

Etiological Spectrum And Antibiotic Resistance Of Uropathogens In Various Forms Of Pyelonephritis: Clinical And Microbiological Research

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ABSTRACT

Pyelonephritis is one of the most common infectious and inflammatory diseases of the urinary system, with a high proportion of hospitalizations and the risk of chronicling the process. The purpose of this study was to analyze the etiological spectrum of pyelonephritis pathogens and determine their sensitivity to the main groups of antibacterial drugs in patients with acute and chronic forms of the disease. The study included 68 patients undergoing inpatient and outpatient treatment. A bacteriological analysis of urine was performed to identify the pathogens and determine their antibiotic sensitivity. It has been established that *Escherichia coli* remains the dominant pathogen, however, an increase in the proportion of *Klebsiella* spp., *Enterococcus* spp. and *Pseudomonas aeruginosa* is observed. A high degree of resistance to ampicillin, tetracycline and fluoroquinolones has been recorded, especially among nosocomial strains. The optimal first-line drugs are cephalosporins of the third generation and carbapenems. The results obtained confirm the need for regular microbiological monitoring and revision of local empirical therapy regimens, taking into account local resistance.

Keywords: *pyelonephritis, antibacterial drugs, escherichia coli, antibiotic sensitivity, antibiotic resistance.*

1. INTRODUCTION

Pyelonephritis is one of the most common diseases of the urinary system, characterized by inflammation of the calyx-pelvis system and kidney parenchyma. The etiology and pathogenesis of pyelonephritis are multifactorial, but the main role is played by bacterial agents that enter the renal tissue in a hematogenous or ascending pathway. The problem of rational choice of antibacterial therapy remains extremely relevant in clinical practice due to the increasing resistance of pathogens to widely used drugs. In conditions of constant. As the frequency of relapses, complicated forms and chronic course of the disease increases, it becomes necessary to conduct a detailed analysis of the etiological profile of pathogens and their sensitivity to various classes of antibiotics [1].

To date, there has been a significant change in the spectrum of bacterial pathogens that cause inflammatory diseases of the urinary system. Previously, *Escherichia coli* was the dominant pathogen, but in recent years the importance of such microorganisms as *Klebsiella* spp., *Proteus* spp., *Pseudomonas aeruginosa*, *Enterococcus* *faecalis* and others. This is due not only to changes in the environmental situation and the widespread use of antibacterial agents, but also to the peculiarities of concomitant pathology, the age of patients, as well as the nosocomial nature of the infection [2].

The choice of an antibacterial drug for empirical therapy requires knowledge of regional and local data on the sensitivity of pathogens. The irrational use of antibiotics leads to the formation of resistant forms of microorganisms, which, in turn, It

limits therapeutic options and increases the risk of an adverse outcome. The effectiveness of treatment directly depends on the correct choice of initial therapy based on modern microbiological monitoring data [3].

The present study is aimed at determining the structure of pyelonephritis pathogens in patients of various age groups, taking into account the form of the disease (acute, chronic, complicated course), as well as studying their sensitivity to the most commonly used antibacterial agents. In addition, the paper examines the features of resistance depending on etiological factors and analyzes the dynamics of sensitivity in recent years. The importance of this topic cannot be overestimated, since it is not only scientific, but also practical. The results of the work can be used in the development of clinical recommendations and algorithms for the management of patients with various forms of pyelonephritis [4].

In addition, understanding the microbiological landscape of the disease allows for more accurate and effective therapy, reducing the risk of chronicling the process and developing complications. The clinical manifestations of pyelonephritis vary depending on the form of the disease, the age of the patient and the presence of concomitant pathology. Acute uncomplicated pyelonephritis is more often diagnosed in women of reproductive age and is usually caused by *E. coli*. At the same time, complicated forms, especially in elderly patients [5].

