Objectives

1. Overview of epidemiology
2. 24hr urine collections
3. Dietary restrictions and recommendations
4. Stones in metabolic syndrome
Epidemiology

- 1 in 11 people in US, prevalence increasing
- prevalence 8.8% (10.6% men; 7.1% women)
  - compared to 6.3%M and 4.1%F in 1994
- more common in obese (11.2%) vs non-obese (6.1%)
- higher prevalence in caucasians (10.3%)
- DM (OR 1.59), obesity (OR 1.55)

Prevalence

Weighted (unadjusted) percent prevalence of stone disease by population characteristic

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20–29</td>
<td>3.4 (2.1–4.7)</td>
<td>3.4 (2.2–4.7)</td>
<td>3.3 (2.0–4.5)</td>
<td>2.5 (1.3–3.7)</td>
</tr>
<tr>
<td>30–39</td>
<td>6.9 (5.0–8.8)</td>
<td>5.9 (4.5–7.2)</td>
<td>6.5 (4.6–8.5)</td>
<td>5.0 (3.5–6.4)</td>
</tr>
<tr>
<td>40–49</td>
<td>9.8 (7.3–12.3)</td>
<td>7.6 (5.6–9.5)</td>
<td>8.1 (5.9–10.4)</td>
<td>6.4 (4.7–8.1)</td>
</tr>
<tr>
<td>50–59</td>
<td>13.1 (10.3–15.9)</td>
<td>8.1 (5.9–10.3)</td>
<td>11.1 (9.3–13.4)</td>
<td>6.9 (4.8–9.0)</td>
</tr>
<tr>
<td>60–69</td>
<td>15.1 (11.9–18.4)</td>
<td>9.4 (6.6–12.2)</td>
<td>16.3 (13.4–19.3)</td>
<td>8.4 (5.6–11.3)</td>
</tr>
<tr>
<td>70+</td>
<td>18.8 (16.5–21.9)</td>
<td>9.4 (7.5–11.3)</td>
<td>18.0 (13.8–21.3)</td>
<td>7.1 (5.5–8.8)</td>
</tr>
<tr>
<td>All ages</td>
<td>10.6 (9.4–11.9)</td>
<td>7.1 (6.4–7.8)</td>
<td>9.2 (8.1–10.3)</td>
<td>5.9 (5.2–6.6)</td>
</tr>
</tbody>
</table>

Unadjusted and population-adjusted percent prevalence of stone disease by population characteristic

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unadjusted, % (95% CI)</th>
<th>Adjusted, % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All groups</td>
<td>10.6 (9.4–11.9)</td>
<td>10.3 (9.2–11.3)</td>
</tr>
<tr>
<td>Non-Hispanic, white</td>
<td>12.8 (11.3–14.3)</td>
<td>11.8 (10.4–13.2)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>7.1 (5.7–8.4)</td>
<td>8.8 (7.4–10.2)</td>
</tr>
<tr>
<td>Non-Hispanic, black</td>
<td>4.5 (3.4–5.6)</td>
<td>4.8 (3.7–5.9)</td>
</tr>
<tr>
<td>Other race/multiracial</td>
<td>5.6 (2.5–8.8)</td>
<td>5.3 (2.2–8.5)</td>
</tr>
</tbody>
</table>

