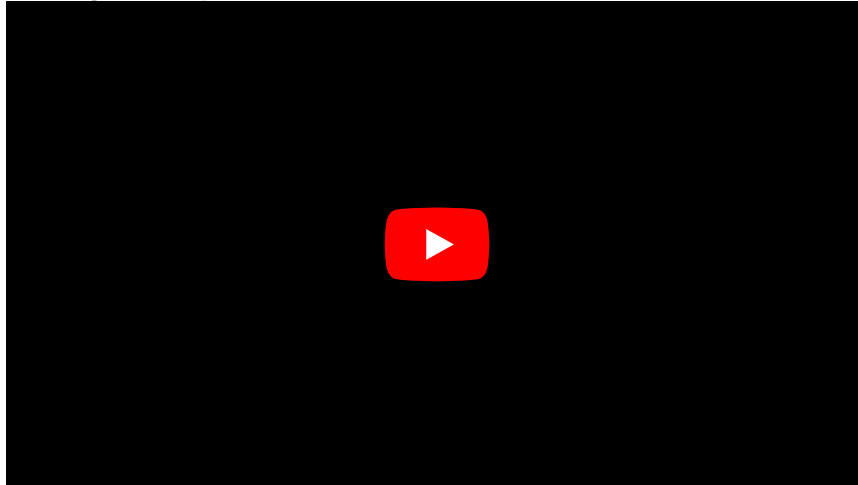


Urinary tract infections

Urinary tract infections (UTIs) are characterized by the presence of microorganisms (most often gram-negative bacteria) in the urinary system (in the excretory urinary tract, or in the renal parenchyma, or prostate).

Papillary necrosis vs Pyelonephritis; (SCD & NSAIDS):



UTI

- *acute x chronic*;
- *asymptomatic x symptomatic*;
- *upper* (pyelonephritis) x *lower* (urethritis, cystitis, prostatitis);
 - **pyelonephritis** - acute or chronic inflammation of the renal interstitium;
 - **urethritis, cystitis** - superficial inflammation of the mucous membranes of the urinary tract;
- *uncomplicated x complicated* (+ other pathology of the urinary tract - stones, vesicoureteral reflux, or associated disease such as diabetes mellitus or immunodeficiency).

Epidemiology

Urinary tract infections are among the most common infections in children - the prevalence is about 1-2%. It affects both sexes, in boys it is more common only in the neonatal period. During school age, the ratio of girls: boys is 10:1. In men, the prevalence increases after the age of 40 due to prostatic hyperplasia and urolithiasis. Recurrences are typical for UTIs.

Etiopathogenesis

The infection is most often caused by Gram - bacteria, mainly ***E. coli***, less often *Proteus mirabilis*, *Klebsiella pneumoniae*, *Enterobacter*, *Pseudomonas*; G + bacteria - *Enterococcus* and *Staphylococcus saprophyticus*.^[1] Some *E. coli* strains tend to adhere to epithelial cells by fimbriae and therefore cause infection more frequently.

The infection most often arises in ascending manner (in women mainly due to the short urethra) - from the large intestine through the perineum to the urethra. UTIs begin in women by colonizing the vaginal vestibule, while in men by colonizing the foreskin, and then the urethra becomes infected and from there the bladder, and rarely the upper urinary tract can become infected.

Hematogenous infections are rare, but may occur in neonates, the chronically ill, and immunosuppressed patients. Oral and barrier topical contraceptives increase the risk of UTIs. Recurrent UTIs in adolescents may indicate sexually transmitted diseases (STDs).^[2]

Risk factors for urinary tract infections include: glycosuria in diabetes, bladder emptying disorders (urethral stricture, vesicoureteral reflux, bladder post-traction residue and prostate hypertrophy), as well as stones and pregnancy. Other risk factors are instrumental examinations of the urethra.

Clinical picture

The course differs depending on whether it is acute cystitis or pyelonephritis:

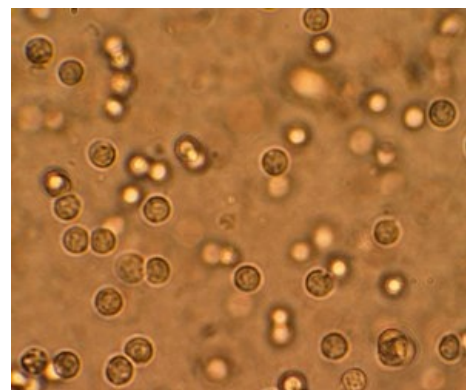
- **acute cystitis** - increasing pain during micturition (terminal dysuria); palpation sensitivity in the lower abdomen;

- **acute pyelonephritis** - dull pain in the lumbar region with fever and chills; pain when the kidneys are deeply palpated and when the lumbar region is tapped.
- In **infants and toddlers**, UTIs may occur with jaundice or even sepsis. You need to ask about specific symptoms, such as an unusual urine odor and diaper blemishes.
- In older children, dysuria (difficult and unpleasant urination), polakisuria (frequent urination), stranguria (sharp urination), abdominal or back pain, and enuresis are present.

