**Urinary infection in adolescents**

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**Abstract**

**Objective:** urinary tract infections are caused by various gram-negative bacteria. *Escherichia coli* is the most common causative agent in all groups of patients. *Staphylococcus saprophyticus* is now recognized as a common cause of urinary tract infection in adolescents and young adult women.

**Methods:** review of literature and clinical experience with urinary tract infections in adolescents at the Pediatric Nephrology Department of Hospital Santa Casa de São Paulo.

**Results:** lower urinary tract infection, hematuria and dysuria were the most frequent symptoms observed in infections caused by *Staphylococcus saprophyticus*. Some asymptomatic cases were observed. The infection may be associated with adverse effects of maternal and fetal health during pregnancy.

**Conclusions:** this article reviews the diagnosis, etiology, treatment, and complications associated with urinary tract infections in adolescents.


**Introduction**

Urinary tract infection (UTI) is characterized by bacterial invasion and multiplication involving the kidneys and urinary tract pathways. UTI represents one of the most frequent infectious pathologies, affecting 5% of pediatric outpatients and representing 50 to 60% of diagnoses in screening procedures of the Children Nephrology Department at the Hospital Santa Casa in São Paulo, Brazil. UTI affects predominantly female patients. Approximately 30% of women will have at least one episode of UTI throughout their lives.1

The prevalence of UTI in children is high, for a peak incidence around the third and fourth year of life. These infections are particularly severe when affecting infants and especially newborn infants. The prevalence of UTI is also higher during adolescence, a period in which hormonal changes favor vaginal colonization by nephritogenic strains of bacteria, which can migrate to the periureteral area and cause urinary tract infection.2 The most important infections in adolescents are those caused by *Staphylococcus saprophyticus* chiefly in sexually-active adolescents.

During gestation, there is an increase in cases of urinary infections affecting up to 37% of women. More importantly, most infected pregnant women present asymptomatic infections that may turn symptomatic. Also, pregnant women...
with vesicoureteric reflux and previous renal scarring presented a greater tendency to being affected by pyelonephritis. These women are also at greater risk for hypertensive disease of pregnancy and for giving birth to premature or low birthweight babies. These newborn infants, in turn, will present a risk for urinary infection up to four-fold higher than normal during the neonatal period. Studies have shown that newborn infants with neonatal UTI harbor, in their large intestines, the same pathogenic bacteria found in the maternal flora. Based on these observations, it is recommended that pregnant women with recurrent UTI be treated with oral nitrofurantoin in prophylactic dosages (1 to 2 mg/kg at bedtime). This treatment can reduce the risk for maternal-infant perinatal and neonatal morbidity and mortality without teratogenic risks for the fetus.3-6

Clinical symptomatology

In adolescents, symptoms are usually correlated to the urinary tract, indicating suspected UTI. In this sense, we observed that in lower urinary tract infections (cystitis) the most prevalent complaints were of pollakiuria, urgency of micturition, tenesmus, dysuria, macroscopic hematuria, and lower abdominal pain or discomfort, all of which may be associated with low fever (< 38 degrees C). Suspected pyelonephritis occurs when symptoms are associated with high fever, involvement of the overall clinical status (toxemia symptoms) and/or lumbar pain (Giordano positive).7,8

Uropathogens

Most uropathogenic bacteria are gram-negative and from the E. coli strain. These bacteria reside mainly in the large intestines and foreskin. The bacteria migrate from these reservoirs and colonize, initially, the external genitalia and periureteral area; after that, the bacteria may ascend through the urinary pathways in association with receptors specific for adhesion of E. coli fimbriae (Gal-Gal receptors), which are found in the uroepithelial cells.9,10

The Staphylococcus saprophyticus is a negative coagulase staphylococcus that can adhere to uroepithelial cells causing a local inflammatory process with systemic repercussions.11,12 This bacterium is considered one of the most common agents of symptomatic UTI in young and middle-aged women (aged 13 to 40 years), especially those who are sexually active. The Staphylococcus saprophyticus is responsible for approximately 15% of cases of UTI within this age range. It rarely affects the male sex and, when it does, it generally affects the elderly (> 60 years). The Staphylococcus saprophyticus can be found in the rectum and, more frequently, in the genital tract of women within the referred age range. It is not found in women aged older than 40 years or in men aged 13 to 40 years, thus suggesting that the vaginal introitus is the most probable reservoir for the bacterium. This predisposition may be secondary to the hormonal state of the host, resulting in greater susceptibility to contamination by Staphylococcus saprophyticus in the vagina, in the periureteral area, and in the uroepithelium.