$CI = confidence interval.$

Risk Factors

Multivariable regression model predicting history of kidney stones

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Odds ratio (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26–39</td>
<td>1.00 (referent)</td>
<td>-</td>
</tr>
<tr>
<td>30–39</td>
<td>1.33 (1.37–2.45)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>40–49</td>
<td>2.18 (1.74–2.75)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female</td>
<td>0.63 (0.52–0.73)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>1.00 (referent)</td>
<td>-</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>0.57 (0.28–0.98)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.60 (0.48–0.73)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other/multiracial</td>
<td>0.57 (0.37–0.89)</td>
<td>0.034</td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>1.00 (referent)</td>
<td>-</td>
</tr>
<tr>
<td>Overweight</td>
<td>1.29 (0.96–1.72)</td>
<td>0.0875</td>
</tr>
<tr>
<td>Obese</td>
<td>1.55 (1.25–1.94)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Household income, $</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$35,000</td>
<td>1.00 (referent)</td>
<td>-</td>
</tr>
<tr>
<td>$35,000–$49,999</td>
<td>1.49 (1.18–1.92)</td>
<td>0.002</td>
</tr>
<tr>
<td>$40,000–$49,999</td>
<td>1.67 (1.23–2.21)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>$50,000–$74,999</td>
<td>1.37 (1.17–1.59)</td>
<td>0.002</td>
</tr>
<tr>
<td>$75,000–$99,999</td>
<td>1.59 (1.22–2.07)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>$100,000–$199,999</td>
<td>1.92 (1.44–2.56)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

CI = confidence interval; BMI = body mass index.
Financial Burden

- estimated annual costs for individuals with urolithiasis
  - $2.1 billion USD in year 2000
  - in 2014 dollars = $2.81 billion


Financial Burden

- 2000 - $2.81 billion
- 2007 - $3.79 billion
- 2030 - $4.57 billion
- Population, obesity, and DM increases estimated to add $1.24 billion/year by 2030
- likely underestimate as cost of healthcare > rate of inflation

Antonelli et al. J Urology. 2014
Who to evaluate

- “A clinician should perform a screening evaluation… on a patient newly diagnosed with kidney or ureteral stones.”

- “Clinicians should perform additional metabolic testing in high-risk or interested first-time stone formers and recurrent stone formers. (Standard; Evidence Strength: Grade B)”

- “Metabolic testing should consist of one or two 24-hour urine collections obtained on a random diet…”

ALUA Guidelines 2014
Who to evaluate

![Diagram showing a flowchart for evaluating kidney stone patients]

CUA Guidelines 2010

One or two 24hr urines?

- retrospective review of 777 pts w/ 2, 24hr urines within 72hrs

- no significant difference in any of the 12 parameters

Castle et al. J Urol. 2010
when comparing mean differences there is significance between 1 and 2 collections

every parameter except Cr, K, Citrate, and P

<table>
<thead>
<tr>
<th>24-Hr Urinary Parameter</th>
<th>Mean Difference</th>
<th>p Value (pairwise t test)</th>
<th>% Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (mg)</td>
<td>4.69</td>
<td>0.08</td>
<td>2.26</td>
</tr>
<tr>
<td>Oxalate (mg)</td>
<td>1.73</td>
<td>0.0002</td>
<td>4.19</td>
</tr>
<tr>
<td>Citrate (mg)</td>
<td>2.81</td>
<td>0.03</td>
<td>0.50</td>
</tr>
<tr>
<td>Urine acid (gln)</td>
<td>0.01</td>
<td>0.03</td>
<td>1.44</td>
</tr>
<tr>
<td>Sodium (mmol)</td>
<td>5.68</td>
<td>0.01</td>
<td>3.33</td>
</tr>
<tr>
<td>Potassium (mmol)</td>
<td>0.6</td>
<td>0.33</td>
<td>0.99</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>2.33</td>
<td>0.04</td>
<td>2.20</td>
</tr>
<tr>
<td>Phosphorus (gln)</td>
<td>0.01</td>
<td>0.16</td>
<td>1.04</td>
</tr>
<tr>
<td>Ammonium (mmol)</td>
<td>0.42</td>
<td>0.32</td>
<td>1.06</td>
</tr>
<tr>
<td>Chloride (mmol)</td>
<td>5.06</td>
<td>0.02</td>
<td>3.06</td>
</tr>
<tr>
<td>Urine urea nitrogen (gln)</td>
<td>0.27</td>
<td>0.002</td>
<td>2.39</td>
</tr>
<tr>
<td>Creatinine (mg)</td>
<td>8.66</td>
<td>0.34</td>
<td>0.50</td>
</tr>
</tbody>
</table>

* Sample difference/sample 1 + sample 2/2.

