# Canadian Urological Association guideline: Evaluation and medical management of kidney stones

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# Disclosures

Dr. Bhojani is a consultant for Boston Scientific, Olympus, and Procept BioRobotics; and participated in the WATER 2 trial supported by Procept BioRobotics.

Dr. Chew has been an advisory board member for and has received honoraria from Auris Surgical, ADVA-Tec, Ambu, Becton Dickinson, Boston Scientific, Cook Medical, Olympus, Storz Medical, Sonomotion, and The Ureteral Stent Company; holds investments in Auris Surgical, Sonomotion, and The Ureteral Stent Company; and has participated in clinical trials supported by ADVA-Tec, Boston Scientific, Cook Medical, Olympus, Storz Medical, and Sonomotion.

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The remaining authors do not report any competing personal or financial interests related to this work

# Background

- This guideline is an update of the 2016 document
- Aims:
  - Identify patients at heightened risk of stone recurrence
  - Outline the required investigations to assess these patients
  - Provide contemporary advice on dietary and medical interventions of proven benefit in the Canadian context
- Based on updated review of the literature (Jan. 1, 2015 to July 1, 2021)

# Metabolic workup (limited)

- Workup (limited)
  - Urinalysis
  - +/- urine culture
  - Serum electrolytes, calcium, creatinine
  - Stone analysis

# Metabolic workup (full)

- Workup (full)
  - Urinalysis
  - +/- urine culture
  - Serum electrolytes, calcium, uric acid, creatinine
  - Stone analysis
  - 2 x 24-hour urine collections
    - Creatinine, volume, calcium, sodium, potassium, oxalate, uric acid, magnesium
  - PTH
    - If high or high normal serum Ca
    - **Or idiopathic hypercalciuria with normocalcemia**
  - Vit D
    - **If PTH elevated**

# Primary and secondary hyperparathyroidism

## Features, investigations, and treatment

| Disorder | Suggestive features | Investigations | Treatment |
|---|---|---|---|
| Primary hyperparathyroidism | ↑ or ↑N serum calcium<br>↑ or ↑N serum PTH<br>Hypercalciuria<br>Calcium oxalate or calcium phosphate stone<br>↓ Bone mineral density | Serum calcium<br><br>PTH<br><br>Vitamin D | Treat vitamin D deficiency<br><br>Referral to endocrinology |
| Secondary hyperparathyroidism | ↑ serum PTH<br>↓ Vitamin D<br>↓ or N serum calcium<br>Hypercalciuria<br>↓ Bone mineral density | Serum calcium<br><br>PTH<br><br>Vitamin D | Treat vitamin D deficiency<br><br>Consider referral to endocrinology |

# General recommendations

- Fluid intake for a daily urine output of 2.5 L
- Calcium 1000–1200 mg/day
  - If supplementation is required, it should be taken at mealtimes
- Animal protein in patients with calcium oxalate or uric acid stones
  - Moderate animal protein intake and avoid purine rich foods
- Limit sodium intake to 1500 mg/day and don’t exceed 2300 mg/day
- Diet rich in fibers, fruit, and vegetables may offer a small protective effect
- Limit vitamin C <1000 mg/day

# Vitamin D

1. In calcium stone formers with vitamin D deficiency, repletion is appropriate; however, monitoring of vitamin D levels and hypercalciuria on repeat testing is necessary *(LE 2-3, Grade C recommendation)*
2. Consider bone mineral density testing in calcium stone formers with evidence of hypercalciuria and/or distal renal tubular acidosis *(LE 2-3, Grade C recommendation)*
3. Treatment of calcium stone formers with either a thiazide diuretic, alkali citrate, or ideally both has been shown to reduce stone recurrence risk and increase bon mineral density and should be considered in patients with documented low bone mineral density *(LE 2-3, Grade C Recommendation)*

# Metabolic syndrome

- Stone disease highly correlates with obesity, diabetes, and metabolic syndrome, and patients should be counselled that proper management of these conditions may reduce their future stone risk *(LE 2-3, Grade D recommendation)*

# Oxalate

1. Patients with hyperoxaluria should minimize their intake of high-oxalate foods. Vitamin B6 supplementation can be considered to lower urinary oxalate levels when dietary modification has been unsuccessful *(LE 2-3, Grade C recommendation)*
2. In patients with enteric hyperoxaluria, elemental calcium or calcium citrate should be given with meals to bind with dietary oxalate to reduce its intestinal absorption *(LE 2-3, Grade C recommendation)*

# INDEX patient #1

**Calcium oxalate or mixed calcium oxalate/calcium phosphate stones**

Recommendations:

