CHALLENGING CASES
IN THE MEDICAL AND SURGICAL MANAGEMENT OF UROLITHIASIS

SWIU 2009

THE PANELISTS

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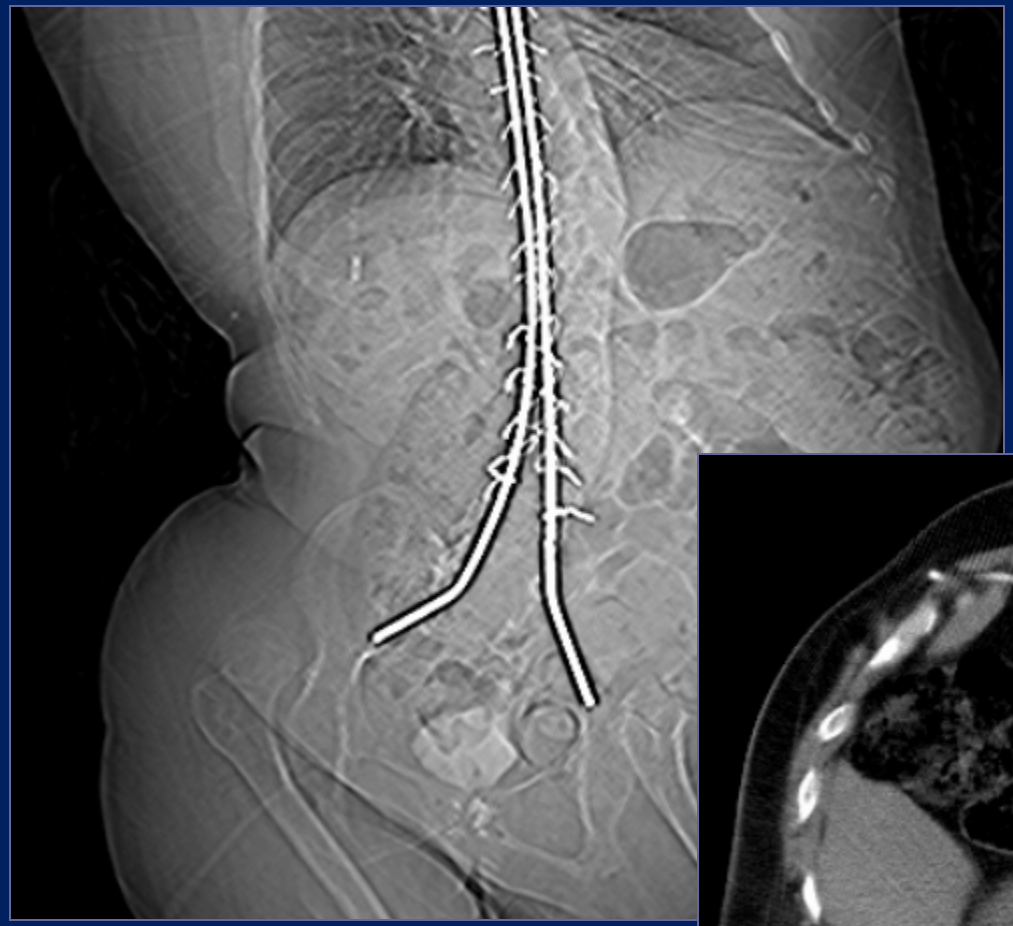
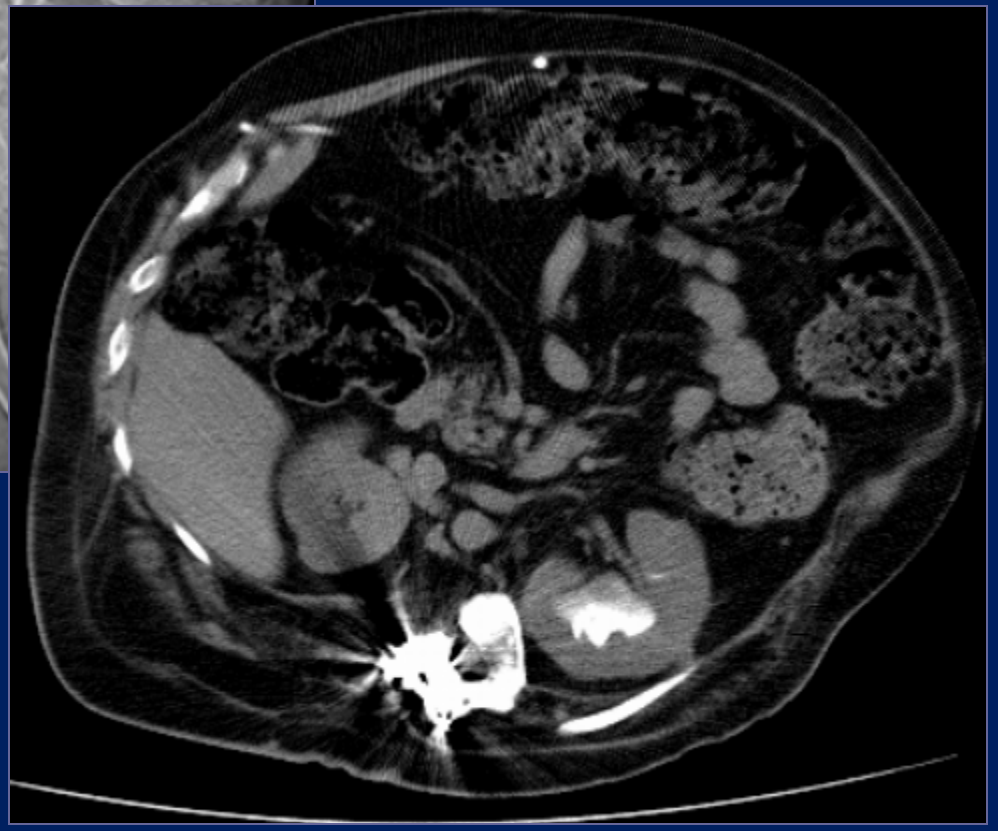
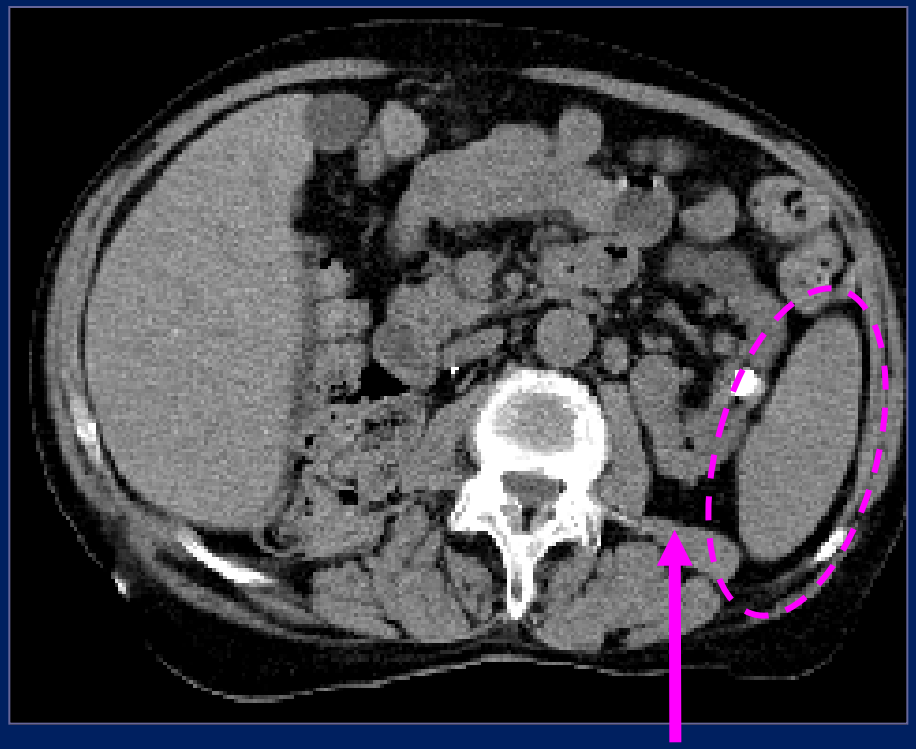
“CHALLENGING CASES”

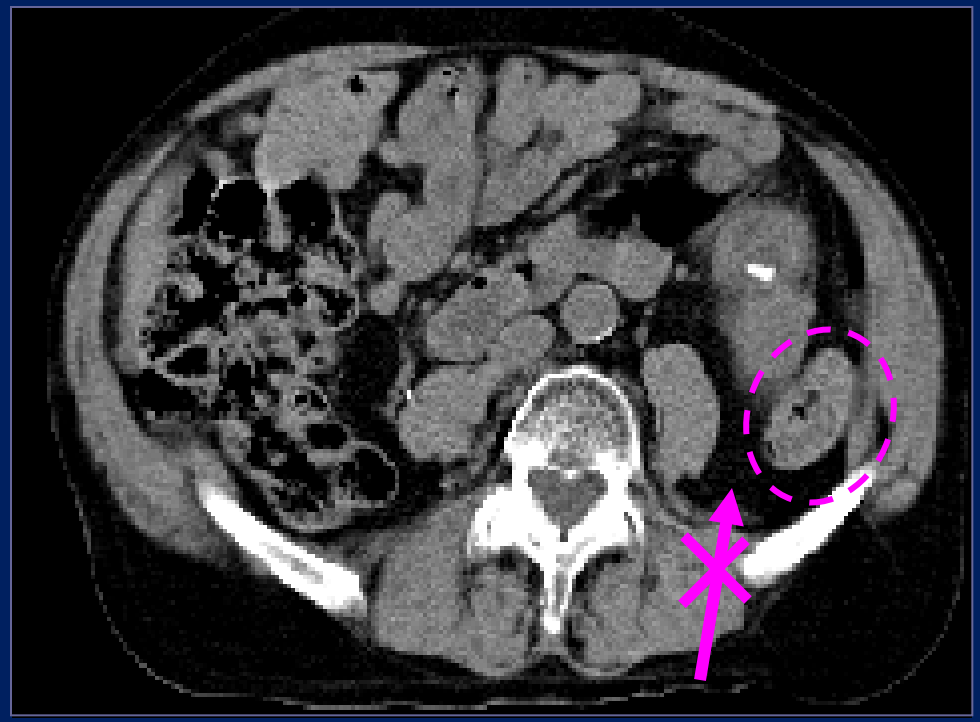
- Typically comprised of large, complex stones
- Also includes stones in patients:
  - With anatomically complex kidneys
  - With unusual body habitus
  - With relational anatomy to the kidney that makes the kidney inaccessible
  - With complicated medical history
  - At high risk for recurrence



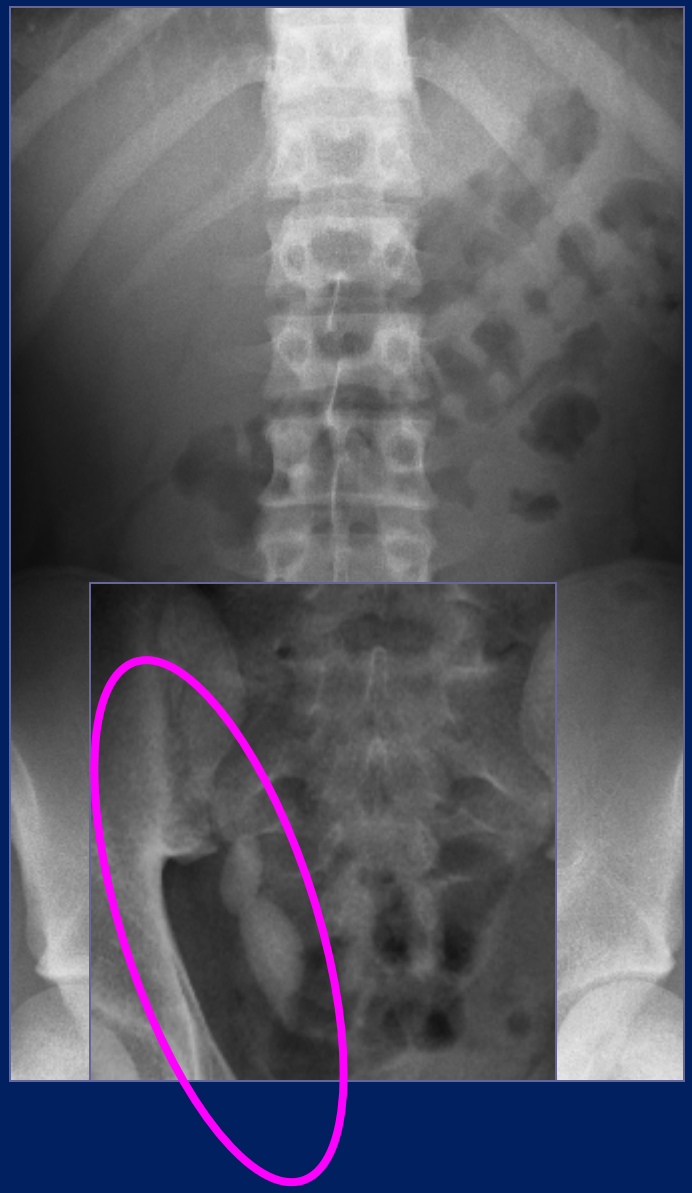




posterior spleen



retrorenal colon



CASE 1

- A 53-yr-old woman with Crohn's disease underwent multiple courses of SWL 15 and 10 years ago for multiple bilateral renal calculi
- Over the last 5 years she has experienced intermittent right flank pain and now has microhematuria
- IVP and CT were obtained. IVP is shown.

