CURRENT APPROACHES TO INFECTIONS: 1

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LOWER URINARY TRACT INFECTIONS

İBRAHIM HALIL ŞÜKÜR[1]

Introduction

Cystitis is defined as an infection of the lower urinary tract, specifically the bladder. These categories are typically subdivided into two primary classifications: complicated and uncomplicated (simple). Uncomplicated cystitis, otherwise known as lower urinary tract infection (UTI), is defined in otherwise healthy men or non-pregnant women. Conversely, complicated cystitis is characterized by the presence of risk factors that can increase the probability and severity of infection or the likelihood of antibiotic treatment failure [1].

Uretrihitis: Urethritis is an infection of the lower urinary tract characterized by inflammation of the urethra, the fibromuscular conduit that allows urine to exit the body in both sexes. In males, the urethra also functions as the channel for semen during ejaculation. This condition is frequently linked to sexually transmitted infections and is broadly categorized into gonococcal and nongonococcal forms. The principal pathogens are *Neisseria gonorrhoeae* and

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Chlamydia trachomatis, both recognized as sexually transmitted organisms [2].

Urethral discharge represents the most frequently reported clinical manifestation of urethritis. The underlying causes may differ according to regional epidemiology and individual sexual behaviors, highlighting the need for a thorough and targeted clinical history. In addition, appropriate diagnostic testing is crucial to support and confirm the information obtained from the patient's history [3].

Prostatitis: Prostatitis refers to infection and/or inflammation of the prostate gland and encompasses a spectrum of clinical syndromes with diverse presentations. The term is used to describe the presence of microscopic inflammatory changes within prostatic tissue and represents an umbrella diagnosis covering a wide array of related clinical entities.

Etiology

Acute cystitis, also known as urinary tract infection (UTI), is typically caused by bacterial infection of the urinary bladder. Women demonstrate a heightened vulnerability to this infection owing to anatomical characteristics that render the rectum in close proximity to the urethral meatus and the relatively shorter length of the urethra in women. In a substantial proportion of cases, ranging from 75 to 95%, the predominant etiological agent of uncomplicated tract infections in women is Escherichia coli, with Klebsiella species ranking second [4].

Other common etiological pathogens include species belonging to the Enterobacteriaceae family, such as Proteus mirabilis, as well as other bacteria, including Staphylococcus saprophyticus and Enterococcus species [5].

Epidemiology

The prevalence of urinary tract infections (UTIs) among the female population was examined, with the results indicating that approximately one-third of the women had experienced at least one UTI by the age of 24 years and half had experienced at least one UTI by the age of 32 years. The annual incidence of self-reported urinary tract infections (UTIs) among women has been documented to be 12%. A study of university cohorts revealed that the annual incidence of urinary tract infections (UTIs) among sexually active women ranged from 0.5 to 0.7 infections per person-year.

Various factors have been identified as potential risk factors for uncomplicated cystitis. These include sexual intercourse, use of spermicide, presence of a new sexual partner within the past year, history of urinary tract infections (UTIs), strong family history of UTIs in first-degree female relatives, and postmenopausal status. The prevalence of acute cystitis is significantly higher than that of pyelonephritis. Current estimates indicate that there are 18–28 episodes of cystitis for every episode of pyelonephritis [6].

The prevalence of asymptomatic bacteriuria in women with diabetes is estimated to be approximately 26%, compared to 6% in women without diabetes. Urinary tract infections (UTIs) are prevalent in patients who have undergone kidney transplantation. Retrospective cohort studies have demonstrated incidence rates ranging from 47% to 75% [7].

The incidence of simple cystitis was relatively low in men. The annual incidence is estimated to be less than 10 cases per 10,000 men under the age of 65 [8].

Pathophysiology

Cystitis is typically the result of bacteria originating from fecal or vaginal flora colonizing the periurethral mucosa and

ascending into the urinary bladder. Uropathogens have the potential to carry microbial virulence factors that enable them to evade host defense mechanisms and the urinary system. Urinary tract infections are significantly less prevalent in men due to the anatomical characteristics of the male reproductive system, including the longer urethra, drier periurethral environment, and antibacterial defenses provided by prostatic fluid. Conventionally, all cases of tract infections observed in men are regarded as complicated. Nevertheless, uncomplicated tract infections are seldom observed in men, particularly in those aged 15–50 years who are sexually active, uncircumcised, or have a history of anal intercourse, provided that there are no risk factors for complicated UTIs, such as urological abnormalities, bladder outlet obstruction, urolithiasis, or recent tract procedures [9].

The pathogenesis of complicated tract infections is largely determined by the underlying host factors. Immune system impairment and autonomic neuropathy-related voiding dysfunction may predispose patients with diabetes to developing UTIs. In renal failure, the accumulation of uremic toxins has been demonstrated to reduce host defense. On the other hand, decreased renal blood flow has been shown to impair the clearance of antimicrobial agents. The presence of kidney stones can result in obstruction, thereby creating a potential focal point for infection. In instances of urinary catheterization, biofilm formation can occur both internally and externally. Furthermore, pathogens may persist in the residual urine pools within the urinary bladder [10].

The most frequently identified bacterium associated with cystitis is Escherichia coli, which accounts for 75–95% of identified cases. Other microorganisms that can lead to cystitis include Klebsiella pneumoniae and Proteus mirabilis (Klebsiella is the second most prevalent cause of UTIs after E. coli). Pseudomonas, enterococci, and staphylococci, including Staphylococcus

saprophyticus, may be identified as the causative agents in patients with a recent history of hospitalization or previous treatment for urinary tract infections (UTIs). In the absence of a single pathogen detected in high numbers, other microorganisms, including Lactobacillus species, Group B streptococci, and coagulase-negative staphylococci, are often regarded as contaminants. However, the presence of true infection cannot be ruled out in such cases [11].

History and Symptoms

Acute cystitis is characterized by a variety of urinary symptoms, including dysuria, increased urinary frequency, sudden urge to urinate (urgency), suprapubic pain or tenderness, and occasionally hematuria. According to a systematic review examining the history and physical examination findings in women with uncomplicated urinary tract infections (UTIs), the combination of dysuria and frequent urination without vaginal discharge or irritation is highly predictive of uncomplicated cystitis (90% correlation). It is important to note that the symptoms may be more subtle or atypical in very young and elderly patients. Absent concomitant signs and symptoms, the presence of cloudy urine or urine described as "malodorous" is generally not sufficient in isolation to diagnose cystitis [12,13].

- Dysuria
- Change in urinary frequency
- Urgency
- Pain or tenderness in the suprapubic region
- Hematuria (rarely)

In patients exhibiting signs of frailty and general unwellness, a wide array of general symptoms, including alterations in mental or functional status, fever, chills, and falls, are frequently associated

with a presumptive diagnosis of urinary tract infection (UTI). Nevertheless, extant evidence demonstrates that only urinary changes—that is, changes in urine color, odor, and macroscopic hematuria—and acute dysuria are reliably associated with a documented urinary tract infection (UTI) [12,14].