1. Thiazide diuretics decrease urinary calcium and stone recurrence in calcium stone forming patients *(LE 1-3, Grade A-B recommendation)*
2. Alkali citrates are effective in increasing urinary citrate and reducing stone recurrence in calcium stone formers *(LE 1-3, Grade A-B recommendation)*
3. In calcium stone formers, allopurinol is effective in reducing stone recurrence in patients with hyperuricemia but does not provide any benefit in patients with normal serum uric acid levels *(LE 1-2, Grade B recommendation)*
4. Empiric treatment with either thiazide diuretics and/or alkali citrates reduces stone recurrence in calcium stone formers with active stone disease who have normal metabolic evaluations *(LE 1-3, Grade B recommendation)*

# INDEX patient #2

**Pure calcium phosphate stones**

Recommendations:

1. Patients with incomplete or complete distal renal tubular acidosis should be treated with alkali citrate therapy *(LE 2-3, Grade C recommendation)*

# Distal renal tubular acidosis: Features, investigations, and treatment

| Disorder | Suggestive features | Investigations | Treatment |
|---|---|---|---|
| Complete distal renal tubular acidosis | Urine pH >5.8<br>↓ serum bicarbonate<br>↓ serum potassium<br>Pure apatite stone<br>Hypocitraturia<br>Hypercalciuria<br>↓ Bone mineral density | Serum electrolytes<br>Urine pH<br>24h urine collection | Alkali citrate<br>Thiazide |
| Incomplete distal renal tubular acidosis | Urine pH >5.3<br>↓ N serum bicarbonate<br>↓ N serum potassium<br>Pure apatite stone<br>Hypocitraturia<br>Hypercalciuria | Serum electrolytes<br>Urine pH<br>24h urine collection | Alkali citrate<br>Thiazide |

PTH: parathyroid hormone, ↑ = high, ↑N = at the high end of normal range; ↓ = low, ↓N = at the low end of normal range.

# INDEX patient #3

**Uric acid stones**

Recommendations:

1. In patients with uric acid stones, urinary alkalization to a pH of 6.5 is first-line therapy
2. Allopurinol may be used as adjunctive therapy in patients with hyperuricemia or hyperuricosuria *(LE 1-3, Grade B recommendation)*