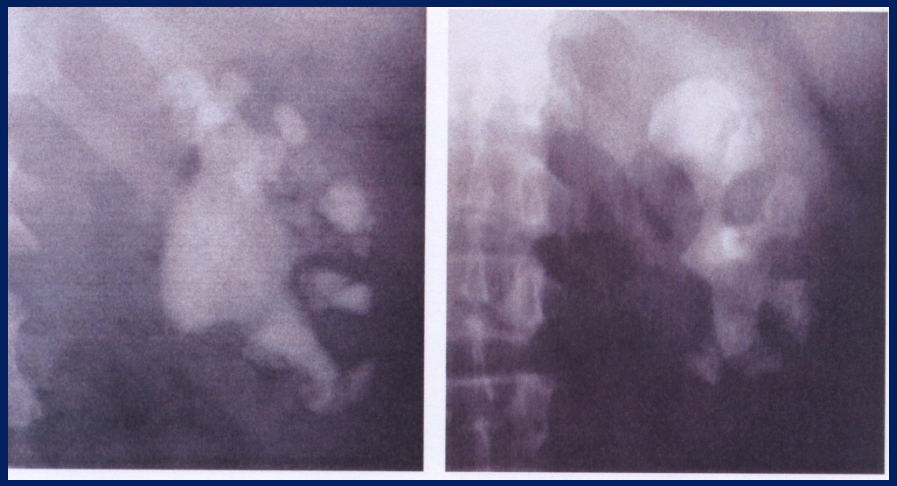

SIZES ARE APPROX


Acq Tm: 10
OMEN

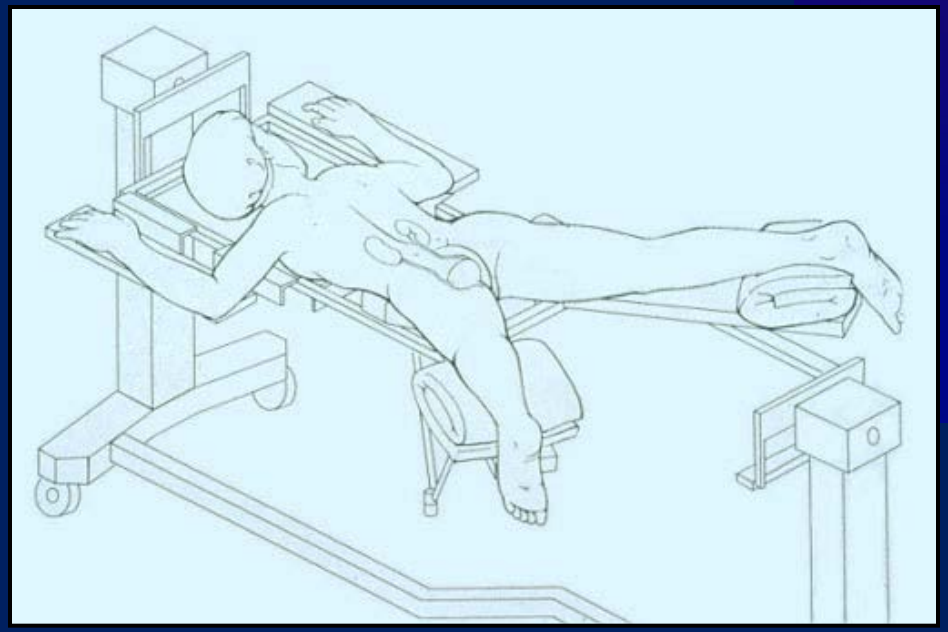
Case 1
Bilateral Simultaneous PCNL

Pre-op assess:

- **Stone burden in each kidney**
- **Anatomy of collecting system,**
- **Renal Scan to determine differential function – treat better kidney first**
- **Sterile urine culture**
- **If 1st side takes < 3 hours then do 2nd side**



Simultaneous Flexible Ureteroscopy & Percutaneous Access



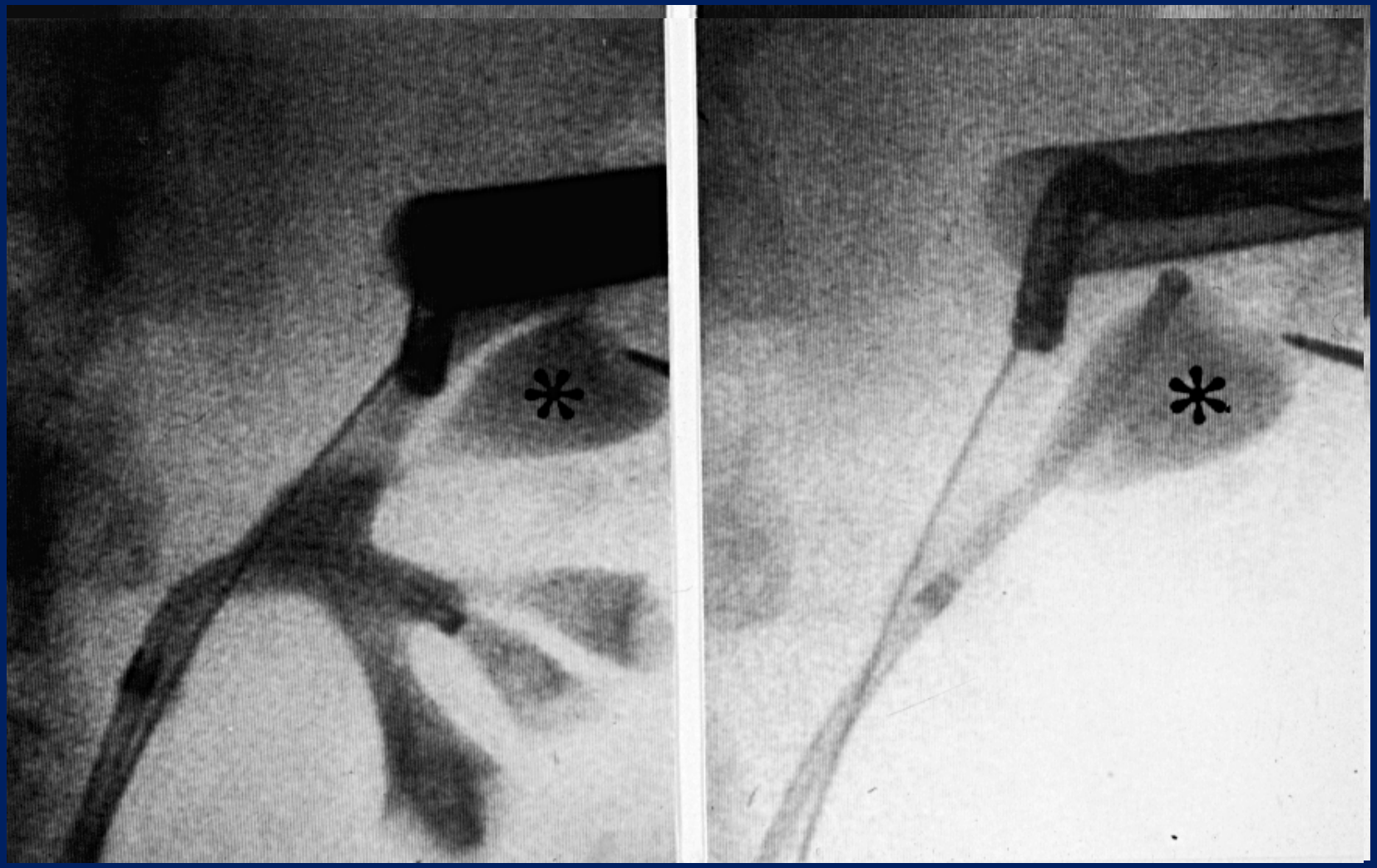
Flexible Ureterorenoscopy
Prone - Head Down 20° Position

PCNL – Steps of the Procedure

1. Flexible ureteroscopy with access sheath
2. Fluoroscopic + ureteroscopic guided needle puncture of collecting system
3. Tract dilation – dilating balloon catheter
4. Nephroscopy & lithotripsy
5. Stent placement & nephrostomy removal
6. Foley catheter placement


11.5 F x 35 cm ureteral access
sheath passed to the UPJ
LIVE

THE INACCESSIBLE CALYX



Solution: DUAL ACCESS - Prone flexible URS

Endoscopic vs Fluoroscopic PCNL
UCI Experience

	EndoPCNL	FluoroPCNL	p value
# Pts	51	70	
Stone size	17 mm^3	16 mm^3	NS
No hydro	27%	12%	0.04
Supra costal	80%	44%	
EBL	158 ml	211 ml	0.03
Transfusions	7.8%	21.4%	0.05

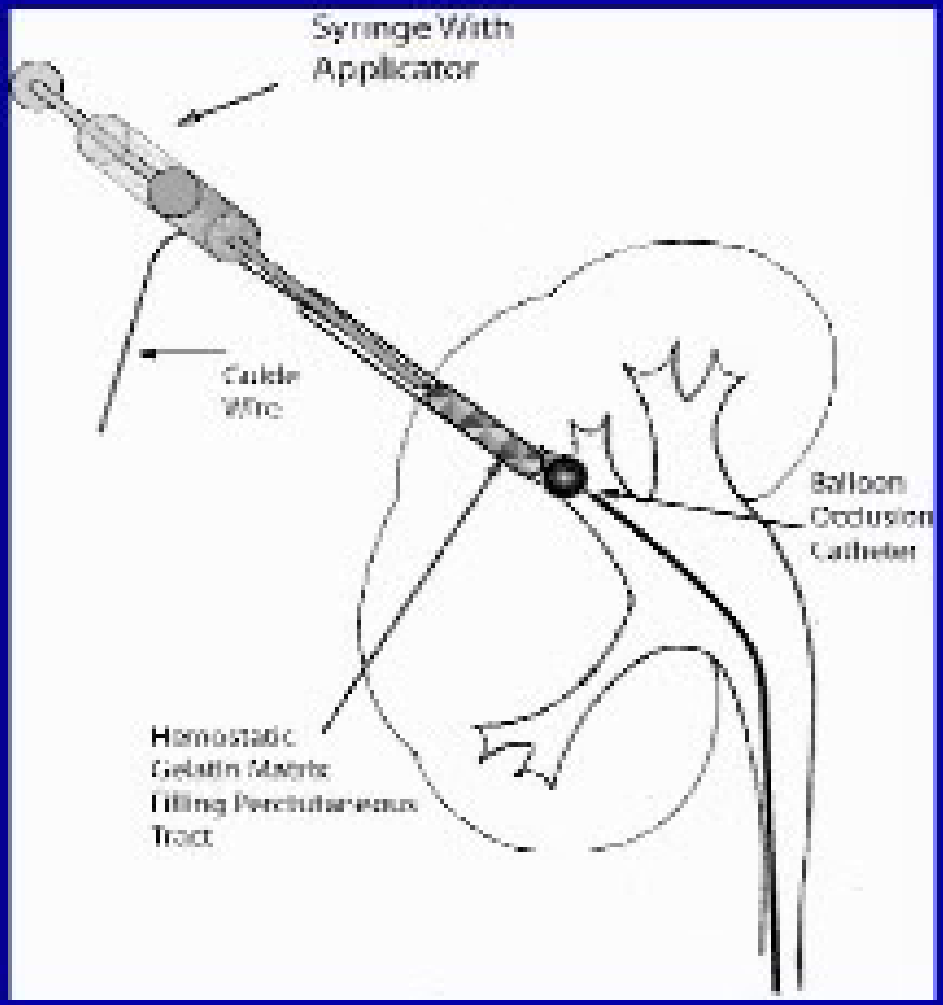
Similar BMI, age and ASA for the two groups

