

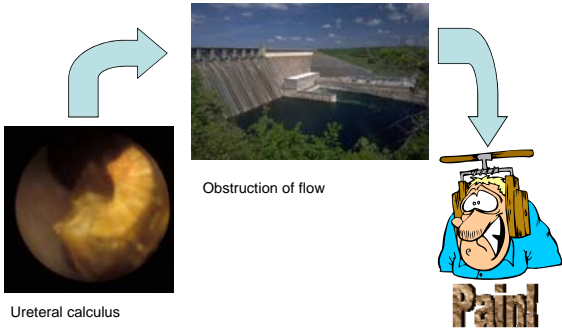
## Urologic Stone Disease Diagnosis and Treatment

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## Urologic Stone Disease



## Urologic Stone Disease



Obstruction of flow

Ureteral calculus

**Pain!**

## Urologic Stone Disease

“I will not cut, even for the stone, but leave such procedures to the practitioners of the craft”

Hippocrates

## Urologic Stone Disease

- Epidemiology
- Classification
- Presentation
- Imaging
- Treatment
- Prevention



## Urologic Stone Disease: Epidemiology

- Prevalance = 2-3% will have urinary tract stone disease
- Nephrolithiasis incidence as high as 12% in industrialized countries
- Recurrence rates for first time stone formers:
  - 10 % first year, 35% at 5 yrs, 50% at 10 yrs
- Men > women
  - Risk of caasian male getting a stone by age 70 is approximately 1 in 8.

### Urologic Stone Disease: Epidemiology

- Peak age of incidence = 20's to 40's
- Male / Female ratio = 3/1
  - Children: ratio is equal
- Geography important...."Stone Belt"
  - Increased in mountains, desert, and tropics
  - Southeast (calcium oxylate stones)
  - East coast (uric acid stones)
- Season important
  - Higher in summer months

### Urologic Stone Disease: Epidemiology

- Water intake
  - How much you drink
    - "the solution to pollution is dilution"
  - What kind of water you drink
    - Presence of excess minerals (sodium carbonate in hard water) or lack of them (zinc)
- Diet (multifactorial)
- Occupation
  - Sedentary jobs higher risk

### Urologic Stone Disease: Stone composition



- Calcium Oxylate
  - Most common kind of stone
  - Most of these patients have hypercalciuria
  - Radio-opaque
- Uric Acid
  - Low urine pH (<5.5)
  - ?gout...increased uric acid load, pH more important
  - Inflammatory bowel disease (dehydration, bicarb loss)
  - Radiolucent

### Urologic Stone Disease: Stone composition

- Infection stones (Struvite)
  - Caused by UTI with urease-producing bacteria (ie Proteus, Klebsiella, Pseudomonas)
  - May grow quite large (Staghorn calculus)
  - Tend to harbor bacteria
  - Radio-opaque
- Cystine Stones
  - Autosomal recessive disorder
  - Cystinuria (cystine poorly soluble)
  - Dense stones, radio-opaque

### Urologic Stone Disease: Stone composition


- Medication stones
  - Triamterine (Dyazide, Maxide)
  - Laxative abuse (ammonium acid urate stones)
  - HIV + patients on triple drug therapy
    - Indinavir crystals
    - Radiolucent (X-ray and CT)

### Urologic Stone Disease: Presentation

- Renal Colic
  - Abrupt onset
  - Affects patient whether sedentary or active
  - Radiating: flank to groin
  - Associated with bladder irritation if distal
  - Nausea, emesis common
  - Ileus, diarrhea can be present

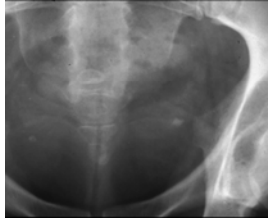
### Urologic Stone Disease: Presentation

- Urinalysis
  - Microscopic or gross hematuria (90%)
  - ? Infection
    - Elevates urgency of management
    - May indicate etiology of stone
  - pH important
  - crystals




### Urologic Stone Disease: Imaging

- Plain Abdominal film
  - Stone visualization variable (bowels, bones, etc)
  - Excellent way to follow radio-opaque stones
  - Can be fooled by calcifications outside of the urinary system



### Urologic Stone Disease: Imaging

- Intravenous Urogram (IVP)
  - Valuable to outline anatomy, stone location, and obstruction
  - Requires good bowel prep for optimal films
  - If significant obstruction, may not identify point of obstruction



### Urologic Stone Disease: Imaging

- Renal Ultrasound
  - Stones will "shadow", but small ones may be missed
  - Renal calculi well seen, ureteral calculi difficult to see
  - Can document Hydronephrosis

