UROLITHIASIS UPDATE

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THE UNIVERSITY OF THE WEST INDIES
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Disclosures

Outline

- Index case
- Introduction
- Etiology
- Risk factors
- Acute stone event
- Conservative management
- Interventional stone treatment
- Summary
- References

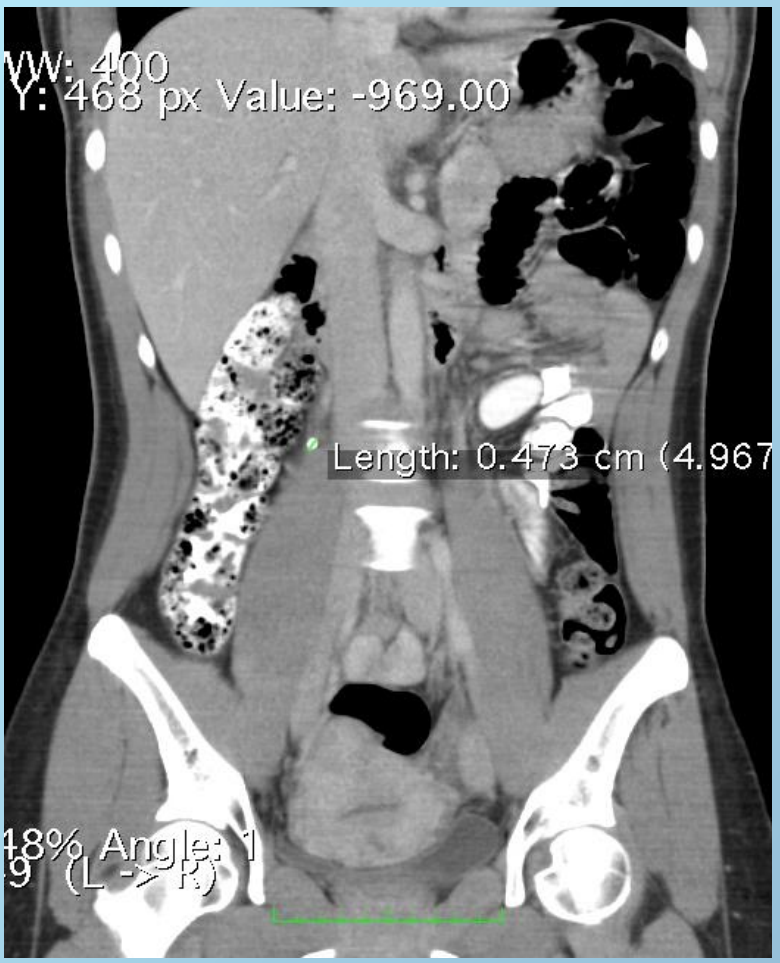
Index Case

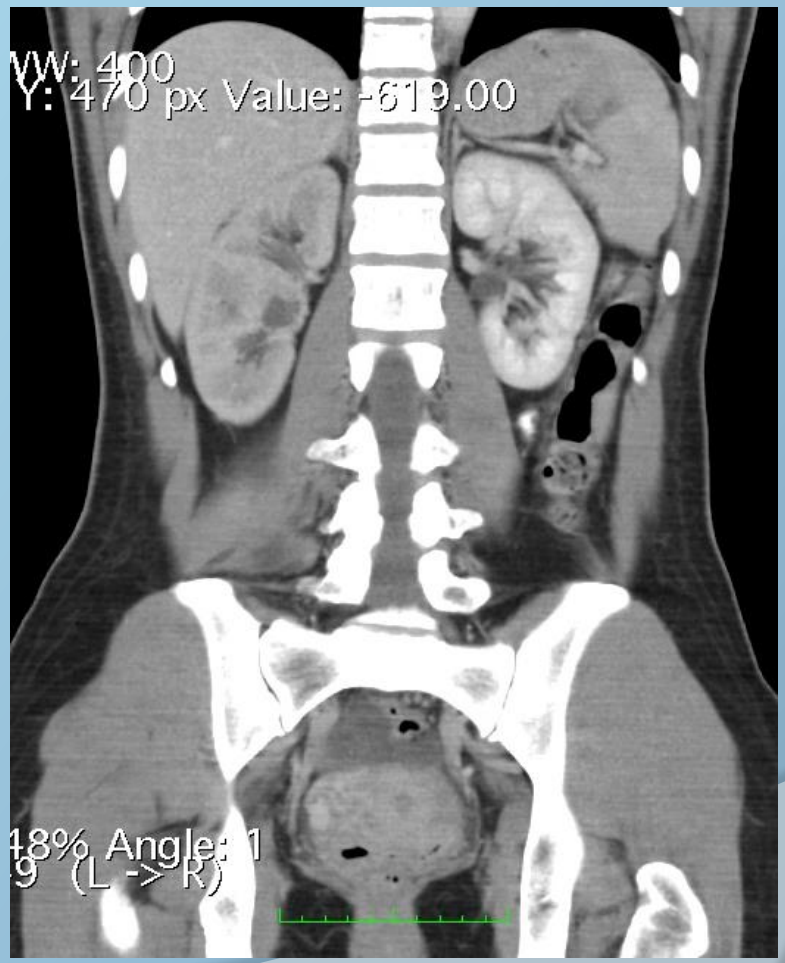
- 42 y.o. female no chronic illnesses R sided abdominal pain radiating RLQ severe
- No associated urinary symptoms, vomited once, no fever
- Abdomen- benign
- KUB ultrasound- small R ovarian cyst small fibroids. Non-specific free fluid RLQ- inflammatory process