Endoscopic vs Fluoroscopic PCNL
UCI Experience

	EndoPCNL	FluoroPCNL	p value
OR Time	+ 19 min		
Chest Tube Postop	3.9%	4.2%	NS
Stone Free ≤1mm	35%	46%	0.26
Sig Residual Fragment >4mm	31%	26%	0.56
Avg Residual Fragment Size	3.1 mm	3.8 mm	NS
Retreatment Rate	24%	36%	0.19

Similar BMI, age and ASA for the two groups

PCNL Complications - HEMORRHAGE



Post-op Management of PCNL Patients

- Indwelling ureteral stent + Foley catheter
- Non-contrast CT scan AM of 1st post-op day
- D/C Foley and discharge POD 1
- If residual stone then outpatient URS + HoL at 1 week
- If stone free then office stent removal at 1 week + 24 hr urine evaluation ordered

Simultaneous Bilateral PCNL Literature Review

M Desai et al: J Endourol 2007; 21(5): 508

Avg # of Pts	70 (Range 3 – 198)
Mean OR Time (mins)	107.6 (45 – 248)
Hgb Drop (gm/dl)	1.9 (1.6 – 2.4)
Transfusion Rate	9.4% (0 – 29%)
2nd Look Nephroscopy	9.9% (3 – 67%)
Mean Length of Stay	5 days (2.5 – 6.6)
Stone Free Rate (KUB)	90% (75 – 100%)

Synchronous Bilateral PCNL: Analysis of Clinical Outcomes, Cost & Reimbursement

A Bagrodia et al: J Urol 2009; 181: 149

	Bilateral Synchronous PCNL	Unilateral Staged PCNL
# of Patients	15	62
Stonefree Rate / 2nd Look Nephroscopy	73%	-
Mean OR Time (mins)	354	477
Length of Stay (days)	3.1	6.3
Transfusion Rate	0	4.7%
Total Cost Surgeon Reimburse	↓ ↓ ($275 – 1000)	↑ ($4 – 5000) ↑

A Fine Balance

The Management of the PCNL Patient

- **After surgical treatment of her stones, a 24-hour urine collection is obtained. Treatment should consist of:**

TV	0.85L	
pH	5.25	
Ca	50	nl (<200 mg/d)
Oxalate	80	nl (<40 mg/d)
Citrate	15	nl >320 mg/d)
Sodium	65	nl (<200 mEq/d)
Uric acid	510	nl (<600 mg/d)

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Crohns and Stones

- Risk of: CaOx, CaPhos, ammonium urate stones
  - Chronic diarrhea
    - Malabsorption of calcium and magnesium
      - Ca^{++} & Mg^{++} malabsorption: ↑oxalate absorption
      - Mg^{++} malabsorption: ↓inhibitory potential for CaOx stones
    - Bicarbonate wasting
      - Acid urine
      - Hypocitraturia
    - Excessive fluid losses
      - Increased urine supersaturation
    - Depletion of oxalate-degrading bacteria in GI tract
  - Increased colonic permeability to oxalate with exposure of mucosa to excess bile salts

Excellent topical review… Worcester EM: Stones from bowel disease. *Endocrinol Metab Clin North Am* 2002;31:979-99

CASE #1
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ENT INFORMATION

[redacted]

UroRisk® Diagnostic Profile

LA

[redacted]

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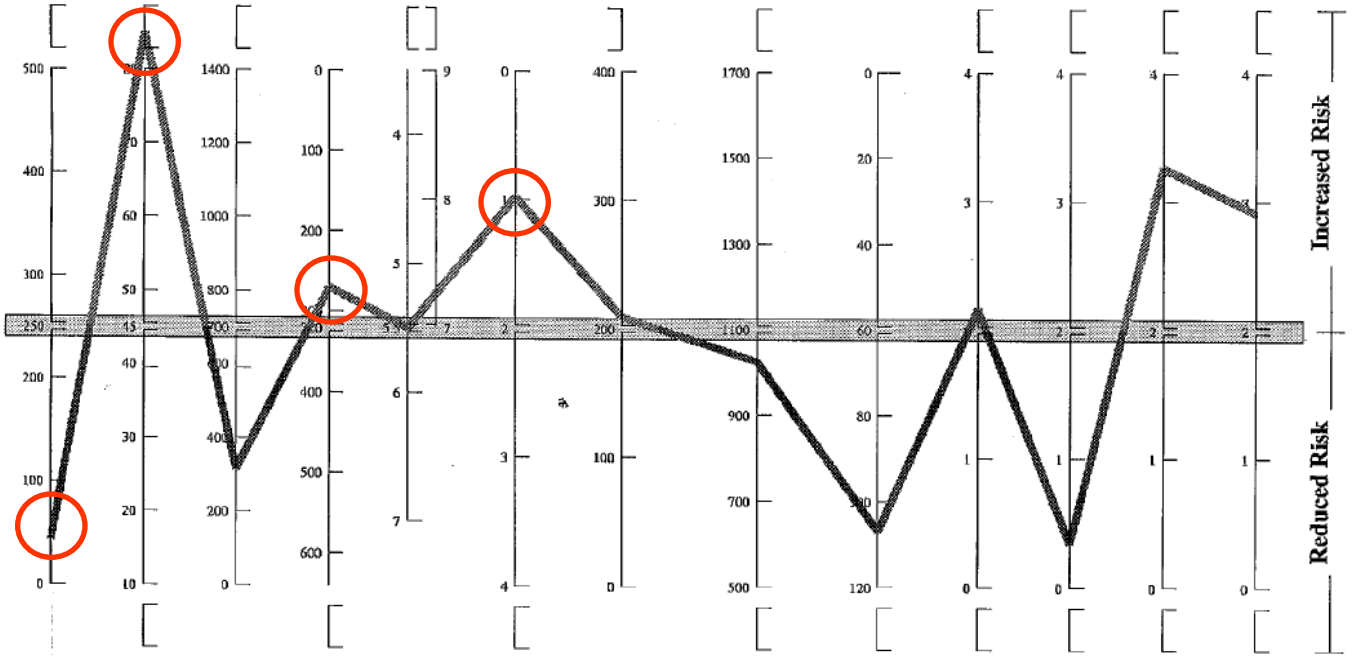
Metabolic					Environmental				Relative Supersaturation			
Ca	Ox	UA	Cit	pH	TV	Na	P	Mg	CaOx	Br	NaU	UA
43 mg/day	86 mg/day	314 mg/day	270 mg/day	5.50	0.98 l/day	209 meq/day	1024 mg/day	107 mg/day	2.16	0.34	3.26	2.91



Other Values	
K	42 meq/day
Creatinine	942 mg/day

24-h urine profile from a patient with Crohn's disease and a h/o stones

Common features: high oxalate, low urinary calcium, low citrate, low TV

KL Penniston, PhD, RD

Crohns – Manage Diarrhea

- Increase dietary fiber intake
  - Both soluble and non-soluble fiber recommended
  - Use fiber supplements if necessary
- Limit dietary fat and fried foods
- Limit dietary lactose if lactose intolerant
- Pancreatic enzymes?
- Probiotics & prebiotics *(effects on diarrhea recently reviewed by de Vrese & Marteau, J Nutr 2007;137:803S-811S)*
  - Enhanced colonization of gut microflora that ferment fibers and carbohydrates not digested in upper GI tract
  - Increased synthesis of fatty acids that support a healthy intestinal barrier (particularly in the lower GI tract)

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Probiotic and Prebiotic Sources

Examples

CLASS/ COMPONENT	SOURCE
Probiotics	
Certain species & strains of *Lactobacilli, Bifidobacteria,* Yeast	Certain yogurts, other cultured dairy products and non-dairy formulations
Prebiotics	
Inulin, fructo-oligosaccharides (FOS), polydextrose, arabinogalactan, polyols (lactulose, lactitol)	Whole grains, onions, garlic, bananas, honey, leeks, artichokes, fortified foods & beverages, dietary supplements
Adapted from International Food Information Council Foundation: *Media Guide on Food Safety and Nutrition: 2004-2006.*	

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Crohns - Manage Hyperoxaluria

- Optimize dietary calcium intake
  - From foods as tolerated; supplements probably needed
  - Time intake with meals and other eating occasions
- Reduce dietary oxalate (and oxalate from supplements) if indicated
  - Efficacy, however, is questionable as increased endogenous production and a low calcium intake are considered primary causes [Siener *et al*, Kidney Int 2003;63:1037-43]
- Eliminate exogenous effectors of oxalate biosynthesis
  - Supplements, foods
- Bile acid binders may work in some cases
- Probiotic supplementation … *strong evidence lacking*
- Pyridoxine supplementation … *evidence lacking*

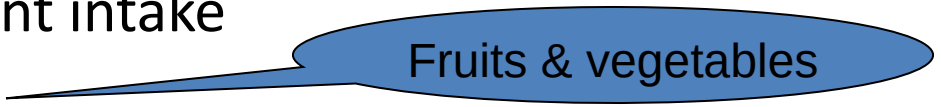
Crohns - Manage Hypocitraturia

- Pharmacologic therapy
- Reduce dietary potential renal acid load (PRAL)
  - Foods with highest (+) PRAL are meat, fish, poultry, cheese
  - Foods with net negative PRAL are most all fruits and most all vegetables
    - Milk and yogurt are net neutral
- Enhance exogenous citrate intake
  - Kang *et al*, J Urol 2007;177:1358-62
  - Penniston *et al*, Urology 2007;70:856-60
  - Touhami *et al*, BMC Urol 2007;7:18 (rats)
  - Aras *et al*, Urol Res 2008;36:313-7
  - Tosukhowong *et al*, Urol Res 2008;36:149-55

Negative results:
- Koff *et al*, Urology 2007;69:1013-6
- Odvina CV, Clin J Am Soc Nephrol 2006;1:1269-74