One or two 24hr urines?

- 813 pts w/ 2, 24hr urines within 10 days reviewed retrospectively
- urine volume and phosphorous significantly different only
- high degree correlation between each variable (Pearson correlation)
- depending on parameter, normal to abnormal result or vice versa in 5.5% - 44.9% of patients
- possible changes in clinical decision making - two 24hr urines recommended
One or two 24hr urines?

Variations between two 24-hour urine collections in patients presenting to a tertiary stone clinic

Madhur Nayan; Mohamed A. Elkousy, MD, MB BCh; Sera Andonian, MD, MSc, FRCSC

Division of Urology, Department of Surgery, McGill University Health Centre, McGill University, Montreal, QC

- 188 pts, samples collected on consecutive days
- means of differences in variables compared to “0”
- significantly different for every parameter
- 17.1% - 47.6% had change from normal to abnormal or vice versa

Two 24hr urines likely ideal

“A detailed metabolic evaluation…will include the addition of ideally two 24-hour urine collections…”
Timing of 24hr urines

- after initial evaluations…
- single 24hr urine within 6 months of initiation of treatment (assess response)
- at least annually, maybe more often, depending on stone activity (patient adherence, metabolic response)
- *expert opinion

AUA Guidelines 2014
Trends in Food Consumption

• increasing stone prevalence correlates strongly with rising caloric intake, fat, protein, fruit, and vegetables (“dark green”)

De et al. Urology. 2014

<table>
<thead>
<tr>
<th>Foods increasing stone risk</th>
<th>1976</th>
<th>2010</th>
<th>Change (%)</th>
<th>Relative Change</th>
<th>Rho</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily calories (cal)</td>
<td>3200</td>
<td>4000</td>
<td>25</td>
<td>4.9% g/cal</td>
<td>0.96</td>
</tr>
<tr>
<td>Fat</td>
<td>145 g</td>
<td>190 g</td>
<td>31</td>
<td>14.5 oz/cal</td>
<td>0.79</td>
</tr>
<tr>
<td>Protein</td>
<td>6.1 oz</td>
<td>6.5 oz</td>
<td>6.5</td>
<td>14.1 oz/cal</td>
<td>0.85</td>
</tr>
<tr>
<td>Wheat</td>
<td>5.4 oz</td>
<td>7.7 oz</td>
<td>42</td>
<td>126.7 g/oal</td>
<td>0.90</td>
</tr>
<tr>
<td>Shellfish</td>
<td>0.06 oz</td>
<td>0.17 oz</td>
<td>183</td>
<td>661 oz/cup</td>
<td>0.76</td>
</tr>
<tr>
<td>Dark green veg</td>
<td>0.023 cup</td>
<td>0.219 cup</td>
<td>850</td>
<td>3326 tsp/cup</td>
<td>0.98</td>
</tr>
<tr>
<td>HPCS</td>
<td>0.24 tsp</td>
<td>10.28 tsp</td>
<td>4100</td>
<td>14.7 tsp/cup</td>
<td>0.79</td>
</tr>
<tr>
<td>Added sugar</td>
<td>25.61 tsp</td>
<td>27.3 tsp</td>
<td>6.6</td>
<td>14.7 tsp/cup</td>
<td>0.72</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foods decreasing stone risk</th>
<th>1976</th>
<th>2010</th>
<th>Change (%)</th>
<th>Relative Change</th>
<th>Rho</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td>1.7 cups</td>
<td>1.7 cups</td>
<td>0</td>
<td>20% cup/cup</td>
<td>0.72</td>
</tr>
<tr>
<td>Fruit</td>
<td>0.7 cup</td>
<td>0.8 cup</td>
<td>7</td>
<td>8.5% cup/cup</td>
<td>0.60</td>
</tr>
<tr>
<td>Vegetables</td>
<td>1.5 cups</td>
<td>1.7 cups</td>
<td>13</td>
<td>9.3% cup/cup</td>
<td>0.78</td>
</tr>
<tr>
<td>Fish</td>
<td>0.3 oz</td>
<td>0.32 oz</td>
<td>6.7</td>
<td>14.7 oz/cup</td>
<td>0.64</td>
</tr>
<tr>
<td>Citrus fruits</td>
<td>0.218 cup</td>
<td>0.168 cup</td>
<td>-22.9</td>
<td>38.3 cup/cup</td>
<td>-0.18 (P = .31)</td>
</tr>
</tbody>
</table>