- Seen gynecologist and surgeon

Index Case

- Pain persisted- baralgin
- U&Es- creatinine elevated
- CT scan

CT ABDOMEN


VW: 400
Y: 468 px Value: -969.00
Length: 0.473 cm (4.967
48% Angle: 1
9 (L -> R)


VW: 400
Y: 470 px Value: -619.00
48% Angle: 1
9 (L -> R)

Management

- Further investigation ?
- Allow for spontaneous passage ?
- Referral urology ?

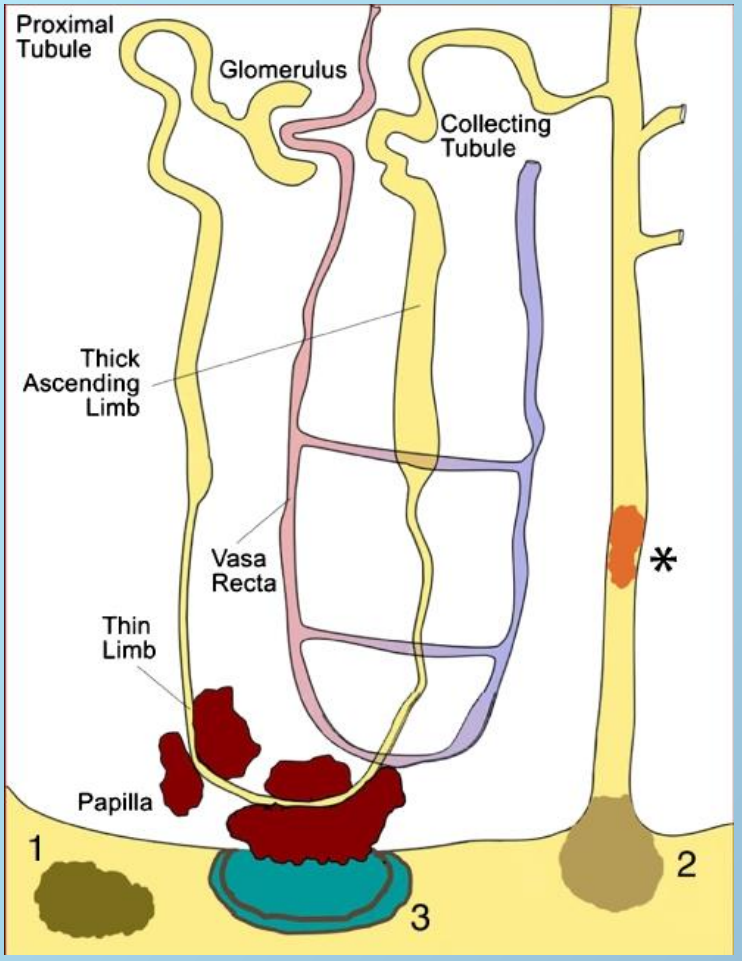
Historical

- Humans have been plagued by urinary calculi since antiquity. Bladder calculi have been discovered in Egyptian mummies preserved for more than 7000 years. Other reports identify presence in north American Indians as early as 1500 BC.

