

# Urinary Tract Infections

**:Lecturer**

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# Objectives:

- Prevalence and etiology of UTI.
- Clinical manifestations and classification including definitions of types of UTI.
- Pathogenesis and pathology of UTI.
- Risk factors for UTI.
- Diagnosis of UTI.
- Treatment of UTI.
- Imaging studies.

## **PREVALENCE AND ETIOLOGY**

**Urinary tract infections (UTIs) occur in 3–5% of girls and .1% of boys**

**In girls, the first UTI usually occurs by the age of 5 yr, with peaks during infancy and toilet training. After the first UTI, .60–80% of girls will develop a second UTI within 18 mo**

**In boys, most UTIs occur during the 1st yr of life; UTIs are .much more common in uncircumcised boys**

**The prevalence of UTIs varies with age. During the 1st yr of -  
life, the male : female ratio is 2.8–5.4 : 1. Beyond 1–2 yr, there  
is a striking female preponderance, with a male : female ratio  
.of 1 : 10**

**UTIs are caused mainly by colonic bacteria. In females,-  
75–90% of all infections are caused by Escherichia coli,  
.followed by Klebsiella spp. and Proteus spp**

**Staphylococcus saprophyticus and enterococcus are -  
.pathogens in both sexes**

**Viral infections, particularly adenovirus, also may occur, -  
.especially as a cause of cystitis**

**UTIs have been considered an important risk factor for the -  
development of renal insufficiency or end-stage renal  
.disease in children**

## CLINICAL MANIFESTATIONS AND CLASSIFICATION

The 3 basic forms of UTI are *pyelonephritis, cystitis, and asymptomatic bacteriuria*

**Clinical pyelonephritis** is characterized by any or all of the following: abdominal or flank pain, fever, malaise, nausea, vomiting, and, occasionally, diarrhea. Newborns may show nonspecific symptoms such as poor feeding, irritability, and weight loss

**Pyelonephritis (Involvement of the renal parenchyma ) is the most common serious bacterial infection in infants <24 mo of age who have fever without a focus. These symptoms are an indication that there is bacterial involvement of the upper urinary tract. Acute pyelonephritis may result in renal injury, .termed pyelonephritic scarring**



**Renal abscess may occur following a pyelonephritis or may be secondary to a primary bacteremia (*S. aureus*).  
Perinephric abscesses may be secondary to contiguous infection in the perirenal area (e.g., vertebral osteomyelitis, psoas abscess) or pyelonephritis that dissects to the renal capsule**

**Cystitis** indicates that there is bladder involvement; symptoms include dysuria, urgency, frequency, suprapubic pain, incontinence, and malodorous urine. Cystitis does not cause fever and does not result in renal injury

**Asymptomatic bacteriuria** refers to a condition that results in a positive urine culture without any manifestations of infection. It is most common in girls. The incidence is 1–2% in preschool and school-age girls and 0.03% in boys. The incidence declines with increasing age. This condition is benign and does not cause renal injury, except in pregnant women, in whom asymptomatic bacteriuria, if left untreated, can result in a symptomatic UTI

## **PATHOGENESIS AND PATHOLOGY**

**Virtually 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 may occur by hematogenous spread, as in endocarditis or in .some neonates**

**If bacteria ascend from the bladder to the kidney, acute-pyelonephritis may occur. Normally the simple and compound papillae in the kidney have an antireflux mechanism that prevents urine in the renal pelvis from entering the collecting tubules. However, some compound papillae, typically in the upper and lower poles of the kidney, allow intrarenal reflux. Infected urine then stimulates an immunologic and inflammatory response. The result may .cause renal injury and scarring**

# **:Risk Factors for Urinary Tract Infection**

- Female gender-**
- Uncircumcised male-**
- Vesicoureteral reflux -**
- Toilet training -**
- Voiding dysfunction -**
- Obstructive uropathy -**
- Urethral instrumentation -**
- Tight clothing (underwear) -**
- Pinworm infestation -**
- Constipation -**
- Anatomic abnormality (labial adhesion ( -**
- Neuropathic bladder -**
- Sexual activity -**
- Pregnancy -**

# DIAGNOSIS

**A UTI may be suspected based on symptoms or findings on urinalysis, or both, but a urine culture is necessary for confirmation and appropriate therapy. The correct diagnosis of UTI depends on having the proper sample of urine. There are several ways to obtain a urine sample; some are more accurate than others**

**In toilet-trained children, a midstream urine sample usually is satisfactory. If the culture shows >100,000 colonies of a single pathogen, or if there are 10,000 colonies and the child is symptomatic, the child is considered to have a UTI. In uncircumcised males, the prepuce must be retracted; if the prepuce is not retractable, this method of urine collection may be unreliable**



**In infants, the application of an adhesive, sealed, sterile-collection bag after disinfection of the skin of the genitals can be useful. A positive culture may reflect a contaminant, particularly in girls and uncircumcised boys. *In such cases, if the* urinalysis result is positive, the patient is symptomatic, and there is a single organism cultured with a colony count greater than 100,000, there is a presumed UTI. If any of these criteria are not met, confirmation of infection with a .catheterized sample is recommended**

**Prompt plating of the urine sample is important, because if-  
the urine sits at room temperature for more than 60 min,  
overgrowth of a minor contaminant may suggest a UTI when  
the urine may not, in fact, be infected. Refrigeration is a  
.reliable method of storing the urine until it can be cultured**