Specific correlations

• Positive correlation
  
  • dark green vegetables (oxalate)
  
  • flour and cereal products (oxalate)
  
  • corn products (oxalate)
  
  • added sugars

De et al. Urology. 2014
Diet modification impacts urine composition

- prospective study - 108 idiopathic recurrent CaOxalate formers
- 86.2% had 2+ abnormalities - most common hyperoxaluria (77%)


Diet modification can reduce stone recurrence

- prospective RCT comparing low calcium diet to normal calcium + low animal protein + low sodium diet
- 120 men (idiopathic, recurrent CaOx stones) for 5 years
- 23/60 recurrences for low calcium diet
- 12/60 recurrences for normal calcium, low protein/sodium diet
- RR 0.49 for low protein/Na diet (RR 0.37 when adjusted for # stone episodes prior to randomization)

Borghi et al. NEJM. 2002
normal calcium diet allows oxalate binding in intestinal lumen - decreases absorbed oxalate
low animal protein diet decreases oxalate endogenous synthesis
criticism: diet components not accessed in isolation, so unclear individual effects low Na/protein

Calcium and oxalate

- hypercalciuria and hyperoxaluria both risk factors for stone formation (Coe)
- 50% oxalate from diet - risk factor for CaOx stones
dietary Ca affects oxalate GI absorption - binds and crystallizes in intestinal lumen, allowing fecal removal
- as long as RDI Ca achieved, oxalate supersaturation unchanged even w/ high-oxalate diet (Lange)

Coe et al. NEJM. 1992
Calcium and stone risk

- prior belief was that increased dietary calcium was risk factor for stones
- low calcium shown to actually increase stone risk (increases oxaluria)
- WHI - 80 000 post-menopausal women followed for ~8 years
- validated WHI food frequency questionnaire
- Avg daily Ca intake 39 mg lower in stone formers (p<0.001)
- Ca supplementation less common in stone formers (p=0.02)
- increased dietary Ca decreased stone incidence by 5 - 28% - incremental decreased risk as dietary Ca increased


Balanced diet

- each meal:
  - 333 mg Ca
  - 250 mg oxalate
- 3x/day

Imbalanced diet

- 400 mg Ca and 20 mg oxalate breakfast/lunch
- 200 mg Ca and 710 mg oxalate dinner

Urinary calcium

- White: balanced diet
- Black: imbalanced
- Urinary calcium higher if taken alone, lower if taken with oxalate
- supersaturation the same


Urinary oxalate

- White: balanced diet
- Black: imbalanced
- Urinary oxalate not affected whether balanced or unbalanced

Urinary oxalate and calcium

- taking RDI calcium (1000-1200 mg/day) lowers urinary oxalate levels

- taking calcium with meals *may* lower urinary calcium levels, but supersaturation stays same

Should we supplement Ca?

- WHI: Ca supplementation less common in stone formers (*Sorenson 2012*)

- WHI RCT: Ca + vit D supplements associated with 17% increased self-reported stone incidence (*Wallace 2011*)

- Curhan 1993: high dietary Ca inversely proportional to stone incidence (RR 0.56 b/w highest and lowest quint)

- Probably best to aim for normal daily calcium intake (1000-1200 mg/d with meals)
Oxalate

- Oxalate-containing foods can be a healthy part of a normal diet (spinach, kale, nuts, etc.)