Diagnosis

Laboratory examination:

- Chemical examination of urine and urinary sediment (in fresh urine obtained from the midstream after washing the genitals with clean water. In women, catheterized urine is ideal);
 - Urine pH ≥ 6 supports suspected UTIs;
 - proteinuria is only in pyelonephritis, and is small (up to 2 g / 24 h);
 - leukocyturia (evidenced by indication papers, more precisely by examination of urinary sediment - positive finding: more than 10 leukocytes per field of view)
 - the most reliable evidence of leukocyturia and erythrocyturia is quantitative urinary sediment from a three-hour urine collection (according to Hamburger) (standard: up to 4000 leukocytes and up to 2000 erythrocytes per minute);
- quantitative bacteriological examination of urine (always performed if a UTI is suspected) - positive finding: 10^5 colonies / ml of urine (but in the case of the presence of clinical signs the cut off value is a lower number of bacteria, in children even with 10^3 colonies / ml);
 - *asymptomatic bacteriuria* - persistent significant bacteriuria without any other symptoms and findings - is often a manifestation of urinary tract damage (anatomical anomalies, stones) in men and children; treatment only in pregnant women, immunosuppressed people, and people prior to surgeries (not only urological surgeries).
 - *urethral syndrome* = recurrent polakisuria and dysuria in young women, usually with a negative or quantitatively low bacteriological finding and without leukocyturia; more detailed examination may reveal less common or sexually transmitted flora (*Chlamydia trachomatis*, *Herpes simplex*); problems are often linked to sexual intercourse (honey-moon cystitis) and usually disappear spontaneously after a few days.^[1]
- The condition for diagnosis is significant **bacteriuria** (above 10^5 / ml), accompanied by **pyuria**, proteinuria, and possibly hematuria;
 - a finding from urine alone is not sufficient for diagnosis - in girls with vaginal influx, urine flows into the vagina and locally irritates, and we can find a similar finding.
- It is always necessary to distinguish benign cystitis from prognostically more severe pyelonephritis;
 - orientation according to the so-called **Jodal criteria** - in pyelonephritis the temperature is above 38.5 ° C, sedimentation is above 25 mm / h, and there is leukocytosis and increased CRP;
 - pyelonephritis is also likely with proven vesicoureteral reflux;
 - **in viral cystitis** (adenoviruses) - pyuria, macrohematuria, and negative bacteriuria;
 - **in chronic cystitis** - often bacteriuria without pyuria.



Pyuria - microscopic image

Imaging methods:

- first choice method: **kidney ultrasound** - we always perform for complicated UTIs;
 - renal parenchyma structure, kidney size, pelvis, calyx, ureter width and bladder wall strength are evaluated;
 - congenital malformations of the urinary tract; the size of the post-micturition residue when a bladder evacuation disorder is suspected are also evaluated;
 - diagnosis of complications: acute focal pyelonephritis, abscess;
- MCUG - to detect vesicoureteral reflux (VUR) and to assess urethral shape; sterile primary VUR tends to spontaneously improve and does not lead to scarring of the kidneys, so there is no need for treatment, therefore the examination is performed only in indicated cases; radiation exposure;
- static scintigraphy of the kidneys (dimercaptosuccinate 99mTcDMSA) - to assess the function of the renal parenchyma and lateral function of the kidneys; in indicated cases 6 months after infection to assess possible renal scarring, i.e., chronic kidney damage; exposure to ionizing radiation.^[3]

Treatment

The aim of treatment is to suppress inflammation, prevent recurrences, and eventually elimination of the cause (resolution of obstruction, extraction of cystolithiasis, etc...). **Early initiation of antimicrobial therapy** is essential. Resting regime, adequate fluid intake (2.5 l / 24 h), regular micturition and defecation are regimen measures that are recommended as part of treatment. Antipyretic therapy is administered as needed (ibuprofen, paracetamol).

For **cystitis**, we choose chemotherapeutics that reach high concentrations in the urine, such as oral **nitrofurantoin**, **trimethoprim**, and **cotrimoxazole**.^[3]

Duration of treatment:

- uncomplicated cystitis 3-7 days;^[3]
- uncomplicated non-recurrent cystitis and urethral syndrome in women - three days of treatment is sufficient;
- recurrent cystitis and in men - 7 to 10 days;
- complicated cystitis - 10 to 14 days and after disappearance we prevent recurrence with one dose of the drug per night for weeks to months.^[1]

