Urinary Tract Infections

Jaime Stevenson PA-C

UTI

- Most common bacterial infection
- 7 million office visits
- 1 million ER visits

UTI

- Infection is a result, bacteria in and of themselves can do nothing except be in contact with living tissue and then, often, only under highly specialized conditions, a problematic infection occurs

Definition

- An inflammatory response of the urothelium to bacterial invasion
  - Usually associated with bacteriuria
    - Presence of bacteria in an otherwise free urine
  - Usually associated with pyuria
    - > 10 WBC/hpf

Bacteriuria

- May represent contamination
- Symptomatic or asymptomatic

Pyuria

- Presence of white blood cells in the urine
- Bacteriuria without pyuria usually indicates colonization without UTI
- Pyuria without bacteriuria may indicate TB, stones, cancer

Urinalysis

- Dipstick Urinalysis
- Urine Microscopy
- Urine Culture
- Urine Cytology

Urinalysis

- Usually void of bacteria or inflammation
- False-positives
  - Pyridium
  - Contamination
- False-negatives
  - Early in infection
  - Dilution
  - Diuresis

Hematuria

- Dipstick Hematuria
- Microscopic Hematuria
  - 3 or more RBCs/hpf
- Red Flags
  - UTI
  - Stones
  - BPH
  - Neoplasm

Dipstick Urinalysis

- Leukocyte esterace
- Nitrites
  - By product of bacteria
  - Typically indicates acute cystitis/pyelo
- Red Blood Cells
  - This should prompt you to do microscopy

Urine Microscopy

- Bacteriuria
  - Sensitivity 40-70%, Specificity 85-95%
- Pyuria
  - >10 WBCs/ hpf
  - Sensitivity 95%, specificity 70%

Urine Culture

- Most definitive test
- Presence of $>10^5$ CFU/ml
- Antimicrobial Sensitivities given
- Not always needed for initial, symptomatic UTI
- Indicated if:
  - Recurrent
  - Symptoms of pyelonephritis
  - Urinalysis not definitive

Pathogenesis

- Virulence factors of bacteria
- Inoculum size
- Inadequacy of host defense mechanisms
- These all play role in determining level of colonization and damage to system

Routes of Infection

- Ascending
  - Vaginal
  - Fecal
- Hematogenous Route
  - Not common
  - *Staph aureus* from oral sites
  - Candida
- Lymphatic
  - Severe bowel infection
  - Retroperitoneal abscesses

Pathogens

- Anaerobes (from bowel flora)
- *E. coli*
  - *85% community acquired*
  - *50% hospital-acquired*
- *Community acquired*
  - *Proteus*
  - *Klebsiella*
  - *S. saprophyticus*
- *Nosocomial Infection*
  - *Klebsiella*
  - *Enterobactor*
  - *Serratia*
  - *Pseudomonas*

Natural Defenses

- *Lactobacilli, coagulase-negative staphylococci, cornyeobacteria, streptococci*
  - Barriers to uropathogenic colonization
- Changes to vaginal environment
  - Estrogens changes
  - Spermicides
  - Antimicrobial agents
  - Vaginal pH

Alterations in Host Defenses

- Obstruction
  - Increases host susceptibility
- Vesicoureteral reflux
- Diabetes mellitus (in women only)
- HIV
- Pregnancy
- Neurogenic bladders (MS, Spinal cord injuries)
  - High pressure systems

Abnormal Urinary Tracts

- Structural Abnormalities
  - Obstruction (stones, BPH, diverticulum)
  - Posterior Urethral valves
  - Vesicoureteral reflux
- Functional abnormalities
  - Renal disease (reduce concentrating ability)
  - Neurogenic bladders (spinal cord injuries, MS)

What type of UTI?

- *Isolated:* first UTI or remote since last one
- *Unresolved:* did not respond to abx
- *Recurrent:* documented UTI after documented successful resolution of infection
- *Bacterial Persistence:* Recurrent UTI caused from abnormality of urinary tract (stones, prostate)

At what level?

