

SELECTED RISK FACTORS FOR URINARY TRACT INFECTIONS

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ABSTRACT

Introduction: Urinary tract infection is predisposed not only by bladder catheterization, but also by advanced age, gender, length of hospitalization, and comorbidities. The urinary catheter breaches the mucosal barrier of the urinary epithelium, which is the cause of the formation of a bacterial biofilm, facilitating the entry of pathogens. Advanced age is associated with prostatic hypertrophy in men and urinary incontinence in women, and accompanying multimorbidity predisposes to more frequent infections. Women, due to the anatomy of the urinary tract, are more likely to develop a urinary tract infection than men. Chronic kidney disease (CKD) weakens the immune system, which can manifest as infections; also, uncompensated diabetes and glucosuria promote the proliferation of bacteria.

The aim of the study was to evaluate selected risk factors of urinary tract infections in a specialized hospital in a group of 66 patients.

Material and methods: The research method used was documentoscopy, and the technique was analysis of the medical records of the Hospital Infection Control Team and the collective nursing records. The study included 66 patients with hospital-acquired urinary tract infections hospitalized at the Józef Dietl Specialist Hospital in Krakow from January to December 2020.

Results: The average length of hospitalization of the studied patients was 32.91 days. The clinical course of urinary tract infection was not influenced by such risk factors as bladder catheterization, old age, gender, length of hospitalization, and diabetes. A correlation between CKD and urinary tract infection was demonstrated. Death occurred more frequently in subjects with urinary tract infection and CKD. A mild clinical course of infection was observed in subjects without CKD.

Conclusions: Concomitant urinary tract infection and CKD were more likely to predispose to death.

Key words: risk factors, urinary tract infection, chronic kidney disease.

INTRODUCTION

There are many risk factors for urinary tract infections (UTIs). The most common predisposing factor for UTIs is bladder catheterization. Older age, gender, length of hospitalization, and comorbidities, i.e. chronic kidney disease (CKD) or diabetes, also affect the risk of UTIs [1].

Bladder catheterization is the most common risk factor for urinary tract infection. Keeping a urinary catheter in the bladder increases the risk of infection by 3-8% per day of catheterization. A urinary catheter disrupts the body's defence mechanisms, causing damage to the mucosal barrier of the urinary epithelium. As a result, bacterial biofilm is more easily formed, which is a potential reservoir for pathogens that come into contact with the bladder. The formed biofilm prevents the action of immune cells and blocks the action of antibiotics. This is a major cause

of bacteriuria in chronically catheterized patients. If the biofilm crystallizes, urine flow may be blocked, exacerbating the infection [2, 3].

Older age (over 65 years) is associated with progressive incontinence or urinary retention by prostatic hypertrophy in men and is associated with more frequent hospitalizations. Older people who are frequently catheterized have lowered immunity and anatomical abnormalities in the urinary tract, which significantly increases the risk of UTIs. Multimorbidity is characteristic for this group of people, which translates into the frequency of infections. The difficulty in diagnosing a UTI is that these individuals rarely manifest clinical symptoms of urinary tract infections, so special attention should be paid to the results of laboratory tests [4].

Women contract urinary tract infections 50 times more often than men. The reason for this is the female anatomy of the urinary tract, which is character-

ized by a shorter urethra and proximity to the urethra and anus. In post-menopausal women, there is a decrease in oestrogen levels, which promotes vaginal atrophy and causes vaginal dryness and an increase in pH, leading to a decrease in the number of lactobacilli, which have a protective effect [2].

Studies show that hospitalization of more than 2 weeks increases the risk of urinary tract infection. Longer hospitalization is associated with a higher risk of infection with *Klebsiella pneumoniae*, which is one of the of the main bacteria responsible for urinary tract infection [5].

