Urinary Tract Infections (UTIs)

(and Urolithiasis)

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OBJECTIVES

• Overview of Urinary Tract Infections
• Review diagnosis, treatments and special populations in UTIs
• Practice interpretation of UA’s
• Biomarkers in UTI’s – new horizons?
• Nephrolithiasis (time-permitting)
The dreadful truth behind urinary tract infections
UTI VERY BASICS

• Urethritis = Urethra
• Cystitis = Bladder
• Pyelonephritis = Kidney
UTI BASICS

• Signs and Symptoms of Cystitis
  – Burning/Dysuria
  – Frequency
  – Urgency
  – Odor
  – Clarity change (hazy)
  – Suprapubic pain
  – Hematuria
  – Fever (may be the only sx in children)
  – Crying/Fussy (kids)
  – Poor PO intake (kids)
• Signs and Symptoms Concerning for Pyelonephritis
  – Any of the previous mentioned sx, plus:
    • Fever
    • Back pain
    • Flank pain
    • Nausea/Vomiting
ETIOLOGY

- Most ascend from urethra and bladder
  - Hematogenous/lymphatic seeding less common

- *E. coli* by far most common overall pathogen
  - Young males also prone to *Proteus* species

- *Corynebacterium urealyticum* in pts in first few months after renal transplant
EPIDEMIOLOGY

- 7-8 million OUTPATIENT and 1 million ED visits annually in the United States
- 6 Million women per year in the U.S. (10%)
  - More common with age, sexual activity
  - 20-50% lifetime chance
  - Higher if institutionalized
- 5-14% of all PEDIATRIC ED visits/year in the U.S.
  - 2.4-2.8% of all children
    - Incidence in uncircumcised boys > girls in first few months of life
    - Incidence greater in girls after first year of life and increases with age
    - Consider structural abnormality, esp if recurrent or in preschool and up male children
EPIDEMIOLOGY

• MEN:
  – Less than 1% overall prevalence up through middle-age
  – 1-3% by age 65
  – 10% ages 80 and greater
  – 25% prevalence in institutionalized men

• UTI is the most common nosocomial infection in the U.S
28 yo generally well-appearing woman, presents c/o worsening urinary frequency, urgency and dysuria x3 days. She admits to mild suprapubic and low back discomfort. Denies vaginal discharge. She is currently sexually active with her husband. Hx cystitis x2

- Exam shows mild suprapubic tenderness. Thin, clear vaginal discharge w/o CMT or adnexal ttp. Rest of exam benign. Afebrile.
- Urine appears clear and pale yellow
UNCOMPLICATED CYSTITIS

• Healthy, non-pregnant females
  – with normal structure/function of the urinary tract
  – (can argue uncircumcised males less than 6-12 mos of age also)

• 50% lifetime risk of any UTI in a female, including simple cystitis
  – 10-11% of women in a given year
History, History

- Previous cystitis is a risk
  - Women decent at self-assessment
    - If she says this is like her last confirmed UTI…it probably is
      - 84-92% chance UTI present

- Dysuria, Frequency or hematuria
  - Odds of UTI are 50%
    - No vaginal complaints increases odds to over 90%
    - With vaginal complaints, decreases to 30%
RISKY BUSINESS…

- Prior cystitis
- Being female
- SEX! We all know this increases UTI risk, right?
  - Odds of UTI increase by factor of 60 in 1st 48 hours after heterosexual intercourse
  - Spermicides during intercourse
- Poor hygiene
RISKY BUSINESS…

- ED ALERT! Routine pelvic exams may be associated with increased UTI risk for up to 7 WEEKS following the exam!
  - Data from Family Med literature after PAP smear
    - Is it PAP smear or pelvic?
      - More data needed
• Non-Antibiotic UTI Prevention:
  – Not supported by evidence
    • Early post-coital void
    • Good hydration
    • Douching

• ?? Cranberries
  – Possible modest benefit at high doses
  – 200-700mL of pure cranberry daily (divided doses)
DIAGNOSIS

• Suprapubic specimen gold standard
  • Cleanest
  • Good luck getting alert adult to ok or parent to ok for kid
• Clean catch
  • Most common
  • How clean is it *REALLY*?
  • Problematic in the very old, the very young, the debilitated
• Cath
  • Technique-dependent quality
  • invasive
DIAGNOSIS