- Cystitis
- Pyelonephritis

Cystitis

- Syndrome of symptoms
  - Dysuria
  - Frequency
  - Urgency
  - Nocturia
  - Incontinence
  - Suprapubic pain
  - Not always infectious
- Asymptomatic

Types of Cystitis

- Not always infection……
- Interstitial cystitis
- Urethritis
- Vagina infections
- Bladder cancer
- Stones (at any level)

Pyelonephritis

- Acute
  - Fever, chills, flank pain
  - Leukocystosis
  - Bacteriuria, pyuria
- Chronic
  - Cortical renal scarring
  - Diagnosed on x-ray
  - Usually not infected

Cystitis
Uncomplicated vs. Complicated

- Uncomplicated
  - Infection in a healthy person
  - Normal function and urinary tract function
- Complicated
  - Abnormal urinary tract
  - Immunocompromised
  - Bacterial resistance or increased virulence
  - Men > females
  - Pregnancy
  - Diabetes
  - Elderly
  - Use of Catheters

Cystitis
Uncomplicated UTI treatments

- Typically three days in women, 7 days in men
- Nitrofurantoin
  - Well-tolerated
  - Can cause intestinal upset
  - Excreted mainly in urine
  - Better for 5 days
- TMP-SMX
  - Women 16% resistance in reinfection if treated recently
- Fluoroquinolones
  - Resistance <5%
  - Twice daily and extended release equally affective
  - Should be limited in uncomplicated patients

Treatment of uncomplicated UTI

- May not be obvious at first but may be evident if hard to treat to appropriate therapy
- Urine culture mandatory
- Mild-to moderate illness
  - Oral fluoroquinolones
  - TMP-SMX
- Ill patients
  - Hospitalization
  - IV Gentamicin plus ampicillin
  - Modify according to susceptibility
- 10-14 days of treatment
- Repeat urine cultures 1-2 weeks off abx

Cystitis Differential Diagnosis

- Urethritis
  - Dysuria, urethral d/c, sexual hx
  - STD's
- Vaginitis
  - Vaginal d/c and/or, irritative voiding sx's, sexual hx
  - PE: d/c of inflammatory cells,
  - Herpes, Chlamydia, gonorrhea, BV, trichimoniasis, yeast

Asymptomatic Bacteriuria

- Positive culture in an asymptomatic patient
- *E.coli* most common
- Not shown to be harmful in healthy adults
- Treat if risk for adverse outcomes is high
  - Pregnancy
  - Undergoing GU surgeries

Unresolved UTI

- Initial therapy inadequate in eliminating symptoms or bacterial growth
- Urine culture to be done if sx's not resolved or return very shortly after Abx tx
- Possible causes:
  - Bacterial resistance to Abx
  - Development of resistance
  - 2 different bacteria with diff. susceptibilities
  - Reinfection with new, resistant species
  - Papillary necrosis, analgesic abuse
  - Staghorn calculus
  - Azotemia (difficult to get high conc. of abx)

Unresolved UTI

- Further studies – appropriate abx chosen
- Treatment
  - Empirical different abx from the first chosen
  - Fluoroquinolones
- Repeat urine culture* important*

Recurrent UTI

- Bacterial persistence
  - Same organism each time
  - Infection occur closely
  - Something in urinary tract as cause
- OR new infection outside urinary tract (Reinfection)
  - Different species
  - Varying interval in between
  - Require long term treatment, sometimes no obvious abnormalities
  - Men can have urethral stricture, cysto recommended

Bacterial Persistence
Possible Causes

- Infected stones
- Chronic Prostatitis
- Ureteral duplication
- Foreign bodies
- Urethra diverticulum, periurethral glands
- Medullary sponge kidney
- Infected urethral cysts
- Vesicovaginal fistula

Struvite Stones

- Infected stones
- Recurrence immediate after stopping abx
- *Proteus mirabilis* most commonly seen
  - Causes alkalinization of urine with precipitation of calcium, magnesium, ammonium and phosphate salts
  - Bacteria persists in stone even if urine negative
- Patients at high risk
  - Indwelling catheters
  - Urinary diversions
  - Other obstructive abnormalities
- Treatment with continuous suppressive therapy and surgery

Bacterial Persistence

- CT IVP
- Cystoscopy
- Retrograde pyelogram
- Voiding cystourethrogram (VCUG)
- Remove or surgical repair of underlying cause