They are associated with polyresistant flora and require a more comprehensive approach to diagnosis and treatment. Chronic pyelonephritis is characterized by a prolonged sluggish course with periodic exacerbations and a significant risk of progression to chronic renal failure. A special category consists of patients with pyelonephritis on the background of urological disorders: urolithiasis, structural abnormalities of the urinary tract, neurogenic bladder. In this group, the risk of relapses and therapeutic [6].

The number of failures increases significantly. In addition, nosocomial pyelonephritis is of great importance, in which infection occurs in a hospital setting. Such infections are typically characterized by polyresistant strains, including *Pseudomonas aeruginosa*, *Acinetobacter* spp. and methicillin-resistant staphylococci [7].

The mechanisms of antibiotic resistance are diverse and include the production of beta-lactamases, changes in the structure of drug targets, active release of the antibiotic from the cell, as well as the formation of biofilms. Especially dangerous. This is the spread of resistance genes located on plasmids, which promotes rapid exchange between different bacterial species. In this regard, regular monitoring of the sensitivity of pathogens in a particular region is of fundamental importance [8].

An important aspect is compliance with the principles of antimicrobial policy: restriction of unjustified use a wide range of antibiotics, the use of narrow-spectrum antibiotics based on the results of sowing and sensitivity analysis, conducting follow-up studies after the end of the course of treatment. Without following these principles, the selection of therapy-resistant strains increases, which ultimately leads to a decrease in the effectiveness of antibiotic therapy in general [9].

From the point of view of epidemiology, the prevalence of pyelonephritis remains high, and the incidence does not have a clear downward trend. This is due not only to an increase in the resistance of microflora, but also to an increase in the proportion of the elderly a population with a decrease in immune protection and a high level of comorbidity. In addition, the proliferation of invasive diagnostic and treatment methods (catheterization, endoscopic interventions) also increases the risk. urinary tract infections. The purpose of our study is to identify the current spectrum of pyelonephritis pathogens and their sensitivity to the most commonly used antibacterial drugs. We set ourselves the task of assessing the differences in etiological composition in different forms of the disease, identify resistant strains and analyze the dynamics of changes in comparison with the data of previous years. This approach will make it possible to adapt therapy regimens and improve the effectiveness of treatment at the level of a particular medical institution or region as a whole [10].

The research methodology includes bacteriological examination of urine, isolation of pure cultures, identification of pathogens using modern microbiological methods, as well as sensitivity testing for EUCAST and CLSI standards. Additionally, the analysis of clinical and epidemiological data, including age, gender, was carried out., anamnesis of the disease, the nature of the course and the presence of concomitant conditions [11].

Special attention in our study is paid to the analysis of differences between outpatient and hospital forms of infection. The data obtained make it possible to identify significant differences in the spectrum of pathogens and the level of resistance, which is important for determining the tactics of empirical treatment. Cases of recurrent course of the disease were also analyzed., in which there is a selection of stable forms under the pressure of previously prescribed drugs. Conducting such studies contributes not only to improving the quality of medical care, but also to reducing the overall level of antibiotic resistance in the population. The practical application of the results will improve the effectiveness of treatment, reduce the duration of hospitalization, reduce the frequency of complications and relapses, and optimize healthcare costs [12].

Thus, the relevance of our study is due to the need to review standard treatment approaches. pyelonephritis taking into account modern microbiological realities. Only an integrated approach based on evidence based medicine and systematic microbiological monitoring can provide effective and safe therapy for patients with this pathology [13].

2. METHODOLOGY

Objective: to study the etiological structure of pyelonephritis to determine the sensitivity of pathogens to appropriate antibacterial drugs.

The study was conducted between April 2023 and October 2023 in the Department of Nephrology. During this time, 68 medical records with a diagnosis of pyelonephritis were analyzed. Of these, 24 were men (average age 54 ± 3.4 years), 44 were women (average age 43 ± 4.1 years). Acute obstructive pyelonephritis was found in 20 of the subjects. 7 patients were diagnosed with acute non-obstructive pyelonephritis, 41 patients were diagnosed with chronic pyelonephritis. The study material was the average portion of morning urine obtained after hygienic toilet of the genitals, before the appointment of antibacterial therapy. The method of investigation is urine culture for microflora and sensitivity to antibacterial drugs.

