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OPTIMIZATION OF TREATMENT TACTICS FOR CHILDREN WITH URINARY TRACT INFECTION

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Abstract:
Development of modern diagnostic methods and optimization of antibiotic therapy for urinary tract infection (UTI) in children. Determine the nature of the microbial landscape for a given region.
Materials and methods. In the period from 10/20/2020 to 10/05/2022, 80 children with UTI were identified in the clinic. The material for the study contain anamnestic information, complaints of patients, clinical data obtained from case histories. **Conclusions.** In 30% of patients with UTIs are caused by urinary passage disorders. The most common causative agent of UTI in children in Uzbekistan was E. coli. The most active antimicrobial drugs against E. coli strains are inhibitor-protected cephalosporin and penicillin, then II-III generation of cephalosporin.
Keywords: Urinary tract infection, urodynamics, bacteriuria, urobiota.

Introduction.

Urinary tract infection (UTI) is one of the significant issues in pediatric urology. The urgency of the problem is due to the high frequency of pathogenetic factors leading to urinary system infections (congenital abnormalities of the urinary organs with impaired urodynamics, combination of vesicoureteral reflux and neurogenic bladder dysfunction, etc.), as well as the specific uropathogenic properties of the pathogens, their ability to persist, and high antibiotic resistance [1]. Because UTIs in children are not subject to mandatory registration, the exact incidence of these infections is unknown [2].

The key indicator of urinary system infection is bacteriuria. The main laboratory method for examining a patient with a UTI is microbiological urine analysis to identify the pathogen species, its virulence, the persistent properties of the urobiota, and to determine the type of bacteriuria [1]. The prevalence of UTIs in children is approximately 18 cases per 1,000 children. The frequency of UTI development depends on age and gender [3].

Among the pathogens causing UTIs in children, Gram-negative flora predominates, particularly Escherichia coli (90%). Gram-positive flora, mainly enterococci and staphylococci, cause 5-7% of infections [4]. Additionally, there are cases of UTIs caused by nosocomial infections, such as Klebsiella, Serratia, and Pseudomonas spp [5].

The factors contributing to the development of urinary tract infections can be divided into several groups. First, anatomical or functional disorders in the urinary system of varying severity, leading to impaired urodynamics: obstructive uropathies, such as megaureter; urolithiasis; neurogenic bladder dysfunction of all types; vesicoureteral reflux (VUR), etc. Second, a significant role in the development of UTIs is played by processes that reduce immune response, including the impairment of bactericidal properties of urinary tract epithelial cell secretions (e.g., Tamm-Horsfall protein); disturbance of renal hemodynamics; damage to glycoprotein structures that prevent bacterial adhesion to the mucosa; and dysfunction in the

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production of components of humoral and cellular immunity (IgG and IgA in urine, neutrophils, and macrophages). The third group of factors involves the biological properties of microorganisms colonizing renal tissue, including their ability to adhere to the urothelium and subsequently invade the renal parenchyma, as well as their antibiotic resistance [6].

In most cases, especially in girls (due to the short and wide urethra, as well as the proximity to the anorectal area), the infection enters the urinary tract via an ascending route. The sources of uropathogenic bacteria are the rectum, perineum, and lower urinary tract. Hematogenous spread of UTIs is now rarely encountered [7,8].

The symptoms of UTIs depend on the child's age, the localization of the inflammatory process, and the severity of the disease. In older children (over 4-5 years old), dysuria, imperative urges, pain and/or burning during urination, possible lower abdominal and/or back pain, tenderness in the costovertebral angle upon percussion and palpation, tenderness above the pubis, and febrile fever are commonly observed. In younger children, hyperthermia above 38°C may be the leading symptom. Other typical symptoms include general malaise, irritability, mood swings, nonspecific signs of intoxication, such as loss of appetite to the point of refusing food, failure to gain weight, nausea and vomiting, and skin mottling [8, 9,10]. The diagnosis is made based on a combination of clinical findings and laboratory-instrumental investigations. In patients with UTIs, leukocyturia, bacteriuria, proteinuria, and deviations from the normal urine specific gravity are typically detected [11].