Introduction

- Urinary stones are polycrystalline concretions occurring in the urinary tract of humans and animals
- Urolith formation is governed by patho-anatomical and physiochemical factors
- ? Theories

Theories stone formation

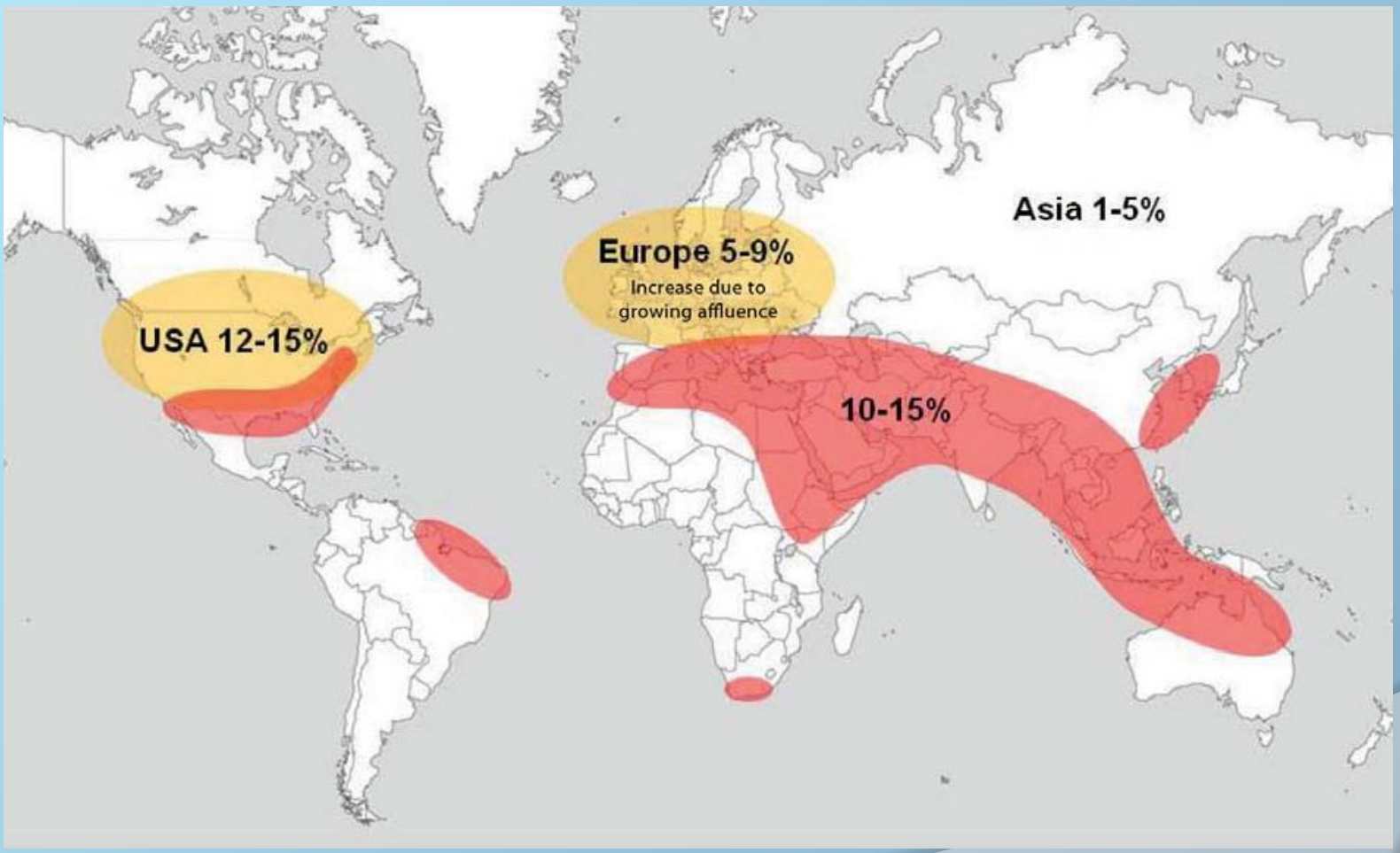


- Nucleation theory
- Stone Matrix theory
- Inhibitor of crystallization theory

Epidemiology

- Urolithiasis is a common and costly disease
- 10% of the population and rising (US figures)
- Significant burden on society
- Changes in lifestyle and improved diagnosis has led to growing incidence and prevalence