The determination of uropathogens was performed using a quantitative method of urine culture on nutrient media (5% blood agar, Endo medium, ZHSA, Saburo). The sensitivity and resistance of uropathogens to antibiotics was determined by the disco-diffusion method using standard methods. In our study, we used discs for the following antibacterial drugs: penicillin group (amoxicillin, amoxiclav), cephalosporins (ceftriaxone, cefotaxime, cefoperazone), aminoglycosides (gentamicin) and fluoroquinolones (ciprofloxacin).

Statistical processing of the received information was performed using the MS Office Excel program, with the calculation of extensive indicators, with statistical significance of $P < 0.05$.

3. RESULT

The most common pathogens in acute pyelonephritis are *Escherichia coli*, *Proteus* spp., *Klebsiella* spp. The etiological structure of chronic pyelonephritis consists of: *Escherichia coli*, *Proteus* spp., *Klebsiella* spp., *Enterobacter* spp., *Citrobacter* spp., *Klebsiella pneumoniae*, *Candida albicans*. The leading causative agent among them was *E. coli*. The degree of bacteriuria in 14 patients (52%) was 105 CFU/ml, in 10 patients (37%) - 104 CFU/ml, in 3 patients (11%) – 103 CFU/ml. The sensitivity of *Escherichia coli* to amoxicillin was $66.6 \pm 7.83\%$. The sensitivity to amoxicillin/clavulanic acid (Amoxiclav) was $77.7 \pm 6.49\%$. The sensitivity to ceftriaxone was $89.1 \pm 3.8\%$, cefotaxime $86.2 \pm 5.3\%$, cefoperazone $97.4 \pm 0.8\%$, ciprofloxacin $83.5 \pm 5.9\%$, imipenem/cilastatin 100%, gentamicin $58.7 \pm 11.4\%$.

Sensitivity of *Proteus* spp. to amoxicillin $75.4 \pm 8.7\%$, to amoxicillin/clavulanic acid (Amoxiclav) $81.2 \pm 7.9\%$, to ceftriaxone sensitivity was $94.3 \pm 2.4\%$, cefotaxime $91.8 \pm 3.0\%$, to cefoperazone 100%, ciprofloxacin $89.5 \pm 4.1\%$, imipenem/cilastatin 100%, gentamicin $49.2 \pm 13.2\%$.

Sensitivity of *Klebsiella* spp to amoxicillin $37.9 \pm 17.7\%$, to amoxicillin/clavulanic acid (Amoxiclav) $64.6 \pm 8.8\%$, to ceftriaxone sensitivity was $81.9 \pm 5.8\%$, cefotaxime $80.4 \pm 6.1\%$, to cefoperazone $87.5 \pm 5\%$, ciprofloxacin $56.7 \pm 12.6\%$, imipenem/cilastatin $89.4 \pm 4.8\%$, Gentamicin $70.2 \pm 9.5\%$.

Sensitivity of *Enterobacter* spp. The resistance to amoxicillin was $72.6 \pm 7.3\%$. The sensitivity to amoxicillin/clavulanic acid was $85.7 \pm 6.1\%$. The sensitivity to ceftriaxone was $93.4 \pm 3\%$, cefotaxime $89.7 \pm 4.3\%$, cefoperazone 100%, ciprofloxacin $86.3 \pm 5.5\%$, imipenem/cilastatin 100%, gentamicin $56.7 \pm 11.9\%$

4. DISCUSSION

Women are more susceptible to the incidence of pyelonephritis. The most common causative agents of acute and chronic pyelonephritis was *E. coli*, which was isolated in $87.5 \pm 4.8\%$ of the studied patients. High sensitivity of *Escherichia coli* to carbapenems (imipenem/cilastatin), cephalosporin (ceftriaxone, cefotaxime, cefoperazone) was determined. These data allow us to confirm the clinical recommendations for the treatment of pyelonephritis, and the resistance of *E. coli* to unprotected penicillin and gentamicin has also been determined. Protected penicillins and fluoroquinolones are recommended in the treatment of uncomplicated outpatient pyelonephritis. Treatment should begin with broad-spectrum antibiotics. When choosing antibacterial agents, it is necessary to take into account the regional resistance of pathogens to antimicrobial drugs, the previous experience of using antibiotics in the patient, the clarification of pathogens in previous exacerbations to increase the effectiveness of treatment and the correct choice of therapy.