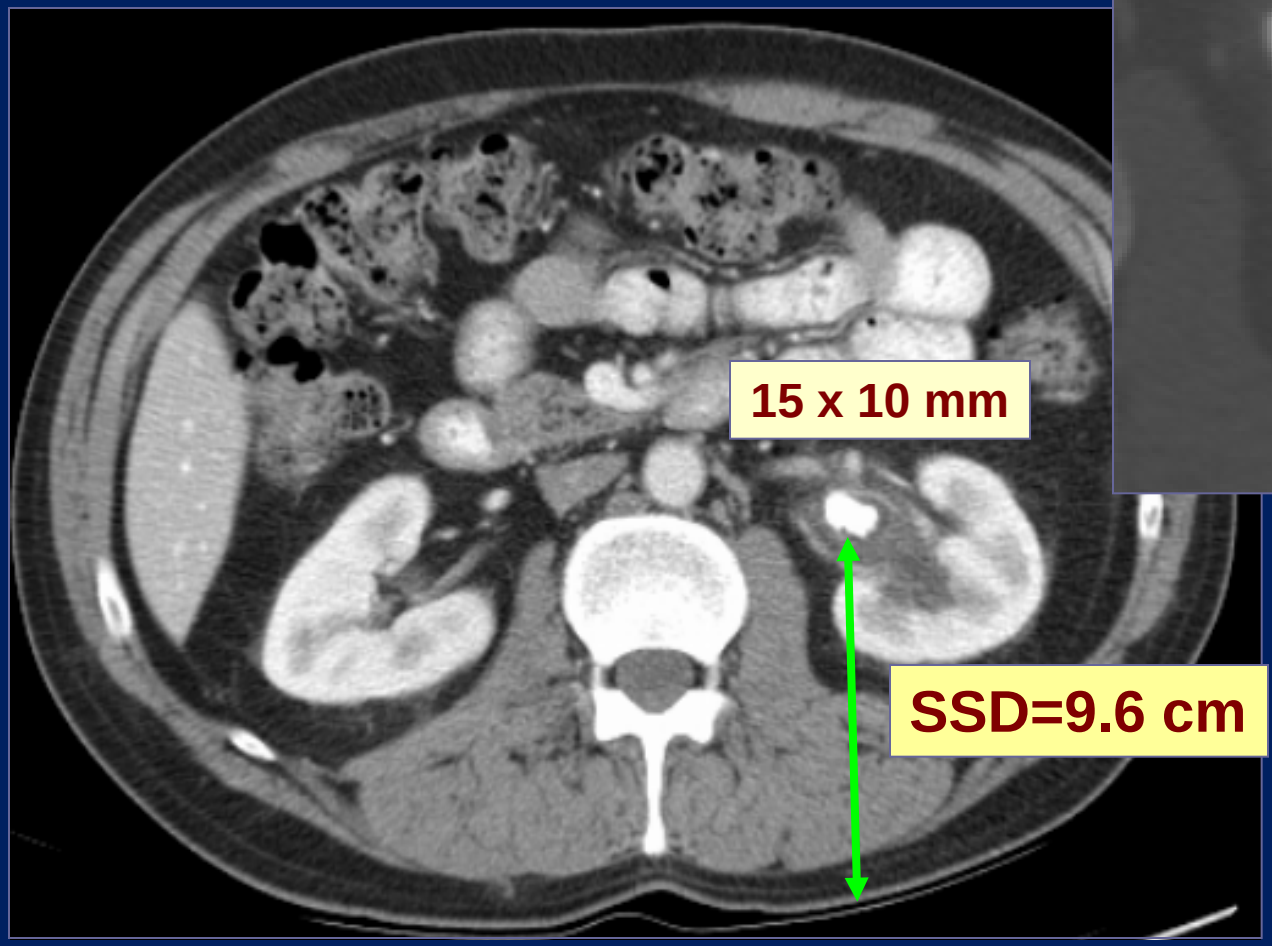
Crohns – Maximize Inhibition

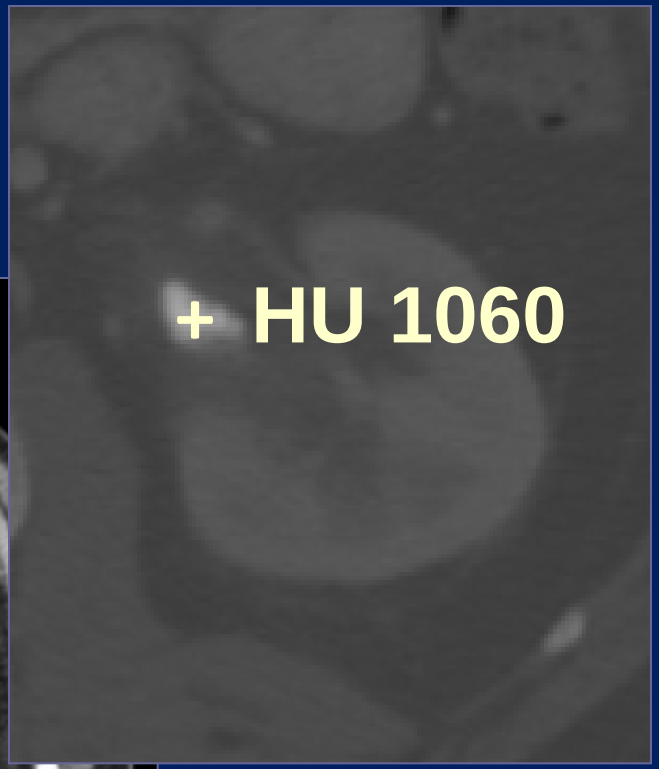
- Fluids appropriate to offset stool losses and to maintain suitably low urine supersaturation
  - Distributed throughout the day
  - Low-sugar, low-calorie beverages recommended
- Magnesium supplementation, if Mg status is low
- Ample antioxidant intake
  - Food sources
  - Supplements (vit. E, vit. C, bioflavonoids…??)
- Reduce stress
  - Diniz *et al*, J Urol 2006;176:2483-7
  - Nahem *et al*, Int J Epidemiol 1997;26:1017-23



CASE 2

- A 55-yr-old man with recently diagnosed T1c prostate cancer underwent a planning CT in anticipation of XRT
- He is otherwise healthy and has no personal or family history of stones
- How would you proceed?


15 x 10 mm
SSD=9.6 cm


+ HU 1060

Surgical Treatment Options

- Based on stone location and size
  - SWL
  - Ureteroscopy
  - Percutaneous nephrolithotomy
- Other considerations
  - Composition
  - Stone attenuation (HU)
  - Skin to stone distance (SSD)

Stone Composition

- Not an issue for PCNL and ureteroscopy
  - Ultrasound and/or holmium laser capable of fragmenting all stone compositions
- SWL low success rate
  - Cystine
  - Brushite
  - Calcium oxalate monohydrate

Stone Attenuation

- **30 patients treated with SWL**
  - **Success rate significantly lower for SA >1000 HU[1]**
- **120 patients undergoing SWL**
  - **Success rate 87.5%**
  - **Stone density > 1000 HU associated with SWL failure[1]**

1. Joseph P, et al. J Urol 2002; 167: 1968-1971
2. El-Nahes AR, et al. Eur Urol 2007; 51: 1688-93

Skin to Stone Distance

- 64 patients treated with SWL[3]
  - SSD center of stone to skin edge
  - >10 cm SSD associated with SWL failure
- Multivariate analysis for SWL failure risk factors:
  - stone composition
  - SSD
  - SA
- < 900 HU & < 9 cm SSD
  - SWL success independent of stone size, location and BMI

3. Pareek G, et al. Urology 2005; 66: 941-4
4. Perks AE, et al. Urology 2008; 72: 765-9.

FACTORS PREDICTING SWL SUCCESS

Perks et al, Urol 72: 765, 2008

Risk Stratification

"Success rates"

<900 HU, SSD <9 cm
91%

<900 HU, SSD ≥9 cm
79%

≥900 HU, SSD <9 cm
58%

≥ 900 HU, SSD ≥ 9 cm
41%

FACTORS PREDICTING SWL SUCCESS

Perks et al, Urol 72: 765, 2008

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79%

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58%

≥ 900 HU, SSD ≥ 9 cm
41%

- **Serum chemistries, including creatinine, potassium, bicarbonate, calcium, phosphorus, uric acid and iPTH were normal. 24-hour urine is shown. Recommended treatment should consist of:**

TV	**1.85L**	
pH	**6.1**	
Ca	**330**	**nl (<200 mg/d)**
Oxalate	**38**	**nl (<40 mg/d)**
Citrate	**600**	**nl >320 mg/d)**
Sodium	**299**	**nl (<200 mEq/d)**
Uric acid	**850**	**nl (<600 mg/d)**

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Calcium Oxalate Stone Disease

- Often no single risk factor
- Nutrition and pharmacologic therapy is tailored to individual risk factor(s)
  - Frequently, these include:
    - Idiopathic hypercalciuria
      - Hypernatriuria
      - High dietary acid load
      - High (refined) carbohydrate intake
      - Low fiber intake
    - Hyperuricosuria
    - Overweight/ obesity

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CaOx Stones - Hypercalciuria

- Pharmacologic therapy
- Reduce dietary salt (NaCl) intake
- Reduce PRAL of diet
- Increase dietary fiber intake
- Ensure optimal calcium intake
  - To regulate GI oxalate absorption, esp. if hyperoxaluric
- Reduce body mass if overweight
- Fish oil supplementation … *evidence from RCTs lacking*
- Recommend treatment, if necessary, for other contributors to hypercalciuria:
  - Excessive bone resorption, hyperparathyroidism, sarcoidosis

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CaOx Stones - Hyperuricosuria

- Pharmacologic therapy
- Reduce dietary effectors of uric acid biosynthesis
  - Beef, pork, fish, seafood, poultry
    - Note that low-fat dairy is NOT included here
  - High-purine foods
    - Mussels, scallops, herring, anchovies, sardines, mackerel, meat extracts & broths, organ meats, sweetbreads (edible glands of an animal), wild game, gravy
  - Fructose
  - Alcohol
- Reduce PRAL of diet
- Reduce body mass if overweight

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CaOx Stones - Hypernatriuria

- Na^+ increases urinary calcium excretion and decreases efficacy of thiazide diuretics
- Must employ dietary strategies
  - Salt shaker contributes only ~10% of dietary Na^+
  - Salt sources are rampant in our food supply:
    - Cheese
    - Salty snacks (chips, popcorn, pretzels, crackers, nuts, seeds)
    - Processed/ packaged foods & entrees, convenience foods
    - Baked goods (including breads…)
    - Sauces, dressings, condiments, spice blends
    - Canned vegetables and soups
    - Restaurant foods
    - Sports beverages

Some European nations are legislating the use of salt in food manufacturing & processing

CASE #2
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Salt Facts

- DRI for Na^+ is 1,500 mg/d
- AHA recommends <2,300 mg/d
- UL for Na^+ is 2,300 mg/d
- Most Americans eat 5,000-6,000 mg Na^+/d
- Risk cutoff for 24-h Na^+ excretion is 200 mEq (4,600 mg)

- 1 tsp. salt, 2,325 mg
- 1 tsp. baking soda, 1,000 mg
- 1 Tbsp. soy sauce, 1,000 mg
- Fast foods:
  - 6” Subway sandwich
    - Cold cut trio, 1730 mg
    - Tuna, 1190 mg
    - Sweet onion chicken teriyaki, 1090 mg
  - Culver’s
    - Taco salad with shell, 1643 mg
    - Grilled chicken cashew salad, 1369 mg
    - Butter burger with cheese, 1207 mg
  - Pizza Hut
    - Thin crust, cheese only, 1 sl, 600 mg
    - Hand tossed-style crust, “Supreme,” 1 sl, 730 mg

KL Penniston, PhD, RD

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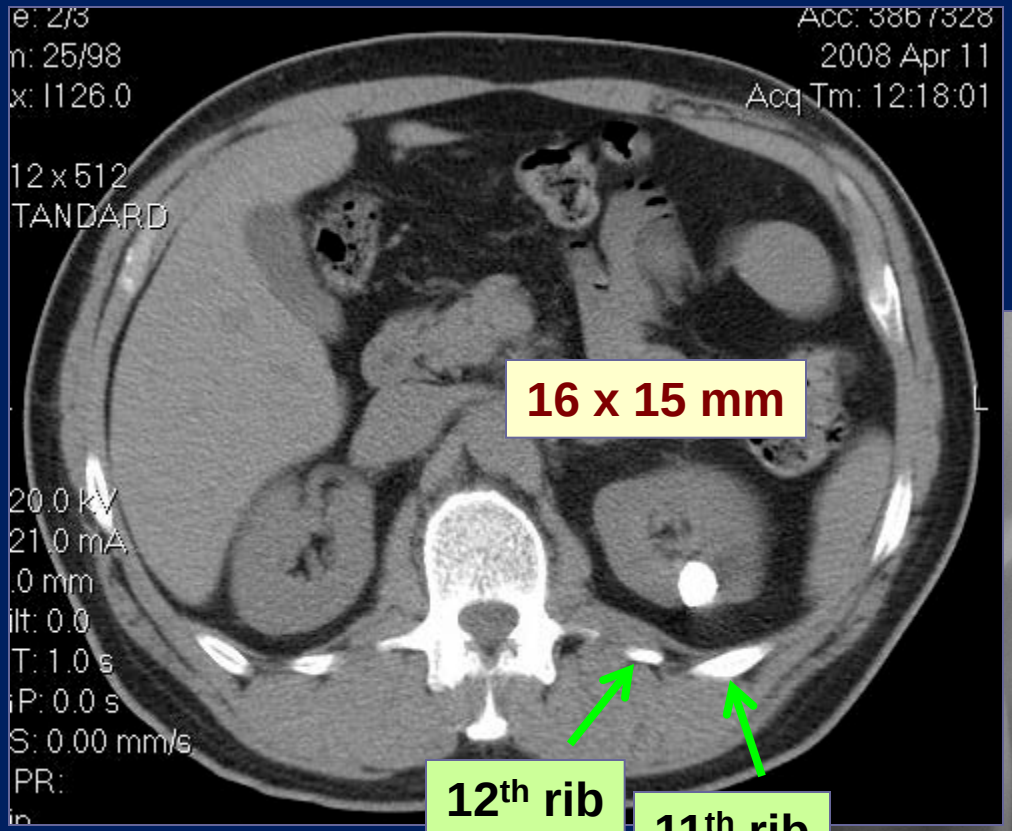
CaOx Stones – Crystal Inhibition