Alterations in the odor and color of urine may be indicative of bacteriuria; however, the absence of concomitant symptoms such as fever precludes the prescription of antibiotic treatment. The recommended approach to mental status changes is to provide hydration for possible dehydration, close monitoring, and evaluation of other possible causes. A body of research has yielded discordant results regarding whether mental status changes in this patient group are indicative of a urinary tract infection (UTI) [14,15].

Criteria for Complicated Urinary Tract Infection:

1. Structural and Functional Abnormalities
Conditions that impair urine flow due to abnormalities in the anatomy or function of the urinary tract constitute the most important criteria:

- **Urinary Obstruction:** Caused by renal calculi, tumors, or urethral strictures.
- **Vesicoureteral Reflux (VUR):** Retrograde flow of urine from the bladder to the kidneys.
- **Neurogenic Bladder:** Impaired bladder emptying secondary to conditions such as spinal cord injury or diabetes mellitus.
- **Renal Cysts:** Particularly in the context of polycystic kidney disease.

2. Interventional and Foreign Body–Related Factors
External interventions involving the urinary tract facilitate bacterial adherence and colonization:

- **Indwelling Catheters:** Use of urinary catheters.
- **Surgical Procedures:** Recent urological operations or cystoscopy.
- **Nephrostomy Tubes or Ureteral Stents.**

3. Host-Related (Patient-Related) Factors

The patient's overall health status may complicate the course of infection:

- **Sex:** All urinary tract infections in males are generally considered complicated due to the risk of prostatic involvement.
- **Metabolic Disorders:** Uncontrolled diabetes mellitus and chronic kidney disease.
- **Immunosuppression:** Resulting from chemotherapy, HIV/AIDS, or immunosuppressive therapy following organ transplantation.
- **Pregnancy:** All urinary tract infections occurring during pregnancy are classified as complicated.

4. Microbiological Criteria

- **Resistant Pathogens:** Infections caused by microorganisms resistant to standard antibiotics (e.g., ESBL-producing organisms).
- **Hospital-Acquired (Nosocomial) Infections.**

Evaluation

The diagnostic approach is based on the presence of pyuria or nitrates in the urine. After physical examination, it is important to make a differential diagnosis based on the patient's laboratory findings [1]. Urinary strip tests (dipsticks) can also be used to diagnose tract infections. These tests detect the presence of

leukocyte esterase, an enzyme produced by leukocytes, and nitrites, which suggests the presence of bacteria belonging to the Enterobacteriaceae family. Because nitrates are only reduced to nitrites in the presence of bacteria, a positive nitrite test strongly suggests bacteriuria [16].

However, culture is also important. Etiological identification of the pathogen is important for continuing treatment specific to the pathogen. Detection of ≥100,000 colony-forming units (CFU)/mL indicates clinically significant bacteriuria; however, in men and in samples obtained by single (straight) catheterization of the bladder, ≥1,000 CFU/mL growth is also considered significant. Bacterial counts of 100,000 CFU/mL do not rule out the presence of urinary tract infection [11].

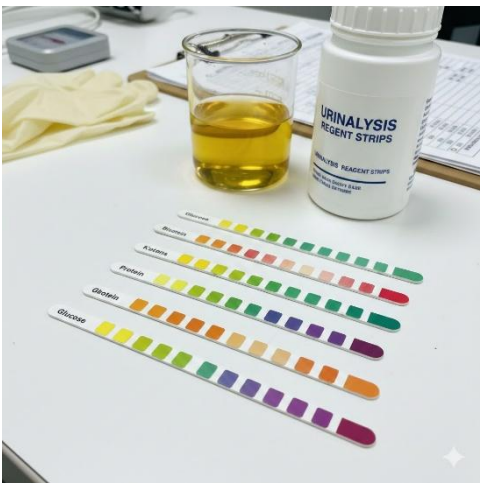

Figure 1: Urinary dipsticks

Radiological examinations are important for identifying complicated patients. It is important to identify patients within 48-72 hours and start appropriate treatment. In patients who do not respond within the first 72 h after treatment, a complicated situation should be considered [17].

Treatment

Antimicrobial agents should be selected based on the patient's risk factors or conditions, such as multidrug resistance. Antibiotic therapy is the basis of treatment. Various agents can be used [18,19]:

- Nitrofurantoin: 100 mg for 5-7 days, twice daily
- Sulfamethoxazole-trimethoprim (SMX-TMP)
- Fosfomycin: single dose, oral, and 3 grams
- Pivmecillinam: 400 mg, 5-7 days, twice daily

Cystitis is relatively rare in men, and studies on this topic are limited. The treatment approach for a healthy man with no risk factors for complicated UTI and no symptoms suggestive of extravesical infection should be similar to that used for complicated UTI in women. Fluoroquinolones are preferred as first-line agents whenever possible because of their broad-spectrum activity and high tissue penetration. However, doxycycline, trimethoprim-sulfamethoxazole (SMX-TMP), and cephalosporins may also be used as initial treatments to reduce quinolone resistance [17].

Important points to consider during treatment

1. Is Urine Culture Necessary in Uncomplicated Cystitis?
Uncomplicated cystitis is a simple bladder infection occurring in otherwise healthy, non-pregnant women.

- **First Episode:** Urine culture is generally not required. In the presence of typical symptoms (dysuria, urinary frequency, urgency), empiric therapy can be initiated.
- **Recurrent Cystitis:** Urine culture is mandatory. Each episode should be microbiologically documented to

determine whether the infection is caused by the same organism or a new strain and to exclude antimicrobial resistance.

- **Other Situations Requiring Culture:** Even at the first episode, urine culture should be obtained in cases of atypical symptoms, lack of response to therapy, suspected pregnancy, or clinical features suggestive of pyelonephritis.

2. Management of Treatment Failure

If symptoms do not improve after 48–72 hours of appropriate therapy:

- **Urine Culture and Susceptibility Testing:** Must be performed if not already obtained.
- **Antibiotic Modification:** Pending culture results, switching to an antibiotic from a different class may be considered, taking into account the possibility of resistance to the initial agent.
- **Evaluation for Underlying Causes:** Persistent infection may indicate a "complicated" condition (e.g., urolithiasis, abscess, or structural abnormality); therefore, imaging studies such as renal or urinary tract ultrasonography should be planned.

3. Duration of Treatment in Men

Due to anatomical considerations, urinary tract infections in men are always regarded as complicated.

- **Duration:** Treatment typically lasts 7–14 days. Short-course regimens (1–3 days), which may be adequate in women, are insufficient in men because of the high risk of prostatic involvement.