Despite the hormonal correlation to infections by Staphylococcus saprophyticus, it is rare to find UTI caused by the bacterium during the gestational period. Hedman and Ringertz7 observed a seasonal variation on the incidence of UTI by Staphylococcus saprophyticus, with a prevalence of cases during the summer and especially associated with prior outdoor swimming. They were also common among professionals handling meat products. However, the authors did not observe a significant correlation with neither sexual activity nor use of birth control pills. According to Jodal et al.,14 Staphylococcus saprophyticus urinary tract infections are commonly characterized by symptoms of inflammation of the lower urinary tract and vesical instability, such as pollakiuria, dysuria (90% of cases), urgency of micturition, suprapubic pain (62% of cases), and low fever (< 38 degrees C). Laboratory exams indicated hematuria (81% of cases) and pyuria (93% of cases). Imaging examination indicated that 63% of patients did not present urinary tract anomalies with a low risk of UTI associated with nephrolithiasis or catheter use.

At the Children Nephrology Services of the Hospital Santa Casa of São Paulo, we also observed that the above symptoms were the most frequent. In this sense, we could mention the case of a 12-year old adolescent who presented with complaints of dysuria, macroscopic hematuria, and suprapubic pain for the past five days. We observed that patient had vesical instability such as urge incontinence and urinary retention. Urine culture indicated 1,000,000 col/ml of Staphylococcus saprophyticus and patient presented normal ultrasonography of the kidneys and urinary pathways. After treatment with nitrofurantoin, patient presented progressive improvement of the urinary symptoms and negative culture. This case illustrates the main findings in adolescents with UTI. Reports of asymptomatic UTI by Staphylococcus saprophyticus are rare. Pyelonephritis affects approximately 10 to 15% of cases of UTI. These data suggest that UTI by Staphylococcus saprophyticus apparently affects adolescents who commonly have healthy urinary tracts and presents low rates of therapeutic failure (approximately 3% of cases).

It is important to remember that with the beginning of sexual activity infections by other sexually-transmitted pathogens may follow, such as Gardeneralla and Chlamydia strain bacteria; in this sense, isolation of these strains requires special culture mediums. Moreover, UTI by Chlamydia can cause isolated microhematuria in adolescents.12,15 In male patients, the urethritis, such as purulent urethral discharge (even between urinations), dysuria, hematuria (usually initial), and suprapubic pain can be caused by gonorrhea. In these cases, there are specific treatments which require simultaneous examination, orientation, and treatment of the sexual partner.
Laboratory confirmation

Urine culture is the only exam for confirmation of UTI, and the reliability of this exam depends on proper collection of the urine sample. Thus, the method of collection varies according to age of the patient. In children aged less than two years, samples are collected by suprapubic tap or bladder catheters; in older children, who present control of the sphincter function, samples are collected preferably by medium urine flow (except in cases of girls with leukorrhea). Queinnien, in a study carried out at our services, observed that the diagnosis of UTI was confirmed in only 60% of the 372 children sent to our nephrology screening services due to suspected UTI. The examination of 66 cases of false UTI showed that inadequate sample collection for urine culture was the main cause of error in diagnosis (59% of cases), followed by sterile leukocyturia (47%). The collection of urine samples by medium urine flow or bag (in girls with leukorrhea) was responsible for contamination in 23% of urine samples by medium urine flow or bag (in girls with leukorrhea). The collection of samples at home by the mother was also an important contamination factor in urine samples and thus indicating false UTI.

Leukorrhea is a common pathology in childhood and distinct from UTI. However, leukorrhea can frequently lead to urinary symptoms that, in turn, lead to uncertain association of diseases. This results from the fact that perineal inflammation can cause erythema, edema, or exulceration of the perirectal region, thus provoking urinary symptoms in approximately 50% of cases (urgency, tenesmus, dysuria, hematuria, pollakiuria, or urinary retention). Evidently, these female patients improve following local treatment of vulvovaginitis and this pathology is rarely associated with UTI. At the Children Nephrology Department of the Hospital Santa Casa, the study of 100 girls with leukorrhea and urinary symptoms confirmed UTI in only 8% of cases. Roughly 40% of these girls who were carriers of leukorrhea also presented oxyuria. Consequently, in cases of suspected UTI with concurrent leukorrhea and in girls of any age group, urine samples should always be collected with bladder catheters. Catheterization will avoid contamination of the sample by the perineal infection.

Imaging diagnosis

The kidneys are particularly sensitive to formation of pyelonephritic scarring during the first two years of life; after this period, this susceptibility decreases progressively until around the age of five to six years, at which point the renal parenchyma of children, similarly to that of adults, becomes resistant to the formation of new scarring. The main objective of imaging investigation in adolescents is to detect possible effects of previous UTI outbreaks to the renal parenchyma. Initially, the evaluation consists of ultrasonography of the kidneys and urinary pathways, which should be complemented with dimercaptosuccinic acid (DMSA) renal scintigraphy for detection of scarring and evaluation of the relative function of each kidney. Excretory urography and/or urethrocystography are indicated only in cases in which the anomalies detected require a better structural and morphological visualization of the urinary tract.