- Increase fruit and vegetable intake
  - Provides dietary alkaline load, K^+, Mg, fiber, phytate, citric acid and antioxidants
    - All of which inhibit stone formation by various mechanisms
- Increase fluid intake, distributed throughout the day
- Optimize/ increase urinary citrate excretion
- Optimize/ increase urine pH to prevent uric acid nidus for CaOx crystal formation

CASE 3

- A 60-year-old man without previous history of stones noticed tea-colored urine on several occasions
- Subsequently, he has had occasional left flank pain
- Office cysto was negative
- CT and IVP were obtained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20.0 kV
21.0 mA
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PR:
16 x 15 mm
12th rib
11th rib

Case 3 – Calyceal Diverticulum with Stone

Approach to management

- **Observation**
- **Retrograde ureterorenoscopy**
- **Antegrade PCNL**
- **ESWL**
- **Laparoscopic diverticulectomy**

ESWL Treatment of Caliceal Diverticula

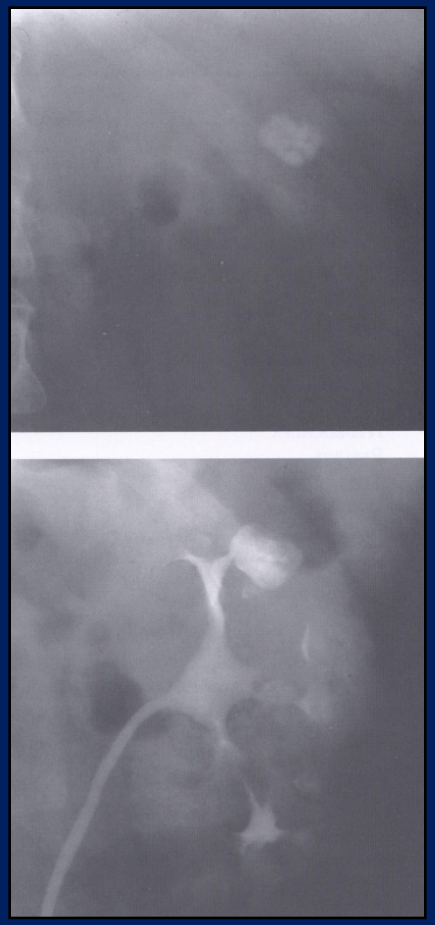
E Matsumoto & M Pearle: Advanced Endourology, S Nakada & M Pearle (eds): 2006, pp229 - 249

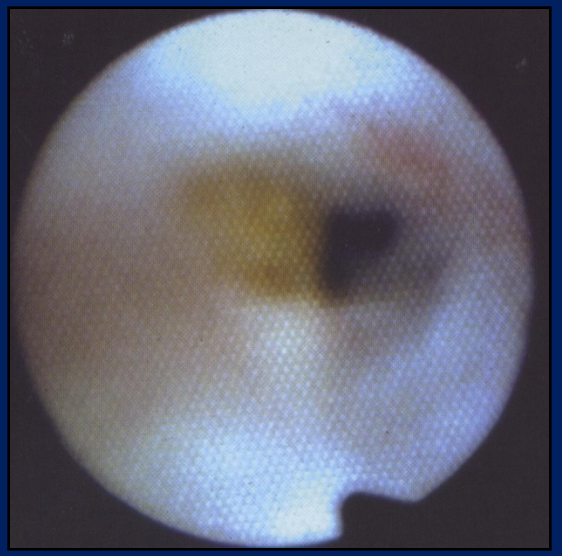
Stone Free Rate	21% (13 – 58%)
Symptom Free Rate	68% (56 – 86%)

SWL for calyceal diverticula and stones is reserved for relatively small stone burden and radiographically patent diverticular neck.

Calyceal Diverticulum with Stone
Retrograde Ureterorenoscopy

- Retrograde ureterorenoscopy
- Identify ostium to diverticulum
- Laser incision into diverticulum
- Remove stone(s)
- Laser fulgurate the diverticulum
- Ureteral stent





Images from Matsumoto's chapter 14 in Advanced Endourology

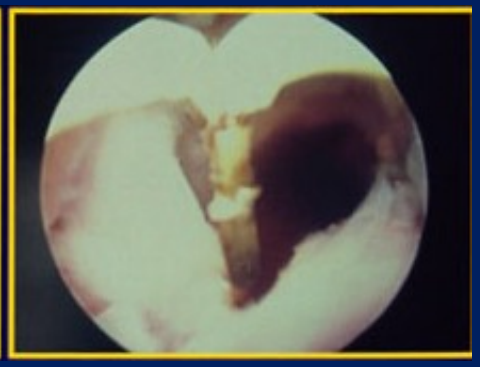
Retrograde Treatment of Caliceal Diverticula

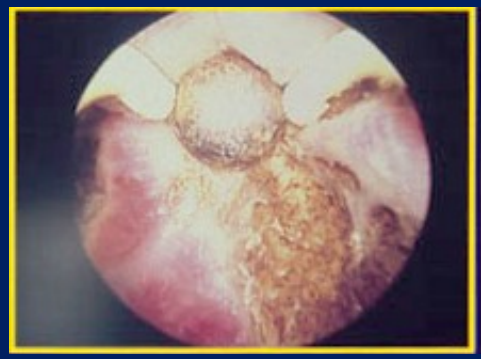
E Matsumoto & M Pearle: Advanced Endourology, S Nakada & M Pearle (eds): 2006, pp229 - 249

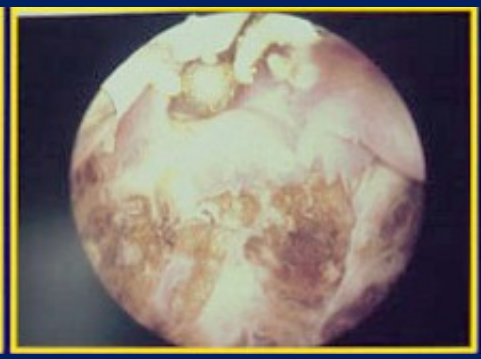
Overall Total Patients	191
Successful entry into tic	88%
Stone Free Rate	78%
Symptom Free Rate	79%
Complications	9%
Follow-up (mos)	1 – 84

Calyceal Diverticulum with Stone
Antegrade Percutaneous Diverticulectomy

- Ureterorenoscopy visualized PCN access
- PCNL removal of stone(s)
- Incision of ostium & fulguration of diverticulum
- Nephrostomy (Cope loop) + ureteral stent







Antegrade Treatment of Caliceal Diverticula

E Matsumoto & M Pearle: Advanced Endourology,
S Nakada & M Pearle (eds): 2006, pp229 - 249

Overall Total Patients	256
Stone Free Rate	89%
Symptom Free Rate	89%
Obliteration of tic	60%
Complications	15%
Follow-up (mos)	25 (18 – 96)

Calyceal Diverticulum with Stone
Laparoscopic Diverticulectomy

S Ramakumar & J Segura: J Endourol 2000; 14(10): 829

# of Patients	7
OR Time	80 Mins
Hospital Stay	3 – 6.6 days
Stone Free Rate	100%
Complications	Urine leak (1) Transfusion (1)

Best reserved for patients with very superficial diverticula who have failed alternate approaches.


© AP

- **After undergoing PCNL with dilation of the diverticular neck and fulguration of the diverticular cavity, the patient is asymtomatic and stone free**
- **He has no family history of stone disease**
- **Serum chemistries reveal a normal serum creatinine, potassium, bicarbonate, calcium, phosphorus, uric acid and iPTH**
- **Should the patient be evaluated metabolically and if so what would you expect to find?**

Metabolic Evaluation for Caliceal Diverticulum

- Metabolic abnormality in 25-100% of caliceal diverticula patients[1-3]
- Matlaga et al[4]
  - 29 Tic vs. 245 CaOx vs. 162 normal patients
  - Tic & CaOx patients similar stone risk parameters
    - Hypercalciuria and high CaOx SS

1. Hsu TH & Streem SB. J Urol 1998; 160: 1640
2. Liatsikos EN, et al J Urol 2000; 164: 18
3. Auge BK, et al. Br J Urol 2006; 97: 1053
4. . Matlaga, BR, et al. Urol Res 2007; 35: 35

Stasis vs. Metabolic Abnormality

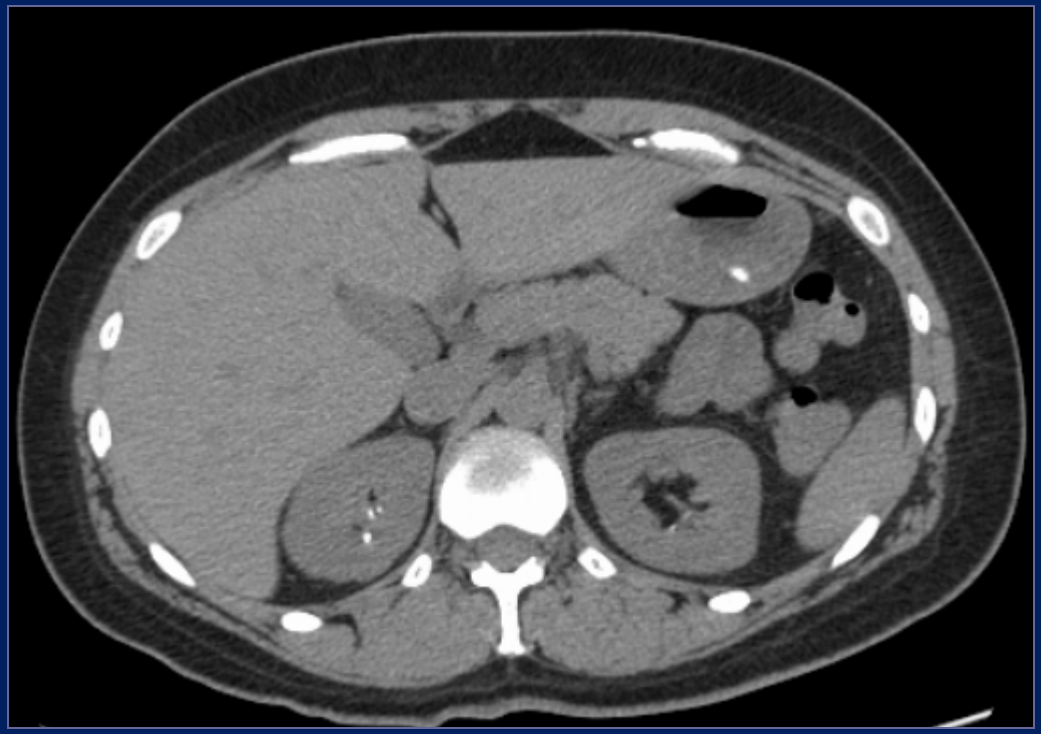
- 3 patients diverticular urine aspiration
- CaOx SS lower in diverticular urine than renal pelvis urine