4. Safe Antibiotics in Pregnancy

Urinary tract infections during pregnancy must be treated to prevent maternal and fetal complications (e.g., preterm birth).

- **Safe Options:**
    - **Fosfomycin:** Single-dose therapy; highly safe.
    - **Cephalosporins:** (e.g., cephalexin, cefuroxime).
    - **Amoxicillin–Clavulanate.**
    - **Nitrofurantoin:** Can be safely used after the first trimester, but is generally avoided in the last weeks before delivery.
- **Agents to Avoid:** Fluoroquinolones (e.g., ciprofloxacin) and tetracyclines are not recommended during pregnancy.

5. Prophylactic Strategies for Recurrent Cystitis

In patients with recurrent infections (≥2 episodes within 6 months or ≥3 episodes per year), the following approaches may be considered:

- **Behavioral Measures:** Adequate fluid intake, voiding after sexual intercourse, and proper genital hygiene.
- **Postcoital Prophylaxis:** If infections are temporally related to sexual activity, a single dose of an antibiotic (e.g., nitrofurantoin or TMP-SMX) taken immediately after intercourse.
- **Continuous Low-Dose Prophylaxis:** Administration of a very low-dose antibiotic once daily at bedtime for approximately 6 months.
- **Immunotherapy:** Oral bacterial lysates that stimulate immune responses against uropathogens (e.g., Uro-Vaxom).
- **Vaginal Estrogen Therapy:** Used in postmenopausal women to restore normal vaginal flora.

Differential Diagnosis

- Painful bladder syndrome
- Pelvic inflammatory disease
- Prostatitis
- Vaginitis
- Urethritis

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UPPER URİNARY TRACT INFECTİONS

BAHATTİN KIZILGÖK[2]

Introduction

The most important part of the upper urinary system is the kidney. Infections, both acute and chronic, resulting in potentially fatal and morbid conditions may occur. Acute pyelonephritis is an infection that can potentially lead to scar formation in the kidneys and may threaten the organ and/or life. An acute pyelonephritis attack can result in significant renal damage, acute kidney injury, abscesses (e.g., nephritic or perinephritic), sepsis or sepsis syndrome, septic shock, and multiple organ failure [1].

Pathophysiology

Acute pyelonephritis develops because of bacterial invasion of the renal parenchyma. This invasion usually occurs via an ascending route from the lower urinary tract, although hematogenous spread may also be observed in some clinical situations.

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Mechanisms of Renal Infection

Ascending spread: After colonizing the periurethral area and bladder, uropathogens ascend through the ureter to reach the kidneys. Although episodes of bacteriuria are common, infection develops only when bacterial virulence factors overcome host defense mechanisms and the cleansing effect of urine flow [2].

Hematogenous spread: More rarely, gram-positive bacteria such as *Staphylococcus* can reach the kidney via the bloodstream in the presence of intravenous drug use or endocarditis. Hematogenous spread of gram-negative bacteria, however, generally requires the presence of predisposing factors, such as urinary obstruction [2].

Basic Bacterial Virulence Factors

Uropathogenic Escherichia coli (UPEC), which is responsible for 70–90% of uncomplicated pyelonephritis cases and a significant proportion of complicated cases, utilizes multiple virulence mechanisms [2]:

Adezin:

Type 1 fimbriae (mannose-sensitive) facilitate initial colonization but may also increase neutrophil binding and bacterial clearance.

P fimbriae (mannose-resistant) is strongly associated with pyelonephritis and sepsis; they enable tight adhesion to uroepithelial cells against the flow of urine.

Siderophores: These are iron chelators with high affinity that support bacterial growth in an iron-limited urinary environment.

Protectins: Surface structures that enhance complement activation and resistance to phagocytosis (e.g., LPS coatings, Tra T, Iss, and Omp T proteases).

Toxins: Molecules such as alpha-hemolysin, cytotoxins, necrotizing factor 1, and secreted auto-transporter toxins damage host tissues and suppress the immune response.

Host–Pathogen Interaction and Inflammation

Epithelial adhesion: UPEC adhesins bind to glycosphingolipid (GSL) receptors on uroepithelial cells, triggering chemokine release.

Natural immune signaling: Toll-like receptor 4 (TLR4) recognizes bacterial components and increases chemokine production, particularly interleukin-8 (IL-8).

Neutrophil migration: IL-8 binds to the CXCR1 receptor on neutrophils, facilitating the transmigration of these cells into the renal interstitium and urine. In susceptible individuals (e.g., children prone to scar formation), decreased CXCR1 expression may weaken the neutrophil response.

Other host defense mechanisms include the flushing effect of urine flow, the inhibitory effects of Tamm–Horsfall protein and uroepithelial mucopolysaccharides on bacterial adhesion, and suitable urinary pH and osmolality for phagocytosis. If these barriers are breached due to increased pathogen virulence or conditions such as urinary stasis associated with obstruction, infection, and parenchymal inflammation develop, this process can lead to suppurative necrosis and potential abscess formation [2].

Epidemiology

Epidemiological data on the incidence of pyelonephritis are limited. In a community-based study examining acute pyelonephritis in the United States, the annual overall incidence was reported to be 15–17 cases per 10,000 women and 3–4 cases per 10,000 men. The estimated incidence in women aged 18–49 years was 28 cases per 10,000 people. At least 250,000 cases of pyelonephritis are

diagnosed annually in the United States. The annual cost of treating acute pyelonephritis is estimated to be approximately $2.14 billion [3,4].

History and Physical Examination

Acute pyelonephritis usually presents with a clinical picture characterized by the coexistence of systemic and genitourinary symptoms, accompanied by characteristic physical examination findings.

The classical triad is as follows [5].

- Fever (often >103°F / 39.4°C), chills, or shaking
- Costovertebral angle (CVA) pain or flank pain
- Nausea and/or vomiting

Additional urinary symptoms are as follows [5]:

- Frequent urination, sudden urge to urinate (urgency), difficulty urinating (hesitancy), or suprapubic pain (may overlap with cystitis)
- Macroscopic hematuria is seen in 30–40% of young women, is rare in men, and requires further evaluation.

