

2003 REVISED EDITION

ABCs

of Medical Management
of Stones

Charles Y. C. Pak, M.D.
with
Donald P. Griffith, M.D.
Mani Menon, M.D.
Glenn M. Preminger, M.D.
Martin I. Resnick, M.D.

**Charles Y. C. Pak
with
Donald P. Griffith
Mani Menon
Glenn M. Preminger
Martin I. Resnick**

ABCs

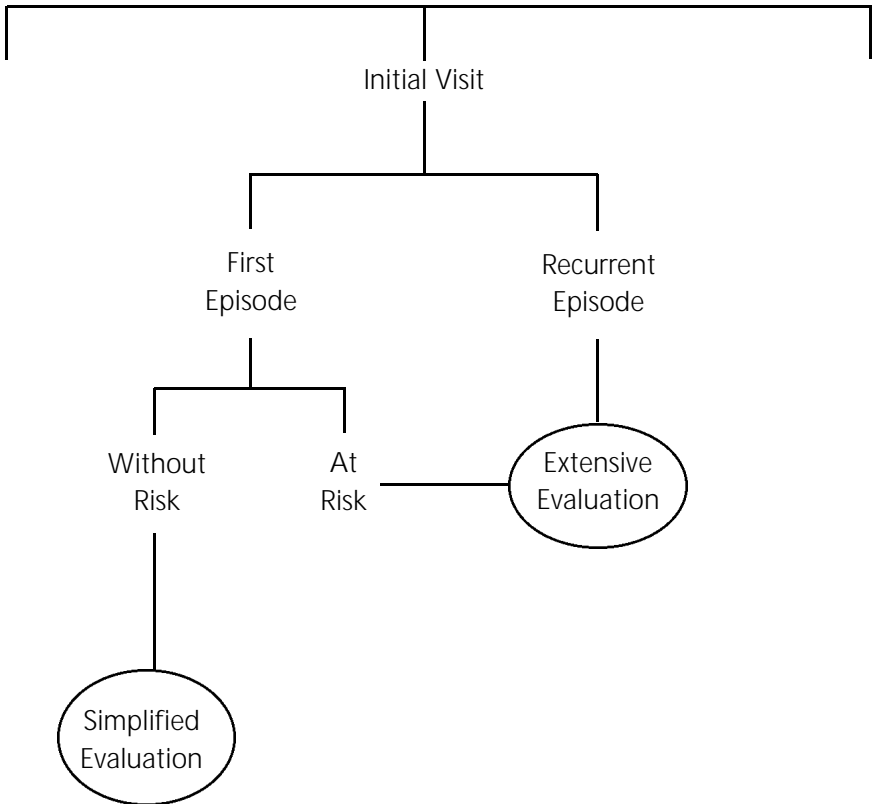
of Medical Management of Stones

A simple, step-by-step approach to diagnosis and prevention of nephrolithiasis.

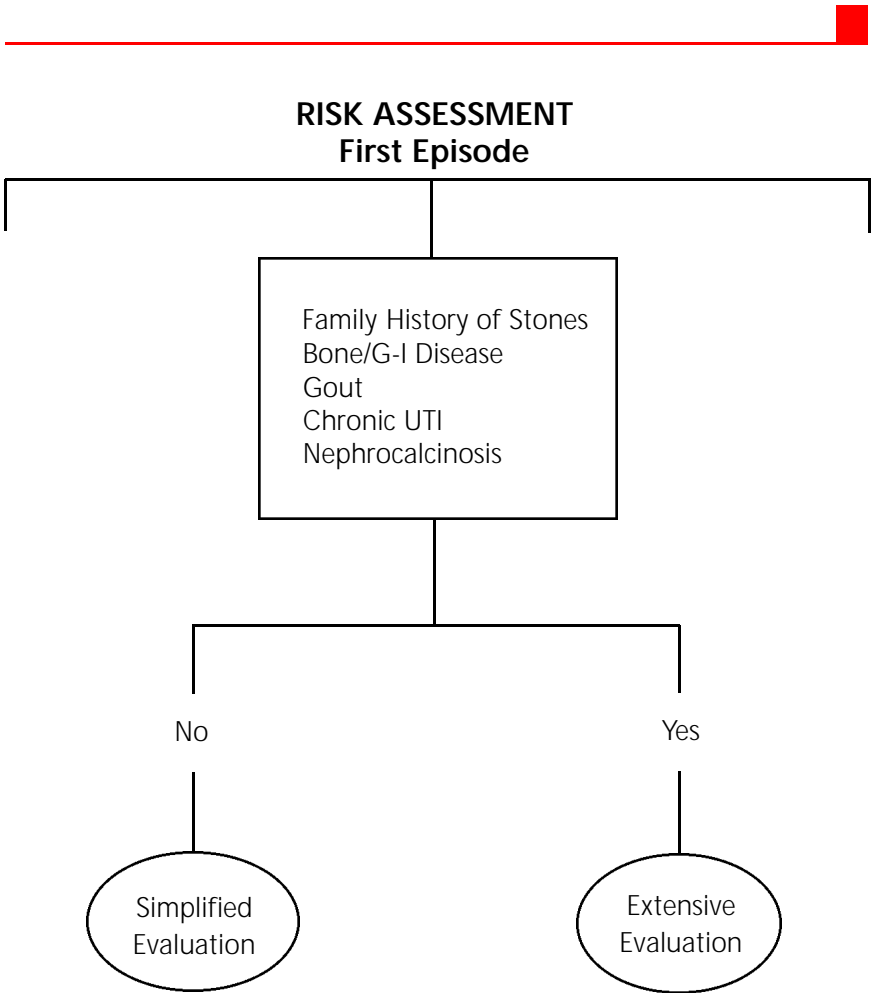
This text has been prepared by the authors purely for educational purposes, in response to requests from many physicians who are confounded by complexities of medical approach to stone disease. There is no restriction on duplication or dissemination of the material. Enclosed recommendations represent a consensus view of the authors. They do not preclude other options or approaches.

