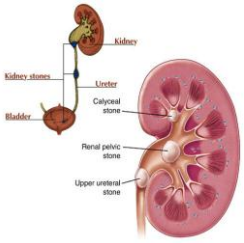
URINARY TRACT CALCULI



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Urinary Tract Calculi Statistics

- Annually approx. 1-2 million in the US have nephrolithiasis
  - Kidney stone disease
- More common in men
- Average age at onset 20-55 years old

Urinary Tract Calculi Statistics

- Increased incidence
  - Caucasian
  - Family hx
  - Previous hx
  - Summer months
    - dehydration

Urinary Tract Calculi
Etiology & Pathophysiology

- Stone formation
  - Multifactorial
    - Metabolic
    - Genetic
    - Climate
    - Lifestyle
    - Occupational Influences

Urinary Tract Calculi
Etiology & Pathophysiology

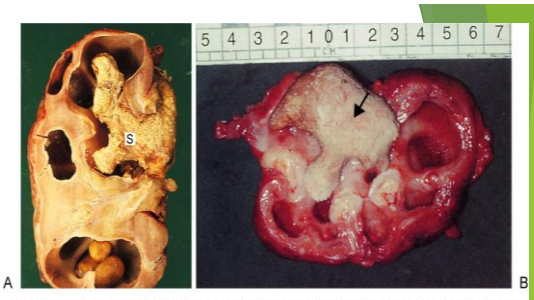
- Stone formation
  - Affected by:
    - Urinary pH
      - ↑ pH (alkaline)
        - Calcium & phosphate stones
      - ↓ pH (acidic)
        - Uric acid & cystine stones

Urinary Tract Calculi
Etiology & Pathophysiology

- Stone formation
  - Other factors
    - Obstruction with urinary stasis
    - UTI
    - Genetics

Urinary Tract Calculi
Complications

- Infection
- Hydronephrosis
- Loss of renal function



A, From Stevens A, Lowe JS, Scott I: *Core pathology: illustrated review in color*: ed 3, London, 2009, Mosby Ltd. *B*, From Bullock N, Doble A, Turner W, Cuckow P: *Urology: an illustrated colour text*, London, 2008, Churchill Livingstone.

Urinary Tract Calculi
Renal Staghorn calculus

Imbedded staghorn calculus

Urinary Tract Calculi
Case Study

- H.C. 45 year old Caucasian male presents to ER c/o
  - R flank pain (severe) since this am
  - Urine is pink-tinged

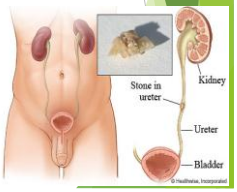
Urinary Tract Calculi

- Types
  - Calcium phosphate
  - Calcium oxalate
  - Uric acid
  - Cystine
  - Struvite (magnesium ammonium phosphate)

- Lewis: pg 1078, table 46-11

Calcium Oxalate Calculi
35-40%

- ↑ incidence in men
- Small, often gets trapped in ureter
- Predisposing factors:
  - ↑ calcium or oxalate in urine
  - Family hx



Calcium Oxalate Calculi

- Treatment
  - ↑ Hydration
  - ↓ Dietary oxalate
    - ↑ tea or fruit juices
  - Potassium Citrate
    - Alkalinize urine
  - Give meds that bind with calcium to prevent absorption
    - Cellulose phosphate

Calcium oxalate stones
Abd X-ray showing bladder calculus

From Bullock N, Dobbie A, Turner W, Cuckow P. Urology: an illustrated colour text. London, 2008, Churchill Livingstone.

Calcium Phosphate Calculi 8-10%

- Mixed stone
  - Struvite or oxalate stone
- Predisposing factors:
  - Alkaline urine
  - Primary hyperthyroidism
- Treat underlying cause

Struvite Calculi 10-15%

- Most common in women
- Predisposing factors
  - Always associated with UTI's
- Treatment
  - Antimicrobials, acidify urine, surgical removal if necessary

Uric Acid Calculi 5-10%

- ↑ risk in men
- ↑ risk in Jewish men

- Predisposing factors:
  - Gout, acidic urine, inherited condition

- Treat:
  - Alkalinize urine with potassium citrate
  - Allopurinol
  - ↓ Purines in diet

