URINARY TRACT INFECTIONS
INTRODUCTION

• Most common serious bacterial infection in young children
• 5% of febrile infants
• Prevalence
  • In 1st year: M : F :: 2.8-5.4:1
  • >1 year, striking female predominance, M:F :: 1:10
  • Higher in uncircumcised boys
DEFINITION UTI

- Tissue response to the presence of significant proliferating bacteria in the urine
- Includes infection of any component of the urinary tract including
  - Pyelonephritis
  - Cystitis
  - Urethritis
- Asymptomatic bacteriuria: a positive urine culture without any urinary symptoms, common in adolescent girls
DEFINITIONS

• Simple UTI: UTI with low grade fever, dysuria, frequency, and urgency; and absence of symptoms of complicated UTI

• Complicated UTI: Presence of fever >39ºC, systemic toxicity, persistent vomiting, dehydration, renal angle tenderness and raised creatinine.

• Recurrent infection: Second episode of UTI.
DEFINITIONS

• Significant bacteriuria: Colony count of 100,000 /mL of a single species in a midstream clean catch sample.

• Asymptomatic bacteriuria: Significant bacteriuria in the absence of symptoms of urinary tract infection (UTI).
ETIOLOGY

• Majority caused by bacteria: most important Enterobacteriaceae: family of gram-negative bacilli.

• >80% acute UTIs caused by: Escherichia coli

• Other causes
  • Proteus mirabilis
  • Klebsiella pneumoniae
  • Pseudomonas aeruginosa

• Less common: Gram-positive cocci
  • Enterococcus and Staphylococcus saprophyticus
OTHER CAUSATIVE ORGANISMS

**Fungal infections**, particularly Candida, usually in:

1. Nosocomial Infections
2. Complicated UTI
3. Catheter-associated UTI

**Viral infections**-under-recognized because of difficulties with culture and identification, but have been associated with cystitis, esp. adenovirus

*Cytomegalovirus* frequently seen in immunocompromised patients, particularly following organ transplantation.
PATHOGENESIS

Ascending infection:
• Bacteria from fecal flora colonize perineum and enter bladder via urethra.
• In uncircumcised boys: pathogens arise from flora beneath the prepuce
• Rarely, bacteria causing cystitis ascend to the kidney to cause pyelonephritis

Hematogenous infection- unusual
• Neonates (GBS, E. coli, Listeria)
• GI disease with peritonitis, sepsis
• Severely ill children with multi-organ disease
• Presence of urinary catheter
HOST FACTORS THAT PREDISPOSE TO UTI

Age
• Uncircumcised boys
• Female infants
• Race/ethnicity

Urinary obstruction
• Neurogenic Bladder
• Dysfunctional elimination
• Vesicoureteral reflux

Sexual abuse

Bladder catheterization

Unsubstantiated risks
• Bathing
• Back-to-front wiping
CLINICAL FEATURES

**Neonates**- Poor feeding, Jaundice, Vomiting, Lethargy, Irritability, failure to gain weight and Fever +/-

**Infants**- Fever, painful micturation, Diarrhoea, foul smelling diapers, vomiting etc

**Child** - Fever without focus Nausea, vomiting, abdominal pain, dysuria, day time urgency-frequency hesitancy incontinence secondary enuresis cloudy urine and Rarely-flank pain
OTHER IMPORTANT PAST HISTORY

• Chronic urinary symptoms
  • Incontinence, lack of proper stream, frequency, urgency, withholding maneuvers

• Previous undiagnosed febrile illnesses

• Chronic constipation

• Previous UTI

• Vesicoureteral reflux (VUR)

• Antenatally diagnosed renal abnormality

• Elevated blood pressure

• Poor growth
FAMILY HISTORY

• Frequent UTI

• VUR

• Genitourinary abnormalities

• Renal failure.
EXAMINATION- PHYSICAL EXAMINATION

• Documentation of blood pressure and temperature.
• Growth parameters
• Abdominal masses-bladder, constipation, renal
• Perineum & genitalia
• Girls-labial adhesions, vulvovaginitis
• Boys-presence & condition of foreskin, stricture at meatus
• If incontinent-spine, perineal sensation, anal tone, power & sensation in lower limbs
• Sexual abuse
INVESTIGATIONS

• Urine

• Blood

• Imaging
URINE

• Dipstick

• Microscopy

• Culture & sensitivity
HOW TO COLLECT URINE ???

- Midstream clean catch
- Bag Collection
- Catheterization
- Suprapubic aspiration
COLLECTION OF SPECIMEN FOR CULTURE

• Child-Clean-catch midstream specimen

• **Neonates and infants:** urine sample is by suprapubic aspiration or transurethral bladder catheterization.

• Urine specimen should be promptly plated within one hour of collection.

