DEPARTMENT OF
UROLOGY

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URINARY CITRATE WASTING AMONG NEPHROLITHIASIS PATIENTS ASSOCIATES WITH OBESITY AND DIABETES MELLITUS

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Disclosures

- none

Introduction

- Metabolic syndrome including obesity, insulin resistance and diabetes increases the risk of stone disease.
- Excretion of most urinary analytes has been shown to increase with body mass index (BMI).
- Citrate is a potent stone inhibitor and a subset of stone patients excrete very high levels of urinary citrate (>1500mg/day).

Objective

- Here we sought to identify and characterize patients with citrate wasting.

Materials and Methods

- Retrospective review of institutional stone dataset
- Matched citrate wasting (>1500mg/day of urinary citrate) 1:3 by age and sex to stone forming controls
- Extracted demographic information, medical history, stone composition and 24 hour urine values

Results

- N = 55 citrate wasters (1.5% of all stone formers) matched to 165 controls
- Higher mean BMI (35 kg/m^2 vs 29.9 kg/m^2, $p < 0.001$) and higher proportion of diabetes (61.8% vs 20.6%, $p < 0.001$)
- No differences in medication use or stone composition

Table 1. Clinical and demographic characteristics of the study cohort

	Control % (n = 165)	Citrate waster % (n = 55)	p-value
Age (mean ± SD)	53.4 ± 11.6	53.2 ± 11.6	0.914
BMI (mean ± SD)	29.9 ± 7.9	35.0 ± 7.3	<0.00´
Gender			
Male	67.3 (111)	67.3 (37)	
Female	32.7 (54)	32.7 (18)	
Race			
White	91.8 (15)	94.5 (52)	0.502
Non-white	8.2 (13)	5.5 (3)	
Past medical history			
Infammatory bowel disease or Diarrhea	5.5 (9)	9.1 (5)	0.339
Hypertension	55.8 (92)	67.3 (37)	0.133
Gout	6.1 (10)	5.5 (3)	0.869
Type 2 diabetes mellitus	20.6 (34)	61.8 (34)	<0.00´
Osteoporosis/immobility/hyperparathyroidism	5.5 (9)	7.3 (4)	0.62
Coronary artery disease / myocardial infarction	14.5 (24)	14.5 (8)	1.0
Cerebrovascular accident	2.4 (4)	5.5 (3)	0.267
Hyperlipidemia	37.0 (61)	40.0 (22)	0.688
Gastroesophageal reflux disease	37.0 (61)	34.5 (19)	0.746
Epilepsy/migraine	4.2 (7)	0 (0)	0.121
Medication			
Allopurinol	3.0 (5)	5.5 (3)	0.406
Hydrochlorothiazide	7.3 (12)	1.8 (1)	0.137
Stone comp*			0.237
Calcium oxalate monohydrate	58.3 (73)	70.0 (28)	
Calcium oxalate dihydrate	10.6 (13)	7.5 (3)	
Brushite	0.8 (1)	0 (0)	
Struvite	0.8 (1)	0 (0)	
Hydroxyapatite	19.5 (24)	5.0 (2)	
Uric Acid	6.5 (8)	15.0 (6)	
Other	2.4 (3)	2.5 (1)	