Variability according to age and risk factors [5]

- **<Children under 2 years old:** Growth and development delay, feeding difficulties, fever, vomiting
- **Elderly:** May present as a change in mental status or nonspecific deterioration in general condition
- **Risk factors for complicated pyelonephritis:** Structural or functional urinary system abnormalities, recent urinary tract intervention, antibiotic use, extreme ages, male gender, and prolonged symptom duration (>7 days)

Vital signs and general condition assessment revealed fever in most patients, although this finding may not always be present; fever may exceed 103 °F in the presence of sepsis, while hypothermia may also be observed. Fever may be accompanied by tachycardia consistent with dehydration or sepsis, and a systolic blood pressure of < 90 mmHg should be considered indicative of shock. The general appearance of patients can vary widely, ranging from mild discomfort to a distinctly ill or toxic appearance; a toxic appearance suggests the presence of complications, such as abscess or sepsis. Physical examination may reveal mild to moderate suprapubic tenderness without signs of peritoneal irritation, whereas mild to moderate costovertebral angle tenderness may be observed on percussion or palpation, either unilaterally or bilaterally. Cervical, uterine, or adnexal tenderness is not normally expected; the presence of these findings should suggest alternative diagnoses, such as gynecological pathologies or urethritis/vaginitis. Blood pressure is usually within normal limits in the absence of underlying hypertension; however, it may be elevated in patients with baseline hypertension or vasoconstriction due to sepsis [5].

Evualition

Urine sample analysis was the first step. For this purpose, midstream urine collection, urethral catheterization, or suprapubic aspiration can be performed. Microscopic examination can be performed on the samples obtained using these methods.

- Pyuria analysis: While 5-10 white blood cells are normal, a count of 20 or more indicates infection.
- Leukocyte esterase
- Nitrate shows a sensitivity of 92-100% in cases of bacteriuria.
- Hematuria

- Proteinuria: Proteinuria exceeding 3 g/day is a sign of glomerulonephritis.
- Bacterial colonies

In all patients diagnosed with pyelonephritis, regardless of whether they are treated as outpatients or inpatients, urine culture is indicated because of the possibility of antibiotic resistance, and must be obtained using appropriate sampling techniques to ensure reliable results. Blood cultures are recommended for all hospitalized patients or those scheduled for hospitalization; cultures are positive in approximately 12–20% of patients. However, bacteremia is not associated with poor clinical outcomes alone unless sepsis or serious comorbidities are present [6,7].

Imaging is recommended for the monitoring and management of patients with the following conditions:

- AIDS
- Uncontrolled diabetes
- Organ transplant
- Conditions causing immunosuppression
- Sepsis and septic shock

Especially within 48 hours after fever and positive culture, if the patient's condition suddenly worsens during follow-up while the specified conditions are present, imaging is indicated in cases of toxicity lasting longer than 72 hours and complicated urinary tract infections.

Treatment

Young female patients presenting with uncomplicated acute pyelonephritis findings and symptoms who can be monitored on an outpatient basis may be candidates for outpatient treatment when appropriate conditions are met. These patients must be healthy and non-pregnant. In addition, prior to discharge, adequate oral or intravenous fluid replacement and antipyretic and analgesic treatment, along with parenteral antibiotic therapy, should be administered as the initial treatment in the emergency department. Studies have shown that outpatient treatment in a carefully selected patient group is as safe as inpatient treatment in patients with similar characteristics, and can be performed at a significantly lower cost [8].

For non-pregnant women and males aged 16 years and older, the first-line treatment for uncomplicated acute pyelonephritis is oral antibiotics, such as cephalexin, amoxicillin/clavulanate, or trimethoprim, provided that susceptibility is confirmed by culture. Ciprofloxacin should be used with caution owing to safety concerns and should be discontinued immediately if serious adverse effects occur, including tendon pain or inflammation. In patients with vomiting, who cannot tolerate oral treatment, or who have a severe clinical presentation, the preferred intravenous antibiotics include (combinations may be considered in cases of suspected susceptibility or sepsis) only in combination, and if susceptibility is confirmed by culture, amoxicillin/clavulanate, cefuroxime, ceftriaxone, ciprofloxacin, gentamicin, and amikacin [8].

For pregnant women aged ≥ 12 years, the first-line antibiotics are cefalexin administered orally and cefuroxime administered intravenously. For children under three months of age, the NICE guidelines recommend referral to a pediatric specialist for intravenous antibiotic treatment. For children over three months of

age and adolescents under 16 years of age, the first choice is oral antibiotics such as cephalexin and, provided sensitivity is confirmed by culture, amoxicillin/clavulanate. For intravenous treatment, amoxicillin/clavulanate, cefuroxime, ceftriaxone, gentamicin, and amikacin are recommended in combination and only if susceptibility is confirmed by culture [8].

Differential Diagnoses

- Acute abdomen
- Pregnancy
- Acute bacterial prostatitis
- Appendicitis
- Served
- Chronic bacterial prostatitis
- He stops
- Endometrial
- Urethritis

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SEXUALLY TRANSMITTED DISEASE

İBRAHIM HALIL ŞÜKÜR[3]

Introduction

Sexually transmitted infections (STIs), previously referred to as sexually transmitted diseases, occur when causative microorganisms are transmitted between sexual partners through oral, anal, or vaginal contact. Owing to their prevalence and potential to cause serious complications, STIs represent a significant problem and burden for health systems. In this context, the natural course and spread characteristics of the most common sexually transmitted infections, as well as approaches to prevention, clinical evaluation, diagnosis, and treatment principles, are discussed [1].

Etiology

STIs are a global public health concern. They spread rapidly in populations with a high incidence and lack of control. They are characterized by specific organisms, transmission routes, signs, and symptoms. Risk factors include multiple partners, contact with individuals carrying STIs, prostitution, and alcohol and substance use. Male circumcision has been shown to significantly reduce the

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risk of acquiring various sexually transmitted infections, including human papillomavirus, genital herpes, and especially the human immunodeficiency virus (HIV). Specifically, regarding HIV, a reduction of approximately 50–60% in the risk of infection has been reported in circumcised men [2].

Chancroid lesions [3]: *Haemophilus ducreyi*is a gram-negative coccobacillus bacterium. Clinically, it can cause more frequent and severe infections, particularly in HIV carriers. Its prevalence has decreased significantly in developed countries, with cases mostly reported in individuals with a history of sporadic cases or contact with endemic regions.

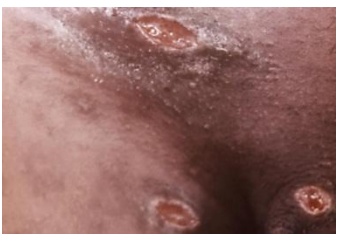

Figure 1: Chancroid [4]

Chlamydia infection [5,6]: The causative agent, a gram-negative bacterium, is typically associated with D–K serotypes. The infection is mostly sexually transmitted and has two different infectious forms in its pathogenesis: elementary and reticular bodies.

Genital herpes infection [7,8]: HSV-1 and HSV-2 viruses cause infection. These viruses contain double-stranded DNA and have an envelope structure that is covered with glycoproteins. HSV-1 is more commonly associated with orolabial infections and is observed more frequently in young individuals and homosexual patients.

Gonorrhea infection [9]: *Neisseria gonorrhoeae is* a gram-negative diplococcus bacterium and is considered the second most

common cause of sexually transmitted infections. It invades mucus-producing epithelial cells and uses glucose for metabolism. The infection is characterized by a marked inflammatory reaction.