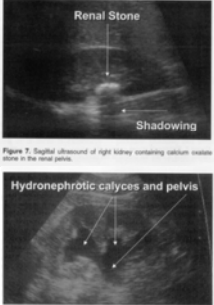
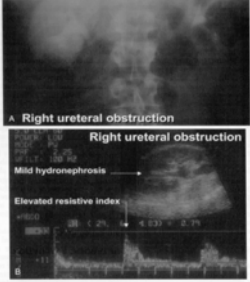


Figure 7. Digital ultrasound of right kidney containing calcium oxalate stone in the renal pelvis.  
Figures from Urol Clinics N America May 2000

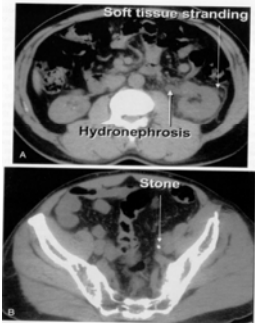
### Urologic Stone Disease: Imaging

- Hydronephrosis may only suggest obstruction
- Resistive index can be used to indicate obstruction



### Urologic Stone Disease: Imaging

- Computed Tomography
  - Becoming the standard (non-contrast helical CT)
  - Cost similar to IVP
  - Rapid assessment
  - Location/size of stone
  - Secondary signs of obstruction (stranding, hydronephrosis)



Figures from Urologic Clin of N America, May 2000

## Urologic Stone Disease

- Epidemiology
- Classification
- Presentation
- Imaging
- **Treatment**
- Prevention



## Treatment Options for Urologic Stones

- Observation
- Chemo-dissolution
- Extracorporeal Lithotripsy (ESWL)
- Percutaneous stone surgery
- Ureterscopy with laser lithotripsy
- Open stone surgery



## Urologic Stone Disease: Treatment

- What do the treatment of stone disease and the sale of real-estate have in common?
- LOCATION, LOCATION, LOCATION



## Observation

- Successful passage dependent on size
  - $\leq 4\text{mm}$  – approx. 90% pass
  - $4-8\text{mm}$  – approx. 40% pass
  - $>8\text{mm}$  – less than 10% pass
- Can wait up to 6 weeks
- Monitor for infection, stone movement



## Chemo-dissolution

- Sounds great, but....
- Can work for Uric acid calculi
  - Raise urine pH  $>6$
  - Sodium Bicarbonate, Urocit-K, Potassium Citrate
- For calcium containing stones
  - No safe, effective agents



## ESWL

- Utilizes focused shock waves generated by various means to fragment the stone
- Ideal for kidney stones
- Lower pole stones, large stones, ureteral stones, poorly visualized stones are problematic
- Must then pass the fragments



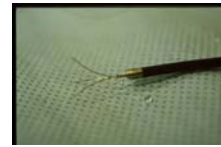
## Percutaneous Stone surgery

- Percutaneous access to the kidney through the flank
- Ideal for large stone burden
- Utilize ultrasound/aspiration, laser, pneumatic impacting devices to fragment and remove stone
- Can render patients with large stone burdens "stone free" in one or two procedures



## Ureteroscopy

- Access through existing channels (bladder and ureter)
- Utilizes small diameter scopes to visualize, fragment, and remove stones
- Ideal for ureteral calculi, smaller renal calculi



## Ureteroscopy "Toys"



Graspers and baskets

Graspers



Lasers



## Ureteroscopy: Semi-rigid ureteroscope



## Ureteroscopy: Flexible ureteroscope



## Factors to Consider

- Size of the stone
- Location of the stone
  - Kidney (upper, middle, lower)
  - Ureter (proximal vs. distal)
- Composition of the stone
  - "hard vs. soft"
- Previous history
  - Previously passed stones
- Presence of infection
  - emergency

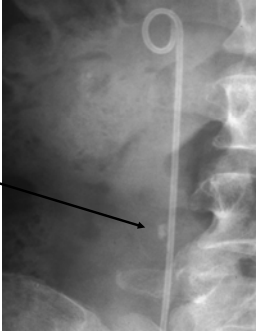
### Stone Treatment Factors

- Size
  - **<4mm**
    - Kidney – Observe vs. ESWL
    - Ureter – Observe, treat if colic or not moving
  - **4 – 8mm**
    - Kidney – ESWL
    - Ureter – Treat, ureteroscopy vs ESWL
  - **8 – 15mm**
    - Kidney – ESWL
  - **Over 15mm or complex stone**
    - Kidney – Percutaneous removal