According to various sources, by the age of 6, 3-7% of girls and 1-2% of boys experience urinary tract infections. The peak age for urinary tract infections is 4-5 years old. To ensure adequate and effective therapy, it is essential to have up-to-date knowledge about the peculiarities of the pediatric organism, the structure and life cycle of the UTI pathogens, and their sensitivity to antibiotics. Despite the availability of effective treatment methods for children with UTIs, the resistance of uropathogens increases annually, which requires the development of new generations of antibacterial drugs. However, the indications for their use in pediatric infections are still not well defined. The reasons for the frequent recurrences of pediatric infections have not yet been fully studied. Therefore, further improvement of existing methods for the treatment and prevention of UTI recurrences, as well as the development of guidelines for the use of new antibacterial drugs in children, appears necessary.

The aim of the study: The aim of the study is to develop modern diagnostic methods and optimize the strategy for antibacterial therapy of UTIs based on the antibiotic susceptibility of pathogens, as well as to explore ways to prevent UTI recurrences in children. Additionally, the study aims to determine the characteristics of the microbial landscape in this region.

Materials and Methods: To achieve the stated goal, a study was conducted involving children aged 4 to 15 years with clinical manifestations of UTIs, if a pathogen was isolated from their urine. From October 20 2020 to October 5 2022, 80 children with UTIs were identified at the Republican Specialized Scientific and Practical Medical Center of Urology. The materials for the study included anamnesis data, patient complaints, clinical information obtained from medical histories, general blood tests, ultrasound (US) of the kidneys and urinary system, as well as urine tests according to Nechiporenko and bacteriological urine analysis. If necessary, additional instrumental studies were performed, including X-ray, computed tomography (CT), cystoscopy, etc.

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Results and Discussion of the Study: Of the 80 children with UTIs, 14 (17.5%) were boys and 66 (82.5%) were girls (Table 1).

Table 1

Distribution of Patients by Gender

	Male	Girl
Quantity	14 (17,5%)	66 (82,5%)
Age < 5 years (n=12).	4 (33,3%)	8 (66,7%)
Age > 5 years (n=80).	10 (12,5%)	70 (87,5%)

Among them, 12 (15%) were under the age of 5, and 68 (85%) were older than 5. The average age of all patients was 9.18±0.36 years, with boys averaging 7.64±0.75 years and girls averaging 9.5±0.39 years.

During the screening, ultrasound (US) of the kidneys, bladder, and urine analysis according to Nechiporenko (microscopic examination with quantitative counting of leukocytes, erythrocytes, and casts in 1 ml of urine sediment) were performed. In cases of anatomical anomalies, kidney stones, urinary tract stones, and complications of urine passage, X-rays, urography, and CT scans were conducted. During the study, 18 patients were diagnosed with hydronephrosis (ureterohydronephrosis) upon ultrasound. Further investigation revealed ureteral strictures in 11 patients, including strictures of the renal pelvis-ureter segment (RPU), the ureterovesical segment (UVS); vesicoureteral reflux (VUR) in 4 patients; and urolithiasis (kidney stones) in 4 patients. Surgical treatment was carried out in these cases, and UTI recurrences were resolved. Neurogenic bladder dysfunction was identified in 5 patients, and nocturnal enuresis in 6 patients.

UTI was considered confirmed if more than 4000 leukocytes and bacteria were found in the urine upon analysis according to Nechiporenko, which served as the basis for conducting a bacteriological study to identify the pathogen. For patients who had received antibiotics in the last month, bacteriological analysis was not performed, as the results could have been unreliable.

