Worcestershire Acute Hospitals NHS Trust

Renal Calculi (PIP)

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The following guidance is taken from the Partners In Paediatrics (PIP)

RENAL CALCULI

RECOGNITION AND ASSESSMENT

Definition

- Presence of crystalline material within urinary tract

Symptoms and signs

- Non-specific recurrent abdominal pain
- Dysuria or painful micturition
- Classical renal colic
- Urinary infection (particularly *Proteus* spp)
- Persistent pyuria
- Macroscopic or microscopic haematuria
- Passage of gravel/stones
- Renal failure

Initial investigations

- Renal ultrasound scan
- KUB AXR
- Urine microscopy, pH and culture

Further investigations

- DMSA scan
  - to determine function when calculi multiple or large
- Repeat renal ultrasound scan
  - to see if stones have been passed
  - to monitor progress of stones
  - 6 weeks after treatment (see below)

IMMEDIATE TREATMENT

- Analgesia for severe pain
- If obstruction present, urgent referral to paediatric urology
- Cefalexin oral if symptomatic for urinary tract infection, adjusted once sensitivities available
  - antibiotic treatment unlikely to eradicate organism in presence of stones

OUTPATIENT MANAGEMENT

Investigations in patients with proven renal calculi

- Blood sample for:
  - creatinine
  - calcium
  - phosphate
  - parathyroid hormone (if calcium raised)
  - uric acid
  - venous bicarbonate
  - pH (warm arterialised capillary sample to coincide with urine pH)
- Random mid-stream urine
  - microscopy, culture and sensitivity
- Early morning urine (first voided specimen) and 24 hr collection (request 'urinary stone screen' and record height and weight on request form) for:
  - calcium
  - oxalate
  - citrate
  - uric acid
  - cystine
  - creatinine

- pH (to coincide with blood pH)
- if 24 hr urine collection unsuccessful request:
  - calcium:creatinine ratio
  - oxalate:creatinine ratio
  - urate:creatinine ratio

Stone analysis

- May give useful information about aetiology
- If stone passage is frequent or associated with symptoms, ask parents to strain urine

Table 1: Characteristics of urinary stones

Type	Appearance	Causes	Radio-opaque*
Magnesium ammonium phosphate	Very soft, white, toothpaste consistency or gravel fragments	• Infection with urea-splitting organisms, especially in children with urinary stasis	No
Calcium oxalate	Hard grey-brown rough surface	• Hypercalciuria (any cause) • Hyperoxaluria	Yes
Calcium phosphate	Large, smooth, pale, friable	• Infection • Renal tubular acidosis • Vitamin D toxicity • Idiopathic hypercalciuria • Immobilisation • Hyperparathyroidism • Sarcoidosis	Yes
Cystine	Pale-yellow, crystalline Maple syrup	• Cystinuria	Yes
Uric acid	Hard, yellow	• Lesch-Nyhan syndrome • Dietary • Induction in haematological malignancies	No
Xanthine	Smooth, soft, brown yellow	• Xanthinuria	No
Dihydroxyadenine	Friable, grey-blue	• Adenine phosphoribosyl transferase deficiency	No

* Radiolucency depends on amount of calcium in the stone and individual patient can have >1 type of stone, each with different radiolucencies