“Stone belt”


Asia 1-5%
Europe 5-9%
Increase due to growing affluence
USA 12-15%
10-15%

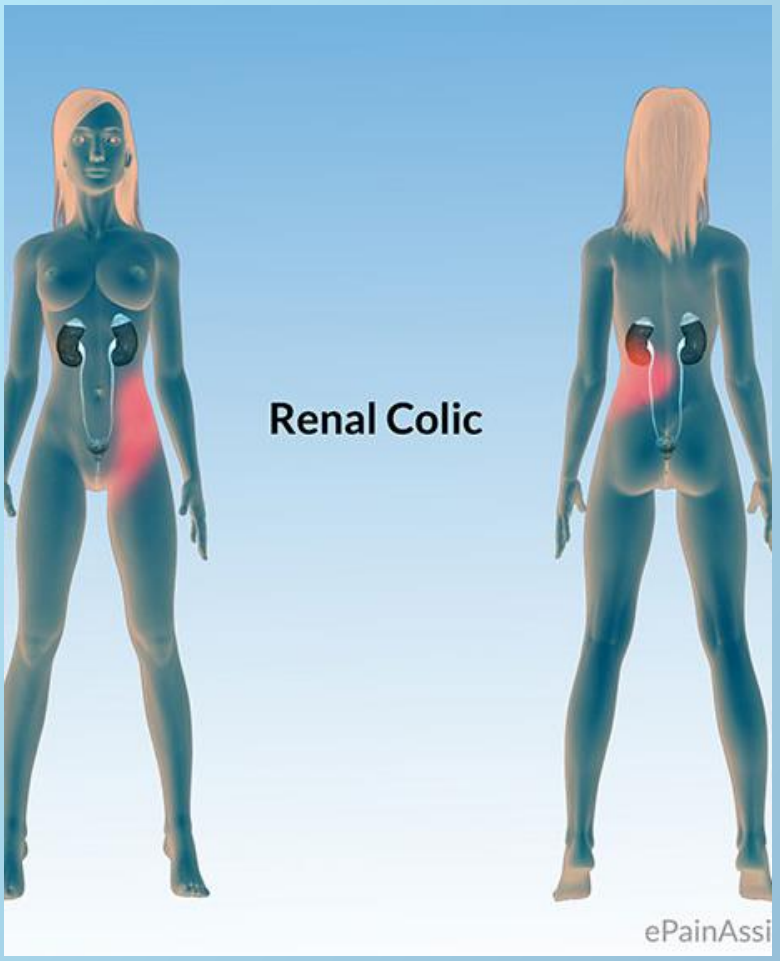
Risk factors

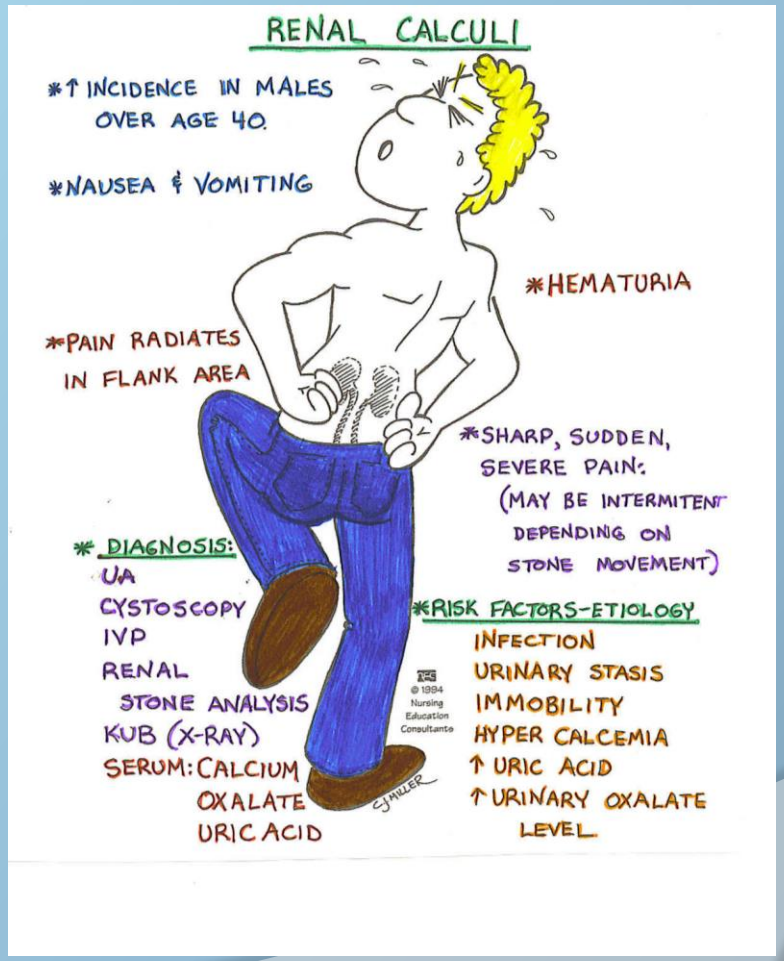
- General – Early onset, familial, uric acid, infected stones
- Diseases – Hyperparathyriodism, SCI, gastrointestinal diseases, metabolic syndrome
- Genetic – cystic fibrosis, RTA, hyperoxaluria
- Drug induced
- Anatomical abnormalities
- Environmental

Diversity of urinary stones

- Calcium oxalate (prevalence 80%)
- Calcium phosphate (carbonate apatite 5%)
- Magnesium ammonium phosphate (struvite/infected stones 5%)
- Uric acid (13%)
- Cysteine, ammonium urate, brushite (rare <1%)
- Fifty percent of patients suffer at least one recurrence, and 10-20% experience three or more further episodes
- Metabolic workup necessary for secondary prevention

Acute stone Event





The acute stone event

- Renal colic- radiating colicky loin to groin pain
- History and examination
- Nausea & vomiting (differentials acute abdomen)
- Before any investigations institute appropriate pain relief

  - NSAIDs level of evidence 1b recommendation grade A
  - Opioids evidence level 4 recommendation grade C

The acute stone event

- History and examination followed by urine dipstick- microhematuria
- KUB ultrasound- non invasive, sensitivity 61-93% and specificity 84-100%
- Ureteric stones may only see hydronephrosis due to overlying bowel gas
- Triad of flank pain, US- ectasia renal calyces, microhematuria- pathopneumonic

The acute stone event

- Low dose plain CT KUB- diagnostic imaging of choice- evidence level 1a recommendation grade A, specificity & sensitivity 99%
- Radiolucent stones seen, and density in Hounsfield units indication of composition
- Blood investigations- electrolytes, uric acid , creatinine, C-reactive protein, CBC, coagulation parameters (recommendation grade A)

Conservative Treatment

- Aim to achieve spontaneous passage (medical expulsive therapy)- evidence level 1a, recommendation grade A
- Not indicated if patient has renal impairment, severe obstruction or persistent nausea and vomiting.
- Alpha-blockers promote spontaneous passage and reduce episodes of colic- level of evidence 1a, recommendation grade A

Conservative Treatment

- For uric acid stones attempt at chemo-litholysis pH 7.0-7.2
- “Watchful waiting” for cases of asymptomatic kidney stones