Cystine Calculi 1-2%

- Genetic autosomal recessive defect
  - Unable to absorb cystine
    - ↑ Cystine = stone formation

- Predisposing factors
  - Acidic urine

Cystine Calculi

- Treatment

  - ↑ Hydration

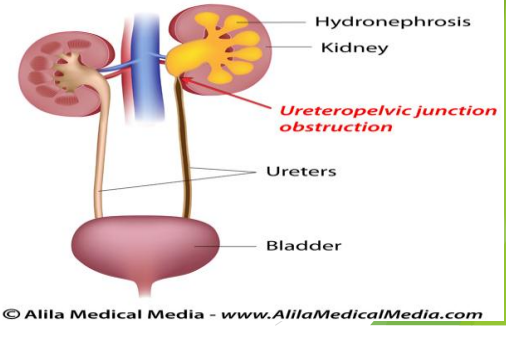
  - Potassium citrate
    - Alkalize urine

Urinary Tract Calculi

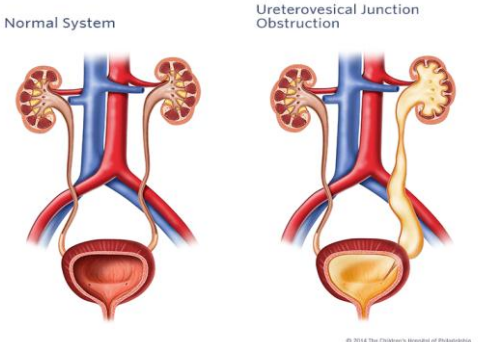
Clinical Manifestations

- Sudden severe pain due to obstruction
  - Common sites of obstruction
    - Ureteropelvic junction (UPJ)
      - Dull pain in costovertebral flank
      - Renal colic
    - Ureterovesicular junction (UVJ)

Ureteropelvic Junction (UPJ)



Ureterovesicular Junction



Urinary Tract Calculi
Case Study

- H.C. is restless and wants to walk around the ER, he requires help
- What other S/S would you assess for?

Urinary Tract Calculi
Clinical Manifestations

- "Kidney stone dance"
- Mild shock, with cool, moist skin
- Pain radiates to lower quadrant of abdomen as stone nears UVJ
- Groin pain & UTI symptoms

Urinary Tract Calculi
Diagnostic Studies

- Noncontrast spiral CT (CT/KUB)
- Ultrasound
- Intravenous pyelogram (IVP)
- Complete UA
  - Hematuria
  - Crystalluria/ urinary pH

Urinary Tract Calculi
Diagnostic Studies

- Intravenous pyelography (IVP)
  - Visualizes urinary tract after IV injection of contrast media
    - Position & shape of kidneys, ureters & bladder
      - Cysts, tumors, lesions & obstructions
  - Contrast may worsen renal function

Urinary Tract Calculi
Diagnostic Studies

- Retrieval & analysis of stones
  - Why?
- Recurrent stones: 24 hour UA
  - Ca, phos, Mg, uric acid, citrate etc
- Labs:
  - Serum calcium, phosphorus, sodium, potassium, bicarbonate, uric acid, BUN, & creatinine levels

Urinary Tract Calculi
Case Study

- H.C. undergoes CT/KUB
  - Reveals two calculi in right renal pelvis and one in the right ureter
- He states that he had a urinary calculi once before (approx. 2 years ago)

Urinary Tract Calculi

- History
  - Previous episodes
  - Medications
    - Include OTC
    - Dietary supplements
  - Family history

Urinary Tract Calculi
Collaborative Care

- Treat acute attack
  - Treat pain with opioids
  - Infection
  - Obstruction
    - Tamsulosin (Flomax)/Terazosin (Hytrin)
      - Relax smooth muscle in the ureter
  - * ID cause if possible

Urinary Tract Calculi
Collaborative Care

- Prevention of further stone development
  - Patient & family hx
  - Geographic residence
  - Nutritional assessment

Urinary Tract Calculi
Collaborative Care (cont.)