- Dipstick
  - Decent test, fast
  - LE, Nitrite:

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>EITHER Positive</td>
<td>75% (67-100%)</td>
<td>82% (67-98%)</td>
</tr>
<tr>
<td>BOTH Positive</td>
<td>35-84%</td>
<td>98-100%</td>
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</tbody>
</table>

- Not all bacteria reduce nitrate to nitrite
  - *S. saprophyticus, Pseudomonas, enterococci*

- LE false positive from contamination
  - vaginitis or cervicitis

- LE Sn decreased by elevated urine protein or glucose (i.e. our patients!)
DIAGNOSIS

• MICROSCOPY
  – Pyuria if >5-10 WBC (cutoff institution dependent, varies in literature)
  – Some hospitals do gram stain (not ours)
    • Labor intensive
    • Accurate only with very high [bacteria]
  – Amount of bacteria visualized misleading as pts can have sx with fewer than 10^5 CFU
  – Any bacteria from a suprapubic specimen is +
A Word Of Caution

• Pregnant Women
  – Treat any bacteria in urine
    • If clearly a dirty catch (i.e. 90,343,534,721 squamous cells seen), consider repeat UA after education
  – Pregnant women at increased risk to progress to pyelonephritis even from asymptomatic bacteruria
  – Maternal-Fetal consequences with bad infection
DIAGNOSIS

• CULTURE
  – The gold standard for dx
    • Suprapubic cath positive if ANY CFUs (or any bacteria on microscopy)
    • Standard often >100,000 CFU for clean catch
      – a real one may be considered positive if greater than $10^2$ CFU
  – NOT NEEDED in uncomplicated cystitis with +dipstick or microscopy and suggestive sx
DIAGNOSIS

• But...we’re EPs! We don’t follow cx.
  – Wrong. We should
    • Especially if deciding not to treat
      – Especially if not treating a kid

  – Obtain Cx:
    • High pre-test probability with unimpressive UA
Imaging

• Not for simple Cystitis
• American Academy of Pediatrics updated guidelines in 2011
  – No longer need to refer for or order voiding cystourethrography for first febrile UTI in children
Name that Bug:

- If this were Vegas…
  - Bet on *E. coli*
- Young women
  - 5-15% *S. saprophyticus*
- *Klebsiella* sp and *Proteus Mirabilis*
- Occasional *S. aureus*
  - Rare in cystitis only (more common in pyelo)
  - Suspect seeding of urinary system
  - IVDA patients
Squash the Bug!

- Our basics are still good
- Antibiograms may overestimate resistance, b/c they do not take into account non-cultured simple cystitis
  - Macrobid
    - 100 mg PO BID x5 days: $ - $$
    - Go-to for pregnancy
      - Question of teratogenicity? Conflicts in literature
    - Not in pts over 65 yrs
    - Not if suspect Pseudomonas or Proteus sp, aerobic gm neg rods
  
  - Bactrim
    - 1 DS tab PO BID x3 days: $
    - Use only if local resistance is under 20%
    - Sulfa allergies a consideration
    - Not in 3rd trimester pregnancy (kernicterus)
Squash the Bug!

– **Cipro**
  - *250mg PO BID* *x3 days*: $
  - Can use other fluorquinolones (levofloxacin or oxaflocacin) also
  - Good in elderly
  - Often second line
    - Depends on local resistance patterns
    - If resistance moderate (10-20%), ceftriaxone IV x1, then home on cipro

– **Fosfomycin**
  - *One-time dose of 3gm PO*: $$$
  - Safe in pregnancy
  - Activity against MRSA, VRE, ESBL
  - Expensive, limited availability in US
    - Have at HFH

– **Keflex falling out of favor**
  - Increasing resistance
  - Still use in pregnancy

– **No amoxicillin or ampicillin**
  - Resistance

– **Augmentin if you’re really stuck**
  - $$$
Hmm…

- Interestingly, literature suggests
  - 25-42% of acute, uncomplicated cystitis will go away even w/o treatment
  - Rarely progresses to severe disease
    - However, complicated infection can look simple early on
    - Err on side of treatment

- How many women never even know have a mild UTI?
She’s Baaack…

• 28 yo woman you treated 3 weeks ago is back, same sx, infected looking UA

  – Re-infection (same or new bug) most likely
  – Failure of treatment/relapse possible, less likely
  – Treat again, send culture this time.
Pain Control for UTI