Treatment

The treatment for UTI is aimed chiefly at eradicating the bacteria from the urinary tract, thus allowing for improvement of symptoms. General orientation for the patient, such as that regarding the recurring characteristic of UTI; appropriate fluid intake; and correction of urination and intestinal habits is important. These pieces of advice can increase effectiveness of drug treatment and interval between infections. The treatment of associated perineal pathologies (leukorrheas and balanoposthitis) is also important to achieve clinical improvement of the patient. Symptons of vesical instability (urge incontinence, urinary incontinence, urgency, tenesmus, retention, and enuresis) can disappear with antibiotic therapy. These symptoms may require specific guidance (Kegel exercises) in combination, occasionally, with oxybutin or imipramine.

Drug treatment should be selected following rigorous criteria considering the possible consequences of the treatment to the normal intestinal flora, which is the main reservoir of uropathogenic bacteria. Antibiotic therapy should be introduced soon after collection of urine sample for urine culture (independently of collection and/or result of urine culture) whenever there is clinical suspicion of UTI. This is because urine culture results can take two to five days to be made available, thus delaying the application of the treatment. In this sense, dip-slide tests (urotube, urobact) allow for rapid results in approximately 18 to 24 hours for confirmation or not of UTI diagnosis. The choice of antimicrobials is usually based on observing the therapeutic response and on the possibility of short-term relapse or reinfection.

Oral treatment

Whenever possible, oral treatment should be applied since it facilitates the treatment and improves compliance. The drugs of choice are nitrofurantoin (3 to 5 mg/kg/day 3 to 4 times daily; patients weighing > 40 kg = 300 to 400 mg/day), which is not indicated for children with creatinine clearance < 50%; nalidixic acid (30 to 50 mg/kg/day or 1,500 to 2,000 g/day in patients weighing > 40 kg, 3 to 4 times daily); cephalaxin (50 to 100 mg/kg/day or 1,500 to 2,000 g/day in patients weighing > 40 kg, every 6 hours). Intramuscular (IM) or intravenous (IV) treatment

IM or IV treatments should be applied when UTI:
- is caused by bacteria resistant to oral medication;
- accompanies signs and symptoms suggestive of pyelonephritis or sepsicemia (high fever, deterioration of overall clinical status, vomiting, toxemia).
The most commonly used drugs are: aminoglycosides, which can be administered intramuscularly and in single doses with no effect on therapeutic response. Aminoglycosides are potentially nephrotoxic and ototoxic and their use requires controlling patient renal function and, if necessary, correction of the dosage according to creatinine clearance; and ceftriaxone, which can be administered, at 50 to 100 mg/kg/day for a maximum of 2g/day, if necessary, with correction of dosage according to the patient.26,27

Other drugs used recently in treatment of UTI

The introduction of the fluoroquinolones at the beginning of the 1980s, especially of ciprofloxacin (10 to 30 mg/kg/day every 12 h for a maximum of 500 mg) and ofloxacin (200 to 400 mg every 12 h), represented an important advancement in the treatment of infections caused by gram-negative bacteria. The use of these drugs for the treatment of severe infections acquired within a community, such as pyelonephritis, decreased hospitalization and allowed for early hospital discharge of patients. Quinolones can be easily administered every 12 hours, offer an excellent bioavailability and a good response against staphylococci and gram-negative bacteria, and reportedly cause little side-effects. These advantages have resulted in excessive and often unnecessary use of quinolones. Due to the widespread and reckless use of the fluoroquinolones for the treatment of urinary infections that could be treated with the usual antibiotic therapy, the common uropathogens, which were highly sensitive to the fluoroquinolones, developed an increased bacterial resistance to the drug. Just recently, new quinolones were made available in the Brazilian market. These new quinolones, especially the gatifloxacin, presented a good response against gram-negative bacteria, including the E. coli, Klebsiella and Proteus. The gatifloxacin acts on two different sites affected by the bacteria: the DNA gyrase and the topoisomerase I and IV and offers less possibility of resistance. This medication should be used exceptionally and only in cases of complicated urinary infections caused by multiresistant bacteria and with the objective of allowing for outpatient treatment.28,29

Conclusions

Our objective was to emphasize the main aspects of the epidemiology, diagnosis, and treatment of urinary infection in adolescents. We observed that within this age group the Staphylococcus saprophyticus is a common agent of UTI (approximately 15% of cases). This staphylococcus usually causes lower urinary tract symptoms, which are frequently associated to hematuria. In pregnant women, the E. coli is still the main bacteria associated to urinary infection. Pregnant women with UTI should always be treated with antibiotics and, in cases of recurrent UTI, patients should be given chemoprophylactic treatment, reducing the risks for complications affecting the mother and the fetus. As referred above, the choice of the antibiotic therapy is of chief importance for the treatment of UTI. Preference should be given to drugs that act directly on the agent of urinary infection and that present the least possible interference on other sites of the organism. These drugs should thus preserve the intestinal flora and the defenses of the patient. Moreover, the reckless use of wide-spectrum antibiotics may act on selection of more virulent bacteria, increasing the risk for renal damage.

References


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