- Prevention (cont.)
  - Activity patterns
  - Immobilization or dehydration

Urinary Tract Calculi
Case Study

- You assess H.C.'s diet and find that he loves red meat and shellfish
- He works as a computer programmer and does not exercise regularly

Urinary Tract Calculi
Collaborative Care

- Teaching
  - Adequate Hydration
  - Dietary sodium restriction
  - Dietary changes
  - Drugs to minimize stone formation

Urinary Tract Calculi
Collaborative Care

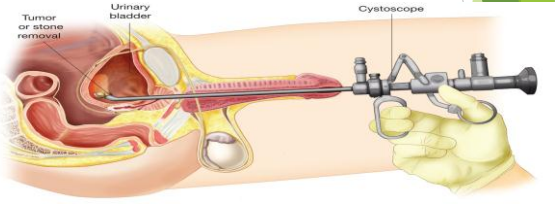
- Struvite stone
  - Antibiotics
  - Acetohydroxamic acid
    - Inhibits bacteria found in UTI's
      - Urease
  - Surgical removal

Urinary Tract Calculi
Collaborative Care

- Indications for surgical removal
  - Stones too large to pass
  - Infection
  - Renal Impairment
  - Persistent pain, nausea or paralytic ileus

Urinary Tract Calculi
Collaborative Care

- Endourologic procedures
  - Cystoscopy
    - Flexible scope



Urinary Tract Calculi
Collaborative Care

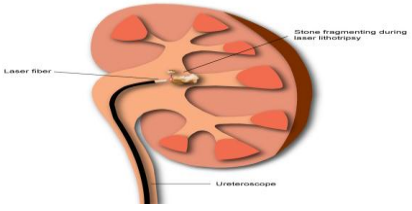
- Endourologic procedures (cont.)
  - Cystolitholapaxy
  - Cystoscopic lithotripsy
  - Percutaneous nephrolithotomy

Urinary Tract Calculi
Collaborative Care

- Cystolitholapaxy
  - Performed for large stones in the bladder
  - Large stones are broken up with a lithotrite (stone crusher)
  - Bladder is irrigated and the crushed stones washed out

Urinary Tract Calculi
Collaborative Care

- Cystoscopic lithotripsy
  - Uses ultrasonic lithotrite to break up stone



Cystoscopic Procedure
Complications

- Hemorrhage
- Retained stone fragments
- Infection
- *Hematuria is common after lithotripsy procedures

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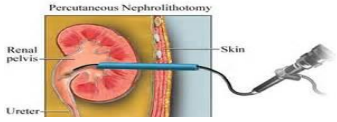
Urinary Tract Calculi
Collaborative Care

- Percutaneous nephrolithotomy
  - Scope is inserted into the kidney pelvis track
    - Stones are fragmented and removed
    - Pelvis is irrigated



Nephrostomy Tube

- Usually left in to ensure the ureter is not obstructed
- Complications
  - Bleeding
  - Infection

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Urinary Tract Calculi
Case Study

- H.C. continues to be in severe pain and is unable to pass any stones
- He is scheduled for a cystoscopy for stone removal
  - Where is the stone?

Urinary Tract Calculi
Collaborative Care

- Surgical therapy
  - Nephrolithotomy
    - Incision into **kidney** to remove stone
  - Pyelolithotomy
    - Incision into the **renal pelvis** to remove stone
  - Ureterolithotomy
    - Incision into **ureter** to remove stone
  - Cystotomy
    - Incision into **bladder** to remove stone

Urinary Tract Calculi
Collaborative Care

- Nutritional therapy
  - Adequate fluid intake
  - Forcing fluids: Contraindicated
  - Low-sodium diet

Urinary Tract Calculi
Nursing Management

- Nursing diagnosis
  - Impaired urinary elimination
  - Acute pain
  - Deficient knowledge

Urinary Tract Calculi
Nursing Management

- Assessment and Planning
  - Pain relief
  - Assess/ prevent urinary tract obstruction

Urinary Tract Calculi
Nursing Management

- Implementation
  - Teach methods to prevent recurrence
    - Adequate fluid intake
      - Goal: produce approx. 2L of UOP per day
    - Change dietary habits
      - Restriction Na+, purines

Urinary Tract Calculi
Nursing Management

- Implementation
  - Teach management of acute episodes
    - Pain management
    - Strain all urine
    - Self-monitor urinary pH
    - Ambulation

Urinary Tract Calculi
Nursing Management

- Evaluation
  - UOP
    - Free flow with minimal hematuria
  - Report satisfactory pain management
  - Verbalize understanding of disease process and measures to prevent recurrence

Questions….The End