- Pyridium (phenazopyridine) – OTC
  - Anti-inflammatory
  - Good for symptomatic relief – may help avoid opiates
  - Instruct patients to only use 2-3 days
    - Can mask concerning sx

- Ibuprofen
  - Anti-inflammatory
  - Anti-pyretic
  - Symptomatic relief
IT’S COMPLICATED…

• DEFINITION: any UTI in someone OTHER than a non-pregnant, healthy female with a normal GU tract
  – Cystitis
  – Pyelonephritis
  • Uncomplicated: non-toxic appearing, tolerating PO
    – Can go home with close follow up
  • Complicated: The sick ones
RISKY BUSINESS ROUND II

• Men
  – Uncircumcised
  – Instrumentation
  – Stones (more on this later)
  – Hypertrophy of Prostate/other obstruction
  – MSM with insertive anal intercourse, esp unprotected
  – HIV or other immunosupression (e.g. transplant meds)
  – Diabetes or renal disease

• Women
  – Pregnancy
  – DM, renal insuff, stones, instrumentation, etc
DIAGNOSIS

• Start with your basic UTI work up as above
• Imaging as needed (next slides)
• In the meantime, treat the patient!
DIAGNOSIS

• Imaging
  – Two common choices: CT vs US
    • U/S good for masses and obstructions (hydronephrosis) but not as reliable for stones
    • CT: great imaging modality, but high radiation
      – Non-contrast for suspected stones
      – With if suspect pyelonephritis or perinephric abscess
      – With and without if suspect above from stone
DIAGNOSIS

• Imaging
  – Not routinely recommended in ED
    • EVEN FOR UNCOMPLICATED PYELONEPHRITIS
      – Clinical diagnosis
  – Use when you get a bounce-back not responding to the treatment you prescribed on your last CAT 3/4 shift
    • r/o Stone, pyelo, perinephric abscess
  – Use in suspected sepsis from pyelo
    • Need to look for obstruction (e.g. stone)
MEN WITH CYSTITIS

• Complicated UTI by definition
• Longer course of treatment
  – 7-10 days
• Same drugs as for women with simple cystitis
  – Nitrifurantoin, fluoroquinolones, bactrim, etc
• If febrile, consider prostatitis
  – DRE
  – STD check
  – Treat appropriately based on presentation
CYSTITIS SPECIAL POPULATIONS

• Keep an extra bit of “spidey sense” in these patients due to comorbidities, communication issues, health status
  – Kids (See above upcoming slides)
  – Grandma and Grandpa
  – Diabetics as above
  – Transplant patients (immunosuppression, more susceptible to infection)
  – SNF/LTC facility residents
Grandma’s Not Right…

- 82 year old female, hx HTN, GERD, Hysterectomy, presents with new incontinence and confusion
  - No fever at home or in ED
  - Unremarkable exam except for mild confusion on the year (thinks it’s 2012) and which ED (thinks she is at DRH)
  - Urine has +LE, +Nitrites, +WBC (11/hpf), Large bacteria
ELDERLY

• Don’t bet on a fever, even in a raging UTI
  – AMS w/o fever is a very common presentation
• Nursing home residents
  – Health-care associated/acquired
  – Fewer symptoms of urinary discomfort, more AMS and fever
• May not be able to verbalize
  – “Veterinary work up”
ELDERLY

• More likely to progress to sepsis than in younger patients
• New incontinence – suspect UTI
• Many co-morbidities
• Indwelling catheters
• Men with prostate disease at increased risk
• UTI: same general pathogens (*E. coli* >80%)

• Boys > Girls as infants, esp if uncircumcised
  – Can be normal for uncircumcised male to have UTI up to one year of age (most common <6mos)

• May just be fussy or not eating
PEDS

• Fever may be only sx
  – Fever w/o clear source is UTI in ~5% of kids less than 2 years
  – Maintain clinical suspicion
– 2007 Meta-analysis
  • More than 2 days fever ≥ 38° w/o source
    – +LR 3.6 (95% CI 1.4-8.8)
  • Fever ≥ 39°
    – +LR 4 (95% CI 1.2-13)
– Even if confirm other source
  • Risk of UTI only decreases from about 6% to 3.3%
• Culture
• Urine < 1 hour old, reliable specimen
  – No LE or nitrites, send cx, follow it up, do not necessarily need to start abx
• Again, don’t jump to arranging imaging if first UTI in either gender, boys if less than 12 mos
• Hx of UTI or abnormality of GU tract
  – Esp with fever – consider imaging
  – Kids can get pyelonephritis too
PEDI STATS

