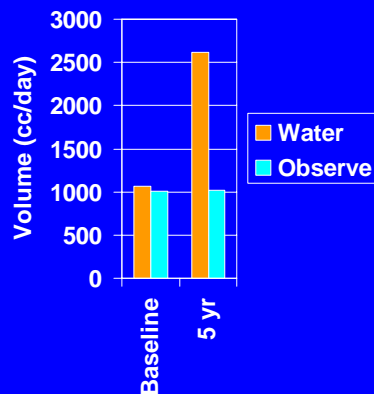
URINARY VOLUME

- Increase fluid intake
- Increase urine output
- Decrease mineral supersaturation
- Decrease stone episodes
- Does it work? How well?

URINE OUTPUT

Borghi J Urol 1996; 155: 839

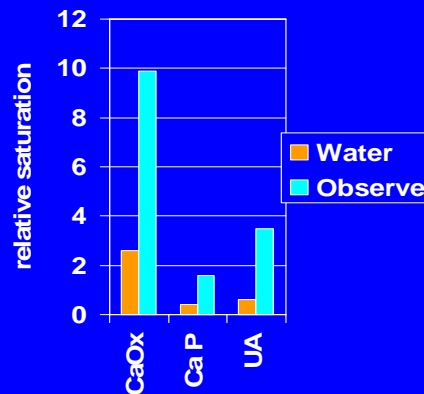
- 199 1st time stone
- 5 yr followup
- Water vs. observe



URINE OUTPUT

Borghi J Urol 1996; 155: 839

- New stones in 12/99 water vs. 27/100 observe
- U Na 158 – 162
- U Ca 244 – 266



FLUIDS VS. URINE

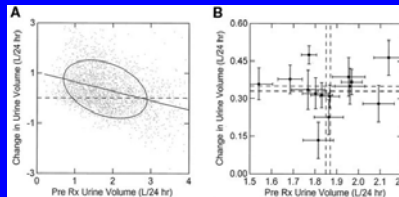
Parks J Urol 2003; 169: 863

- \uparrow fluid \rightarrow \downarrow supersaturation \rightarrow \downarrow stones
- “increase fluids, decrease sodium”
- 2877 hypercalciuric patients studied
- 13 sites
- HCTZ vs. no
- Instructed > 2 L/day, < 100 mEq salt

FLUIDS VS. URINE

Parks J Urol 2003; 169: 863

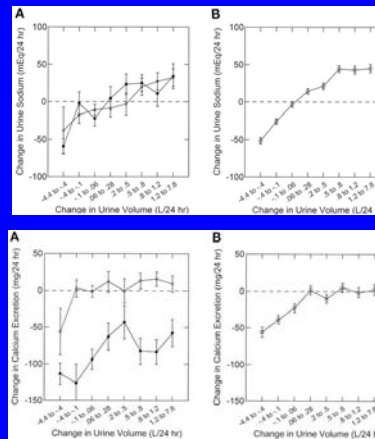
- Mean urine output increased 350 ml
- Cutoff 2.8 L



FLUIDS VS. URINE

Parks J Urol 2003; 169: 863

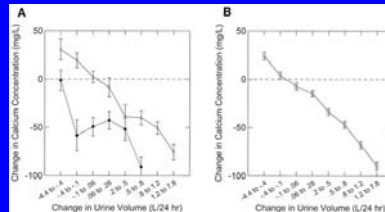
- \uparrow U vol \rightarrow \uparrow U Na
- \uparrow U vol \rightarrow \uparrow U Ca



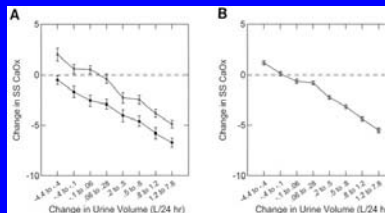
FLUIDS VS. URINE

Parks J Urol 2003; 169: 863

- \uparrow U vol \rightarrow \downarrow U [Ca]
- > 500 cc/day



- \uparrow Uvol \rightarrow \downarrow SSCaOx
- > 1 L for 50%



FLUIDS VS. URINE

Parks J Urol 2003; 169: 863

- Pts increase Na as they increase volume
- “One would think that nothing could be less complex than the advice to increase urinary volume and decrease urine sodium but in practice this advice is not simple to implement.”