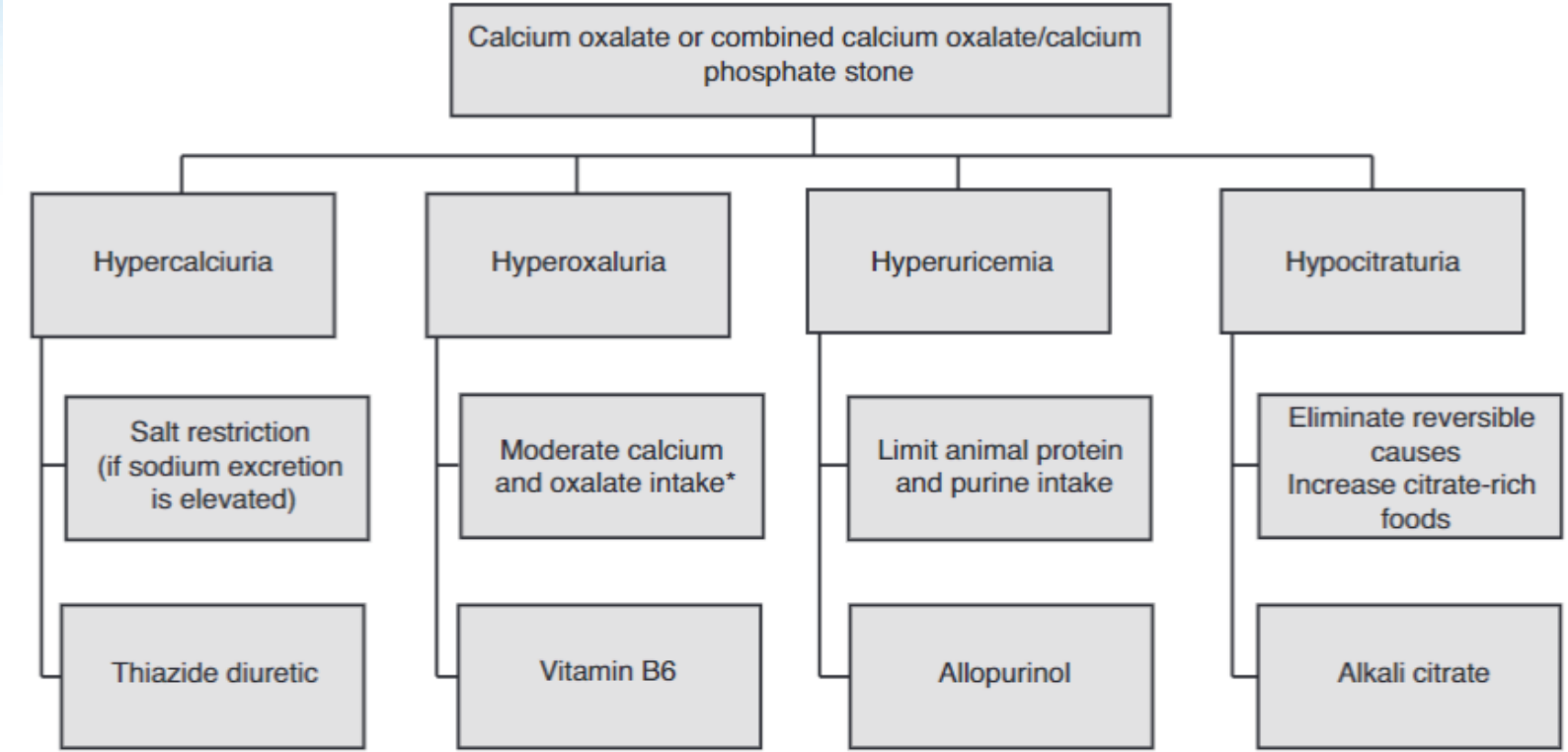
# INDEX patient #4

**Cystine stones**

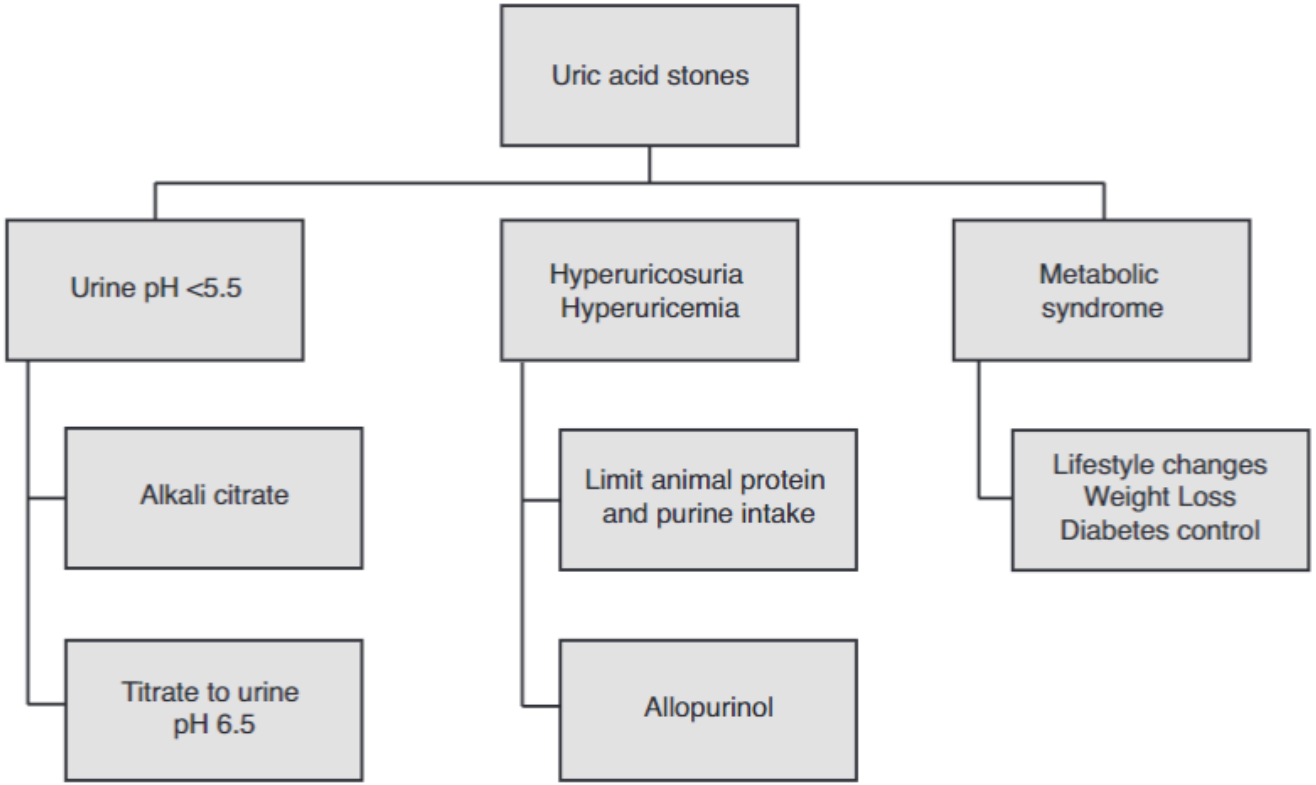
Recommendation:

1. Cystine stone formers should be counselled to target 3 L of urine output daily, restrict their sodium intake, and moderate their protein intake to reduce stone formation. Urinary alkalization of the urine targeting a urine pH of 7–7.5 is the initial therapy.
2. Thiol-binding agents should be considered second line therapy *(LE 3-4, Grade C recommendation)*

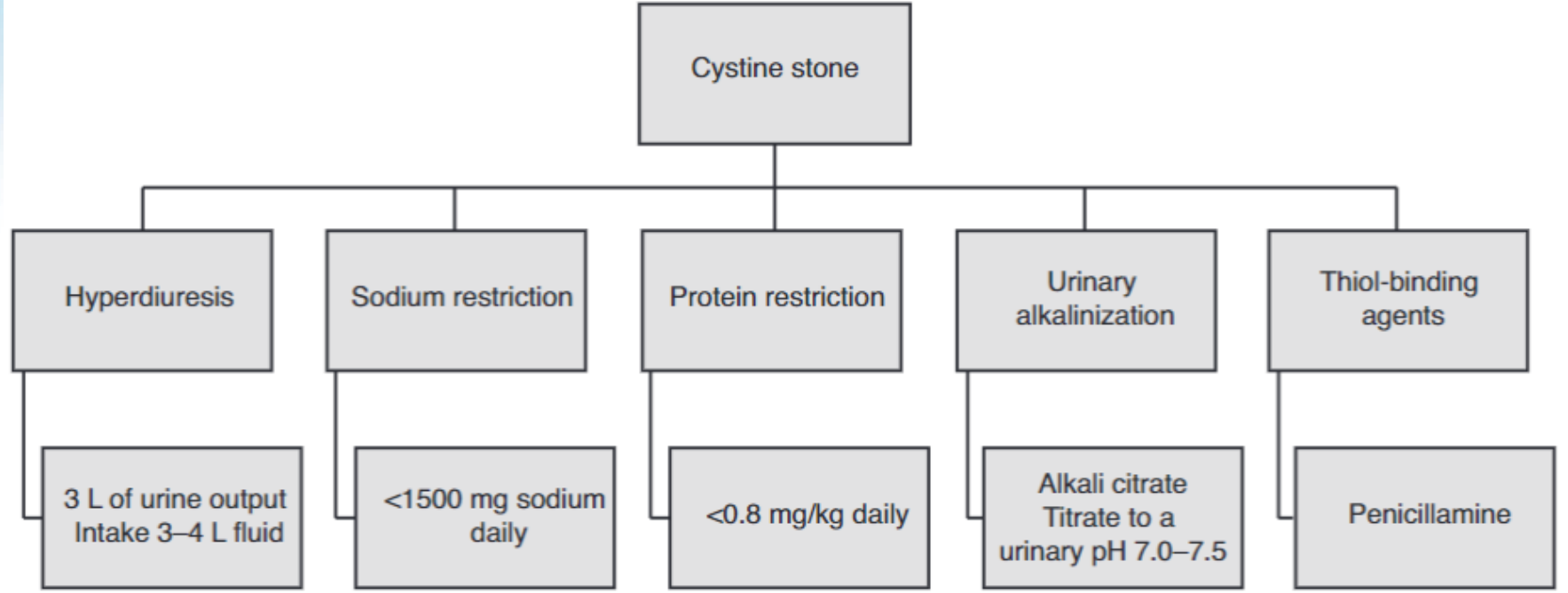
# Dietary and medical treatments for calcium oxalate or mixed calcium oxalate/phosphate stones



# Dietary and medical treatments for patients with uric acid stones



# Dietary and medical treatments for patients with cystine stones



# Pediatric stone disease

- Recommendation: All children with stone disease should undergo an in-depth medical evaluation and may benefit from a multidisciplinary approach with urology and nephrology *(LE 3, Grade D recommendation)*

# Summary

- For patients at risk of recurrent renal stones, a detailed medical evaluation and an individualized approach to dietary and pharmacological prevention are important aspects of their care
- Urologists, in addition to providing state-of-the-art surgical care to our patients, should be capable of providing up-to-date metabolic assessment and optimal prevention strategies as part of a comprehensive approach to stone management