Conservative treatment

- Rates of stone passage
  - Distal Stones-

    <5mm- 71-98%

    6-10mm- 25-79%

  - Proximal stones-

    <5mm- 29-98%

    <10mm- 10-53%

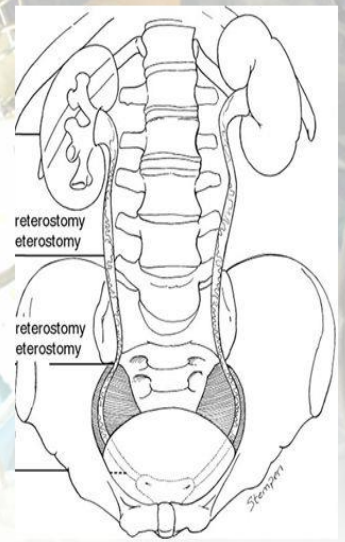
Ureter

Divided into 3 segments:

(1) upper- from the renal pelvis to the upper border of the sacrum

(2) middle- upper to the lower border of the sacrum

(3) lower (distal)- lower border of the sacrum to the bladder



Indications for surgery

- Stone growth
- Size >15mm
- Persistent symptoms
- Obstruction- high grade
- Infection
- Renal insufficiency
- Solitary kidney
- Social/patient choice- profession/travel

Active stone removal

- Decision on individual basis based on stone size, location, composition (if known), patient preference, patient factors, and local expertise.
- Treatment recommendations are shifting towards ureteroscopy and percutaneous nephrolithotomy, but shock wave lithotripsy still effective. Open and laparoscopic techniques rarely indicated.

Surgical Options

- Extracorporeal shock-wave lithotripsy (ESWL)
- Ureterorenoscopy (URS)
- Percutaneous nephrolithotomy (PNL)
- Laparoscopy
- Open surgery

Metabolic evaluation & Prevention

- After stone passage every patient should be assigned to a HIGH or LOW risk group for stone formation
- Stone material should be subjected to stone analysis (spectroscopy)
- Without analysis of the stone no specific prophylaxis can be carried out (recommendation Grade A)

Low Risk

Classification of urinary stone patients as uncomplicated on the basis of their medical history

Findings	Action
First episode	Cave: History of "frequent kidney pain" in childhood, but unclear origin
Age: adult	
No anatomic abnormalities	Exclusion of, for example, horseshoe kidney and outlet stenosis
Probable correlation with lifestyle	For instance, stone formation at or soon after a time of unusual stress and specific compensation reactions
Negative family history of urolithiasis	Cave: Hints of possibly undiscovered stones in family members through statements such as "There was something, but I can't quite remember..."
Single stone	Assessment with suitable imaging procedures

High Risk

Classification of urinary stone patients as high risk

Finding	Action
Age; child or adolescent	Consider assessing siblings for risk of lithogenesis
Brushite, uric acid/urate, infectious stones	Bear other accompanying minerals in mind in diagnosis and treatment
Chronic psychovegetative stress	Establish severity, perhaps with aid of validated stress-assessment systems
Single kidney	
Malformation of the urinary tract	
Disorders of gastrointestinal function	E.g., Crohn disease, ulcerative colitis, sprue, chronic pancreatitis, liver cirrhosis, small bowel resection
High recurrence rate	More than three stones in 3 years. Changes in stone type (principal and subsidiary mineral phase) or composition may indicate alterations in metabolic conditions
Hyperparathyroidism (HPT)	Five forms of HPT, primary to quinary
Nephrocalcinosis	Numerous causes, e.g., following renal tubular acidosis, primary hyperoxaluria, sarcoidosis, HPT, chronic glomerulitis
Positive family history	Consider assessing patient's children for risk of lithogenesis
Primary hyperoxaluria	Two types, autosomal-recessive hereditary disease
Renal tubular acidosis	Test by means of urinary pH curve, blood gas analysis, and ammonium chloride load test
Residual stone fragments	Possibly consider endoscopic means of stone removal, particularly when the concrement is of a type that resists disintegration by ESWL, e.g., brushite, cystine, whewellite
Cystine, 2,8-dihydroxyadenine, xanthine stones	Stone formation genetically determined; lifelong metaphylaxis is mandatory

Risk stratification

- Risk status of stone formers important- defines the probability of recurrence, and important for pharmacological treatment
- Only high risk formers require specific metabolic evaluation, stone type decides further testing

Medical prophylaxis

Principal substances used in medicinal prophylaxis of urinary stones (e13)