**Selection of simplified or extensive evaluation at initial visit.
Apply a simplified evaluation in patients with single stone episode without risk. Consider an extensive evaluation in patients with recurrent episode or first episode at risk.**

SCHEME FOR DIAGNOSTIC EVALUATION



History constituting increased risk for stone development. If present in patients with first episode, an extensive evaluation is advised. If absent, a simplified evaluation may be applied.



History and laboratory tests to be obtained during simplified evaluation.

SIMPLIFIED EVALUATION

Hx:

- Dietary aberrations
- Stone-provoking medications
- Fluid loss
- Urinary tract infection

Laboratory Tests:

- Stone analysis (e.g., StoneComp® Test)
- Serum Ca, P, electrolytes and uric acid
- 24-hour urine stone risk profile analysis (e.g. StoneRisk® Diagnostic Profile, UroRisk® Diagnostic Profile)
- Urinalysis & urinary sediment (crystals)
- Urine culture (if clinically indicated)
- KUB

During simplified evaluation, factors constituting dietary aberrations.

DIETARY ABERRATIONS

- Low fluid intake
- High Ca intake
- High oxalate diet
- Sodium excess
- Animal protein excess
- Low citrus fruit intake

STONE-PROVOKING MEDICATIONS

- Acetazolamide
- Ca-channel blockers
- Vitamin C
- Triamterene
- Ca / Vitamin D
- Uricosuric agents
- P-binding antacids
- Furosemide
- Theophylline

During simplified evaluation, medications which might cause or exaggerate nephrolithiasis.

STONE ANALYSIS

Diagnostic importance of stone analysis.



STONE TYPE	ETIOLOGY
Radiopaque Stone	
Calcium oxalate	Hypercalciuria, hyperoxaluria, hyperuricosuria, hypocitraturia, hypomagnesiuria, low urine volume
Calcium phosphate (hydroxyapatite)	Primary hyperparathyroidism, renal tubular acidosis, sodium alkali therapy
Struvite or carbonate apatite	Urinary tract infection with urea-splitting organisms
Cystine	Cystinuria
Radiolucent Stones	
Uric acid	Gouty diathesis, hyperuricosuria, chronic diarrheal syndrome, dehydration, low urinary pH
2,8-Dihydroxyadenine	2,8-Dihydroxyadeninuria
Triamterene	Triamterene therapy
Xanthine	Xanthinuria
Silica	Magnesium trisilicate therapy

SERUM

Ca, P : Primary hyperparathyroidism

K, CO₂ : RTA

Uric Acid : Gouty diathesis

P : Hypophosphatemic AH

If present, extensive evaluation

During simplified evaluation, diagnostic utility of blood tests.

URINALYSIS

- Crystal identification
- pH (by electrode)
 - < 5.50 = Gouty diathesis
 - > 7.50 = Infection lithiasis
- Quantitative cystine (if suspect cystinuria)
- Culture
 - If suspect presence of urea-splitting organisms: Infection stones
 - If abnormal, extensive evaluation

During simplified evaluation, diagnostic value of urine analysis and culture.

Conservative measures to be applied in patients with single stone episode without risk.

TREATMENT OF FIRST EPISODE Conservative Measures

- Avoidance of stone-provoking drugs
- High fluid intake
- Dietary oxalate restriction
- Dietary sodium restriction
- Avoidance of animal protein excess
- Avoid extremes of calcium intake

Do not restrict calcium if bone disease is present/suspected

Two forms of extensive evaluation to be applied in patients with recurrent episode or first episode at risk.