CASE

- 61 yo female recurrent calcium stones
- Vol 867 cc, oxalate 434 umol, sodium 126 mmol
- Increase fluids, decrease oxalate
- Vol 1542 cc, oxalate 384 umol, sodium 258 mmol

TYPES OF FLUID

Curhan NEJM1993; 328: 833

Decreased risk

- Tea 14%
- Coffee 10%
- Beer 21-60%
- Wine 39-60%

Increased risk

- Apple juice 35%
- Grapefruit juice 37%

Water, lemonade

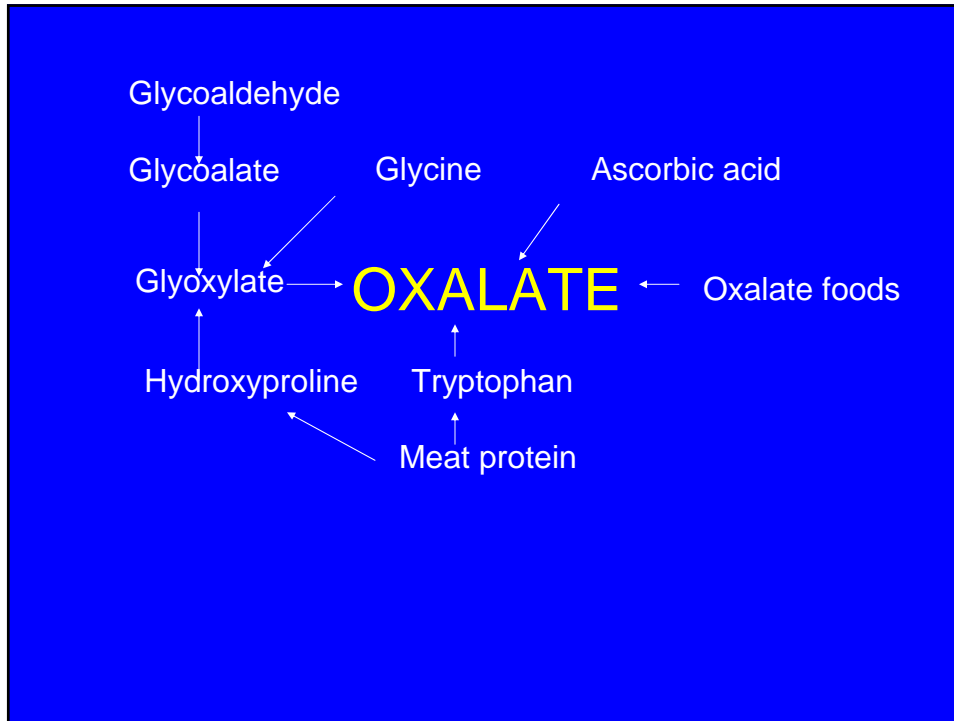
DIET: CA⁺⁺ VS OXALATE

- Most stones are CaOx
- Molar basis: oxalate > Ca
- Lower dietary calcium → lower U Ca
- Osteoporosis?

DIETARY CALCIUM

Curhan NEJM 1993; 328: 833

	1	2	3	4	5
Diet Ca (mg)	516	664	783	937	1326
RR	1.0	0.71	0.64	0.61	0.56



DIET

Borghi NEJM 2002; 346: 77

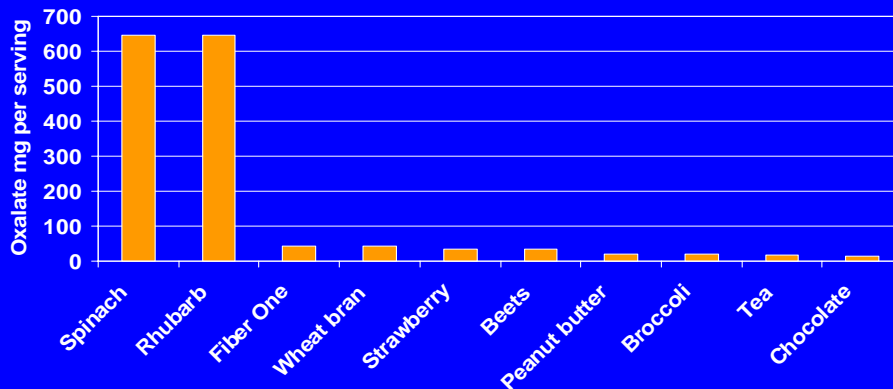
- 120 men idiopathic hypercalciuria
- Low Ca vs. normal Ca, low protein/salt
- Increase fluids
- 5 year followup
- Randomized prospective trial