Substance	Goal	Dosage	Remarks	Stone types amenable to treatment
Alkaline citrates	– Alkalization of urine – Compensation of hypocitraturia lowers the proportion of ionized calcium in the urine. This often suffices to treat mild hypercalciuria (5–8 mmol/day). – Regulate acid – base balance in RTA and metabolic acidosis	5–12 g/day (14–36 mmol/day), children: 0.1–0.15 g/kg BW/day – Calcium oxalate metaphylaxis: to urinary pH 6.5–6.8 – Uric acid metaphylaxis: to urinary pH 6,5–6,8 – Uric acid litholysis: to urinary pH 7.0–7.2 – Cystine metaphylaxis: to urinary pH 8.0–8.5	Dose size and frequency depend on urinary pH or need to compensate acidosis. Cave: Phosphate precipitation possible in cystine metaphylaxis (→ high urinary pH)	– Calcium oxalate – Uric acid – Cystine – Non-infection-associated calcium phosphates
Allopurinol	Lowering of – Hyperuricosuria – Hyperuricemia	100–300 mg/day, children: 1–3 mg/kg BW/day	– 100 to 200 mg/day in isolated hyperuricosuria – Dose adjustment in renal insufficiency Cave: high-dose allopurinol treatment can lead to xanthinuria	– Uric acid – Calcium oxalate (only if uric acid elevated in serum or urine) – Ammonium urate – 2,8-Dihydroxyadenine
Calcium (Ca)	Lowering of enteral hyperoxaluria	160 mg corresponding to 100 mg Mg) with each meal, maximum 500 mg/day	Intake 30 min before each main meal Cave: hypercalciuria (→ testing)	Calcium oxalate
L-Methionine	Urinary acidification	600–1500 mg/day to urinary pH 5.8–6.2	Cave: contraindicated in RTA – pointless in calcium phosphates unless associated with infection (→ supporting antibiosis)	– Infectious stones – Ammonium urate – Calcium phosphate
Magnesium (Mg)	– Compensation of isolated hypomagnesiuria – Lowering of enteral hyperoxaluria – Mg (versus Ca) → non lithogenic level	200–400 mg/day, children: 6 mg/kg BW/day	Dose reduction in renal insufficiency, intake with main meals	– Calcium oxalate
Sodium carbonate	– Urinary alkalinization – Compensation of hypocitraturia, to lower proportion of ionized Ca in urine – Regulation of acid–base balance in RTA and metabolic acidosis	4.5 g/day, target urinary pH: see alkaline citrates	Dose depends on urinary pH or need to compensate acidosis	– Calcium oxalate – Uric acid – Cystine
Pyridoxine (vitamin B6)	Lowering of endogenous hyperoxaluria	Initially 5 mg/kg BW/day, maximum 20 mg/kg BW/day	If no effect, discontinue after 1 year at latest Cave: polyneuropathy	– Calcium oxalate
Thiazide (hydrochlorothiazide)	Increase in tubular Ca reabsorption in hypercalciuria (>8 mmol/day) so that renal Ca excretion goes down	12.5–50 mg/day (gradually increase dosage), children: 0.5–1 mg/kg BW/day)	– Decreased glucose intolerance – Increase in serum uric acid Cave: – Tendency to hypotension – Potassium loss – (hypocitraturia)	– Calcium oxalate – Calcium phosphate
Tiopronin	Intermediate conversion of poorly soluble cystine to cysteine + cysteine–drug complex (readily soluble)	Initially 250 mg/day, maximum 2000 mg/day	Cave: – Tachyphylaxis – Proteinuria	– Cystine

Secondary prevention

- Increased fluid intake- 2.5-3L/day, SG urine <1010
- Nutritional advice/ balanced diet- rich in vegetables and fiber, normal Ca, limited NaCl, limited animal protein
- Lifestyle advice- normal BMI, adequate physical activity, balance excessive fluid loss

Summary

- Urolithiasis widespread and increasing in prevalence
- Acute renal colic can be managed conservatively in most cases
- Wide range of options available for surgical treatment but dependent on multiple factors (individual basis)
- Patients classified high and low risk- guide subsequent investigations and management
- Risk adapted prevention reduces risk of recurrence

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