UTI In Children

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Why important?

UTI causes renal scarring
- this leads to chronic renal failure
  - Leading cause of end stage renal failure in children worldwide
- Hypertension
Therefore:

**Investigations** are directed towards identifying those children with UTI’s that are at risk of developing chronic renal failure.

**Treatment** aimed at hopefully preventing damage/further damage.
What predisposes someone to a UTI

- **Residual urine**
  - Reflux
  - Obstruction
  - Bladder dysfunction
    - Dysfunctional voiding
    - Neurogenic bladder

- **Nidus for infection**
  - Stones crystals
  - Foreign body

- **Bacterial factors**
  - Virulence factors

- **Local host defence**
  - Increase susceptibility to bacteria
    - Antibacterial activity of bladder wall
    - Increased receptivity to bact fimbria
  - Trauma to external urethral meatus
    - Bubble bath
    - Wiping method
  - Periurethral colonisation with Pathogenic organisms (children < 5yrs)

- **Systemic diseases**
  - Malnutrition (Kwashiorkor)
  - Diabetes mellitus
  - Immune deficiency diseases and immunosuppression (steroids)
UTI

- Upper tract Pyelonephritis
  - TEMP > 38.5
- Lower tract
Incidence

- Overall incidence 1-3% of all children
  - Female > males except first month

- \(\frac{1}{2}\) girls and \(\frac{1}{3}\) boys

- Have underlying detectable renal abnormalities
  - Vesico-ureteric reflux
  - Obstructive lesion
Factors which predispose to renal scarring include

- Congenital obstructive uropathy (structural or neurogenic)
- Young age with acute pyelonephritis, especially <1-2 years of age. Older children are still at risk.
- Delay in antibiotic therapy
- Severe VUR (Grade III-V)
- Recurrent acute pyelonephritis
How to make a Paediatrician grumpy

- Is this really a UTI!
  - Extensive investigations
  - Unpleasant procedures
  - Expensive
  - Long term consequences/follow up for child
How to collect urine and diagnose UTI correctly

- Careful attention to detail – NB
- Methods
  - Bag method
  - Clean catch
  - Suprapubic
  - In and out catheter
Bag specimen

- Clean genitalia with sterile water
- Remove immediately after micturition
- **Unacceptable** for culture - only good for screening
- If positive (dipstix leuc or nitrite) then send another specimen using other collection method
Positioning of the patient for suprapubic bladder aspiration  The child is restrained in the supine and frog leg position. This permits adequate stabilization of the pelvis. The site for needle insertion is in the midline, approximately one to two centimeters above the pubic symphysis. Adapted from King, C, Henreting, FM. Pocket Atlas of Pediatric Emergency Procedures, Lippincott Williams and Wilkins, Philadelphia 2000.
Gentle traction of the labia majora in females to visualize the urethra. Gentle traction of the labia majora in girls facilitates the visualization of the urethra for transurethral bladder catheterization.
‘In +out catheter’: boy
Processing urine

- Send to lab within 1 hour
  - Bact count doubles every 20 min
- In refrigerator <4 degrees for 24 hours
  ie do not leave urine specimens lying around will result in false positive’s
Very varied.
High index of suspicion often necessary.
In babies often not related to urinary tract.

(NB: Urine investigation is essential in any child with undiagnosed disease/fever).
Clinical picture : newborn + infants

- Often a picture of septicaemia.
- Prolonged neonatal jaundice.
- Renal failure
- Hypo- or hyperthermia
- Apathy or irritability
- Convulsions.
- Poor feeding or development
- Diarrhoea, vomiting
- Acidosis
- Poor urine stream in boys (Posterior urethral valve)
Clinical picture: older child

- **Upper urinary tract** (Pyelonephritis)
  - mostly systemic signs.
  - Fever above 38.5°C.
  - Rigors/convulsions.
  - Vomiting. Dehydration.
  - Abdominal pain. Tender renal angles
  - Sometimes dysuria

- **Lower urinary tract** (Cystitis) –
  - few systemic signs.
  - Minimal or no fever.
  - Lower abdominal/bladder tenderness.
  - Dysuria and frequency.
  - Malodorous urine – sometimes bloody.
  - Crying on micturition.
  - Chronic nappy rash.
  - Secondary enuresis.
SYMPTOMS MIMICKING UTI’s