### Stone Treatment Factors

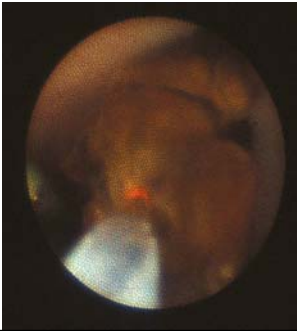
- Location
  - Kidney
    - ESWL for stones less than 1.5 – 2cm
    - Percutaneous approach for large or lower pole stones
  - Ureter
    - Ureteroscopy for any location
      - Flexible ureteroscope for upper ureter
      - Semi-rigid ureteroscope for lower/mid ureter
    - ESWL for upper ureteral stones that are well seen

### Right Mid-ureteral calculus: Stent in place

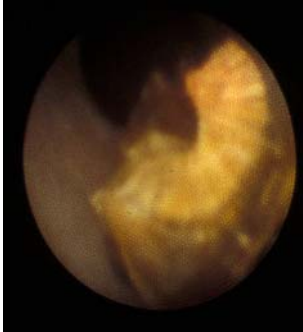
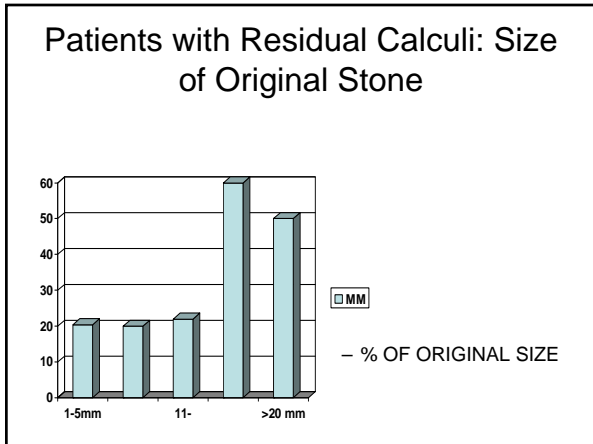


calculus

### Holmium laser fiber on a ureteral calculus



### Calculus has been partially fragmented

## ESWL Treatment of Upper Ureteral Calculi

Litho	Stone Free (%) 3 mo	
	Proximal	Mid
HM-3	91	91.2
MFL-5000	81.3	58
HM-4 & MPL-9000	68.5	82
Piezolith & LTO2	70.2	73.4
Lithostar	82.4	81.1
Modulith	81.0	80.0

## Ureteroscopy

### Distal Ureteral Calculi: Success of Treatment

1990 - 1995	91.2%
1996 - 2001	96.4%

## Urologic Stone Disease: Follow-up

- Stone Analysis
- KUB and Renal U/S
  - Rule out residual fragments, silent hydronephrosis, new stones
- Metabolic evaluation
  - Recurrent stone formers
  - Young patients with positive family history of stones
  - Bilateral stones

## Metabolic Stone Work up

- Complete Serum metabolic panel
  - Calcium, Uric acid, Creat., Bicarbonate
- U/A
- 24 hour urine collection
  - Sodium, calcium, Phosphorus, Oxylate, Uric acid, Citrate, magnesium
  - Volume, urine pH



## Metabolic Stone Work up: Common Problems

- Low Urine volume (<2 liters/day)
  - Increased super saturation of Calcium oxylate and or uric acid
  - Treatment: drink more water!
- High urine sodium (another Diet Coke please)
  - Increases urine calcium
  - Treatment: Decrease dietary sodium

## Metabolic Stone Work up: Common Problems

- Increased urinary calcium
  - Hyperparathyroidism
    - Treat primary disease
  - Renal leak (high fasting urine calcium)
    - Thiazide diuretic
  - Hyper absorption (normal fasting urine calcium)
    - Dietary restriction of calcium

### Metabolic Stone Work up: Common Problems

- Low Urine Citrate
  - Citrate is a stone “inhibitor”
  - Lowered with thiazide diuretics
  - Treatment: Potassium citrate or Urocit-K, alternative is “lemonade therapy”
    - Lemons are good source of citrate with the least calcium and sodium
- High urinary oxalate
  - Can result from calcium restriction
  - Treatment: Adequate calcium, dietary restriction

### Metabolic Stone Work up: Common Problems

- Dieting
  - “Atkins” diet or similar....low carb, high protein
  - Urine gets acidified (ash)
  - Uric acid load up
  - Obesity is risk factor for stones independently
  - Stone risk increased
  - Counterbalanced by hydration and possibly alkalinization (potassium citrate)



### Urologic Stone Disease: Summary

- Common problem with classic presentation (colic)
- Diagnosis commonly made with spiral CT
- Treatment based on size and location of the stone
  - Ureteroscopy, ESWL, percutaneous
- Metabolic evaluation and treatment recommended for recurrent stone formers or those at risk

### Thank You