Interpretation of results

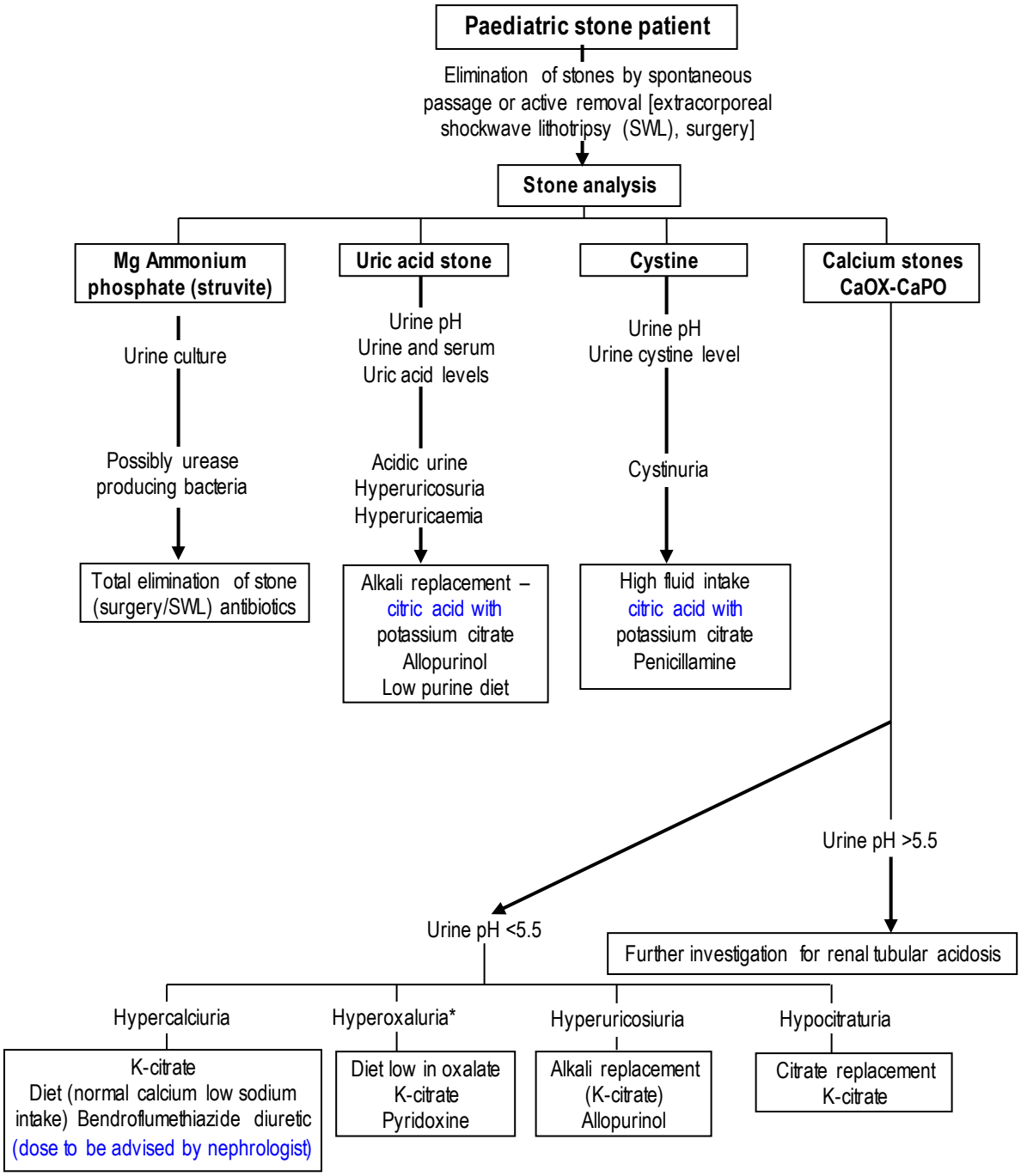
- Urinary pH
  - pH <5.3 in presence of normal capillary pH and bicarbonate excludes distal renal tubular acidosis
  - when above criteria not met, a more formal test of renal acidification required in those with nephrocalcinosis or in recurrent stone formers
  - pH >6 with capillary bicarbonate <18 mmol/L is seen in mild distal tubular acidosis
- Calcium:creatinine (mmol/mmol) ratio consistently >0.2 indicates hypercalciuria
  - absorptive hypercalcuria – normal fasting calcium:creatinine ratio raised post-milk
  - renal hypercalcuria – calcium:creatinine ratio raised fasting and post-milk
- Oxalate:creatinine (mmol/mmol) ratio is age-dependent, and suggestive of hyperoxaluria if it exceeds following thresholds:
  - aged <6 months: 0.35
  - aged 6–11 months: 0.2
  - aged 1–2 yr: 0.18
  - aged 3–6 yr: 0.11
  - aged 7–14 yr: 0.08
  - aged >14 yr: 0.065
- Uric acid/creatinine (mmol/mmol) ratio is age-dependent, and suggestive of hyperuricaemia if it exceeds following thresholds:
  - aged <1 yr: 1.5
  - aged 1–2 yr: 1.26
  - aged 3–6 yr: 0.83

- aged 7–10 yr: 0.67
- aged 11–14 yr: 0.45
- aged >14 yr: 0.4
- Magnesium:creatinine ratio <0.2 may increase stone formation
- Calcium:citrate ratio <0.6 may increase stone formation
- Cystine, if present, is indicative of cystinuria
- Overall solubility index (RS value)
- negative value: stable urine
- value 0–1: metastable (liable to precipitate if seeded)
- value >1: spontaneous precipitation

TREATMENT

- Treat any metabolic disorder identified by above investigations, seek advice from regional nephrology service
- Keep urine free from infection, particularly in those with history of *Proteus mirabilis* infection by prompt treatment if symptomatic
- Advise liberal fluid intake
- adolescent 3 L/day
- pre-puberty (school age) 1.5 L/day
- Additional measures for recurrent stone formation or idiopathic hypercalciuria (in order):
- dietary assessment to optimise oxalate, vitamin C, calcium, and vitamin D intake
- reduced sodium intake in idiopathic hypercalciuria, if sodium excretion >3 mmol/kg/day
- high fibre diet with cellulose or whole wheat flour to reduce calcium and oxalate absorption
- For specific treatments – see **Algorithm for metabolic investigations** and discuss with regional nephrology service

Algorithm for metabolic investigations



*Hyperoxaluria patients should be referred to the regional nephrology service renal centre