5. CONCLUSION

The study found that pyelonephritis in patients of different age categories and clinical forms has significant differences in the spectrum of pathogens, as well as in the level of sensitivity to antibacterial drugs. This highlights the need for an individualized approach to the diagnosis and treatment of urinary tract infections. The data obtained indicate a high variability of the microbial landscape, which requires regular updating of clinical recommendations and adjustment of empirical therapy.

The revealed differences in the sensitivity of microorganisms in outpatient and inpatient settings indicate the need for differentiated prescribing of antibacterial drugs. Community-acquired forms are more often caused by sensitive strains of *E. coli*, while resistant strains prevail in hospital settings, including representatives of the genera *Klebsiella*, *Pseudomonas* and *Enterococcus*. This confirms the need for early identification of the pathogen and an antibioticogram.

Based on the analysis of the sensitivity of pathogens to antibacterial drugs, it was found that a significant part of the strains demonstrate multidrug resistance. This limits the possibilities of effective treatment and requires the development of new antimicrobial therapy strategies, including the use of reserve drugs, as well as efforts to prevent the spread of resistant forms.

Modern realities require a revision of approaches to the use of antibiotics in clinical practice. An important component. The goal is the rational use of antibacterial drugs based on the principles of evidence-based medicine. The appointment of therapy should take into account local sensitivity data, the patient's medical history, and specific features. clinical picture and epidemiological factors. This is especially important for patients with recurrent or complicated pyelonephritis, who are much more likely to have resistant strains. In addition, the results of our study confirm the need to implement antimicrobial stewardship programs on at the level of medical institutions. These programs include training of medical personnel, monitoring of appointments. The development of local treatment protocols and the active participation of clinical pharmacologists in the management of patients. Such measures can reduce the level of unjustified use of antibacterial agents and prevent the spread of resistance.

The issue of diagnosis deserves special attention. Widespread adoption of rapid identification methods to determine the pathogen and its sensitivity, significantly increases the effectiveness of therapy and reduces the time before the start of adequate treatment. The development of molecular genetic diagnostic methods also opens up new perspectives in identifying pathogens and determining their resistant characteristics.

One of the key problems remains the lack of standard approaches to the management of patients with chronic forms of pyelonephritis, especially against the background of concomitant diseases such as diabetes mellitus, hypertension, and metabolic syndrome. This category of patients requires a multi-level risk assessment and a multidisciplinary approach to treatment and follow-up. Regular microbiological monitoring, preventive treatment and correction of background pathology are necessary conditions for achieving stable remission.

In addition to the clinical aspects, the economic component of the problem should also be taken into account. An increase in the frequency of resistant forms of pathogens leads to an increase in the cost of treatment, an increase in the duration of hospitalization and a deterioration in the quality of life of patients.

Thus, the proper use of antibacterial drugs and the introduction of preventive programs are not only of medical, but also of significant socio-economic importance.

The results of this study can be used in the development of empirical antibacterial therapy algorithms., formation of local forms and educational programs for doctors of various specialties. The creation of regional resistance maps based on the data obtained will optimize the therapeutic and diagnostic process and increase the effectiveness of clinical practice.

Thus, the presented study contributes to the systematization of knowledge about modern etiological and microbiological features of pyelonephritis. It highlights the need for continuous monitoring, improved diagnostic methods, and the implementation of sound antimicrobial policies at all levels of healthcare. Promising areas of further research include the development of new antibacterial agents, the study of resistance mechanisms, and the creation of personalized treatment protocols based on the molecular typing of pathogens.