- “Low-oxalate” diets are difficult given ubiquity of oxalate

- Normal calcium, low-animal protein, low-salt diets can effectively decrease urine oxalate excretion

Oxalate in our diet

- Ubiquitous in our diet

- Spinach is major contributor - easier to focus on eliminating one item?

- Should we even bother trying to limit oxalate?

Low oxalate diet
- administered x 3mo
- oxalate 45.9 to 40.2 mg/d

RDI Ca, free Ox diet
- low animal protein
- low salt
- oxalate 50 to 35.5 mg/d

Conclusion: normal Ca diet better than restricting oxalate (decreased Gl oxalate absorption - more excretion)
What about salt?

- Increased NaCl dietary load leads to increased urine Ca excretion
- Low sodium diet decreases urinary calcium AND oxalate excretion
- Low sodium diet x 3 months achieved 38% and 34% reduction in excreted calcium for men/women respectively
- 100mEq NaCl reduction = 80-100mg reduction calciuria (similar to thiazide diuretic)


Reducing dietary sodium reduces calciuria/oxaluria

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>Baseline and follow-up (3 mo) urinary measurements in each treatment group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline (n = 102)</td>
</tr>
<tr>
<td>Control diet</td>
<td>Low-sodium diet (n = 108)</td>
</tr>
<tr>
<td>Volume (mL/d)</td>
<td>1754 ± 787</td>
</tr>
<tr>
<td>Creatinine (mg/d)</td>
<td>1677 ± 433</td>
</tr>
<tr>
<td>Urea (g/d)</td>
<td>27 ± 9</td>
</tr>
<tr>
<td>Sodium (mmol/d)</td>
<td>220 ± 63</td>
</tr>
<tr>
<td>Chloride (mmol/d)</td>
<td>216 ± 69</td>
</tr>
<tr>
<td>Potassium (mmol/d)</td>
<td>59 ± 19</td>
</tr>
<tr>
<td>Calcium (mg/d)</td>
<td>418 ± 100</td>
</tr>
<tr>
<td>Phosphorus (mg/d)</td>
<td>998 ± 316</td>
</tr>
<tr>
<td>Magnesium (mg/d)</td>
<td>115 ± 40</td>
</tr>
<tr>
<td>Uric acid (mg/d)</td>
<td>658 ± 212</td>
</tr>
<tr>
<td>Citrate (mg/d)</td>
<td>624 ± 275</td>
</tr>
<tr>
<td>Oxalate (mg/d)</td>
<td>33 ± 13</td>
</tr>
<tr>
<td>Sulfate (mmol/d)</td>
<td>24 ± 7</td>
</tr>
<tr>
<td>Ammonium (mmol/d)</td>
<td>41 ± 13</td>
</tr>
<tr>
<td>pH (24 h)</td>
<td>5.99 ± 0.47</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25 ± 3</td>
</tr>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>129 ± 13</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>83 ± 9</td>
</tr>
</tbody>
</table>

1 All values are crude (ie, unadjusted for baseline differences) means ± SDs, BP: blood pressure.
2 Derived by using ANCOVA; differences between group means at follow-up were tested with adjustment for differences at baseline.

DASH Diet

- sodium 1500-2300 mg/day
- grains: 6-8 servings
- vegetables: 4-5 servings
- fruits: 4-5 servings
- dairy: 2-3 servings
- lean meat/poultry/fish: <6 servings
- nuts/seeds/legums: 4-5 servings/week
- fats and oils: 2-3 servings

mayoclinic.org

- non-significant increase in urinary oxalate w/ DASH (p=0.08)
- higher fruits/veg
- trend decrease in CaOx supersaturation on DASH (p=0.08)
- even w/ higher oxalate

DASH diet conclusions

- don’t limit general oxalate intake - high oxalates ok (fruits, vegetables)
- ++fruits (citrate)
- normal to high Ca diet (1000 mg/d)
  - eat with oxalates to bind in GI tract (Taylor & Curhan, Oxalate Intake and Risk of Nephrolithiasis, JASN 18:2198, 2007)
- CaOx crystals eliminated in feces
- low sodium
- low animal protein