<table>
<thead>
<tr>
<th>Positive Test Result--to Rule in UTI</th>
<th>Positive LR*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrite</td>
<td>25</td>
</tr>
<tr>
<td>Microscopy, bacteria</td>
<td>5</td>
</tr>
<tr>
<td>Microscopy, leukocytes</td>
<td>4</td>
</tr>
<tr>
<td>Leukocyte esterase (LE)</td>
<td>5 (approx. range 2 to 18)</td>
</tr>
<tr>
<td>Gram stain</td>
<td>19</td>
</tr>
</tbody>
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- LR > 10 helpful to increase dx certainty
- LR = 1 not helpful test result
- LR < 0.2 very helpful to rule out

- Adult literature varies more, but concept the same

http://www.cincinnatichildrens.org/assets/0/78/1067/2709/2777/2793/9199/c2dda8f2-f122-4cc4-9385-f02035d4f322.pdf
• Evidence questionable to implicate
  – Direction of wiping
  – Bubble baths
  – Nighttime enuresis
Antibiotic Choice

- **Peds Simple Cystitis**
  - Cefixime – $$$, 😊 taste
  - Keflex - $, 😊 taste
  - Bactrim - $$, ☹ taste
  - Macrobid - $, ☹️ taste

- **Peds Complicated UTI/Pyelo**
  - Cefixime, keflex, bactrim
  - Ceftriaxone - $$, IM/IV (inpatient)
  - NOT macrobid (penetration not sufficient)
TRANSPLANT

• Immunosuppressed
• Renal transplant pts at esp. high risk
• Common – estimates 50% of transplant pts have bacteruria and/or cystitis
• Often ASYMPTOMATIC
  – Like pregnant women, TREAT
  – Untreated, can progress to sepsis
    • In kidney recipients, risk graft inflammation/fibrosis
• Need close f/u w/transplant if discharged
PYELONEPHRITIS

• Review:
  – Bacterial infection of the kidneys
  – Uncomplicated: non-toxic appearing, tolerating PO
    • Can go home with close follow up
  – Complicated: The sick ones
PYELO…When Can I Send Home??

• Some EM literature criteria:
  – Stable VS (tachycardic, hypotensive and AMS is bad, right?)
  – Normal kidney function by history and labs
  – Low suspicion for obstructive pathology
  – Good pain control
  – Well hydrated
  – Tolerating PO meds and nutrition
  – NOT pregnant (unless looking fabulous and has immediate follow up)
TREATMENT

- UNCOMPLICATED Pyelo - Outpatient
  - Cipro
    - 500mg PO BID x7 days - $
      - Resistance: Consider IV cipro dose in ED before discharge, or dose of IV ceftriaxone
    - Alternative: levofloxacin 750mg PO BID x5d
  - Bactrim
    - 1 DS tab PO BID x14 days
      - High resistance makes this second line
      - IV ceftriaxone before discharge
TREATMENT

• UNCOMPLICATED pyelo - Outpatient
  – Augmentin
    • 875mg PO BID x10-14 days: $$$ w/o insurance
  – Third Generation Cephalosporins
    • Better than keflex
    • $$$
  – NO NITROFUANTOIN
    • Cannot reach effective serum or tissue concentration
So that pyelo you sent home? Yeah. S/he’s back. And Sick.

- Uncomplicated Pyelo should improve in 48-72 hours on treatment
- Sometimes fail outpatient
- Consider:
  - PYOnephrOSIS
    - Pus and obstruction: infection trapped by stone or other obstruction in collecting system
    - Emergent Drainage
      - CALL UROLOGY (or transfer if needed in community)
So that pyelo you sent home?
Yeah. S/he’s back. And Sick.