EXTENSIVE EVALUATION Recurrent Episode First Episode at Risk

- Full ambulatory protocol
- Simplified ambulatory evaluation

FULL AMBULATORY PROTOCOL

Visit 1 : Random diet
History
Serum Ca, P, electrolytes and uric acid
24-hour urine for stone risk factors on customary diet and fluid intake

Visit 2 : Restricted diet
Serum Ca, P, electrolytes, uric acid and PTH
24-hour urine for stone risk factors
Fast and calcium load test (if warranted by persistent hypercalciuria)

Visit 1 and 2 - two weeks apart. If possible, bone density with hypercalcemia or marked hypercalciuria

Full ambulatory protocol representing an extensive evaluation useful in a research setting.

Simplified ambulatory evaluation, representing an extensive evaluation designed for private practice setting.

SIMPLIFIED AMBULATORY EVALUATION

1. 24-hour urine stone risk analysis (e.g., StoneRisk® Diagnostic Profile, UroRisk® Diagnostic Profile)
2. Dietary modification pending results of 1
3. Abbreviated stone risk analysis (e.g. StoneTrack® Monitoring Test) plus serum Ca, P, electrolytes, uric acid and PTH following dietary modification
4. Bone density in hypercalcemia or marked hypercalciuria

StoneRisk®, UroRisk®, and StoneTrack® are registered trademarks of Mission Pharmacal Company.

DIETARY MODIFICATION

(for diagnostic assessment)

<u>Finding</u>	<u>Modification</u>
TV < 2 l/day	Fluid intake
Na > 200 meq/day	Na restriction
Ox > 45 mg/day	Ox restriction
Ca > 250 mg/day	Ca restriction (mod)
UA > 600 mg/day SO ₄ > 30 mmol/day	Restriction of animal proteins

From 24-hour urine stone risk analysis, identify abnormal risk factors. Apply appropriate dietary measures as described here.

Description of various dietary measures. After 1-4 months of such a dietary modification, perform abbreviated stone risk profile. From results of full and abbreviated stone risk analysis, make diagnosis.

DIETARY MODIFICATION

(for diagnostic assessment)

- High fluid intake
At least 10-10 oz glasses/day (enough to assure urine output of > 2 L/day)
- Sodium restriction
Avoidance of salty foods and salt shaker
- Oxalate Restriction
Avoidance of nuts, spinach, chocolate, tea, Vitamin C
- Calcium Restriction
Avoidance of dairy products, spinach
Diagnostic purpose only

DIETARY MODIFICATION

(for long-term treatment)

- High fluid intake
- Sodium restriction
- Oxalate restriction
- Avoidance of purine gluttony if possible
- Increased citrus fruit intake
- Calcium restriction (moderate) in hypercalciuria (only in the presence of normal bone density)

Whether or not metabolic abnormalities are present from preceding diagnostic evaluation, apply to all patients with recurrent episode or first episode at risk a dietary modification for long-term management. Provide additional specific measures for different metabolic abnormalities (to be described).

Treatment of hypercalciuria with low bone density and normocalcemia.

TREATMENT

Hypercalcemia:

Further work-up

Hypercalciuria with Low Bone Density and Normal Serum Ca:

Probable fasting hypercalciuria with normal PTH or Vitamin D-dependent AH

Chlorthalidone 25 mg/day or

Indapamide 2.5 mg/day + K₃Cit
(e.g., Urocit®-K) 20 meq bid, or

Orthophosphate (e.g., Neutra-Phos-K®)
500 mg P tid/qid

Urocit®-K and Neutra-Phos-K® are registered trademarks of Mission Pharmacal Company and Alza Pharmaceuticals respectively

ABSORPTIVE HYPERCALCIURIA TYPE I FASTING HYPERCALCIURIA w Normal PTH

Urinary Ca > 250 mg/day on StoneRisk®
Diagnostic Profile, UroRisk® Diagnostic
Profile or StoneTrack® Monitoring Test

Normal serum Ca and PTH

Rx:

Chlorthalidone 25 mg/day or Indapamide
2.5 mg/day + K₃Cit (e.g., Urocit®-K)
20 meq bid

Sodium restriction

SCP (e.g., Calcibind®) 5 g bid with oxalate
restriction in TZ resistance/intolerance
without bone disease

Avoidance of Ca restriction in the
presence of low bone density

**Treatment of
absorptive
hypercalciuria
Type I or fasting
hypercalciuria
with normal
parathyroid
function.**

ABSORPTIVE HYPERCALCIURIA TYPE II

Urinary Ca

> 250 mg/day on StoneRisk® Diagnostic
Profile or UroRisk® Diagnostic Profile

< 250 mg/day on StoneTrack® Monitoring
Test (follow-up abbreviated test profile)

Normal Serum Ca and PTH

No evidence of bone disease

Rx:

Moderate dietary Ca restriction, or

Chlorthalidone 25 mg/day or Indapamide

2.5 mg/day + K₃Cit (e.g., Urocit®-K) 10 meq bid

**Treatment of
absorptive
hypercalciuria
Type II.**

Treatment of renal hypercalciuria.