In 25 (30%) of the patients, the UTIs were caused by congenital anomalies and disturbances in urine passage, which required surgical intervention. Bacteriological examination was conducted for 28 patients. In 4 cases, no microbial growth was detected. In 23 cases, E. coli was identified, and in 1 case, P. mirabilis was found. Urine tests in 19 (23.75%) cases showed leukocytes in the urine up to 10,000, in 25 (31.25%) cases from 10,000 to 50,000, in 8 (10%) cases from 50,000 to 100,000, and in 28 (35%) cases, more than 100,000 leukocytes per 1 ml of urine (Diagram 1). In 9 cases, erythrocytes were detected. The urine pH ranged from 5.00 to 7.22.

(Diagram No. 1).

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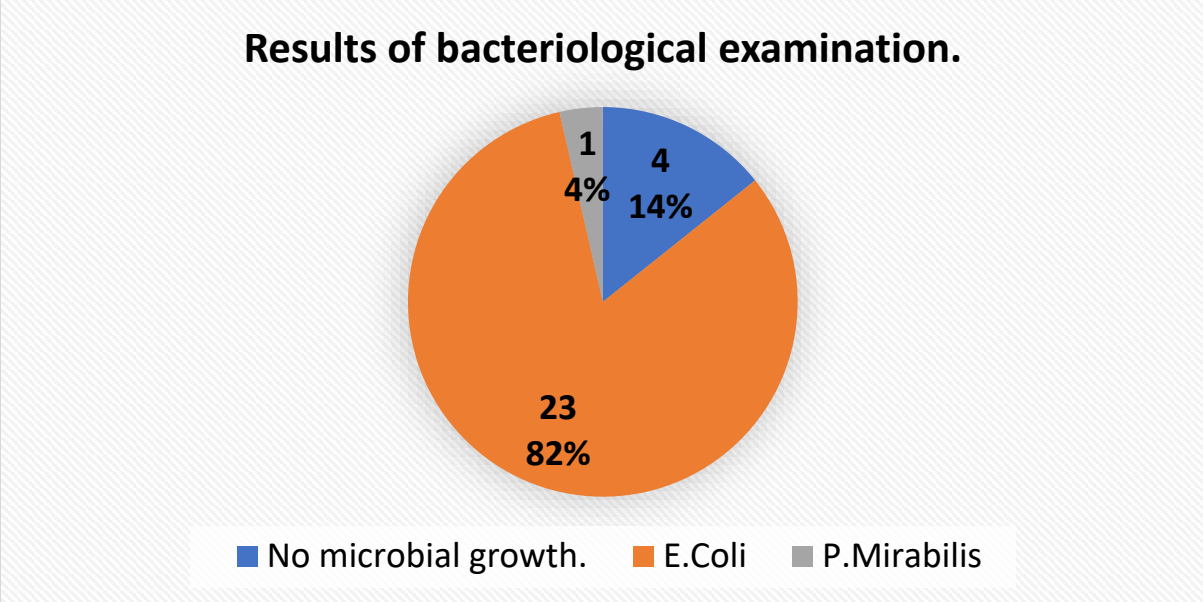

According to the results of bacteriological testing, in 20 cases, the pathogens were sensitive to beta-lactamase inhibitor-protected cephalosporins (cefpodoxime/sulbactam), in 18 cases to beta-lactamase inhibitor-protected penicillins (amoxicillin/clavulanic acid), in 13 cases to second- and third-generation cephalosporins (cefuroxime, ceftriaxone, ceftazidime), and in 12 cases, sensitivity to fosfomycin was determined, among others.