- Renal Abscess
  - parenchymal
  - +/- need for drainage

- Emphysematous Pyelonephritis
  - BADNESS
  - Diabetics
  - High mortality rate even if treated

- IMAGE THESE PATIENTS IF YOU ARE SUSPICIOUS
56 year old diabetic patient with sx of pyelonephritis and sepsis. You get a plain film, then a CT and see...
CALL IN THE CAVALRY

- Emphysematous Pyelonephritis
  - Bad, bad, bad, bad, bad, no good
    - 13-50% mortality
  - Gas-forming bacteria leading to parenchymal necrosis
  - Diabetics almost exclusively
    - High fever, flank pain, vomiting, possible large leukocytosis on CBC, elevated creatinine
    - Often also have obstructive pathology or poor kidney function
37 yo female patient, hx HTN, daily IVDA, EtOH abuse, returns 60 hours after discharge for UTI and gastritis, c/o b/l flank pain, febrile to 40.1, vomiting, but alert, smelling of EtOH. You get labs and a CT and....
RENEAL ABSCCESS

• Treat for MRSA
• Treat hemodynamic compromise PRN
• Call Urology – likely needs drainage
  – Open or percutaneous
TREATMENT

- COMPLICATED Pyelo – ADMIT
  - Ceftriaxone if pregnant
  - Piperacillin-Tazobactam
  - Imipenem
  - Meropenem
  - Ampicillin + Tobramycin
  - Vancomycin + Tobramycin OR Gentamycin

- May be septic – treat accordingly
Hey Doc, My Pee is Green!

- **Red:**
  - Blood (cystitis, myoglobin, tumors, stones, etc),
  - Rifampin, pyridium
  - Beets, blackberries and rhubarb

- **Orange:**
  - Rifampin, pyridium, sulfasalazine
  - Dehydration

- **Blue/Green:**
  - Amitriptyline, indomethacin, and propofol (prolonged use)
  - Dye from diagnostic testing
  - Food dyes

- **Dark Brown:**
  - Chloroquine and primaquine, antibiotics metronidazole and nitrofurantoin, senna, and methocarbamol
  - Aloe, fava beans, rhubarb
BIOMARKERS

• Swiss study
  – Proadrenomodullin and urea
    • Impact on admission decisions for pt’s w/UTI
    • Predict adverse outcomes
      – Transfer to ICU, death, UTI recurrence, any rehospitalization
    • Both higher on inpatients compared to outpatients
      – Combination of both low sends more ppl outpt, no increase in adverse events
      – proADM may be better in renal pts
    – proADM overall more predictive
  • May be worth more investigation
To Treat or Not to Treat, That is the Question

- 26 yo female, 22 weeks pregnant, no urinary tract symptoms
  - Color: Yellow
  - Clarity: clear
  - pH: 6.8
  - Protein: negative
  - Glucose: negative
  - Ketones: negative
  - Bilirubin: negative
  - Blood: negative
  - Leukocyte Esterase: negative
  - Nitrites: negative
  - WBC/hpf: none
  - RBC/hpf: 1
  - Casts: none
  - Squamous Epith. Cells: 2
  - Bacteria: moderate
To Treat or Not to Treat, That is the Question

- 34 yo female, mild suprapubic discomfort x2 days

- **Color**: Yellow
- **Clarity**: hazy
- **pH**: 6.5
- **Protein**: negative
- **Glucose**: negative
- **Ketones**: negative
- **Bilirubin**: negative
- **Blood**: small
- **Leukocyte Esterase**: negative
- **Nitrites**: positive

- **WBC/hpf**: 6
- **RBC/hpf**: 6
- **Casts**: none
- **Squamous Epith. Cells**: 2
- **Bacteria**: few
To Treat or Not to Treat, That is the Question

- 29 yo female, fever to 38.7, cough and CXR suggestive of atypical pna. UCG negative, no urinary complaints

  - **Color**: Yellow
  - **Clarity**: clear
  - **pH**: 6.8
  - **Protein**: negative
  - **Glucose**: negative
  - **Ketones**: negative
  - **Bilirubin**: negative
  - **Blood**: negative
  - **Leukocyte Esterase**: negative
  - **Nitrites**: negative
  - **WBC/hpf**: none
  - **RBC/hpf**: 2
  - **Casts**: hyaline
  - **Squamous Epith. Cells**: 2
  - **Bacteria**: moderate
To Treat or Not to Treat, That is the Question

