

L7. URINARY TRACT INFECTIONS (UTI)

UTI considered a risk factor for the development of renal insufficiency or end-stage renal disease in the children.

Prevalence:

UTI occur in 1% of boys and 1-3% of girls.

The prevalence varies with age, during the 1st year of life its more common in the males (especially uncircumcised males) with a male: female ratio of 2-5:1.

Beyond 1-2 yr of age, the females are more commonly to have UTI with male: female ratio of 1:10.

Causative M.O. (Etiology):

UTIs are caused primarily by colonic bacteria.

In girls, 75-90% of all UTI are caused by *Escherichia coli*, followed by *Klebsiella* spp. and *Proteus* spp.

In boys, the *E. coli* is also the most common M.O, but some studies shows that in boys older than 1 yr of age, the *Proteus* and *E. coli* are equal as a cause of UTI.

Adenovirus and other viral infections can occur in both sexes, especially as a cause of cystitis with gross hematuria (hemorrhagic cystitis).

Pathogenesis:

Nearly all UTIs are ascending infections. The bacteria arise from the fecal flora, colonize the perineum, and enter the bladder via the urethra.

In uncircumcised boys, the bacterial pathogens arise from the flora beneath the prepuce.

In some cases, the bacteria causing cystitis ascend to the kidney to cause pyelonephritis.

Rarely, renal infection occurs by hematogenous spread, as in endocarditis or in some neonates.

Risk factors of UTI:

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|---------------------------------------|--------------------------------------------|
| 1. Female gender | 9. Tight clothing (underwear) |
| 2. Uncircumcised male | 10. Pinworm infestation |
| 3. Vesicoureteral reflux | 11. Constipation |
| 4. Toilet training | 12. Anatomic abnormality (labial adhesion) |
| 5. Voiding dysfunction | 13. Neuropathic bladder |
| 6. Obstructive uropathy | 14. Sexual activity |
| 7. Urethral catheterization. | 15. Pregnancy |
| 8. Wiping from back to front in girls | |

Classification of UTIs: There are 3 basic forms of UTI, which are:

1. Pyelonephritis
2. Cystitis
3. Asymptomatic bacteriuria.

Focal pyelonephritis (nephronia) and renal abscesses are less common.

Pyelonephritis:

Acute pyelonephritis is a term refer to the infection of renal parenchyma.

Pyelitis is infection of renal pelvis without involvement of renal parenchyma.

Acute pyelonephritis can result in renal injury, called **pyelonephritic scarring**.

Clinical features of pyelonephritis is characterized by any or all of the following:

Abdominal, back, or flank pain; fever (*may be the only manifestation*); malaise; nausea, vomiting; and, occasionally, diarrhea

Newborns can show nonspecific symptoms such as poor feeding, irritability, jaundice, and weight loss.

Pyelonephritis is the most common serious bacterial infection in infants younger than 24 mo of age who have fever without an obvious cause

Renal abscess can occur following a pyelonephritic infection caused by the usual uropathogens or may be secondary to hematogenous infection (*S. aureus*).

Cystitis: indicates infection of the urinary bladder.

Symptoms: dysuria, urgency, frequency, suprapubic pain, incontinence, and mal-odorous urine.

Cystitis does not cause fever and does not result in renal injury and mal-odorous urine is not specific for a UTI.

Acute hemorrhagic cystitis often is caused by *E. coli*; but it also caused by adenovirus types 11 and 21.

Adenovirus cystitis is more common in boys; it is self-limiting, with hematuria lasting approximately 4 days.

Asymptomatic bacteriuria: refers to a condition in which there is a positive urine culture without any manifestations of infection.

It is most common in girls. The incidence is <1% in preschool and school age girls and is rare in boys.

It is benign condition and does not cause renal injury, except in pregnant women, in whom asymptomatic bacteriuria, if left untreated, can result in symptomatic UTI.

Diagnosis of UTI:

UTI is suspected based on the symptoms or findings on urinalysis, or both.

Urine culture necessary for confirmation and appropriate therapy.

Ways of urine collection:

1. **Midstream urine sample:** is usually used in toilet trained children. In the female, the introitus should be cleaned before obtaining the urine specimen and in the uncircumcised male, the prepuce must be retracted to avoid contamination with skin flora.
2. **suprapubic aspirate or urethral catheterization** are used in non-toilet trained child

3. Collection bag (adhesive, sealed, sterile bag) applied to genitalia after disinfection of the skin

The results of urine culture obtained by adhesive bag is dependable only if the culture is negative or if a single uropathogen is isolated. However positive culture of multiple pathogens can result from skin contamination especially in girls and uncircumcised boys.