In **pyelonephritis**, we choose substances with a high concentration in the blood. If pyelonephritis is suspected, treatment should be started immediately; any delay increases the likelihood of scarring. The choice of antibiotic depends on the regional prevalence of pathogen resistance. In uncomplicated pyelonephritis, we empirically administer **potentiated aminopenicillins** and **cephalosporins of the 2nd or 3rd generation**.^[3] With adequate treatment, the clinical condition should improve within 24-48 hours. We adjust antibiotic therapy according to urine cultivation and antibiotic susceptibility testing. There is no difference between oral and intravenous treatment (in children from about 2-3 months). Indications for IV ATB are structural congenital defects of the urinary tract, intolerance after ATB or fluid intolerance, and severe or septic course of infection. The recommended duration of antibiotic treatment in children is 10-14 days.^[3]

- Supportive therapy: cranberry extracts have a beneficial effect on recurrent UTIs (competitive inhibition of bacterial body adherence to the uroepithelium), probiotics (lactobacilli colonize the outer orifice of the urethra and expel gram-negative flora), and immunotherapy with application of extracts of bacterial bodies of the responsible agents.^[2]
- Diuresis should be monitored daily at home, blood pressure should be measured, urine should be collected for quantifying bacteriuria, and the chemical composition of urine should be checked with test papers.
- Spa care - is a long-term subject of dispute;
 - it is associated with the drinking of mineral waters, with the establishment of a certain regime of regular fluid intake and emptying.

Prognosis

- serious late complications are rare;
- uncomplicated lower UTIs tends to recur, but they do not endanger patients with renal failure;
- complicated UTIs tends to cause acute pyelonephritis and renal function decreases due to infection and underlying disease (urinary incontinence);
- main late consequences- scars, these most often occur at the age of 3-4 years;
- the scarred kidney carries a risk of recurrence of infection, hypertension, renal dysfunction;
- A clear risk factor for scarring is vesicoureteral reflux, but also hydronephrosis, urolithiasis, nephrocalcinosis etc...

Cystitis vs. pyelonephritis

Cystitis

- most often in young women (often related to sexual intercourse) and old men (permanent catheterization of the bladder);
- Clinical picture: dysuria worsening at home, polakisuria, palpable pain over the labia;
- Diagnosis: clinical picture, quantitative bacteriuria, urine + sediment;
 - in urine: leukocytes, bacteria, and sometimes erythrocytes;
 - severe cystitis may be accompanied by macroscopic hematuria.^[1]

Acute pyelonephritis

- Clinical picture: dull pain in the lumbar region, fever, constipation, severe forms under the clinical picture of urosepsis;
- Diagnosis: FW, complete blood count, CRP, S-creatinine (serum creatinine levels are increased), urine, ultrasound;
 - Renal ultrasound is performed to rule out blockage of urine outflow and abscesses in the kidney.^[1]
- **Jodal's diagnostic criteria**:
 - significant bacteriuria;
 - Body temperature > **38 °C**;
 - FW > **30 mm/h**;
 - CRP > **20 mg / l**;
 - **3 criteria** are necessary for diagnosis with bacteriuria always being present.^[4]

Chronic pyelonephritis (chronic interstitial nephritis)

- sonography and X-ray diagnosis of deformed tissue and scars of renal parenchyma;
- it is most often the result of unrecognized vesicoureteral reflux in childhood;
- also as a result of abuse of analgesic mixtures;

- Clinical picture: often asymptomatic and is diagnosed in a late stage as the cause of *hypertension* and *decreased renal function*;
- Diagnosis: physical findings are not diagnostic, urinary findings tend to be poor;
 - proteinuria that is up to 1 g/24 h accompanied by leukocyturia;
- in the late course of chronic interstitial nephritis, blood pressure and proteinuria increase, signaling accelerating progression.^[1]

References

Related articles

- Acute pyelonephritis (pediatrics)
- Urine examination
- Examination of the child's uropoietic system
- Urinary tract infections / case report
- Purulent pyelonephritis with papillary necrosis (preparation)

External links

- Doporučené postupy ČLS JEP: Infekce močových cest (<http://www.cls.cz/dokumenty2/postupy/r114.rtf>)
- Doporučené postupy ČLS JEP: Infekce dolních močových cest (<http://www.cls.cz/dokumenty2/postupy/r158.rtf>)
- Doporučené postupy ČLS JEP: Infekce močových cest – mikrobiologická diagnostika (<http://www.cls.cz/dokumenty2/postupy/t155.rtf>)

Citations

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 2. LEBL, J, J JANDA a P POHUNEK, et al. *Klinická pediatrie*. 1. vydání. Galén, 2012. 698 s. s. 603-605. ISBN 978-80-7262-772-1.
 3. ZIEG, Jakub a Eliška BÉBROVÁ. Diagnostika a léčba infekce močových cest u dětí z pohledu současných poznatků. *Pediatric pro praxi* [online]. 2015, roč. 16, vol. 4, s. 238-242, dostupné také z <<https://www.pediatricpropraxi.cz/pdfs/ped/2015/04/07.pdf>>.
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