Human Immunodeficiency Virus and Acquired Immunodeficiency Syndrome [10,11]: HIV are retroviruses that contain two single-stranded ribonucleic acids enclosed in an envelope. The signs and symptoms of primary HIV infection are generally flu-like and often considered an acute viral syndrome. Symptoms appear approximately 4–10 weeks after infection. HIV-1 accounts for the vast majority of HIV infections in the United States. Acquired immunodeficiency syndrome (AIDS) is defined as the late stage of HIV infection, and although the median time from HIV to AIDS progression is approximately 11 years, there is significant variability among individuals. It has also been reported that the risk of developing syphilis in HIV-infected patients is approximately 77 times higher than that in the general population.

Human Papillomavirus [12]: It is a virus that contains double-stranded deoxyribonucleic acid and replicates in the basal cell layer of stratified squamous epithelium. This replication process leads to cellular hyperplasia and may predispose some patients to carcinoma development. HPV types 16 and 18 are defined as oncogenic strains that induce malignant transformation, whereas HPV types 6 and 11 are the most common strains responsible for anogenital warts, known as condyloma acuminata. HPV is recognized as the most common sexually transmitted infectious agent in the United States and worldwide.

Syphilis [13,14]: This disease is caused by the spirochete bacterium *Treponema pallidum* (T. pallidum). *T. pallidum* is an extremely slow-growing microorganism that cannot be cultured using standard methods and cannot be directly visualized using routine light microscopy. Owing to the presence of few surface

proteins in its outer membrane and the absence of lipopolysaccharides, the initial immune response is generally weak. The disease typically presents as a painless, well-defined lesion called a chancre that develops at the site of inoculation. The clinical course is variable and is classified into primary, secondary, and tertiary stages, depending on the duration of the disease. According to the Centers for Disease Control and Prevention (CDC), the incidence of this infection has increased in recent years. Syphilis is more common in low-income communities and developing countries, particularly where access to healthcare is limited. Globally, approximately 12% of men who have sex with men have been reported to be affected by this infection.

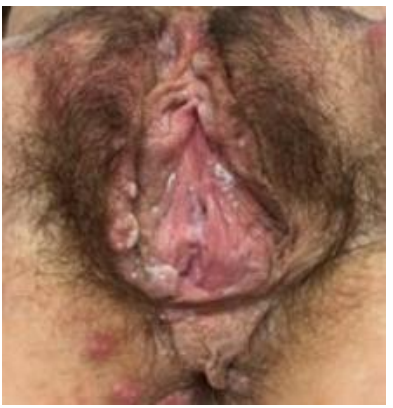

Figure 2: Genital Syphilis [15]

Epidemiology

HPV is the most common STI. It is seen in 80% of sexually active people at any given time, and 42% of individuals aged 18-59 are infected. In addition, there are 1.6 million cases of chlamydia. In addition to rising STI rates in the United States, 12% of the population has herpes infections. The worldwide HIV prevalence was 37 million in 2016 [16,17].

Evaluation

Chancroids: When evaluating the patient history and examination findings, they must be distinguished from herpes and syphilis ulcers. It is associated with one or more deep painful ulcers. The "School of fish" finding in Gram staining is 80% sensitive. [3].

Chlamydia: Diagnosis is made by nucleic acid testing of vaginal, urinary, or endocervical samples.

Genital Herpes: In addition to nucleic acid screening of samples taken from clinical examinations and ulcerations, viral culture is used [8].

Gonorrhea: In female patients, nucleic acid screening is recommended for vulvovaginal or endocervical samples, whereas in male patients, nucleic acid screening is recommended for urine or urethral samples [9].

HIV: Blood or secretions are used for diagnosis. Antibodies were the primary test for these samples. PCR and immunoassays can also be used for this purpose. In high-risk individuals, testing is performed at regular intervals [11,16].

Treatment of STIs in Pregnancy

Sexually transmitted infections that are treatable (chlamydia, gonorrhea, syphilis, and trichomoniasis) can be successfully treated with antibiotics that are considered safe during pregnancy. Viral STIs, on the other hand, cannot be cured, but they can generally be controlled, and the risk of perinatal transmission is minimized through various antiviral agents and protective approaches. For detailed information on specific STI treatments during pregnancy, it is recommended to refer to the 2021 World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) STI guidelines [18].

Treatment and Management

The Centers for Disease Control and Prevention (CDC) updated the STI Treatment Guide in 2021, emphasizing patient-centered approaches for specific groups, such as pregnant women, adolescents, the prison population, men who have sex with men, women who have sex with women, and transgender individuals. Treatment planning is based on preferred regimens, and consultation with infectious disease specialists and pharmacy departments is recommended in cases of drug intolerance or allergy. These guidelines emphasize the combined evaluation of clinical findings, physical examination, and laboratory tests in the diagnosis and treatment of STIs, and recommend individualized management for each infection [19].

The treatment approach for acute epididymitis is determined based on the patient's age and possible etiology. In men aged < 35 years, the most common causative agents are *Chlamydia trachomatis* and *Neisseria gonorrhoeae*, and a combination of ceftriaxone and doxycycline is recommended. In older age groups, where enteric microorganisms are predominant, fluoroquinolones are preferred, whereas combined treatment approaches are used when the etiology is unclear or in men who have sex with men. A single dose of azithromycin or ceftriaxone is effective in the treatment of chancroid, with a clinical response usually observed within 1–2 weeks; if no response is achieved, misdiagnosis, concomitant HIV infection, or antimicrobial resistance should be considered [19,20].

The first-line treatment for Chlamydia infections is doxycycline; azithromycin or amoxicillin is preferred during pregnancy. In cases of persistent or recurrent urethritis, the presence of *Mycoplasma genitalium* should be investigated, and treatment should be adjusted according to resistance status. For the

management of primary and recurrent attacks of genital herpes infections, acyclovir, famciclovir, or valacyclovir is used, and suppressive therapy reduces the frequency of recurrence. Topical antiviral treatments are not recommended owing to their limited clinical efficacy [5,19].

The primary approach to gonorrhea treatment is a single dose of ceftriaxone, with the addition of doxycycline recommended to address the possibility of concurrent chlamydia infection. Long-term antibiotic therapy is required for rare infections, such as granuloma inguinale and lymphogranuloma venereum, and treatment should be continued until the lesions completely heal. Beta-lactam antibiotics are ineffective in *Mycoplasma genitalium* infections owing to the absence of a cell wall; sequential or alternative antibiotic regimens are used, considering the increasing macrolide resistance, and a cure test is recommended after treatment [8,19].

