

Urinary tract infections – a diagnostic and therapeutic problem

Abstract

Introduction

Urinary tract infections (UTIs) are among the most common bacterial infections in humans, occurring in both hospitalized and non-hospitalized patients. The most frequent etiological agent of UTIs remains *Escherichia coli*, responsible for approximately 70–90% of uncomplicated urinary tract infections. In complicated infections and hospital settings, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Enterococcus faecalis*, as well as multidrug-resistant strains, including those producing extended spectrum β -lactamases (ESBLs) or carbapenemases are more commonly isolated.

Aim of the study

The aim of this study was to assess the frequency of positive urine culture results among patients hospitalized at the Mazovian Specialist Hospital Ltd. in Radom (M.S.S.), and to identify the dominant etiological agents in both midstream urine samples and samples collected from catheterized patients. Additionally, the study analyzed the incidence of hospital-acquired urinary tract infections and the antimicrobial susceptibility of the isolated uropathogens, with particular attention to resistance mechanisms.

Publication I

The publication “*Urinary tract infections: epidemiological and clinical aspects*” is a review article describing the pathogenesis, epidemiology, and clinical symptoms observed in patients with urinary tract infections. It also discusses available treatment options and resistance mechanisms, which are increasingly observed among uropathogens.

Publication II

“*Diagnosis and classification of urinary tract infections in hospitalized patients*” is the second review article forming the basis of this doctoral dissertation. It presents issues related to the diagnosis of urinary tract infections from both analytical and microbiological perspectives and discusses important pre-analytical aspects, as well as UTI classification with therapeutic recommendations for each form of infection.

Publication III

The empirical study titled “*Hospital urinary tract infections in healthcare units on the example of Mazovian Specialist Hospital Ltd*” aimed to assess the incidence of urinary tract infections among patients hospitalized at M.S.S., taking into account ward distribution, the method used, and the timing of urine sample collection for microbiological testing.

Methodology: To identify the etiological agent, urine cultures were performed using the Hoeprich method on blood agar and MacConkey agar, with disposable plastic loops of 0.01 ml and 0.001 ml volume. The cultures were incubated at 35–37°C for 24–48 hours. Readings were taken after 24 hours by assessing the number of colonies grown. Results were presented as colony-forming units per milliliter of urine (CFU/ml). The χ^2 test was used for statistical analysis. Calculations were carried out using IBM SPSS Statistics version 27.

Results: In 2021, there was a decrease in the number of positive results compared to 2020, except for the Pulmonology and Pulmonary Oncology Clinic and Internal Medicine Clinic I, where an increase was observed in 2021. In Internal Medicine Ward II, a higher percentage of positive results was found in urine samples collected from catheterized patients. The most frequently isolated pathogens were *E. coli* and *Enterococcus* species. *Candida albicans*, *Acinetobacter baumannii*, and *P. aeruginosa* were more commonly identified in samples from catheterized patients. A decrease in the incidence of hospital-acquired UTIs was also observed in 2021 compared to 2020. These infections were more common in catheterized patients. The most frequently isolated pathogen from samples collected after 72 hours of hospitalization was *Enterococcus* spp.

Conclusions: The study found that the dominant etiological agent of UTIs was *E. coli*, while hospital-acquired infections most commonly involved *Enterococcus* species. *C. albicans*, *A. baumannii*, and *P. aeruginosa* were significantly more frequently isolated from catheter-derived urine samples than from midstream samples. These microorganisms were mostly identified in patients hospitalized for more than 72 hours, qualifying them as hospital-associated pathogens.

Publication IV

The empirical study titled “*Drug susceptibility of uropathogens isolated from patients treated at the Mazovian Specialized Hospital in Radom*” analyzed the antimicrobial susceptibility of pathogens responsible for UTIs in patients hospitalized at M.S.S.

Methodology: Antimicrobial susceptibility of the isolated microorganisms was determined using the Phoenix M50 automated system (Becton Dickinson). To assess differences in susceptibility, the χ^2 test and the Fisher-Freeman-Halton test were used. Statistical analyses were performed using IBM SPSS Statistics version 28.

Results: The analysis showed that *E. coli* exhibited higher resistance to β -lactam antibiotics (13.57%) than to aminoglycosides (5.71%). Resistance of *E. coli* to fluoroquinolones (28.24%) was significantly higher than to other tested antibiotic groups, including β -lactams, aminoglycosides, and fosfomycin. *E. faecalis* and *E. faecium* were more frequently resistant to aminoglycosides (49.38% and 49.11%, respectively) than to glycopeptides (3.42% and 16.42%). In the case of *K. pneumoniae*, resistance was most often observed to β -lactam antibiotics (45.72%) and less frequently to aminoglycosides (18.11%) and fosfomycin (23.64%). *P. mirabilis* showed higher resistance to aminoglycosides (38.34%) and fluoroquinolones (49.09%) than to β -lactams (19.13%). For *P. aeruginosa*, the highest resistance level was observed for fluoroquinolones (33.33%), and lower levels for β -lactams (21.18%) and aminoglycosides (19.74%). In the case of *A. baumannii*, resistance to β -lactam antibiotics predominated (95.00%), exceeding resistance to aminoglycosides (86.42%). Notably, *A. baumannii* was more frequently resistant to fluoroquinolones (98.08%) than to β -lactams.

Conclusions: The analysis of antimicrobial resistance profiles of isolated microorganisms revealed a high level of resistance to fluoroquinolones among all tested pathogens. However, susceptibility to aminoglycosides and fosfomycin remained relatively preserved. A high percentage of β -lactam-resistant strains was observed among *K. pneumoniae* and *A. baumannii* isolates. No significant differences were found in the frequency of microorganisms with resistance mechanisms between hospital-acquired and community-acquired infections.

The obtained results clearly indicate a significant problem of urinary tract infections among hospitalized patients at M.S.S. The high incidence of infections in catheterized patients may suggest both insufficient patient preparation for proper diagnostics material collection and an excessive frequency of catheterization procedures. Moreover, the extensive use of fluoroquinolones in inpatient settings may significantly contribute to the emergence and spread of antimicrobial resistance among microorganisms to this class of antibiotics.