• If delay sample can be stored in a refrigerator at 4ºc for up to 12-24 hours.
SUSPECTED UTI

- **Leucocyturia** – WBC (Pus cells)
  Uncentrifuged > 10 /mm3  Centrifuged > 5 / hpf
  (can occur in Fever, GN, Stones, FB in urinary tract)

- **Urinary enzymes**: Leucocyte esterase, Nitrite
  (combined: Moderate sensitivity and specificity)
# URINE CULTURE - SIGNIFICANCE

<table>
<thead>
<tr>
<th>Method</th>
<th>Colony count</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suprapubic</td>
<td>Any number</td>
<td>99%</td>
</tr>
<tr>
<td>Catheter</td>
<td>$&gt; 50 \times 10^3$</td>
<td>95%</td>
</tr>
<tr>
<td>Midstream</td>
<td>$&gt; 10^5$ CFU/ml</td>
<td>90-95%</td>
</tr>
<tr>
<td>Bag specimen</td>
<td></td>
<td>Unacceptable</td>
</tr>
</tbody>
</table>

(lower counts significant if symptoms persistent, antibiotics, diuretics)

*Note:* Prompt plating of the urine sample Or refrigeration until plated
Contamination is suspected, *e.g.*, mixed growth of two or more pathogens,

Growth of organisms that normally constitute the periurethral flora (lactobacilli in healthy girls; enterococci in infants).

UTI is strongly suspected but colony counts are equivocal.
MANAGEMENT

• Relief of acute symptoms

• Treatment of infection

• Identification of any underlying abnormalities
  • prevention of recurrence
  • prevention of long-term complications
MANAGEMENT

• Initiate immediately after culture drawn: Reduces severity of renal scarring

• Empirical initially - change as per culture & sensitivity reports

• Older children, otherwise well, cystitis: oral therapy x 7 days
ORAL ANTIMICROBIALS - UTI

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose [mg/kg/day]</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefixime</td>
<td>8-10, BID</td>
<td></td>
</tr>
<tr>
<td>Coamoxiclav</td>
<td>30-35 BID</td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>10-20, BID</td>
<td></td>
</tr>
<tr>
<td>Ofloxacin</td>
<td>15-20, BID</td>
<td></td>
</tr>
<tr>
<td>Cephalexin</td>
<td>50-70, BID</td>
<td></td>
</tr>
</tbody>
</table>
DURATION OF TREATMENT

• Infants and children in complicated UTI: 10-14 days.

• Simple UTI: 7-10 days.

• Adolescents with cystitis: 3 days

• Following treatment prophylactic antibiotic therapy is initiated in children below 1 year of age.
MANAGEMENT

Intravenous therapy indicated -
• Dehydrated, Vomiting
• Unable To Drink Fluids
• <1 Mo Of Age
• Suspected Urosepsis

Duration 10-14 days

Initially: Inj Ceftriaxone (50-75 mg/kg/24 hr, not to exceed 2 g)

OR

Inj Ampicillin (100 mg/kg/24 hr) + an aminoglycoside
e.g. Inj. Gentamicin (3-5 mg/kg/24 hr)
FURTHER INVESTIGATIONS

Indications:

1. Girls 2 years of age with a first UTI

2. Boys of any age with a first UTI

3. Children of any age with a febrile UTI

4. Children with recurrent UTI

5. First UTI in a child of any age with an abnormal voiding pattern, poor growth, hypertension, family history of renal disease
• Aim of investigations is to identify patients at high risk of renal damage.

• Chiefly those below one year of age, and those with VUR or urinary tract obstruction, includes ultrasonography, dimercaptosuccinic acid (DMSA) scan, micturating cystourethrography (MCU).
• Provides information on kidney size, number and location.
• Presence of hydronephrosis.
• Urinary bladder anomalies and post-void residual urine.
• Ultrasonography should be done in all patient with diagnosis of first UTI.
VOIDING CYSTOURERETROGRAM (VCUG)

Indicated

• Vesicoureteric reflux
• Bladder outlet obstruction
• Other anomalies
MICTURATING CYSTOURETHROGRAPHY (MCU)

- Main indication in children is urinary tract infection.
- MCU is recommended 2-3 weeks after treatment.
- MCU detects Vesicoureteric Reflux (VUR).
- Provides anatomical details regarding the bladder and the urethra.
VUR - GRADING

GRADING SYSTEM

Grade I  Into nondilated ureter
Grade II  Into pelvis and calyces without dilatation
Grade III  Mild to moderate dilatation of ureter and renal pelvis
Grade IV  Moderate dilatation and/or tortuosity of ureter
Grade V  Severe dilatation and tortuosity of ureter, renal pelvis, and calyces
NUCLEAR IMAGING: DMSA SCAN
TECHNETIUM-LABELED 2,3-DIMERCAPTOSUCCINIC ACID

1. To confirm acute pyelonephritis

2. For assessment of renal scarring
DMSA RENAL SCAN

• DMSA scan is carried out 2-3 months after treatment.