- Dysfunctional voiding
- Local irritants
  - Foam baths, detergents, soap, chlorine, pin worm, foreign bodies, tight clothes and nylon panties, nappy dermatitis, (ammonia, monilia) injury and meatal ulceration.
- Vulvitis
  - relative oestrogen deficiency. Frequently associated with a discharge. Treat with Premarin cream nightly for 7 days. Antibiotic if the culture is positive.
- Emotional problems with or without secondary enuresis.
  - Often attention-seeking or adaptation problem.
- Constipation
- Unusual organisms. Chlamydia & mycoplasma
Side room investigations: **Urine dipstix**

- **Blood/protein:**
  - non-specific; many other causes

- **Leukocyte esterase test:**
  - Sensitive for leukocytes but not specific for UTI’s –especially in girls. Reliable if negative

- **Nitrite test for bacteria:**
  - (Bacterial reduction of nitrate to nitrite in the urine within the bladder takes 3-4 hours).
  - Very reliable (99%) if positive, but gives a false negative result in ± 50%.

- **pH:** alkaline urine - Proteus infection.
Urine with any positive parameters should be cultured

Negative screening tests are valuable and generally accepted as negative

Be aware of limitations.
Side room investigations: microscopy

- **Bacteria:**
  - False positive: old urine; collection method
    - Uncentrifuged: 2-3 moving organisms/h.p.f.
    - Centrifuged: 15-20 organisms/h.p.f
      - correlate well with a bacterial count of 100,000 organisms/ml
  
- **White blood cells:**
  - may also give false positive and false negative results.
    - **Centrifuged:**
      - < 5 WBC/h.p.f. = negative
      - > 5-10 WBC/h.p.f. = suggestive, but not diagnostic.
    - **Uncentrifuged:**
      - < 4000 WBC/ml = negative

- **Microscopy:** wbc + bacteria = 99% specificity
Other causes of wbc in urine

- Fever
- Acute systemic/virus infections
- Dehydration
- Vulvovaginitis & urine reflux in vagina. (Contamination from female genitalia.) Balanitis
- The glomerulonephritides, interstitial nephritis
- Half treated UTI’s (Antibiotic)
- Appendicitis
- Tuberculosis (Relatively uncommon in children)
- Kidney stones (Usually infective in children)
- Cystic diseases of the kidneys
- After polio vaccination
Culture: When do you have proof of infection?

- $>10^5$ organisms
  - Clean catch
- $>10^5$
  - Catheter
- Any growth
  - Suprapubic collection
Gram-negative bacilli. *Escherichia Coli* most common (± 80%).

- Klebsiella spp,
- Enterococci (*Enterococcus faecalis*)
- Proteus spp in boys (urine alkaline)
- Pseudomonas and Serratia.
- Candida albicans
Treatment and investigations

- Aimed at treating infection as rapidly as possible and treating/managing underlying conditions that predispose to recurrence and scarring
Early treatment can prevent or diminish renal damage!

- Bedrest if acutely ill.
- High fluid intake and regular voiding
- Antipyretic medications
Treatment

- ‘Septic’ child /vomiting/<3 months:
  - Intravenous antibiotics for ±48 hours & then oral e.g. Cephalosporins

- Without systemic signs (‘non septic’):
  - Oral antibiotics: Amoxycillin/clavulinic acid (Augmentin), Cefuroxime (Zinnat), Cefaclor

- Duration of treatment:
  - 7-10 days.
  - 10-14 days with obstruction.

- Adjust antibiotic dosage in renal failure.
Prophylactic chemotherapy

Not routine anymore

- No good proof that change outcome
- Breed resistance

- May be tried on an **individualized** basis
  - Recurrent or "chronic" cystitis in girls:
  - Underlying urogenital abnormality eg reflux, obstruction.
  - Infants with >1 episodes
  - Children with stones
  - Dysfunctional voiding
Further investigation:

- Want to find underlying abnormality of urinary tract
- Balance this against over investigating every child with a UTI
CONFIRMED UTI
ALL PATIENTS HAVE ULTRASOUND® (U/S) AS SOON AS POSSIBLE
Refer If No Further Imaging Available

Normal U/S

No further infections

Normal

Abnormal U/S

Other Abnormality

Abnormal U/S

2nd UTI or 'Atypical' UTI

Repeat U/S

+ 

DMSA &
(assess upper tract/renal involvement)

Dilated Kidney only – PUJ (pelvi-ureteric junction) obstruction need MAG3 Nuclear study

MCUG
Boys < 3yrs or Girls not potty trained
(exclude valve/reflux)

Indirect Cystogram (Nuclear Medicine)
Boys > 3yrs or Girls Potty-trained
(exclude VUR/bad scar)

Refer If No Further Imaging Available

Abnormal Scarring

Presumed reliable 3rd trimester Antenatal U/S not available in all patients

* Dilated Kidney only - PUJ (pelvi-ureteric junction) obstruction need MAG3 Nuclear study

& DMSA in our setting best early as compliance better + if bad 'defect' proceed with investigations
Vesicoureteric reflux

- retrograde flow of urine out of the bladder and into the ureters and kidneys.
- most common congenital abnormality of the urinary tract.
VUR

- **Primary reflux**: Congenital dysfunction of the vesico-ureteric junction.