- 16 yo female, febrile to 40.1, HR 110, left flank pain, vomiting, WBC 17,000
  - Color: Dark yellow
  - Clarity: cloudy
  - pH: 7
  - Protein: negative
  - Glucose: negative
  - Ketones: negative
  - Bilirubin: negative
  - Blood: negative
  - Leukocyte Esterase: positive
  - Nitrites: positive

  - WBC/hpf: 121
  - RBC/hpf: 150
  - Casts: none
  - Squamous Epith. Cells: 1
  - Bacteria: large
To Treat or Not to Treat, That is the Question

- 41 yo male, in ED after unintentional APAP overdose for his chronic pain. No urinary sx.
  - **Color**: Yellow
  - **Clarity**: clear
  - **pH**: 6.8
  - **Protein**: negative
  - **Glucose**: negative
  - **Ketones**: negative
  - **Bilirubin**: negative
  - **Blood**: negative
  - **Leukocyte Esterase**: positive
  - **Nitrites**: negative
  - **WBC/hpf**: 75
  - **RBC/hpf**: 5
  - **Casts**: none
  - **Squamous Epith. Cells**: none
  - **Bacteria**: none
To Treat or Not to Treat, That is the Question

• 12 month old uncircumcised male with fever to 39.1, no other clear source of fever. History UTI x1, E. coli sensitive to cefixime. Straight cath specimen
  
  - **Color**: Yellow
  - **Clarity**: hazy
  - **pH**: 6.7
  - **Protein**: negative
  - **Glucose**: negative
  - **Ketones**: negative
  - **Bilirubin**: negative
  - **Blood**: none
  - **Leukocyte Esterase**: positive
  - **Nitrites**: positive
  
  - **WBC/hpf**: 4
  - **RBC/hpf**: 1
  - **Casts**: hyaline
  - **Squamous Epith. Cells**: 0
  - **Bacteria**: moderate
To Treat or Not to Treat, That is the Question

• 71 yo male with known BPH, HTN on HCTZ, no other problems, c/o aching abdominal pain. Afebrile.

- **Color**: Yellow
- **Clarity**: clear
- **pH**: 4.9
- **Protein**: negative
- **Glucose**: negative
- **Ketones**: 1+
- **Bilirubin**: negative
- **Blood**: moderate
- **Leukocyte Esterase**: negative
- **Nitrites**: positive

- **WBC/hpf**: 3
- **RBC/hpf**: 10
- **Casts**: none
- **Squamous Epith. Cells**: 0
- **Bacteria**: moderate
To Treat or Not to Treat, That is the Question

- 45 yo male paraplegic from a spinal cord GSW in 2007, presents with indwelling suprapubic catheter c/o vomiting and diarrhea x2 days. Overall well appearing, afebrile, AOx3.

- **Color**: Yellow
- **Clarity**: hazy
- **pH**: 6.5
- **Protein**: negative
- **Glucose**: negative
- **Ketones**: 1+
- **Bilirubin**: negative
- **Blood**: moderate
- **Leukocyte Esterase**: negative
- **Nitrites**: negative

- **WBC/hpf**: 13
- **RBC/hpf**: 2
- **Casts**: hyaline
- **Squamous Epith. Cells**: 0
- **Bacteria**: large
To Treat or Not to Treat, That is the Question

- 51 yo female diabetic with burning dysuria and vaginal discharge. Sexually active with several male partners.
  - Color: Yellow
  - Clarity: cloudy
  - pH: 6.4
  - Protein: 1+
  - Glucose: 2+
  - Ketones: negative
  - Bilirubin: negative
  - Blood: small
  - Leukocyte Esterase: positive
  - Nitrites: positive
  - WBC/hpf: 15
  - RBC/hpf: 21
  - Casts: none
  - Squamous Epith. Cells: 18
  - Bacteria: moderate
To Treat or Not to Treat, That is the Question

- 21 yo female with vague suprapubic discomfort, myalgias, rhinorrhea, cough.
  - **Color**: Yellow
  - **Clarity**: clear
  - **pH**: 7.1
  - **Protein**: 0
  - **Glucose**: 0
  - **Ketones**: negative
  - **Bilirubin**: negative
  - **Blood**: small
  - **Leukocyte Esterase**: negative
  - **Nitrites**: negative
  - **WBC/hpf**: 1
  - **RBC/hpf**: 2
  - **Casts**: hyaline
  - **Squamous Epith. Cells**: 22
  - **Bacteria**: large
A Case:

- 46 yo healthy male presents c/o R flank pain radiating to his right testicle. Began about 3 hours ago, is the worst pain he has ever had. Waxes and wanes. Vomiting.
  - Patient is writhing in pain in 234. He is pale, clammy. Afebrile. Hypoactive bowel sounds
  - You examine his genitalia and find it to be normal in appearance, size, no lumps, and non-tender. No abnormalities.
  - His urine is positive for microscopic blood
UROLITHIASIS

• Incidence on the rise
  – All age groups
• Generally young adults, middle aged men
  – 70% of ureteral calculi (origin: kidney) between ages 20-50
• Asymptomatic usually, until they obstruct or decide to take a trip down Ureter Lane
• The major cause of progressive renal damage from stones is infection, and stones themselves can LEAD to infection (trapped bacteria)
“Ow, ow ow!”

- PAINFUL
  - Have heard women describe it as more painful than natural vaginal birth

- Sudden onset, +/- colicky
  - Flank, abdominal and/or testicular or labial pain

- Many causative factors

- Pass spontaneously or may require surgical intervention

- Obstructive stones may lead to infection
RISKY BUSINESS III

- Hx: personal or family
- Men: white more than black
- Dehydration and/or desert living
- Metabolic pathology
  - Recurrent UTI
  - Sarcoidosis
  - Gout
  - Laxative abuse (dehydration)
  - RTA type I
  - Crohn’s
  - Primary hyperparathyroid
  - Hyperuricosuris
  - Hypernitraturia
  - Milk-alkali syndrome
UROLITHIASIS

- Calculi secondary to UTIs most commonly occur in women who experience recurrent UTIs with *Proteus*, *Pseudomonas*, and *Providencia* species.
Do You Have the Stones??

• Calcium Oxalate
  – 75%
  – +/- Calcium phosphate component
  – Heavy dairy consumption (>1 quart milk/day)
  – Hyperparathyroidism
    • 67% of patients
  – PUD (wasn’t this on the MRE?)
    • Patients take in extra Ca++ with food
  – Crohn’s/UC/radiation
    • Leads to hyperoxaluria from bowel disease
Do You Have the Stones??

- Magnesium-ammonium-phosphate (Struvite)
  - 15%
  - A.K.A. “Infection Stones”
    - Almost always associated with UTI
      - Urea-splitting organisms
        » Proteus, Klebsiella, Pseudomonas, Staph, Providencia
  - Often staghorn form
  - “coffin-lid” crystals on microscopy
History Matters…

- 34 yo female, history of frequent UTI and new/different flank pain radiating to groin. CT shows b/l, non-obstructing stones.
  - Stones may be FROM infection, but they can also complicate
    - UTI with presence of stones = difficulty with sterilizing urinary tract (bugs like to hang out in stones)
Do You Have the Stones??

- Uric Acid = 10% of stone in the U.S.
  - Excess uric acid in the urine
  - Gout patients
  - Risk increases with use of uricosuric agents
  - RADIOLUCENT (others generally radio-opaque)
  - Rarely staghorn
Do You Have the Stones??

• Cystine Stones
  – Rare – only 1%
  – Inborn error of metabolism
    • May see in kids
  – Often Staghorn
Differential: Pain suggestive of Urolithiasis

• Large
  – **RENAL**: Renal infarcts, tumors, blood clots, pyelonephritis,
  – **URETER/URETHRA**: Urothelial tumors, ureteral strictures, mets, Urinary retention
  – **ABDOMEN**: Peritonitis, Biliary colic, SBO
  – **VASCULAR**: AAA, SMA thrombosis
  – **FEMALE GU**: Cervical ca, endometriosis, ovarian vein thrombosis
  – **MALE GU**: testicular torsion, epididymitis, tumors
  – **MSK**: strain, sprain
Okay, so you suspect a stone

- UA
  - No RBC’s does NOT mean no stones (10-20% of patients will not have blood on UA)
    - Can still have severe obstruction w/o RBC’s
  - Most hospitals don’t examine crystals routinely

- BUN/Creatinine
  - Not mandatory for previously healthy pts
  - *Must do if hx single kidney or renal insufficiency*
Okay, so you suspect a stone

• CBC
  – Only utility in case where strongly suspect stone is if patient also looks infected

• Calcium/Phos
  – May point to underlying pathology (Sarcoidosis, hyperparathyroid), but not critical to ED workup for nephrolithiasis
Is a Picture Worth 1,000 Words?