• Early DMSA scan soon after a UTI, is not recommended.

• DMSA is a sensitive technique for detecting renal parenchymal infection and cortical scarring.
Immediate complications

- Sepsis
- Perinephric abscess

Long term sequelae

- Renal scar
- Hypertension (HT)
- End-stage renal disease (ESRD)
PREVENTION OF RECURRENT UTI-GENERAL

• Adequate fluid intake and frequent voiding.
• Constipation should be avoided.
• In children with VUR, regular and volitional low pressure voiding with complete bladder emptying is encouraged.
• Double voiding.
• Circumcision reduces the risk of recurrent UTI in infant boys, and therefore have benefits in patients with high grade reflux.
## EVALUATION AFTER THE FIRST UTI

<table>
<thead>
<tr>
<th>Age &lt;1 yr</th>
<th>Age 1-5 yr</th>
<th>Age &gt;5 yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound</td>
<td>Ultrasound</td>
<td>Ultrasound</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>DMSA scan</td>
<td>DMSA scan</td>
</tr>
<tr>
<td>MCU</td>
<td>MCU if ultrasound or DMSA scan is abnormal</td>
<td>If ultrasound abnormal: MCU and DMSA scan</td>
</tr>
<tr>
<td>DMSA renal scan</td>
<td>DMSA scan is abnormal</td>
<td></td>
</tr>
</tbody>
</table>
RECURRENT UTI

• At any age should undergo detailed imaging with ultrasonography,

• MCU and DMSA scintigraphy.
PREVENTION OF RECURRENT UTI-ANTIBIOTIC PROPYLAXIS

Indications for prophylaxis

• UTI below 1-yr of age, while awaiting imaging studies

• VUR

• frequent febrile UTI (3 or more episodes in a year) even if the urinary tract is normal.
ANTIMICROBIALS - PROPHYLAXIS OF UTI

• Medication       Dose, mg/kg/day       Remarks
• Cotrimoxazole    1-2                    Avoid in infants
                                <3 mo, glucose-6-phosphate dehydrogenase deficiency
• Nitrofurantoin   1-2                    May cause vomiting
                                and nausea; avoid in infants <3 mo, G6PD deficiency, renal
## ANTIMICROBIALS - PROPHYLAXIS OF UTI

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose, mg/kg/day</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cephalexin</td>
<td>10</td>
<td>Drug of choice in first 3-6 mo of life</td>
</tr>
<tr>
<td>Cefadroxil</td>
<td>5</td>
<td>An alternative agent in early infancy</td>
</tr>
</tbody>
</table>
VESICOURETERIC REFLUX

- VUR is seen in 40-50% infants and 30-50% children with UTI, and resolves with age.
- Its severity is graded using the International Study Classification
  - Grade I to V, based on the appearance of the urinary tract on MCU.
- Lower grades of reflux (grade I-III) are more likely to resolve.
- Secondary VUR is related to bladder outflow obstruction as with posterior urethral valves, neurogenic bladder or a functional voiding disorder.
VESICOURERETERIC REFLUX

- Moderate to severe VUR, if bilateral- risk factor for pyelonephritis and renal scarring, with subsequent risk of hypertension, albuminuria and progressive kidney disease.
- The risk of scarring is highest in the first year of life.
- The presence of intrauterine VUR has been associated with renal hypoplasia or dysplasia.
## MANAGEMENT OF VUR

<table>
<thead>
<tr>
<th>VUR Grade</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades I and II</td>
<td>Antibiotic prophylaxis until 1 yr old. Restart antibiotic prophylaxis if breakthrough febrile UTI</td>
</tr>
<tr>
<td>Grades III to V</td>
<td>Antibiotic prophylaxis up to 5 yr of age. Consider surgery if breakthrough febrile UTI. Beyond 5 yr: Prophylaxis continued if there is bowel bladder dysfunction</td>
</tr>
</tbody>
</table>
SCREENING OF SIBLINGS AND OFFSPRING FOR VUR

• Reflux is inherited in an autosomal dominant manner with incomplete penetrance; 27% siblings and 35% offspring of patients show VUR.
• Ultrasonography is recommended to screen for the presence of reflux.
• Further imaging is required if ultrasonography is abnormal.
SUMMARY

• UTI may present as a febrile illness without localization hence *high index of suspicion required*

• May bring to notice presence of VUR/obstructive anomaly

• Early & aggressive treatment of acute pyelonephritis prevents renal damage, HT, ESRD.
Thank You