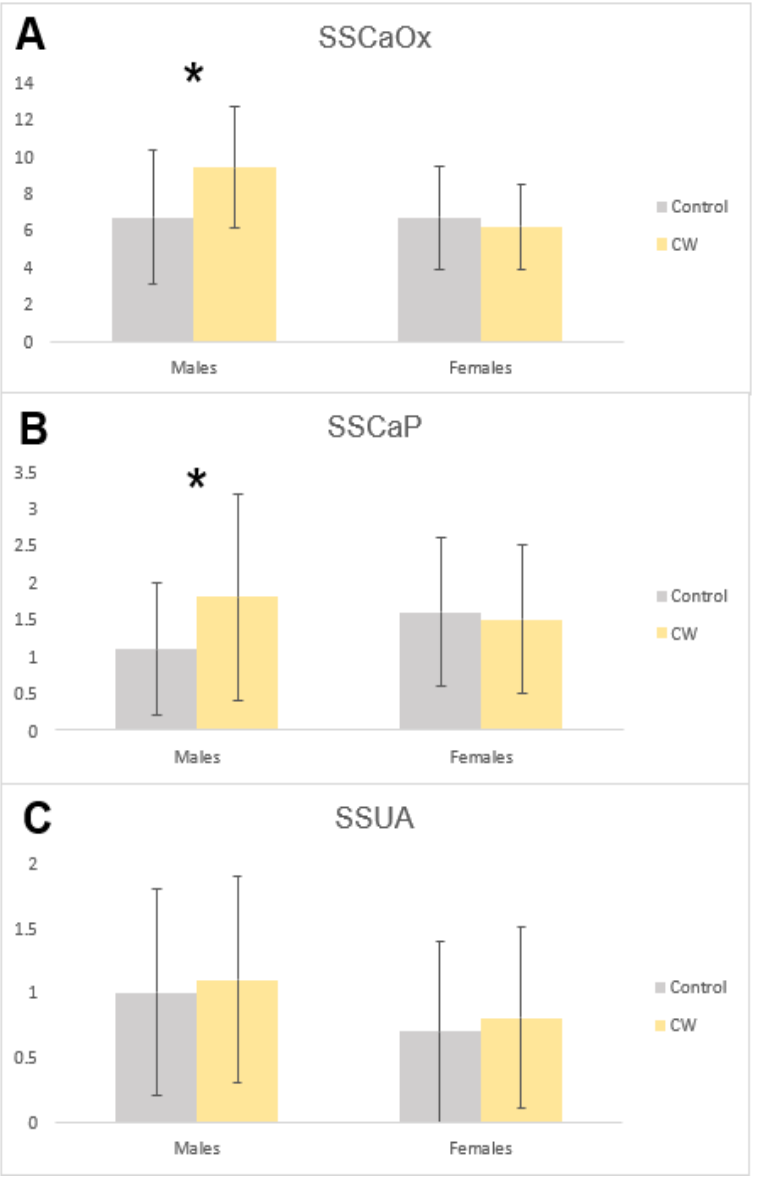
* stone composition was available in n = 123 controls, n = 40 citrate wasters

Results

- 24 hour urines showed increased excretion of most urinary analytes
- On sub-analysis by sex, the supersaturation of CaOx and CaPhos was significant different only for men

Table 2. Comparison of 24-hour urine characteristics between citrate wasters and controls

	Control (n = 165)		Citrate waster (n = 55)		
	Mean	SD	Mean	SD	p-value
BMI (kg/m^2)	29.9	7.9	35	7.3	<0.001
Volume (L)	2	0.9	2.6	0.9	<0.001
Calcium (mg)	230.2	126	413	197.3	<0.001
Oxalate (mg)	39	16.6	52.8	15.6	<0.001
Citrate (mg)	631.3	345.5	1868.1	366	<0.001
pH	6.1	0.5	6.1	0.6	0.992
Uric acid (g)	0.7	0.2	1	0.3	<0.001
Sodium (mmol)	183.6	77.8	281.4	113.4	<0.001
Potassium (mmol)	61.8	24.8	86.7	23.7	<0.001
Magnesium (mg)	103.8	46	149.1	56.7	<0.001
Phosphorus (g)	1	0.4	1.4	0.5	<0.001
Ammonium (mmol)	37	15.4	43.7	17.8	0.008
Chloride (mmol)	176.5	72.7	264.4	111.5	<0.001
Sulfate (meq)	40.5	16.8	53	20.4	<0.001
Creatinine (mg)	1470.9	436.8	1988.7	691.9	<0.001
Creatinine per Kg	16.6	4.1	18	4.8	0.045
Supersaturation					
Calcium oxalate	6.7	3.3	8.4	3.4	0.002
Calcium phosphate	1.3	1	1.7	1.3	0.013
Uric acid	0.9	0.8	1	0.8	0.406



Conclusions

- Nephrolithiasis patients who excrete > 1500mg of urinary citrate per day are more likely to be obese and diabetic, with generally worse urinary analytes overall relating to stone recurrence risk.
- Unclear mechanism - is there a maximal inhibitory effect of citrate?
- What are the clinical implications of this finding?

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