Reinfections

- Most common in women, girls from ascending infections (bowel)
- Men = urinary abnormalities
- Vesicovaginal or vesicoenteric fistula?
  - Hx of pneumaturia, fecaluria, diverticulitis, pelvic surgery, obstipation, radiation therapy

Reinfections

- Risk Factors
  - Diabetes
  - Incomplete bladder emptying
  - Stricture
  - Stones
  - Obstructive symptoms
- Need to identify cause/route of infection
  - Intercourse
  - Spermacides
  - Diaphragms
  - Atrophic vaginitis (decreases lactobacilli = increased *E.Coli*)
  - Prolapse

Post-coital Infections

- Infections clearly related to sexual activity
- Behavioral modifications
  - Voiding with sufficient stream afterwards
  - Wiping front to back
  - Eliminate douching and tub baths
- Peri-coital antibiotics
  - Pre- or post- antibiotic treatment
  - Nitrofurantoin 100 mg, Septra DS, Kelfex 125 or 250 mg

Prophylactic Antibiotics

- Effect on Bowel and Vaginal flora
- Eliminate bacteria and doesn't cause resistance
- Best choices:
  - Nitrofurantoin
    - Only affects vaginal flora
  - Trimethoprim alone or TMP-SMX
    - Eliminates both vaginal and rectal flora
  - Fluoroquinolones
  - Cephalexin (small dose)
    - No bowel flora resistance at low dose

Effect of prophylaxis therapy

- 95 % decrease in recurrent rates
- Given at night
- Anywhere from 6-12 months
- Started after negative urinalysis
  - Recommend repeat urine culture after abx
- If breakthrough infection, further work-up may be indicated
  - May be asymptomatic, monitor urine q 1-3 months
- Urinary antiseptics can be used, not as effective
  - Methenamine mandelate

Self-start Intermittent therapy

- Given script for antibiotics to self-treat when symptomatic
- Broad-spectrum abx preferred (ie fluoroquinolones)
- Not always recommended without cultures

Other methods

- Cranberry Juice
  - Blocks adherence of bacteria to bladder epithelium
  - Low-risk patients consuming 200-750 ml daily or cranberry –concentrate tablets May reduce the risk of symptomatic, recurrent infection by 12% to 20%
  - Content can vary therefore results vary
  - Controversial

Pediatric UTIs

Pediatric UTIs

- Must have adequate urinalysis and culture
- Avoid Delay in diagnosis
  - May cause significant scarring
- Treat empirically immediately and then confirm specific antimicrobial therapy ASAP via culture

Pediatric Treatment

- Oral antibiotics for most non-toxic
  - 10 day course 82% effective (3 day course only 55%)
- IV antibiotics if toxic