• If story is classic, patient non-toxic and has history of similar, may treat clinically, no image

• Suspect infection or pt with atypical sx or suspect a significant obstruction → Image

• Non contrast CT is standard in US
  – Sn = 97%, Sp = 96%
  – Calculi as small as 1mm, but may underestimate stone size
Is a Picture Worth 1,000 Words?

- Intravenous Pyelography
  - Out of favor since CT
  - 96% sensitive
  - Can quantify degree/severity of obstruction
  - Can’t use in renal insufficiency patients
  - May take TWO HOURS to perform
Is a Picture Worth 1,000 Words?

• Ultrasound
  – No radiation
  – Poor sensitivity for stones smaller than 5mm, ureteral stones
    • Overall sensitivity 37-64%
  – GREAT for hydronephrosis (Sn 85-94%, Sp 100%)
  – Can use in obese persons who don’t fit the CT
Do SOMETHING, Doc!

- NSAIDs = first line
  - Toradol in ED (if pt vomiting from pain, can’t give PO)
  - Decreases ureterospasm, also decreases renal capsular pressure by decreasing GFR
    - Watch out in pt’s w/renal disease (ok, so NSAIDs are out in Detroit)
- Antiemetic PRN
- Narcotics for refractory pain; IV in ED, PO for home
Do SOMETHING, Doc!

- **MEDICAL EXPULSIVE THERAPY**
  - $\alpha$ – antagonism and calcium channel blockade
    - Tamsulosin (Flomax) or nifedipine (Adalat)
      - Off label use
    - Help distal stones come out, decrease time for higher stone passage
    - Block ureteral smooth muscle contraction
  - Data is for stones <5mm
  - Decreases narcotic use, return to ED, and admissions for colic
  - We should do this more
• Home with a strainer
  – Save sediment to take to a urologist for analysis
  – If no strainer, pee into jar, let settle, look for sediment. If none, toss. Repeat

• Home with pain control, ?MET
  – Naproxen or Ibuprofen
  – Likely opiate also

• Zofran
Home Again, Home Again, Jiggity, Jig

• PRECAUTIONS
  – Save sediment for analysis
    • Need Urology follow up
  – Hydrate

• Return to ED
  – Intractable pain, nausea/vomiting
  – Fever or chills
  – Difficulty voiding
A Word On Kids

- Most common stone still Calcium Oxalate
- Hypercalciuria
  - Prolonged immobilization
  - Hyperparathyroid
  - Prolonged use of steroids
  - Loop diuretics
  - Neoplasms (including lymphoma/leukemia)
  - MOST COMMON = IDIOPATHIC
- UTI less likely to lead to stones that adults
A Word On Kids

• DIET!
  – High animal protein
  – Salt
  – Refined carbohydrates (white flour)
  – Soda (phosphoric acid)

• Anatomic abnormalities
  – Vesicoureteral reflux
  – UPJ or UVJ obstruction
  – Neurogenic bladder

Happy Meal, anyone?
A Word On Kids

• Medical Conditions
  – Some like adults
    • Distal RTA
    • UC or Crohn’s
    • Hyperparathyroid
    • Cancers
  – Some more common in kids
    • Cystic Fibrosis
    • Wilson Disease
    • Lesch-Nyhan Syndrome
A Word On Kids

• Work-Up
  – UA, Ucx
  – Lytes, calcium, phos, mag
  – CT if suspicious for obstruction or cannot r/o other pathology
A Word On Kids

• ED TREATMENT
  – Aggressive hydration
    • 1.5-2x maintenance IVF
  – Pain control (morphine and toradol)
  – Admit with intractable pain or vomiting or infection
  – Not many studies on α-blockade in kids
A Word On Kids

• Sending Home
  – Need Urology and/or Nephrology follow up
  – Stress importance of hydration to parents
  – DIET CHANGES
    • Low protein, low sodium, high potassium
    • No soda pop
  – If child has failed outpatient, can try thiazides or potassium citrate IF in consult with a pediatric Nephrologist
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