DIET

Borghi NEJM 2002; 346: 77

	Low Ca	Low Ca	N Ca	N Ca
Volume	1755	2187	1852	2296
UNa	227	201	241	123
UCa	11	6	11	6
UOx	367	411	411	333
SS CaO	10	5	10	3
Stones		23/60		12/60

OXALATE FOODS



Smoked meat, vitamin C, Worcestershire sauce, nuts

CASE

- 57 yo woman left flank pain 3 wks
- Similar to prior stones ESWL
- Exam mild L CVAT
- CT KUB 9 mm left UPJ stone
- ESWL

EVALUATION

- Stone: Ca Ox monohydrate
- 24 hr urine: 1.8 L, Ca 3.0 mmol (<7), UA 3, Na 189 (<217), oxalate 555 (<340), citrate 1.1 mmol (1-6)
- ICA 1.26, iPTH 2.3, UA 355 umol (<350)

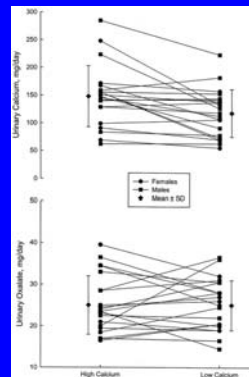
DIET HISTORY

- Breakfast: tea
- Lunch: turkey sandwich, iced tea
- Dinner: Meat/chicken/fish, spinach/broccoli
- Snacks: chocolate, nuts

CALCIUM VS. OXALATE

Heller J Urol 2003; 169: 470: 2003

- Ca vs Ox UCaOx
- Normals placed on high and low Ca diets (Curhan 5)
- ↑ vol 1814 vs 1591
- ↑pH 6.3 vs. 6.0
- ↑ citrate 849 vs 751
- U Ox no change



CALCIUM VS. OXALATE

Heller J Urol 2003; 169: 470: 2003

- Hi Ca moderate Ox does NOT ↓ Uox
- Does not ↓ SSCaOx
- ↑ volume
- ↑ pH
- ↑ K

TABLE 3. Effect of dietary calcium on relative saturation ratio

	Diet		p Value (significant)
	High Ca	Low Ca	
Relative saturation ratio calcium oxalate:			
Uncorrected	4.3 ± 2.2	4.5 ± 2.3	0.51
Corrected for urine vol.	4.9 ± 2.5	4.5 ± 2.3	0.42
Corrected for urine vol. and other confounding factors	5.6 ± 3.0	4.5 ± 2.3	(0.03)
Relative saturation ratio brushite (CaHPO ₄):			
Uncorrected	1.6 ± 1.4	1.0 ± 1.0	(<0.01)
Corrected for urine vol.	2.0 ± 1.6	1.0 ± 1.0	(<0.01)
Corrected for urine vol. and other confounding factors	1.3 ± 1.3	1.0 ± 1.0	(<0.01)
Urinary undissociated uric acid (mg/day):			
Uncorrected	74 ± 59	108 ± 53	(<0.01)
Corrected for urine vol.	73 ± 59	108 ± 53	(0.02)
Corrected for urine vol. and other confounding factors	108 ± 53	108 ± 53	(0.01)

DIET AND DRUGS

Pak J Urol 2003; 169: 465

- Dietary calcium and oxalate restriction
- HCTZ 50 mg, K citrate (40 mEquiv)
- Volume 2.2 L → 2.7 L, p<0.001
- U Na 196 mg → 197 mg
- Stones/yr 2.9 → 0.05, p<0.001