- **Secondary reflux**: Secondary to:
  - Congenital paraureteric diverticulum
  - Infravesical obstruction - posterior urethral valve in boys
  - Ectopic ureter or duplication of the ureters
  - "Prune belly" syndrome
  - Neurogenic bladder (Obstructive effect)
VUR

- **Incidence:**
  - ± 30% of children (especially babies) with UTI have reflux.
  - (Less common in black children).
  - 2/3 of children with reflux (Grade IV + V) are at risk of developing scarring if they acquire an infection.
Grading of VUR:

- **Grade I**  Only up into the ureter, but not up into the calyces
- **Grade II**  Up to the calyces, with no dilatation of the ureter or calyces
- **Grade III**  Early dilatation of the ureter and calyces
- **Grade IV**  Moderate dilatation of the ureter and blunting of the calyces
- **Grade V**  Severe dilatation of the ureter and calyces. Ureter often tortuous
Treatment of vesico-ureteric reflux: TCH policy

- Grade I-II reflux:
  - Chance of spontaneous resolution is good.
  - Vigilance for infections

- Grade III:

- Grade IV-V:
  - Debatable treatment: Prophylaxis and repair surgically may be tried on individualized basis. Chance of spontaneous resolution is poor (50%).
$100 for speeding and $250 for misleading the public.
New developments

- Vaccine against UTI
## Test Characteristics of Tests Used to Diagnose Urinary Tract Infections in Children

<table>
<thead>
<tr>
<th>Test Characteristic</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive likelihood ratio</th>
<th>1/negative likelihood ratio</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dipstick</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Leukocyte esterase (LE)</td>
<td>84 percent</td>
<td>78 percent</td>
<td>4</td>
<td>0.2</td>
<td>†</td>
</tr>
<tr>
<td>Nitrite</td>
<td>50 percent</td>
<td>98 percent</td>
<td>25</td>
<td>0.5</td>
<td>†</td>
</tr>
<tr>
<td>Nitrite or LE</td>
<td>88 percent</td>
<td>93 percent</td>
<td>13</td>
<td>0.1</td>
<td>†</td>
</tr>
<tr>
<td>Nitrite and LE</td>
<td>72 percent</td>
<td>96 percent</td>
<td>18</td>
<td>0.3</td>
<td>†</td>
</tr>
<tr>
<td><strong>Microscopy</strong></td>
<td></td>
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<tr>
<td><strong>Uncentrifuged</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pyuria (&gt;10/mM3) (all ages)</td>
<td>77 percent</td>
<td>89 percent</td>
<td>7</td>
<td>0.4</td>
<td>†</td>
</tr>
<tr>
<td>Pyuria (&gt;10/mM3) (&lt;2 yr)</td>
<td>90 percent</td>
<td>95 percent</td>
<td>18</td>
<td>0.1</td>
<td>†</td>
</tr>
<tr>
<td>Bacteriuria (gram stained)</td>
<td>93 percent</td>
<td>95 percent</td>
<td>19</td>
<td>0.1</td>
<td>†</td>
</tr>
<tr>
<td>Overall (P+B) = enhanced</td>
<td>85 percent</td>
<td>99.9 percent</td>
<td>85</td>
<td>0.1</td>
<td>†</td>
</tr>
<tr>
<td>Overall (P or B)</td>
<td>95 percent</td>
<td>89 percent</td>
<td>9</td>
<td>0.1</td>
<td>†</td>
</tr>
<tr>
<td><strong>Centrifuged</strong></td>
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<tr>
<td>Pyuria (&gt;5/hpf)</td>
<td>67 percent</td>
<td>79 percent</td>
<td>3</td>
<td>0.4</td>
<td>†</td>
</tr>
<tr>
<td>Bacteriuria</td>
<td>81 percent</td>
<td>83 percent</td>
<td>5</td>
<td>0.2</td>
<td>†</td>
</tr>
<tr>
<td>Overall (P+B)</td>
<td>66 percent</td>
<td>99 percent</td>
<td>7</td>
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