The results of the study showed that a single microorganism most often causes UTIs in children. The main pathogens of UTIs in children in Uzbekistan are representatives of the Enterobacteriaceae family, primarily E. coli, which is found in more than 95% of cases. (Diagram No. 2)

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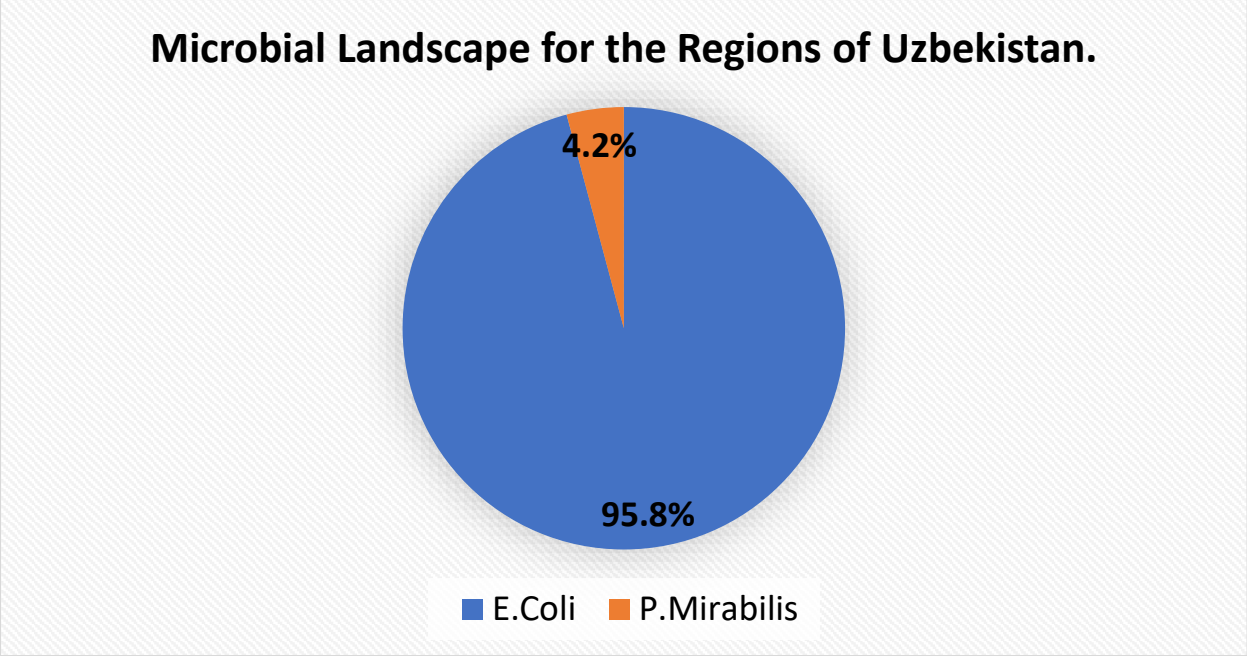

Conclusions: Patients presenting with complaints suggestive of a urinary tract infection should undergo ultrasound (US) of the kidneys and bladder, as well as a urine analysis. It is recommended to perform bladder ultrasound in two stages: the first stage with a filled bladder and the second stage after it is emptied. This simple method allows for the detection of bladder emptying abnormalities or the presence of anatomical abnormalities. If deviations from the norm are detected, further diagnostic tests such as X-ray, CT, cystoscopy, etc., should be conducted.

In 30% of patients with urinary tract infections (UTIs), the condition is typically caused by disturbances in urine passage, and the primary goal of treatment should be to address the underlying cause of the urinary dynamics disorder. The most common pathogen of UTIs in children in Uzbekistan is E. coli.

The most active antimicrobial agents against E. coli strains isolated from children with UTIs are beta-lactamase inhibitor-protected cephalosporins (cefpodoxime/sulbactam), beta-lactamase inhibitor-protected penicillins (amoxicillin/clavulanic acid), and second- and third-generation cephalosporins (cefuroxime, ceftazidime, ceftriaxone).

For urinary tract infections in children, ultrasound (US) of the kidneys, bladder, and urine analysis should be used as screening methods. Bacteriological testing should be conducted if possible. When treating UTIs, antibiotics that the pathogens are sensitive to should be prescribed. In cases where bacteriological testing is not available, beta-lactamase inhibitor-protected penicillins and cephalosporins, including second- and third-generation cephalosporins, should be used as first-line treatment.

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