Management of HIV infection is based on determining the viral load and CD4 count and initiating antiretroviral therapy early. Suppression of the viral load significantly reduces transmissibility, and pre-exposure prophylaxis is recommended for HIV-negative but high-risk individuals. Vaccination is emphasized as the primary prevention for HPV infections, and treatment of genital warts is planned using surgical, ablation, or topical methods, depending on the characteristics of the lesion and patient preference [19,21].

The gold standard for syphilis treatment at all stages is benzathine penicillin G, and high-dose intravenous penicillin is required for neurosyphilis. Serological follow-up after treatment is mandatory, and patients should be informed that the Jarisch–Herxheimer reaction may occur, particularly during early stage treatment, and that this is not a drug allergy. Metronidazole is the primary agent used to treat trichomoniasis, and retesting is recommended for female patients after treatment. For patients

presenting after a sexual assault, the CDC recommends evaluation for possible STIs, emergency contraception, HIV, and viral hepatitis [12,19].

In general, the 2021 CDC guidelines recommend the use of nucleic acid amplification tests in symptomatic patients with STIs, not delaying empirical treatment if the results are not available, and screening all patients for HIV and syphilis. A system-based and comprehensive approach to differential diagnosis is emphasized as a fundamental principle to ensure early diagnosis and appropriate treatment.

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SURGICAL ANTIBIOTIC PROPHYLAXIS

BAHATTIN KIZILGÖK[4]

Introduction

In modern surgical practice, preventing postoperative infectious complications is critical for reducing patient morbidity and mortality. In this context, preoperative antibiotic prophylaxis is a proactive approach that aims to prevent pathogen colonization by introducing therapeutic agents into the system before surgical trauma. In the literature, the level of evidence that routine prophylaxis use in elective surgical procedures improves clinical outcomes is increasing daily. In particular, retrospective and prospective data from 2008 show that the prophylactic approach in major orthopedic procedures, such as total hip and knee arthroplasty, reduces the incidence of surgical site infection (SSI) by more than 80% compared to cases where prophylaxis is not administered [1].

Current clinical guidelines define the use of prophylactic antibiotics as a standard care protocol in cases involving bioprostheses or foreign body implantation, bone grafting

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procedures, invasive procedures requiring extensive dissection, and surgical cases where massive blood loss is anticipated.

Pharmacokinetic Timing and Tissue Activity

Optimization of prophylactic efficacy is directly related to the timing of antibiotic administration. The primary pharmacokinetic goal is to maintain tissue concentrations above the minimum inhibitory concentration (MIC) from the moment the surgical incision is made until the end of the procedure. For commonly used antibiotic agents, the ideal administration window has been determined to be the 30 to 60-minute period prior to skin incision.

Timing errors are one of the main causes of prophylactic failure, especially in surgical procedures performed under a tourniquet (extremity ischemia). Administering antibiotics after tourniquet inflation dramatically reduces its effectiveness because it prevents the agent from reaching the surgical site via the vascular route. Therefore, ensuring tissue perfusion and drug saturation before vascular occlusion is essential for the continuity of operational success [2,3].

Commonly encountered organisms [4]

- Staphylococcus aureus
- Staphylococcus epidermidis
- Aerobic streptococci
- Anaerobic cocci

Mechanism of Action

In determining the preferred agents for surgical prophylaxis, the pharmacodynamic profile of the drug plays a decisive role, in addition to its spectrum of activity. In the literature, antibiotic classes that generally exhibit bactericidal properties have been highlighted

in terms of prophylactic efficacy. The fundamental rationale behind the bactericidal approach is not only to suppress the proliferation of potential contaminants in the surgical field but also to minimize the risk of infection at its source by directly eradicating microorganisms.

However, it should be noted that the mechanisms of action of antibiotics may vary depending on bacterial susceptibility patterns and serum/tissue concentrations applied. In this context, some agents may exert both bacteriostatic and bactericidal effects in a dose-dependent manner.

For example, clindamycin, a protein synthesis inhibitor, exhibits bacteriostatic effects at low plasma concentrations; however, it can gain bactericidal activity at increased dosages. The critical parameter for clinical success is the establishment of sufficient bactericidal concentrations against pathogens in the vascular bed and target tissue microenvironment prior to incisional trauma.

Administration

In clinical protocols, the vast majority of preoperative prophylactic agents are administered intravenously (IV) to ensure rapid and predictable tissue saturation. The key components of prophylactic success are the timing of the first dose, intraoperative redosing based on the duration of the operation, duration of prophylaxis, and dose modifications in patients with comorbidities such as obesity. Careful management of these parameters not only reduces the incidence of surgical site infections (SSIs) but also prevents adverse effects and the development of antimicrobial resistance in line with the principles of rational antibiotic use [5].

The general approach is to administer antibiotics within a 30-60 minute window prior to incision; however, the pharmacokinetic properties of some agents require specific protocols. For example,

agents such as vancomycin and levofloxacin, which require a longer infusion time, should be started at least 120 min before the start of surgery.

In patients currently receiving antibiotic therapy due to an existing infection, if the agent used has an appropriate spectrum against surgical site pathogens, an additional dose may be administered within the first 60 min following the incision to maintain tissue concentration. However, in patients with renal insufficiency receiving regular vancomycin therapy, prophylaxis should be supported with cefazolin instead of additional vancomycin loading to minimize the risk of toxicity and provide broad-spectrum protection [6].

Contraindications

Beta-lactam Allergies and Contraindications of Prophylaxis

The widespread use of beta-lactam antibiotics, particularly cephalosporins, in surgical prophylaxis protocols necessitates careful evaluation of contraindications to these agents. The presence of an Immunoglobulin E (IgE)-mediated or Type 1 hypersensitivity reaction to penicillin in the patient's medical history is a major clinical condition that limits the use of penicillins, certain cephalosporin derivatives, and carbapenems.

Type 1 reactions typically occur after a short latent period of 30-60 minutes following parenteral or oral administration of the drug and are characterized by life-threatening symptoms such as urticaria, bronchospasm, or systemic anaphylaxis.

Differential diagnoses and alternative strategies

In the clinical decision-making process, distinguishing between true allergic reactions and non-specific intolerance is essential for rational drug management. In cases with no history of

type 1 reactions or exfoliative dermatitis (such as Stevens-Johnson Syndrome (SJS) and Toxic Epidermal Necrolysis (TEN)), carbapenems are considered safe prophylactic options.

In this context, obtaining a detailed medication allergy history from each patient is an essential component of the preoperative preparation phase, aimed at optimizing standard preoperative regimens and preventing potential complications.

Monitoring

Antimicrobial Resistance Management and the Importance of Local Surveillance

Surgical site infections (SSIs) have a multifactorial etiology; however, inappropriate antibiotic use is one of the most critical risk factors in this process. The success of prophylactic strategies depends on fundamental parameters, such as the selection of the appropriate agent, pharmacokinetically optimal timing of the first dose, and adherence to intraoperative redosing protocols. Although institutional-level standard prophylaxis guidelines exist, periodic monitoring of local microbial resistance patterns and correlating these data with SSIs incidence are essential [7].