Role of DASH diet

- shows promise in decreasing urinary CaOx supersaturation
- beneficial for overall cardiovascular health
- may be more effective when combined with some form of oxalate restriction (spinach)
Summary - Dietary recommendations

- normal calcium, low animal protein, low salt
- some oxalate restriction may be useful (i.e. spinach)
- fluid intake
- evidence for DASH diet
Elevated BMI affects urine parameters

Effect of being overweight on urinary metabolic risk factors for kidney stone formation

Linda Shavit$^{1,2}$, Pietro Manuel Ferraro$^3$, Nikhil Jobri$^3$, William Robertson$^{1,4}$, Steven B. Walsh$^3$, Shabbir Mooschala$^3$ and Robert Unwin$^3$

- 2132 pts - 863 (40.5%) overweight, 436 (20.5%) obese
- no significant difference for urine volume or Mg
- significantly increased urine Ca, Ox, Na, uric acid
- uric acid stone formation positively correlated with BMI
- higher probability CaOx, UA, and mixed stone formation with elevated BMI

Shavit et al. Nephrol Dial Transplant. 2015
Elevated BMI increases stone formation risk

Obesity, Weight Gain, and the Risk of Kidney Stones

- men >200lbs RR 1.44; BMI >30 RR 1.33
- 34-59 y.o. women >200lbs RR 1.89; BMI >30 RR 1.90
- 27-44 y.o. women >200lbs RR 1.92; BMI >30 RR 2.09

Taylor et al. JAMA. 2005

Diabetes and stone risk

Diabetes mellitus and the risk of nephrolithiasis

- RR of stones if patient has DM
  - men: 0.80*
  - older women: 1.29
  - younger women: 1.60

- increased risk of DM if Hx of stone disease for both men and women

Taylor et al. JAMA. 2005
Acidic urine in metabolic syndrome

**Acidic urine in metabolic syndrome**

**Original Articles**

**Low Urine pH: A Novel Feature of the Metabolic Syndrome**
Naim M. Maalouf,*† Mary Ann Cameron,*† Orson W. Moe,*† Beverley Adams-Huet,†† and Kheshayar Sakhaee†

*The Charles and Irene Pak Center for Mineral Metabolism and Clinical Research and Departments of †internal Medicine and ‡Clinical Sciences, University of Texas Southwestern Medical Center, Dallas, Texas

- 24-hr urine pH in non-stone formers (n=148)
- significantly lower pH in metabolic syndrome patients
- urine pH correlated with degree of insulin resistance
- relevant for uric acid stones


- pathophysiology not well-understood
- increased acid excretion and/or impaired buffering
- differences in food intake?
- insulin affects acid/base homeostasis - specifically ammonium production (buffer)
BMI = BAD

• uric acid stone prevalence increased in overweight and metabolic syndrome patients
• probability of stone formation higher in overweight patients
• elevated BMI positively correlated with increased stone formation
• may be more exaggerated in women
• metabolic syndrome associated w/ changes in urine pH

Can obese patients follow diet recommendations?

• Toricelli et al (2014) - 214 stone formers retrospectively reviewed
• BMI <30, 30-40, and >40
• 24hr urines before and after dietary counselling
• all groups showed significant improvement
• super-obese pts had greater oxalate reduction (p=0.04)
• so YES, obese patients do benefit from dietary counselling!
Take home points

24hr urines, diet, metabolic syndrome

Summary

• stone disease is prevalent, increasing, and is associated w/ significant health care costs

• two 24hr urines are likely ideal

• normal calcium intake (1000-1200mg/d) and decreased animal protein and salt (DASH diet may be helpful)

• fluid intake and some oxalate restriction (spinach?)

• metabolic syndrome increases stone risk
Whole patient health

Healthy diet, weight loss, exercise.

Thank you!

Questions?

Dr. Ben Chew