THIAZIDES

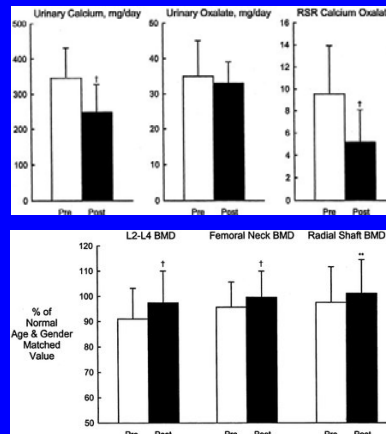
Preminger AUA Update 1995; 14: 6

- Thiazides → hypocalciuria
- ↑bone density
- Effect stabilizes at 2 years
- Decreases citrate
- Effective for AH1 and RH

DIET AND DRUGS

Pak J Urol 2003; 169: 465

- ↓Uca ↓RSR CaOx
- U Ox no change
- ↑BMD



JH 39 yo male right renal calculus

- Stone: Ca oxalate monohydrate
- Serum Ca 9.8, uric acid 6.7, PTH 37
- 24 hr urine: 1.8 L, pH 5, Ca 306, oxalate 74, uric acid 1273, Na 225

DIET HISTORY

- Breakfast: coffee or Dr. Pepper
- Lunch: BBQ, iced tea, "sides"
- Dinner: "I like hamburgers", cola

METABOLIC MANAGEMENT

Risk	Data	Management
Low volume	< 2 L	Fluids, restrict Na
AH 1	UCa	HCTZ, K citrate, NaCellulosePhos, diet
AH 2	UCa	Diet, NaCellulosePhos
Hypocitraturia	U citrate, (pH)	K citrate, lemonade
Hyperoxaluria	U Ox, PTH	Diet, cholestyramine
Parathyroidism	S Ca PTH	Surgery
Hyperuricosuria	U UA (S UA)	K citrate (allop), diet
Renal hypercalciuria	UCa, PTH	HCTZ, orthophosphate, diet

CASE

- 58 yo male
- Right renal colic x 2 mos
- Urgency, frequency x 3 days
- PMH, PSH negative
- Exam negative

METABOLIC EVALUATION

- Stone Ca Ox monohydrate
- 24 hr urine volume 2 L, Ca 280 mg, UA 640 mg, citrate 312 mg
- Serum ICA 1.31 mmol/L, iPTH 8.6, UA 414

CASE #2

- 38 yo male left renal colic
- 7 prior stones
- PMH COPD psoriasis, ESWL
- Meds topical steroids
- Exam psoriasis

EVALUATION

- 24 hr urine: 2.2 L, Ca 22.5 mmol (< 7), oxalate 455 umol (<440), citrate 2.7 mmol, Na 233 mmol, UA 6 mmol
- Serum Ca 2.48 mmol/L (<2.6), phosphate 0.8 (0.8-1.5), UA 454 umol (<450), alk phos 121
- iPTH 3.2 pmol/L (1-8.2), ICA 1.26 (mmol/L)

EVALUATION

- 1,25 di-OH-vit. D 510 pmol/L (40-120)
- Prednisone (vit D 310, urine Ca 9.9)
- Reduced dietary sodium, oxalate
- K Citrate

CASE

- 57 yo woman left flank pain 3 wks
- Similar to prior stones ESWL
- Prior metabolic evaluation hyperoxaluria, cannot maintain diet
- Exam mild L CVAT
- CT KUB 9 mm left UPJ stone
- ESWL

EVALUATION

- Stone: Ca Ox monohydrate
- 24 hr urine: 1.8 L, Ca 3.0 mmol (<7), UA 3, Na 189 (<217), oxalate 455 (<340), citrate 1.1 mmol (1-6)
- ICA 1.26, iPTH 2.3, UA 355 umol (<350)

CB

- 56 yo woman left renal colic x 1 yr
- > 10 stones
- ESWL, ureteroscopy
- PMH: morbid obesity
- PSH: ileogastric bypass
- 1.5 cm left ureteral stone
- ESWL
- COM

EVALUATION

- 24 hr urine: 0.9 L, Ca 1.8 mmol, Ox 1957 umol (<340), citrate 2.5 (1-4), UA 3, Na 85
- ICA 1.19 (1.17-1.29), iPTH 16.3 (<8.2)

WHEN TO EVALUATE?

- All stone-formers? 80% risk at 8 yrs
- 97% metabolic workups risk factors
- Medical compliance ↓ time
- Increase fluids, decrease animal protein
- Limited evaluation
- Full evaluation