**A urinalysis should be obtained from the same specimen-  
that was cultured. Pyuria (leukocytes in the urine) suggests  
infection, but infection can occur in the absence of pyuria  
and pyuria can be present without UTI. Microscopic  
hematuria is common in acute cystitis. White blood cell  
casts in the urinary sediment suggest renal involvement, but  
in practice these are rarely seen. If the child is asymptomatic  
and the urinalysis result is normal, it is unlikely that there is  
a UTI. However, if the child is symptomatic, a UTI is possible,  
.even if the urinalysis result is negative**

**With acute renal infection, leukocytosis, neutrophilia, and elevated erythrocyte sedimentation rate and C-reactive protein are common. The latter two are nonspecific markers of bacterial infection, and their elevation does not mean that the child has acute pyelonephritis. With a renal abscess, the white blood cell count is markedly elevated to  $>20,000\text{--}25,000/\text{mm}^3$ . Because sepsis is common in pyelonephritis, particularly in infants and in any child with obstructive uropathy, blood cultures should be considered**

# TREATMENT

**Acute cystitis should be treated promptly to prevent possible progression to pyelonephritis. If the symptoms are severe, a specimen of bladder urine is obtained for culture, and treatment is started immediately. 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**

**If treatment is initiated before the results of a culture and-sensitivities are available, a 3- to 5-day course of therapy with trimethoprim-sulfamethoxazole is effective against most strains of E. coli. Nitrofurantoin (5–7 mg/kg/24 hr in 3 to 4 divided doses) also is effective and has the advantage of being active against Klebsiella-Enterobacter organisms. Amoxicillin (50 mg/kg/24 hr) also is effective as initial treatment but has no clear advantages over sulfonamides or .nitrofurantoin**

**In acute febrile infections suggestive of pyelonephritis, a 10--to 14-day course of broad-spectrum antibiotics capable of reaching significant tissue levels is preferable. Children who are dehydrated, are vomiting, or are unable to drink fluids, are  $\leq 1$  mo of age, or in whom urosepsis is a possibility should be admitted to the hospital for intravenous .rehydration and intravenous antibiotic therapy**

**Parenteral treatment with ceftriaxone (50–75 mg/kg/24 hr, - not to exceed 2 g) or ampicillin (100 mg/kg/24 hr) with an aminoglycoside such as gentamicin (3–5 mg/kg/24 hr in 1 to 3 divided doses) is preferable. The potential ototoxicity and nephrotoxicity of aminoglycosides should be considered. Treatment with aminoglycosides is particularly effective against *Pseudomonas* spp., and alkalinization of urine with sodium bicarbonate increases their effectiveness in the urinary tract**



**Oral 3rd-generation cephalosporins such as cefixime are as-effective as parenteral ceftriaxone against a variety of gram-negative organisms other than Pseudomonas, and these medications are considered by some authorities to be the .treatment of choice for oral therapy**

**The oral fluoroquinolone ciprofloxacin is an alternative-agent for resistant microorganisms, particularly Pseudomonas, in patients older than 17 yr used on occasion for short-course therapy in children with Pseudomonas UTI. However, the clinical use of fluoroquinolones in children should be restricted because of potential cartilage damage**

**Children with a renal or perirenal abscess or with infection-in obstructed urinary tracts often require surgical or percutaneous drainage in addition to antibiotic therapy and .other supportive measures**

**Prophylaxis against reinfection, using sulfamethoxazole--trimethoprim, or nitrofurantoin at  $\frac{1}{3}$  of the normal therapeutic dose once a day, often is effective. Prophylaxis with amoxicillin or cephalexin also may be effective, but the risk of breakthrough UTI may be higher because bacterial resistance may be induced. Other indications for long-term prophylaxis (e.g., neurogenic bladder, urinary tract stasis .and obstruction, reflux, calculi)**

# IMAGING STUDIES

**:Renal sonogram should be obtained to-**

- Rule out hydronephrosis and structural urinary\* •**
- .abnormalities**
- Suggest acute pyelonephritis by demonstrating an\* •**
- .enlarged kidney**
- .Demonstration of many but not all renal scars \***
- .Sonography also is sensitive for detecting pyonephrosis \***

## **-Voiding cystourethrogram (VCUG)**

### **:Indications**

- .All children with a febrile UTI\***
- .Girls who have had 2 or 3 UTIs in a period of 6 mo\***
- .Boys with more than one UTI\***
- If the renal sonogram shows any significant abnormality,\*  
such as hydronephrosis, disparity in renal length, or bladder  
.wall thickening**
- Before the child is discharged from the hospital is\***
- .appropriate and ensures that the evaluation is complete**

**Renal scanning with technetium-labeled DMSA or-  
:glucoheptonate is useful to**

- .differentiate between an acute and a chronic process\***
  - .Demonstrates parenchymal involvement\***
  - .Demonstrates the presence of scar\***
- The likelihood of developing future scar at the site of\***
- .pyelonephritis**

**Computed tomography is another diagnostic tool that can -  
diagnose acute pyelonephritis, and detect the presence of  
.scars**

***DSMA (dimercapto succinic acid) is a radioisotope that is  
.injected into veins. It goes directly to the kidneys  
A special camera, called a gamma camera, is used to take  
pictures of the kidneys and show how the kidneys are  
.working***