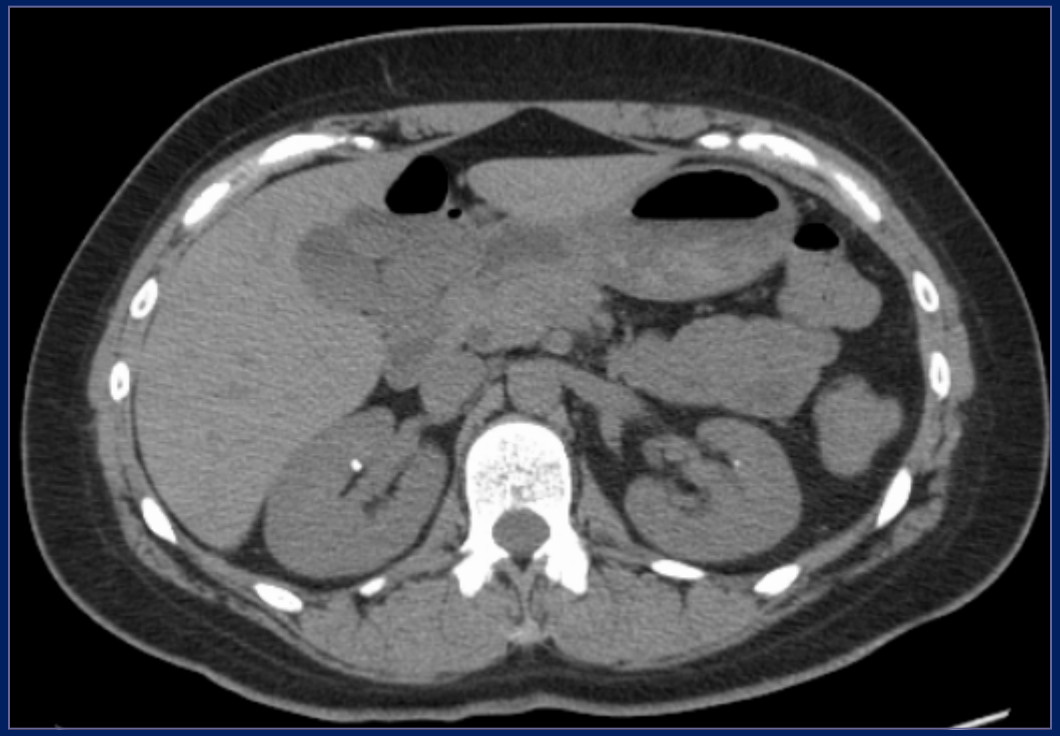
- Hypothesis:
  - Urine stasis allows ppt of CaOx from urine to form stone thus lowering SS

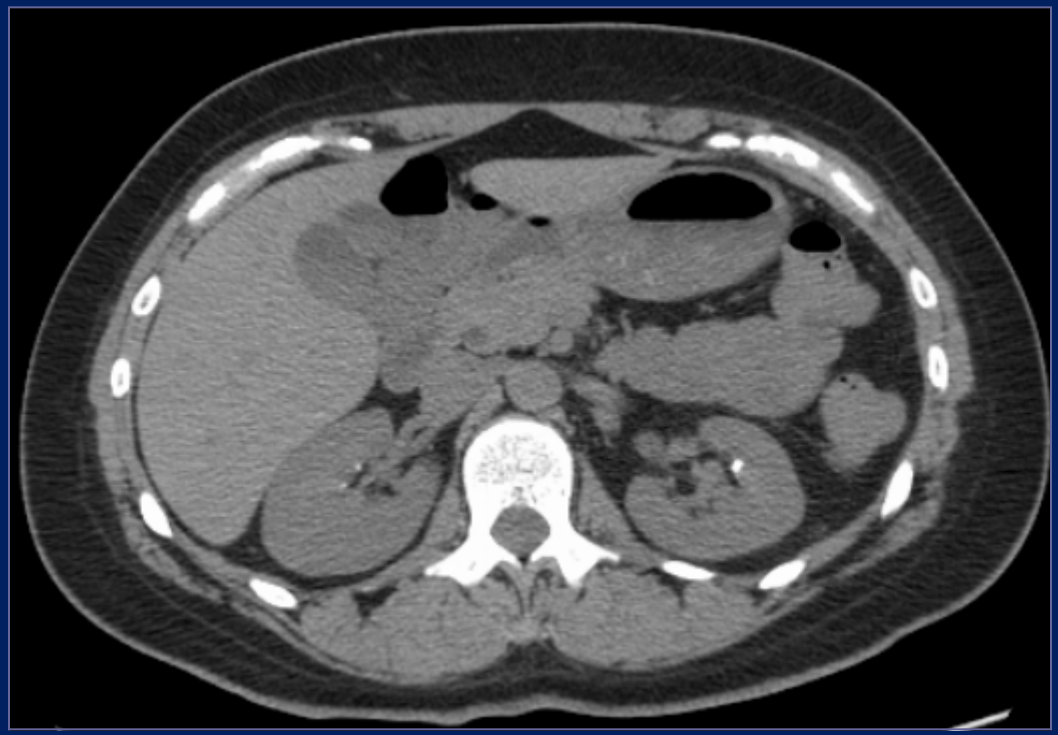
- Most likely both stasis and metabolic abnormalities contribute to stone formation

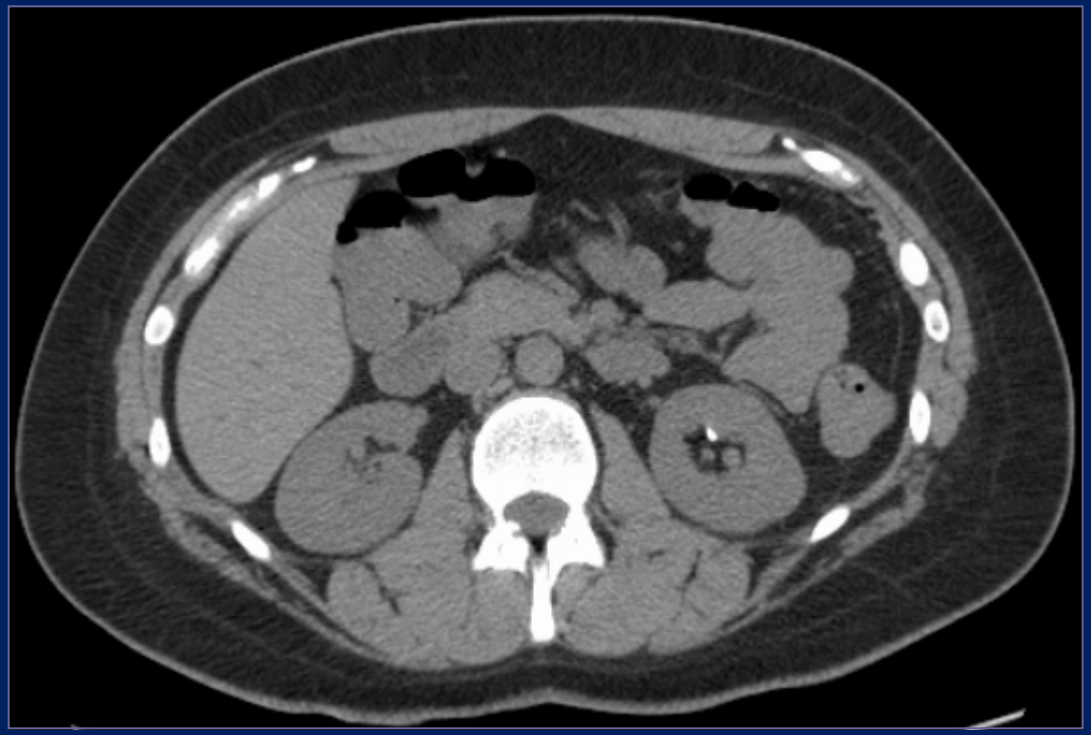
CASE 4

- A 36-year-old woman with a history of stones has recurrent bilateral flank pain
- She occasionally passes stones, but frequently requires ER visits for pain
- She desires surgical intervention to clear the stones
- KUB and representative CT images are shown
- Would you agree to surgery and what procedure would you recommend?









To Treat or Not to Treat

- Nonmobile caliceal stones can cause pain
- 26 patients treated[1]
  - 10 SWL
  - 15 PCNL
  - 1 open surgery (1988)
- 25/26 had complete resolution of their pain

1. Coury TA, et al. Urology 1988; 32: 119-23

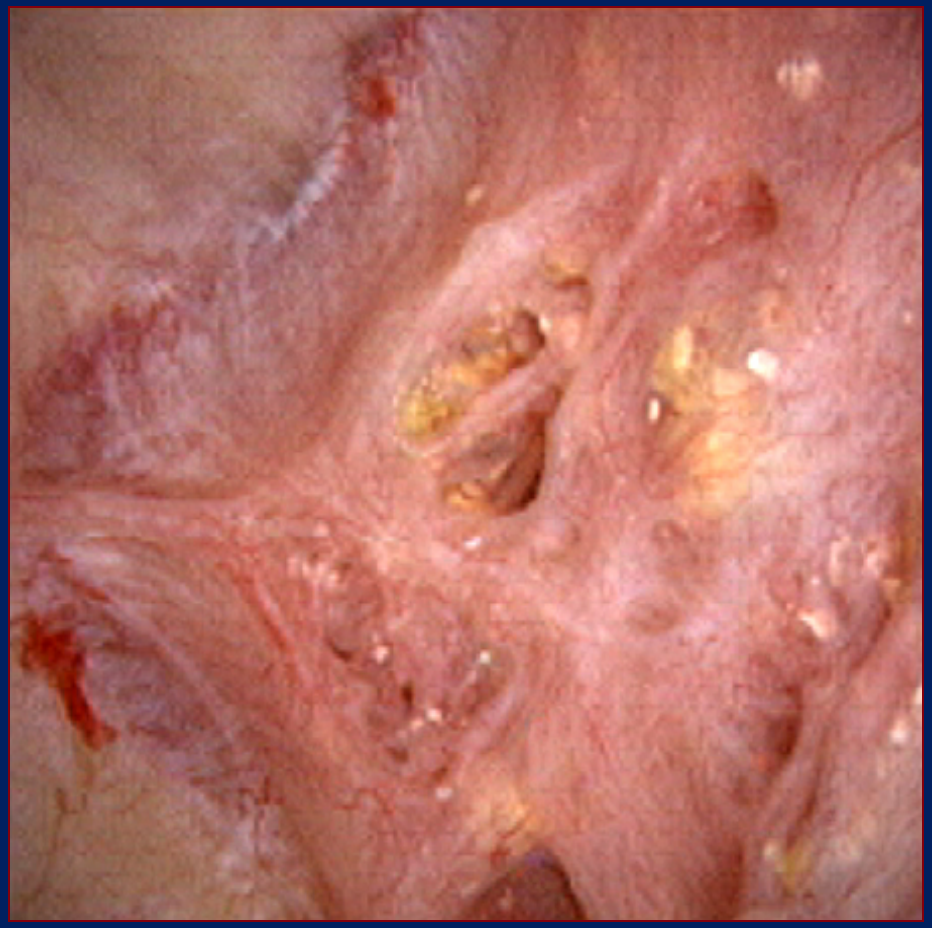
To Treat or Not to Treat

- 3 institutions retrospective review 1999-2008
- Ureteroscopic laser endopapillotomy
- 65 patients 176 procedures
- 82.8% significantly less pain or no pain
- Mean duration of resolution 26.2 months
- 60% had >1 year symptom relief
- No change in GFR from preop to follow-up

Gdor Y, et al. Ureteroscopic laser endopapillotomy to treat chronic flank pain associated with papillary calcification. Abstract WCE 2008

Ureteroscopy

- Access sheath
- Pressurized irrigant
- Holmium laser
- Unroof submucosal stones
- Basket large fragments
- Stent for 72 hours
- Expect stent pain 8%



- After ureteroscopy and stone removal, she is stone free. Stone analysis reveals 90% CaAp and 10% CaOx(m)
- She has a hx of frequent migraine headaches resistant to most medications except Topamax which she takes at 50 mg BID

TV	2.25L	
pH	6.89	
Ca	220	nl (<200 mg/d)
Oxalate	27	nl (<40 mg/d)
Citrate	220	nl >320 mg/d)
Sodium	175	nl (<200 mEq/d)
Uric acid	475	nl (<600 mg/d)

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Topamax (Topiramate)

- Antiepileptic drug
  - Increasingly used for migraines and for weight loss
    - If predictions of increased use for weight loss are true, we will need to get a handle on the medical management of side effects with respect to lithogenic risk!
- Associated with a kidney stone in 1.5% of patients in published clinical trials
  - But… risk may be <u>under-reported</u>
    - 13 of 24 (54%) individuals on topiramate monotherapy or polytherapy developed clinical evidence of urolithiasis after a mean duration of 36.4 months
      - Goyal *et al*, Pediatr Neurol 2009;40:289-94

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Topamax and Stones

- Underlying abnormality is renal tubular acidosis
  - Inhibition of carbonic anhydrase in the proximal and distal renal tubules
    - **Profoundly low urinary citrate**, high urine pH, high urine HCO_3, high urine brushite saturation, no change in urine Ca^{++}, low serum HCO_3 & K^+
      - » Unexpected finding in one trial was a lower urinary oxalate concentration
    - Calcium apatite is major crystal moiety formed
      - » References: Welch *et al,* Am J Kidney Dis 2006;48:555-63
        Kuo *et al*, J Endourol 2002;16:229-31 Wasserstein *et al*, Epilepsia 1995;36(suppl 3):153