Changes in local resistance profiles may necessitate the dynamic revision of prophylactic agent preferences. For example, if clindamycin, which is commonly preferred in populations with penicillin allergies, loses its effectiveness owing to the increasing resistance prevalence and leads to an increase in SSIs rates, switching to vancomycin in this patient group becomes a rational option [7].

Rational Antibiotic Use and Class Protection Strategies

To control the new resistance patterns observed in the antibiogram data and minimize selection pressure, prophylactic

regimens should be regularly validated. In centers with a high prevalence of carbapenem-resistant organisms (CRO), the conservation of broad-spectrum agents is of strategic importance. In this context, preferring cefoxitin over ertapenem in contaminated procedures, such as colorectal surgeries, when clinically indicated, is an evidence-based and rational approach to limit the excessive and unnecessary use of carbapenem antibiotics [7].

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URINARY TRACT INFECTIONS IN CHILDREN

ZAHIDE ORHAN OK[5]

Introduction

Urinary tract infections (UTIs), one of the most common bacterial infections encountered in childhood, develop as a result of pathogenic microorganisms ascending from the urethra to the renal parenchyma. Anatomical localization of the infection is a key determinant of clinical management and prognosis.

Anatomical and Clinical Classification

The USEs were examined in two main groups according to the catchment area:

- **Upper Urinary Tract Infections:** These conditions involving the renal parenchyma and ureters, characterized by more pronounced systemic symptoms (**yelonephritis**).
- Lower Urinary Tract Infections: Infections limited to the bladder (**cystitis**) or urethral mucosa (**urethritis**).

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In the literature, unlike these tables, the absence of bacterial growth in standard urine cultures despite the presence of leukocyturia is defined as **sterile pyuria**, whereas the detection of significant bacterial colonization in urine without clinical symptoms or signs of inflammation is termed **asymptomatic bacteriuria**.

Complex UTI and Atypical Course Criteria

In pediatric UTI management, the definition of "complicated infection" requires deepening diagnostic processes and a more aggressive treatment approach. The following situations have been evaluated in the **spectrum of complicated UTI** in clinical practice:

- **Age Factor:** All infections developed during the neonatal period.
- **Systemic Involvement:** Presence of urosepsis or renal abscess.
- **Anatomical Abnormalities:** Congenital anomalies of the kidneys and urinary tract (**CAKUT**), presence of a bladder or abdominal mass.
- **Microbiological Factors:** The infectious agent is an atypical microorganism other than *Escherichia coli*.
- Treatment Response: Failure to observe clinical and laboratory improvement within the first 72 h despite initiation of an appropriate antibiotic regimen.

Etiology

Colonic bacteria are primarily responsible for the etiology of UTIs. *Escherichia coli* is the most common causative microorganism, accounting for approximately 85–90% of all UTIs. *Klebsiella*, *Proteus*, *Enterococcus*, and *Enterobacter* species are among the other common causative agents [1].

Proteus species are also associated with kidney stone formation. *Pseudomonas* species, *Staphylococcus aureus*, and group B *Streptococcus* are usually detected in association with congenital anomalies of the kidney and urinary tract (CAKUT), history of genitourinary surgery, catheterization, or recent antibiotic use. *Enterococcus* species are a common cause of catheter-associated UTIs.

Hematogenous spread to the urinary system may occur in newborns and children with immunodeficiency. Group B Streptococcus, Candida species, Staphylococcus aureus, and Salmonella species can spread via the hematogenous route and cause pyelonephritis [2].

Epidemiology

The prevalence of urinary tract infection (UTI) in children varies depending on various factors, such as age, sex, race, and circumcision status. By the age of seven, 8.4% of girls and 1.7% of boys had had at least one episode of this infection. UTI incidence peaks during critical periods, such as infancy, toilet training, and the onset of sexual activity in girls. The main risk factors include female sex, young age, Caucasian race, uncircumcized male infant, and the duration and severity of high fever. Vesicoureteral reflux (VUR), congenital anomalies of the kidney and urinary tract (CAKUT), bowel-bladder dysfunction (BBD), and spinal dysraphism, among other anatomical or functional disorders, significantly increase the risk [3,4].

Approximately 7% of infants with fever during infancy have been found to have UTI as the underlying cause. Girls under one year of age and uncircumcised male infants under three months of age are in the highest risk group; indeed, the risk of UTI in uncircumcised male infants under three months of age with fever is 20%, while in circumcised infants, this rate drops to 2.4%. The UTI calculator

developed by the University of Pittsburgh, which is based on criteria such as age, sex, and fever duration, has standardized clinical outcomes by preventing unnecessary tests to improve diagnosis and treatment processes. In addition, while additional risk factors such as sexual activity, pregnancy, kidney stones, and diabetes come into play in older children, previous antibiotic use is also known to increase this risk. While VUR and BBD are defined as the most critical factors in terms of recurrence, there is insufficient evidence in the literature that hygiene habits (wiping direction), encopresis without constipation, and bubble baths increase the risk of UTI [5,6].

Pathophysiology

Regular flushing of the urinary tract is one of the body's most critical defense mechanisms against infection; however, uropathogenic E. coli (UPEC) strains can overcome this defense owing to their specific virulence factors. Fimbriae (especially P-fimbriae) on the surface of UPEC, which function according to a lock-and-key model, enable the bacterium to adhere tightly to the uroepithelium, causing it to resist the cleansing effect of urine flow. Virulence factors, such as toxins, protectins, and siderophores, which accompany this adhesion process, increase the pathogenicity of the bacterium in the host cell, facilitating the establishment of infection [7].

In addition to physiological processes, mechanical factors also increase the risk of UTI. For example, constipation increases urinary storage pressure by applying pressure to the bladder neck and causes residual urine to remain inside after urination. Furthermore, the entire colon creates a serious reservoir for pathogenic bacteria, increasing the risk of infection. During adolescence, specific conditions such as sexual intercourse, pregnancy, infrequent urination habits, and a history of cystitis, as well as urolithiasis (stone

disease), anatomical anomalies, or the presence of foreign bodies, can add to these risk factors and complicate the clinical picture [7].

Medical History and Physical Examination

The clinical presentation of tract infections varies greatly depending on the child's age and the anatomical location of the infection. In infants during the first three months of life, the picture is characterized by systemic and nonspecific findings such as fever, vomiting, hypothermia, jaundice, feeding difficulties, and irritability, while in children under two years of age, the most common clinical sign is usually fever without any other focus. The inability of children in this age group to localize pain can complicate the diagnostic process; in contrast, older children can help establish a diagnosis by describing their symptoms more clearly [2].