In conclusion, it is important to note that the fight against antibiotic resistance requires efforts not only from doctors and researchers, but also from patients, the healthcare system and society as a whole. Only an integrated approach based on interdisciplinary collaboration and support for initiatives to preserve the effectiveness of antibiotics can stop the spread of resistant strains and ensure successful treatment of infectious diseases, including pyelonephritis.

REFERENCES

- [1] Kiseleva T.N., Bobkova I.A. Modern approaches to the treatment of urinary tract infections. — *Nephrology*. 2020. Vol. 24, No. 1. pp. 45-52.
- [2] Gorelov A.V., Urazova G.R. Antibiotic resistance: a global problem and national strategies. — *Infectious diseases*. — 2021. — Vol. 19, No. 2. — pp. 67-74.
- [3] Gusev E.I., Kornienko V.N. Urological infections: clinic, diagnosis, treatment. — M.: GEOTAR-Media, 2019. — 328 p.
- [4] Kovalev I.V., Sedov A.A. The problem of choosing empirical antibacterial therapy for pyelonephritis. — *Russian Medical Journal*, 2018, No. 5, pp. 30-35.
- [5] European Association of Urology (EAU). Guidelines on Urological Infections. — 2023. — URL: <https://uroweb.org/guidelines/urological-infections>
- [6] Zvereva E.V., Subbotin A.R. Changes in the sensitivity of uropathogens to antibiotics in a hospital setting. — *Antibiotics and chemotherapy*. — 2020. — Vol. 65, No. 7-8. — pp. 24-30.
- [7] WHO. Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report. — Geneva: World

Health Organization, 2022. — 98 p.

- [8] Prokofieva T.Yu., Smirnov D.A. Biofilms and their role in the development of resistance in chronic pyelonephritis. — *Clinical microbiology and antimicrobial chemotherapy*. 2019. Vol. 21, No. 3. pp. 202-208.
- [9] Zhizhin S.M., Orlova I.A. Chronic pyelonephritis: clinical recommendations and management tactics. — *Doctor*. — 2021. — No. 10. — pp. 40-45.
- [10] Berdnikova N.V., Kuzmina L.P. Microbiological features of uropathogens in women with recurrent pyelonephritis. — *Journal of Microbiology, Epidemiology and Immunobiology*. - 2022. — No. 4. — pp. 56-62.
- [11] Sinyakova L.A. Retsidiviruyushchiye infektsii mochevykh putey: slozhnosti up- roshchennoy diagnostiki. [Recurrent Urinary Tract Infections: the Complexity of a Simplified Diagnosis] / L.A. Sinyakova // *Urologiya segodnya* [Urology Today]. — 2013. — 1. — P. 3-7.
- [12] Kameneva O.A. Etiologicheskaya struktura i antibiotikorezistentnost' vzbuditeley vnebol'nichnykh infektsiy mochevyvodyashchikh putey v Sankt-Peterburge, 2013-2015. [Etiological Structure and Antibiotic Resistance of Pathogens of Community-Acquired Infections of the Urinary Tract in St. Petersburg, 2013-2015] / O.A. Kameneva, S.E. Morozova, O.E. Puchenko [et al.] // *Antibiotiki i khimioterapiya* [Antibiotics and Chemotherapy]. — 2017. — 62(9-10). — P. 19-26.
- [13] Palagin I.S. Sovremennoye sostoyaniye antibiotikorezistentnosti vzbuditeley vnebol'nichnykh infektsiy mochevykh putey v Rossii: rezul'taty issledovaniya «DARMIS» (2010-2011). [Current State of Antibiotic Resistance of Pathogens Causing Community- Acquired Urinary Tract Infections in Russia: "DARMIS" Study (2010–2011)] / I.S. Palagin, M.V. Suhorukova, A.V. Dekhnich [et al.] // *Klinicheskaya mikrobiologiya i antimikrobnaya khimioterapiya* [Clinical Microbiology and Antimicrobial Chemotherapy]. — 2012. — 14(4). — P. 280-302.
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