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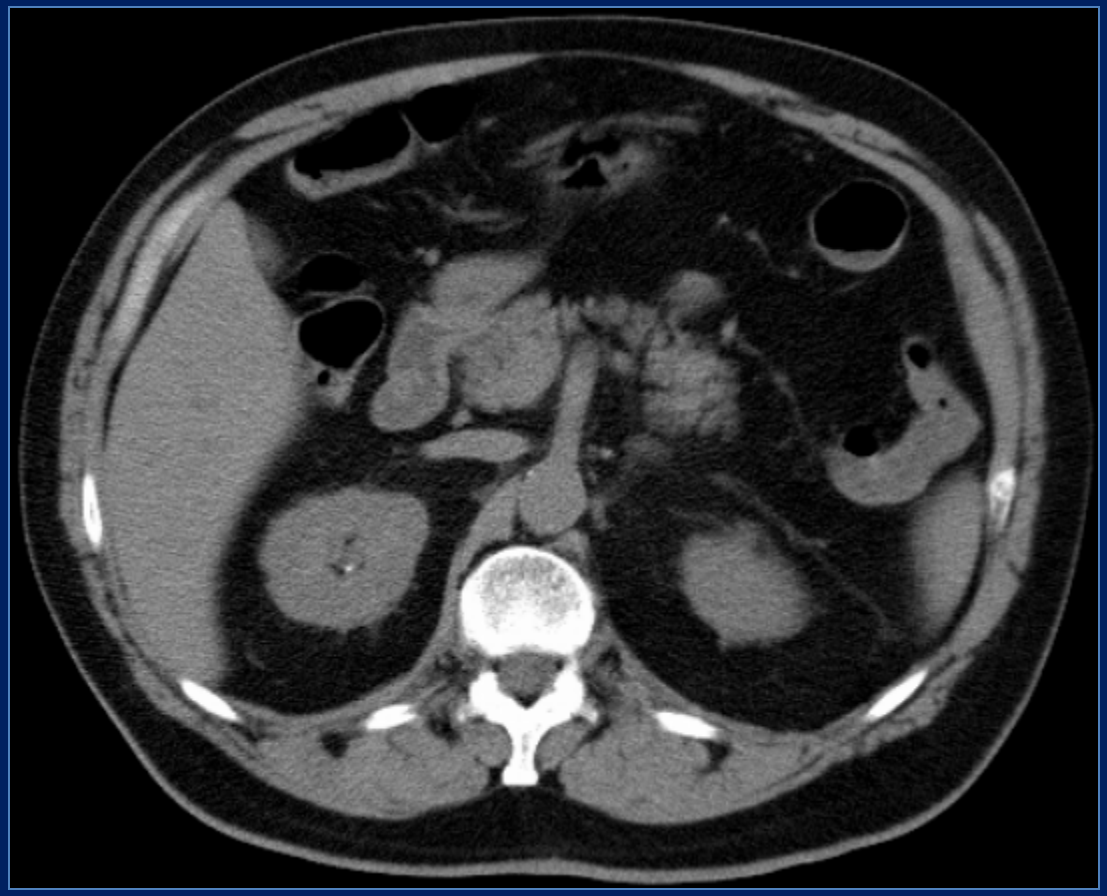
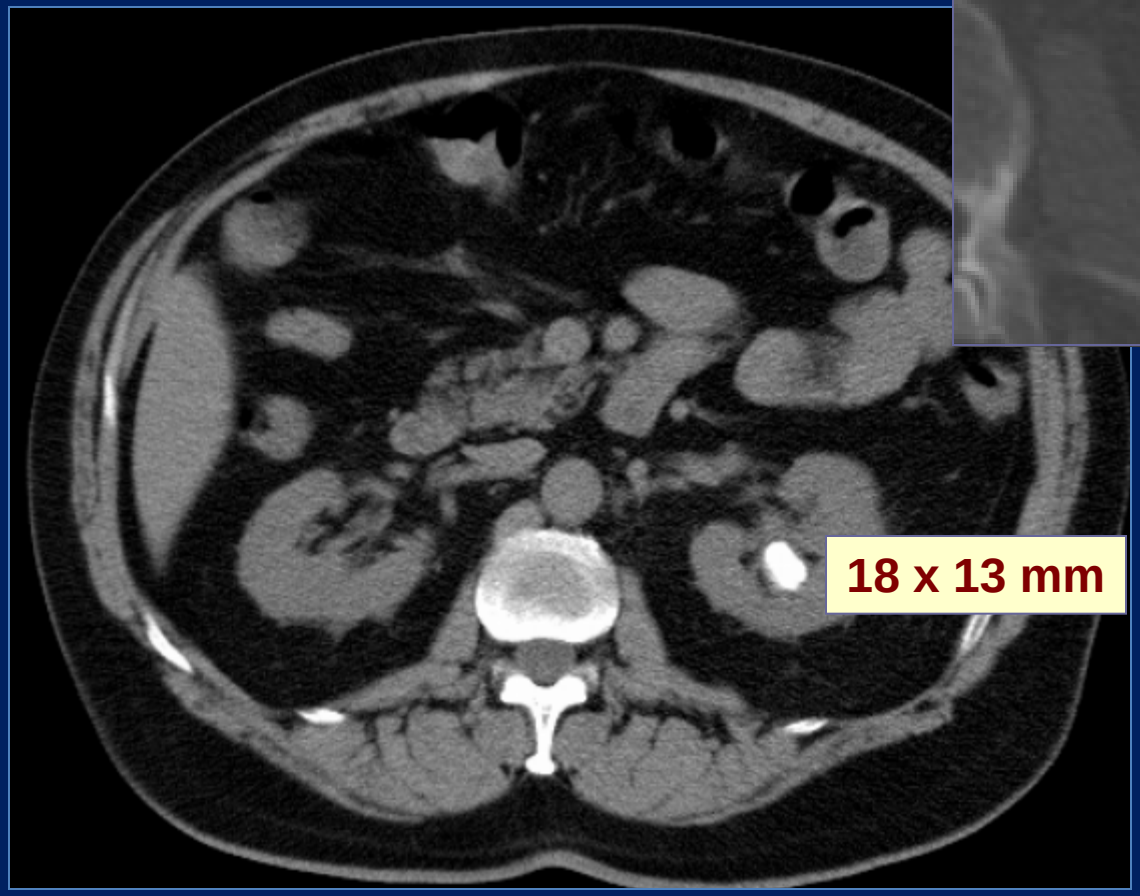
Topamax - Medical Management

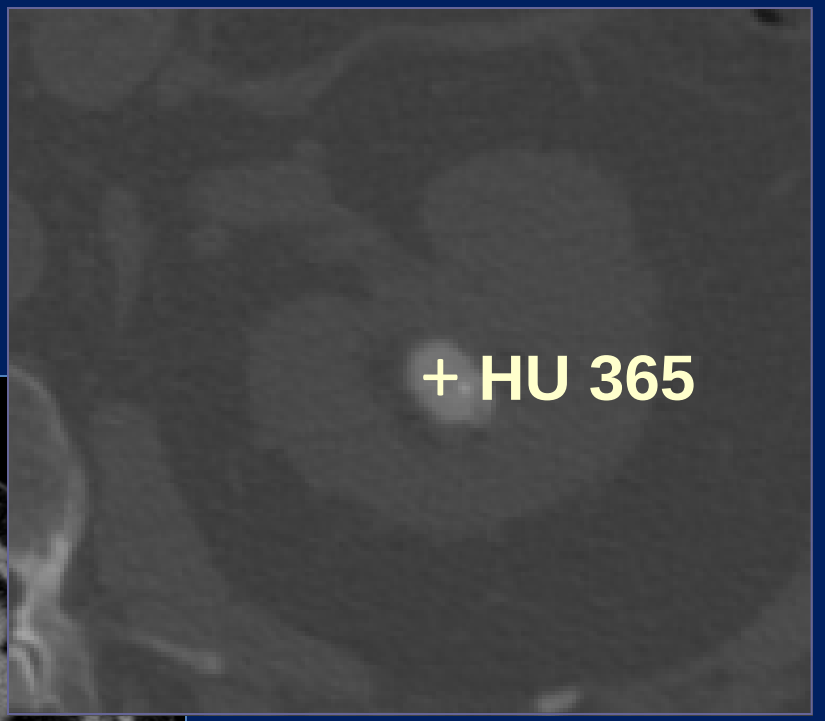
- Patients reluctant to stop therapy
- So must treat metabolic side effects/ risk factors
  - Hypocitraturia
    - Potassium citrate?
      - No studies… *Need to weigh benefit against risk of* ↑*urine pH*
    - Increase dietary alkaline load (K^+ sources) and dietary citrate
      - No studies…
  - High urine pH
    - Acidify urine, e.g., with ascorbic acid?
      - No studies… *Need to weigh benefit with risk of higher oxalate*
  - High brushite saturation in urine
    - Push fluids

CASE 5

- A 63-year-old man with Type II DM, hypercholesterolemia and HTN has mild intermittent left flank pain
- UA revealed microhematuria
- Cystoscopy was negative
- IVP and CT were obtained