RENAL HYPERCALCIURIA

Urinary Ca > 250 mg/day

High serum PTH

Rx:

Chlorthalidone 25 mg/day or

Indapamide 2.5 mg/day + K₃Cit

(e.g., Urocit®-K) 20 meq bid

Urocit®-K is a registered trademark of Mission Pharmacal Company.

HYPERURICOSURIC CA NEPHROLITHIASIS

Urinary uric acid > 700 mg/day

pH > 5.50

CaOx stones (recurrent)

History of animal protein excess (purine
gluttony)

Normocalcemia

Rx:

Allopurinol (e.g., Zyloprim®) 300 mg/day, if
serum uric acid > 8 mg/dl
urinary uric acid > 800 mg/day

Potassium Citrate (e.g., Urocit®-K)
15 meq bid, if hypocitraturic
urinary uric acid 600-800 mg/day

**Treatment of
hyperuricosuric Ca
nephrolithiasis.**

Zyloprim® and Urocit®-K are registered trademarks of Prometheus Laboratories and Mission Pharmacal Company respectively.

Treatment of hypocitraturic Ca nephrolithiasis. Apply dietary modification if hypocitraturia is due to animal protein excess, deficient intake of citrus fruits or sodium abuse.

HYPOCITRATURIC CA NEPHROLITHIASIS

Urinary citrate < 450 mg/day

Evidence of RTA, CDS or TZ Rx

Rx:

K₃Cit (e.g., Urocit®-K) 20-40 meq bid

Treatment of gouty diathesis.

GOUTY DIATHESIS

Urinary pH < 5.50

Uric acid/Ca stones

Personal/family history of gout

High serum uric acid and triglycerides

No animal protein excess or CDS

Rx:

K₃Cit (e.g., Urocit®-K) 20-40 meq bid

Allopurinol (e.g., Zyloprim®) 300 mg/day for

Serum uric acid > 8 mg/dl

Urinary uric acid > 800 mg/day

Zyloprim® and Urocit®-K are registered trademarks of Prometheus Laboratories and Mission Pharmacal Company respectively.

Comparative effects of potassium citrate and sodium citrate.

COMPARISON OF POTASSIUM CITRATE ACTION WITH THAT OF SODIUM CITRATE

	Potassium Citrate	Sodium Citrate
Urinary calcium		= ,
Urinary citrate		
Inhibitor activity, calcium oxalate		= ,
Prevention of calcium stones	+ + +	+ +
Urinary pH		
Prevention of uric acid stones	+ +	+ +

Treatment of infection stones.

INFECTION STONES

Urinary pH > 7.50

High urinary ammonium

Positive culture with urea-splitting organism

Struvite or carbonate apatite stones

Rx:

Acetohydroxamic Acid (e.g., Lithostat®) a urease inhibitor, 250 mg tid/qid

Antibiotics

Stone removal

Treatment of associated metabolic abnormalities

Treatment of cystine stones.

CYSTINE STONES

Positive quantitative test for cystine

Cystine on stone analysis

Rx:

K₃Cit (e.g., Urocit®-K) 10-20 meq bid to maintain urinary pH between 6.50 - 7.00

If urinary cystine concentration is > 300 mg/l, Tiopronin (e.g., Thiola®) or d-Penicillamine (e.g., Cuprimine®) 300 mg tid

Adjust dose to keep cystine < 200 mg/l

ABBREVIATIONS

1. AHabsorptive hypercalciuria
2. CDSchronic diarrheal syndrome
3. G-I.....gastrointestinal
4. UTIurinary tract infection
5. Ox.....oxalate
6. RTArenal tubular acidosis
7. SCP.....sodium cellulose phosphate
8. StoneComp® Test..... identifies chemical components of stones
9. StoneRisk® Diagnostic Profile . . assessment of urinary
UroRisk® Diagnostic Profile metabolic, environmental and physicochemical factors
10. StoneTrack® Monitoring Test . .simplified profile with Ca, oxalate, uric acid, citrate, sodium, total volume and pH
11. TVtotal volume
12. TZ.....thiazide

This publication is printed and distributed for education purposes by
MISSION PHARMACAL COMPANY, San Antonio, TX 78230 1355

Curriculum vitae for authors available on request.

***For additional copies call: 1-800-292-7364
or e-mail: customerservice@missionpharmacal.com***