A detailed history and targeted physical examination are crucial for a definitive diagnosis, as symptoms vary depending on the site of inflammation. For example, **urethritis** is characterized by itching and discharge, **acute cystitis** by dysuria, frequent urination, foul-smelling urine, and suprapubic pain, and **acute pyelonephritis** by systemic findings such as fever, flank pain, and vomiting. History must include questions about constipation, urinary disorders, and past antibiotic use. Physical examination should carefully evaluate critical findings such as abdominal distension, palpable masses (indicating hydronephrosis or fecal impaction), costovertebral angle tenderness, and suprapubic tenderness [2].

Evaluation

Nonspecific symptoms in young children make it difficult to diagnose UTI, and a non-contaminated urine sample is required for a definitive diagnosis. Common methods used to obtain urine samples from children who are not toilet-trained include urine bag

collection, midstream clean urine sampling, catheterization, and suprapubic needle aspiration.

The "Quick-Wee" method is a technique based on rubbing a gauze pad soaked in cold (2.8 °C) physiological saline solution against the suprapubic region to stimulate urination in children who have not undergone toilet training and to obtain a contamination-free urine sample [8].

Figure 1: Quick Wee methods

- Leukocyte esterase: a condition caused by white WBCs or leukocytes in urine, a sign of pyuria.
- Nitrites: Observed with the metabolic activity of Gram-negative bacteria
- Microscopy: Bacteria, white blood cells, and red blood cells were detected.
- Urine Culture: The number of bacteria considered significant for the diagnosis of UTI varies depending on the method of obtaining the urine sample. Accordingly, >100,000 colony-forming units (CFU)/mL in midstream urine samples, >50,000 CFU/mL in samples obtained by catheterization, and >1,000 CFU/mL in samples obtained by suprapubic aspiration were considered diagnostically significant [9].

- Blood tests: These tests are not routine; however, an elevated white blood cell (WBC) count indicates inflammation. Additionally, prolonged sedimentation and increased C-reactive protein (CRP) and procalcitonin levels may be observed.
- Renal ultrasound: Renal ultrasound is recommended for all young children experiencing their first febrile UTI and for older children with a history of recurrent UTIs. Ultrasonographic evaluation of the kidneys and bladder should be performed to detect any anatomical or structural abnormalities [10].
- Dimercaptosuccinic Acid Scan: Renal scintigraphy with 99m technetium-dimercaptosuccinic acid (DMSA) should be considered in children with renal parenchymal abnormalities detected on ultrasonography or in cases with a history of recurrent febrile UTI. Although DMSA scintigraphy is the gold standard method for diagnosing acute pyelonephritis and renal scars, it is not recommended for routine evaluation of acute pyelonephritis. This examination should be performed approximately 6 months after acute infection to detect renal scarring (reflux nephropathy) following acute pyelonephritis. [10,11].

Treatment

Early urine culture can be obtained to identify the bacteria and determine effective antibiotic therapy. Oral treatment may be used depending on patient compliance and effectiveness. However, parenteral antibiotic therapy may be considered in the management of sepsis, bacteremia, hypoxic conditions, hemodynamic instability, immunocompromised states, and when oral treatment is not tolerated.

Antibiotic options and dosages used for parenteral (intravenous or intramuscular) empirical treatment of urinary tract infections (UTIs) in children are organized as follows, based on AAP guidelines [10]:

- **Ceftriaxone is** administered at a dose of 75 mg/kg every 24 hours.
- **Cefotaxime is** administered at a total daily dose of 150 mg/kg, divided into doses every 6-8 hours.
- **Seftazidim**is was administered at a daily dose of 100-150 mg/kg, divided into doses every 8 hours.
- Gentamicin is administered at a total daily dose of 7.5 mg/kg, divided into 8-hour intervals.
- **Tobramycin**is was administered at a daily dose of 5 mg/kg, divided into doses every 8 hours.
- **Piperacillin** is preferred at a daily dose of 300 mg/kg, administered in divided doses every 6-8 hours.

Antibiotic options and dosages used for the oral empirical treatment of urinary tract infections (UTIs) in children are organized as follows, according to AAP guidelines [10]:

- **Amoxicillin clavulanate is** administered in a total daily dose of 20–40 mg/kg, divided into three doses.
- **In the sulfonamide** group, **trimethoprim-sulfamethoxazole (TMP-SMX)** is administered in two doses at a daily rate of 6–12 mg/kg trimethoprim and 30–60 mg/kg sulfamethoxazole, provided it is not used in infants under 2 months of age. **Sulfisoxazole** is preferred at a daily dose of 120–150 mg/kg, divided into four doses.

- **Cephalosporins** offer a wide range of options: **cefixime** at a single daily dose of 8 mg/kg, **cefpodoxime** at a total of 10 mg/kg in two doses, **cefprozil** at two doses totaling 30 mg/kg, and **cefuroxime axetil** at two doses totaling 20–30 mg/kg. Additionally, **Cephalexin** is administered in a total daily dose of 50–100 mg/kg, divided into four separate doses.

The duration of antibiotic treatment should be determined based on the child's age, severity of the clinical picture, and whether the infection affects the lower or upper urinary tract [12].

- Antibiotic treatment is recommended for 7–14 days in infants, children younger than 24 months, and older children diagnosed with pyelonephritis.
- For older children diagnosed with cystitis, a 3–7 day course of antibiotic treatment is usually sufficient. In the treatment of cystitis in children, 2–4 day courses of oral antibiotics have been shown to be as effective as 7–14 day courses of treatment.
- Children with acute pyelonephritis can be successfully treated with oral antibiotics for 10–14 days or with oral treatment following 2–4 days of intravenous antibiotic therapy.[12]
- Asymptomatic bacteriuria should generally not be treated outside of pregnancy because if left untreated during pregnancy, it can progress to acute infection and lead to pyelonephritis. Antibiotics should be administered for 3–7 days to pregnant women with asymptomatic bacteriuria, and appropriate treatment reduces the risk of premature birth and low birth weight.

The prophylactic antibiotic options and recommended dosages used to prevent urinary tract infection (UTI) recurrence in children are summarized below [13]:

- A single daily dose regimen is generally preferred for UTI prophylaxis in children. One of the most commonly used agents, **TMP-SMX**, can be administered at a single daily dose of 2 mg/kg (based on trimethoprim) or twice weekly at a dose of 5 mg/kg.
- Another option, **nitrofurantoin**, is prescribed as a single daily dose of 1-2 mg/kg, while the recommended prophylactic dose for **cephalexin** is 10 mg/kg once daily.
- Additionally, penicillin group antibiotics, such as **ampicillin** at 20 mg/kg daily and **amoxicillin** at 10 mg/kg daily, can be used as a single dose for prophylactic treatment.

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