18 x 13 mm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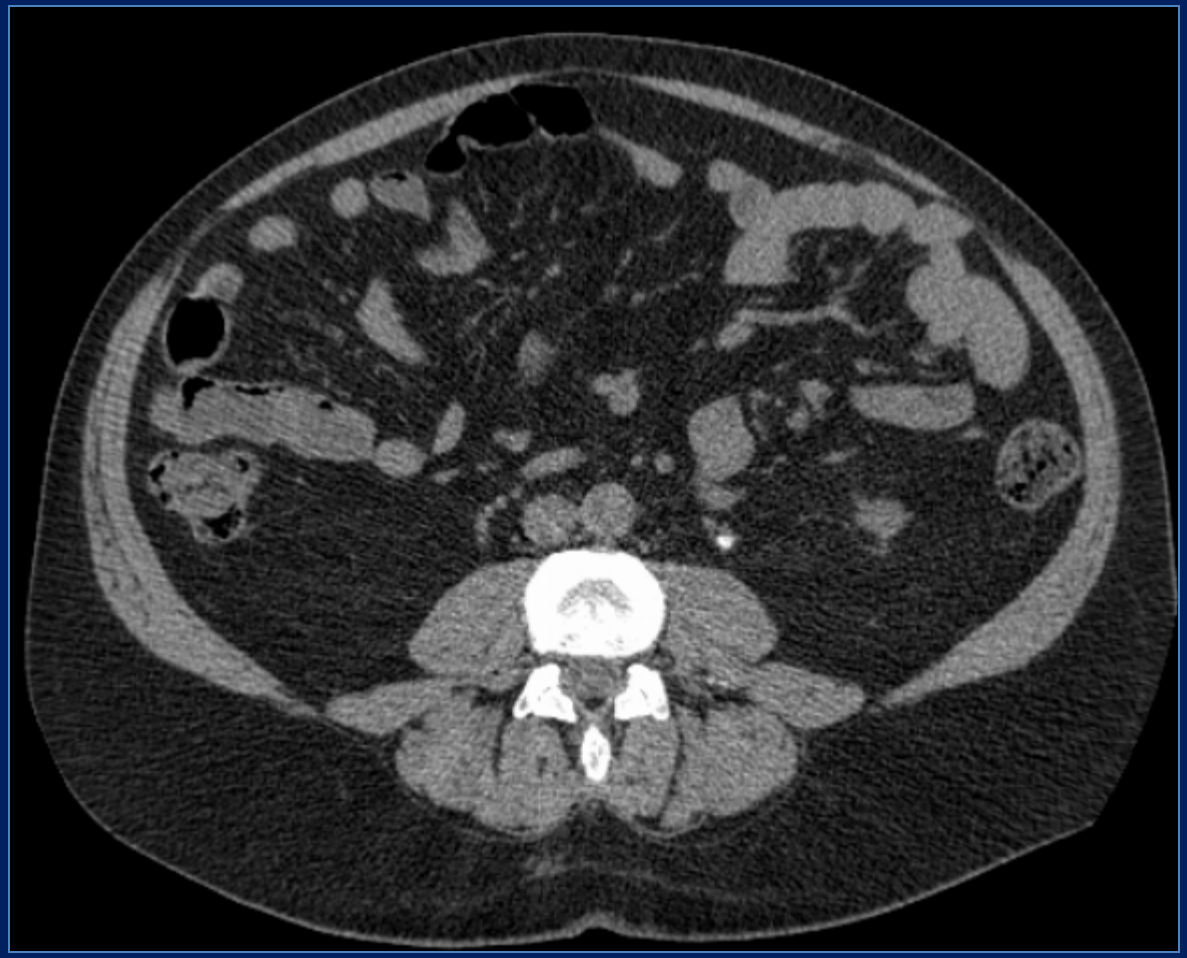
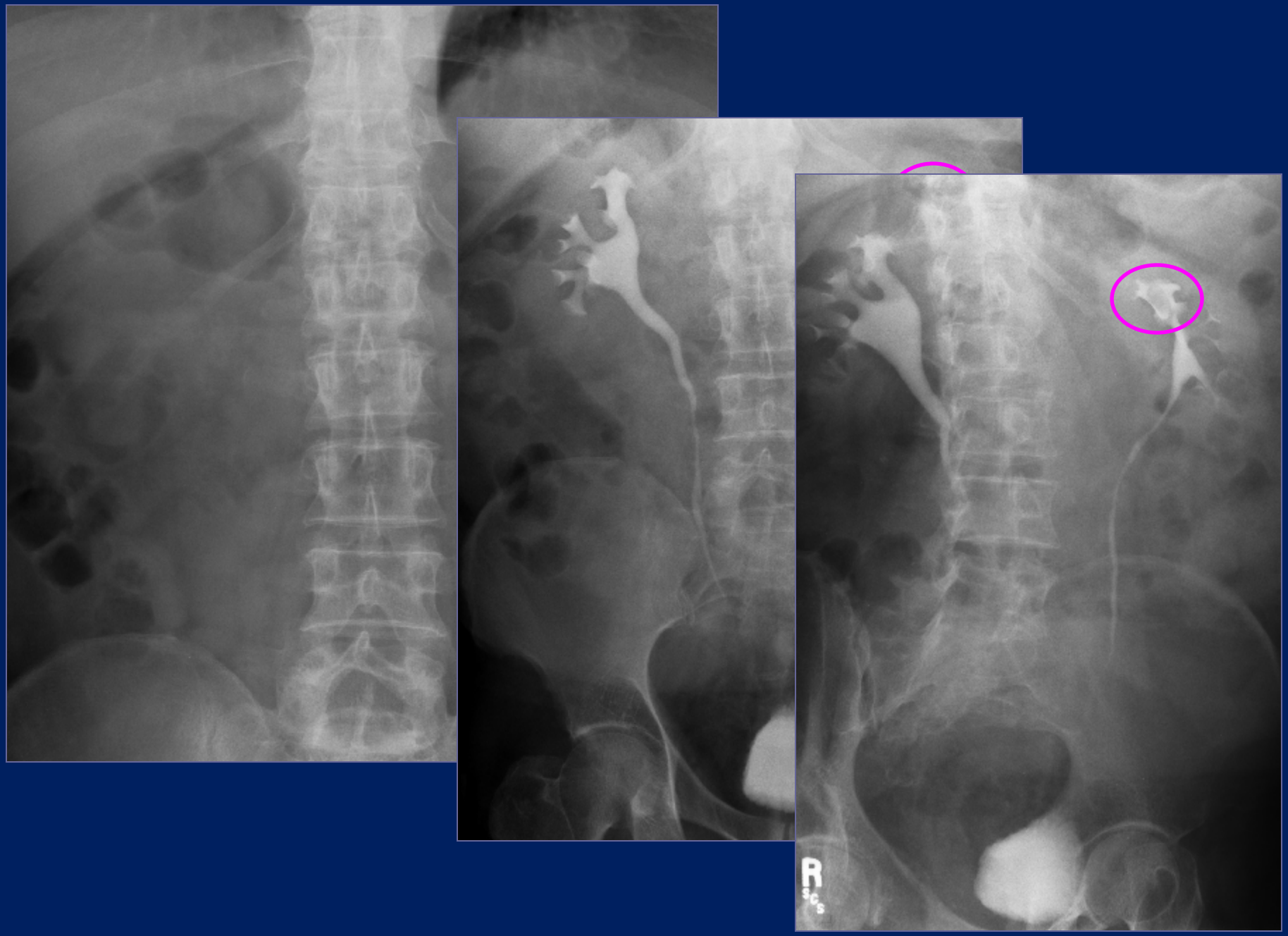


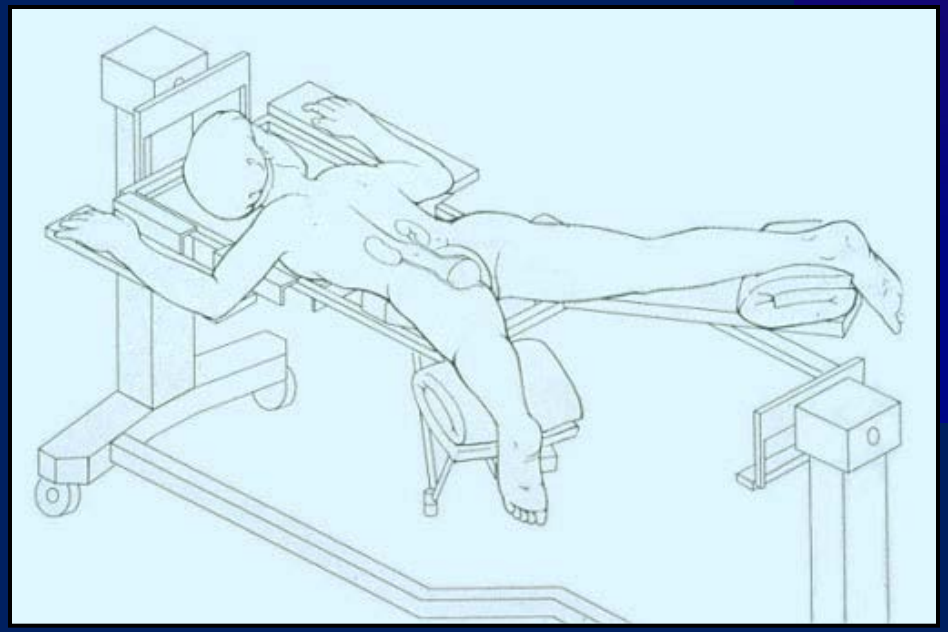


Case 5
Diabetic with Radiolucent Renal Calculi

Pre-op assess:

- **Stone burden in each kidney by CT scan**
- **Anatomy of collecting system by CT IVP / RGP**
- **Renal Scan to determine differential renal function**
- **Sterile urine culture**
- **Admit day pre-op for IV antibiotics**

Simultaneous Flexible Ureteroscopy & Percutaneous Access



Flexible Ureterorenoscopy
Prone - Head Down 20° Position

PCNL – Steps of the Procedure

1. Flexible ureteroscopy with access sheath
2. Fluoroscopic + ureteroscopic guided needle puncture of collecting system
3. Tract dilation – dilating balloon catheter
4. Nephroscopy & lithotripsy
5. Stent placement & nephrostomy removal
6. Foley catheter placement

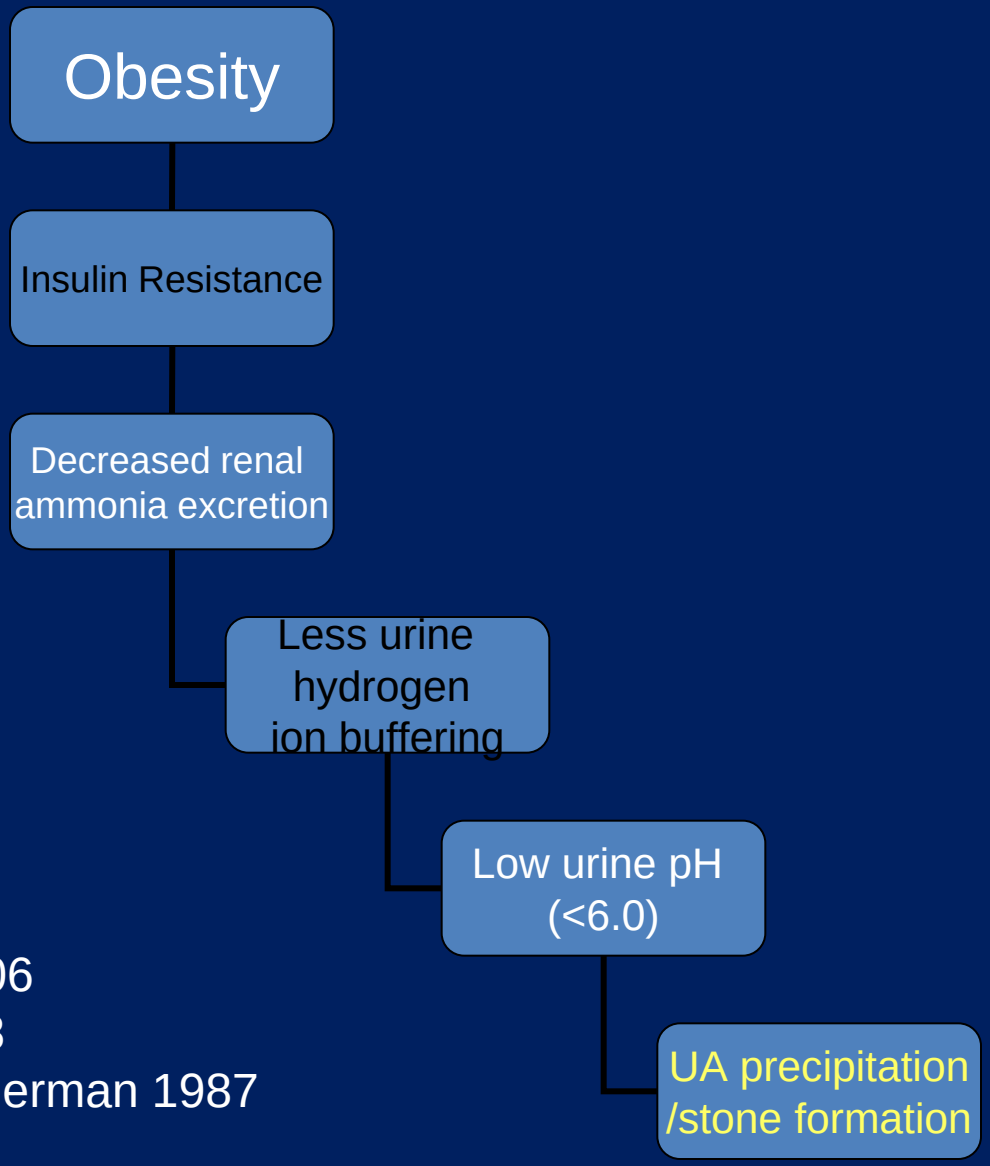

11.5 F x 35 cm ureteral access
sheath passed to the UPJ
LIVE

- After treatment of his stone, a 24-hour urine specimen was collected
- What treatment should be recommended?

TV	1.75L	
pH	5.15	
Ca	275	nl (<200 mg/d)
Oxalate	37	nl (<40 mg/d)
Citrate	495	nl >320 mg/d)
Sodium	175	nl (<200 mEq/d)
Uric acid	235	nl (<600 mg/d)

UA Stones and Metabolic Syndrome

- **+ association between obesity, urine pH, & UA SS[1]**
- **Insulin necessary for renal production of ammonia[2,3]**



1. Taylor and Curhan 2006
2. Krivosikova, et al 1998
3. Chobanian and Hammerman 1987

Metabolic Treatment

- Potassium citrate and fluids
- Watch CaP & CaOx SS
  - urine calcium is high
  - May need thiazides in future base on stone type
- Allopurinol
  - May be beneficial if concurrent gouty diathesis
  - Not necessary if not hyperurocosuric[1]
- Expect urine UA levels to rise with alkaline therapy
- Follow with CT

1. Tiselius HG, et al, BJU International 2001;88:158-168

CONCLUSIONS
Selection of Optimal Treatment

- **Surgical Management**
  - Accurate estimation of stone burden
  - Determination of intrarenal anatomy
  - Assessment of relational anatomy of the kidney

- **Medical Management**
  - Comprehensive management of stone formers does not stop at surgical removal
  - Identify pts w/ risk factors for stone formation
  - Evaluate high risk pts