The collected urine should be examine and cultured as early as possible because if the urine remain at room temperature for more than 60 min, overgrowth of a minor contaminant can suggest a UTI when the urine might not be infected. Refrigeration is a reliable method of storing the urine until it can be cultured.

Positive results of urinalysis:

1. Positive nitrates and leukocyte esterase tests.
2. Microscopic hematuria is common in acute cystitis, but microscopic hematuria alone does not suggest UTI.
3. WBC casts suggest renal involvement (pyelonephritis).

If the child is asymptomatic and the urinalysis is normal, the UTI is unlikely. However, if the child is symptomatic, the UTI is possible even if the urinalysis result is negative.

Pyuria: is refer to the presence of leukocytes on urine microscopy. It suggests infection, but infection can occur in the absence of pyuria, so it is confirmatory more than diagnostic. Conversely, pyuria can be present without UTI.

Sterile pyuria (positive leukocytes in urinalysis, with negative urine culture) may occur in partially treated bacterial UTIs, viral infections, renal tuberculosis, renal abscess, UTI in the presence of urinary obstruction, urethritis as a sexually transmitted infection, inflammation near the ureter or bladder (appendicitis, Crohn disease), or interstitial nephritis (eosinophils).

Positive results of urine culture: it depends on the way of urine collection:

1. In suprapubic or catheter sample, the child is considered to have a UTI if the culture shows >50,000 colonies of a single pathogen, or if there are 10,000 colonies of a single pathogen and the child is symptomatic.
2. In a collection bag sample, the child is considered to have a UTI if the urinalysis result is positive, the patient is symptomatic, and there is a single organism cultured with a colony count >100,000. If any of these criteria are absent, confirmation of infection with a catheterized sample is indicated.

Treatment of UTI:

Acute cystitis: should be treated promptly to prevent progression to pyelonephritis. If the symptoms are severe, the treatment is started before getting results of the culture, but if the symptoms are mild or the diagnosis is doubtful, treatment can be delayed until the results of culture are known, and the culture can be repeated if the results are uncertain.

Empirical antibiotic therapy for acute cystitis are:

1. **Trimethoprim-sulfamethoxazole (TMP-SMX)** or **trimethoprim** for 3-5 days are effective against many strains of *E. coli*.
2. **Nitrofurantoin** (5-7 mg/kg/24 hr in 3-4 divided doses) is also effective and has advantage of being active against *Klebsiella* and *Enterobacter* organisms.
3. **Amoxicillin** (50 mg/kg/24 hr) also is effective as initial treatment but has a high rate of bacterial resistance.

Clinical pyelonephritis (febrile UTI): Indications of hospital admission are: dehydration, vomiting, inability to drink fluids, patients 1 mo of age or younger, complicated infection, or possibility of urosepsis.

The treatment include:

1. I.V. fluids .
2. Broad spectrum antibiotics capable of reaching significant tissue levels for 7-14 days, these AB are:
 - I. I.V. ceftriaxone (50-75 mg/kg/24 hr) or cefotaxime (100 mg/kg/24 hr).
 - II. I.V. ampicillin (100 mg/kg/24 hr) with aminoglycoside (gentamicin 3-5 mg/kg/24 hr in 1-3 divided doses). Aminoglycosides are effective against *Pseudomonas* spp., and alkalinization of urine with sodium bicarbonate increases its effectiveness in the urinary tract.
 - III. Nitrofurantoin should not be used routinely in children with a febrile UTI because it does not achieve significant renal tissue levels.
 - IV. Oral fluoroquinolone (e.g. ciprofloxacin and Levofloxacin)is an alternative agent for resistant microorganisms, particularly *Pseudomonas*, in patients older than age 17 yr (should avoided in younger children because risk of cartilage destruction)

Renal or perirenal abscess or infection in obstructed urinary tracts can require surgical or percutaneous drainage in addition to antibiotic therapy and other supportive measures. Small abscesses may initially be treated without drainage.

Management of Recurrent UTI:

1. Identification and treatment of the underlying cause: bladder–bowel dysfunction, severe constipation, neuropathic bladder, urinary tract stasis and obstruction, severe vesicoureteral reflux, and urinary calculi.
2. Prophylactic antibiotics using trimethoprim or nitrofurantoin at 30% of the normal therapeutic dose once a day.
TMP-SMZ, amoxicillin, or cephalexin can also be effective, but the risk of break through UTI may be higher because of bacterial resistance.