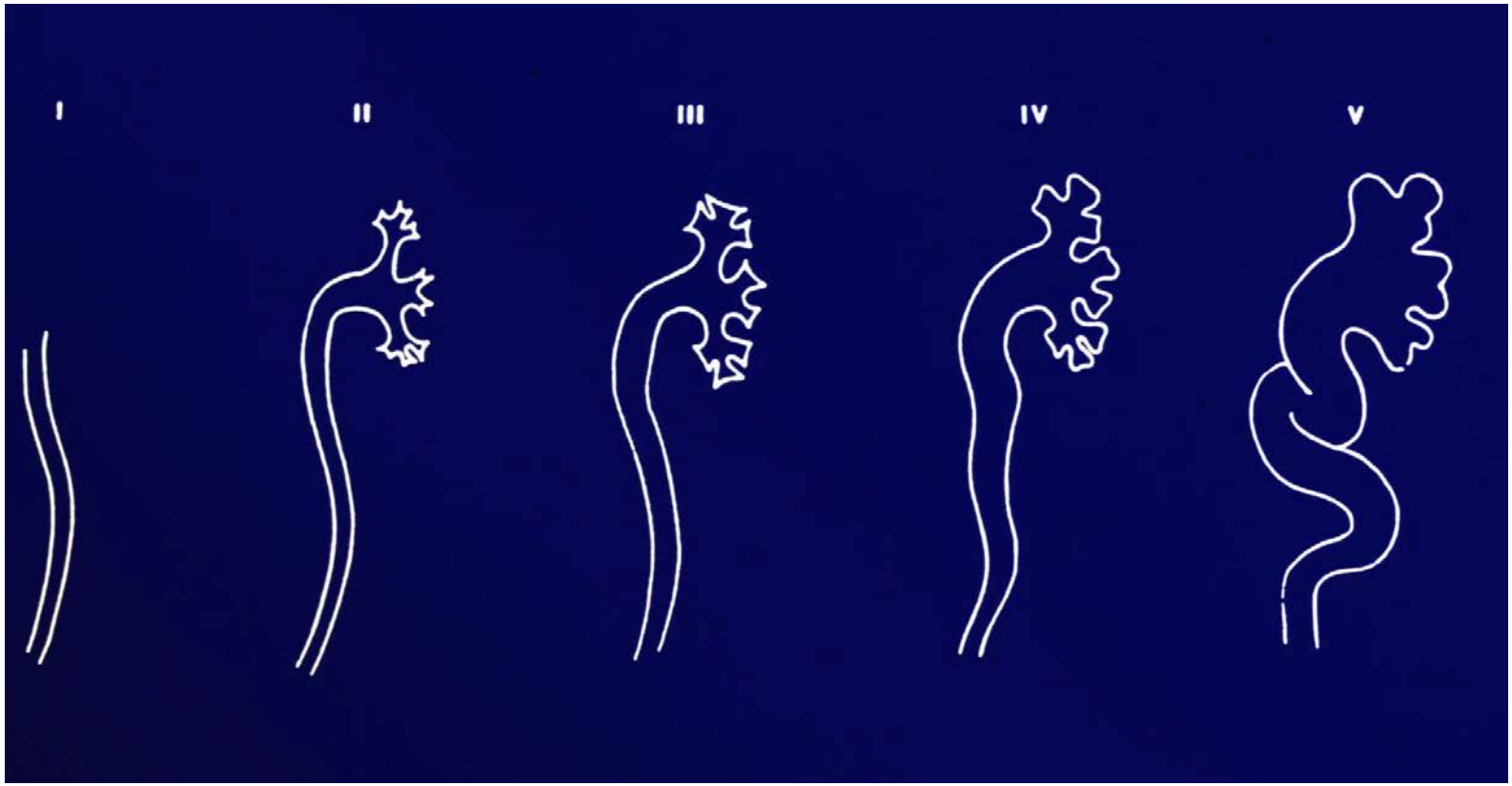
Pediatrics
Why Image?

- Altered Host Anatomy
  - VUR in 1/3 children with UTI.
  - Scarring in 12% with UTI. (especially early)
  - Scarring in 1/3 with UTI and VUR.
- Hydronephrosis
  - UTI often first sign of urinary tract obstruction.
  - Progressive renal damage with obstruction.

Pediatrics
Method of Cystography

- Fluoroscopic Voiding Cystourethrogram
  - Anatomic evaluation of bladder, ureters and urethra.
    - Precise grading of VUR
    - Detection of other pathology (PUV, ureterocele)
- Nuclear Voiding Cystourethrogram
  - Continuous imaging.
  - Less radiation exposure

Vesicoureteral Reflux



Pediatric UTI
Renal Scarring

- Renal Sonography
  - Good screen for hydronephrosis
  - Bad screen for mild scarring
- DMSA Renal Scintigraphy
  - Twice as sensitive for scar detection.
  - May help in localizing pyelonephritis.
  - Not available everywhere.

Pediatric UTI
Follow-up studies

- International Reflux Study: 80% resolution of low-grade VUR over 5 years,
- Resolution occurs but takes years.
- Renal sonography and VCUG every 18 months

Pediatric
Surgical correction of VUR

- Indications
  - Breakthrough UTI despite antibiotic prophylaxis.
  - Poor tolerance or compliance with antibiotics.
  - High Grade VUR (Grade IV-V)
  - Progression of scarring
- Relative Indications
  - Persistence of VUR into adolescence.
  - Poor renal growth.
  - Parental preference