There is a strong association between CKD due to polycystic kidney disease and urolithiasis and a higher risk of UTI. Patients with CKD manifest changes in host protective functions and urinary tract dysfunction. These changes include loss of antibacterial properties of urine or decreased production of urinary tract mucosal epithelium. The presence of CKD weakens the immune system; more specifically, innate and adaptive immunity. Exposure to uremic toxins leads to chronic inflammation and immune dysfunction [6].

Diabetes increases the risk of infectious diseases, and most often predisposes to the development of urinary tract infections, especially in immunocompromised individuals. The condition increases the risk of developing acute pyelonephritis, asymptomatic bacteriuria, and complications of urinary tract infections. Research suggests that hyperglycaemia is a contributing factor to bacterial infections, in which kidney damage can occur through direct pathogen invasion. In addition, faster growth of bacteria in the urine has been noted in people with high glucose levels. Uncontrolled diabetes promotes immune dysfunction, i.e. impaired function of neutrophils, macrophages, NK (natural killer) cells, and the antioxidant system, as well as humoral immunity. Chronic hyperglycaemia also leads to acidosis, which impairs immune system activity [7, 8].

The aim of the study was to assess selected risk factors for urinary tract infections in terms of their incidence among patients hospitalized in a specialized hospital in 2020.

MATERIAL AND METHODS

The study was conducted at the Józef Dietl Specialist Hospital in Krakow in a group of 66 patients who developed hospital-acquired UTIs in 2020. The study was based on the available records of the Hospital Infection Control Team and the aggregate nursing records. The necessary materials were collected from May 2021 to February 2022. Consent for access to medical records was obtained from the hospital director. The study was done in accordance with the requirements of the Declaration of Helsinki. In the first stage, all observed risk factors for UTI were analysed, followed by an analysis of selected and

most common risk factors for UTI. The clinical course of the infection was divided according to the criteria adopted by the Hospital Infection Control Team into slight, mild, severe, and death.

The research method used in the study was documentoscopy, which is categorized as a quantitative research method. The technique used was an analysis of the Hospital Infection Control Team's records and the aggregate nursing records. The conducted study was retrospective in nature.

The collected material was statistically analysed using IBM SPSS software. The results of nominal and ordinal variables were presented by absolute (n) and relative (%) counts. To assess the relationship between these variables, contingency tables were performed and chi-square (χ^2) tests were used. The results of quantitative variables were presented using descriptive statistics and histograms. The limit of statistical significance for the statistical tests used was $p < 0.05$.

RESULTS

The study group included 30 men (45.5%) and 36 women (54.4%). The average age of patients who developed urinary tract infections was 71.70 years. The oldest person was 97 years old, and the youngest was 20 years old. Most of the group (66.7%) lived in urban areas, while the rest (33.3%) lived in rural areas.

Of the 13 risk factors observed for UTI, 6 were selected for analysis: number of days of hospitalization, presence of a urinary catheter, age (over 65 years), gender, uncompensated diabetes, and CKD. The most common risk factors for URI were prolonged hospitalization, the presence of a urinary catheter, and old age. Figure 1 shows a frequency of occurrence of selected and most common risk factors.

More than half of the subjects were hospitalized for more than 21 days. The mean duration of hospitalization was 32.91 days, the median was 29.50 days, and the standard deviation was 16.981. The shortest hospitalization lasted one day, and the longest was 90 days (Table 1).

The predominant clinical course of urinary tract infection, which accounted for 40 cases, was mild (60.6%). A slight clinical course occurred in 15 cases (22.7%). The severe clinical course of the infection occurred in 8 patients (12.1%). In subjects with urinary tract infection, death occurred in 3 cases (4.5%).

The clinical course of urinary tract infection was not influenced by the presence of a urinary catheter (no statistically significant relationship, $p = 0.509$), age of the subjects (no statistically significant relationship, $p = 0.512$), gender (no statistically significant relationship, $p = 0.263$), length of hospitalization (no statistically significant relationship, $p = 0.399$), and uncompensated diabetes mellitus (no statistically significant relationship, $p = 0.984$). Chronic kidney dis-

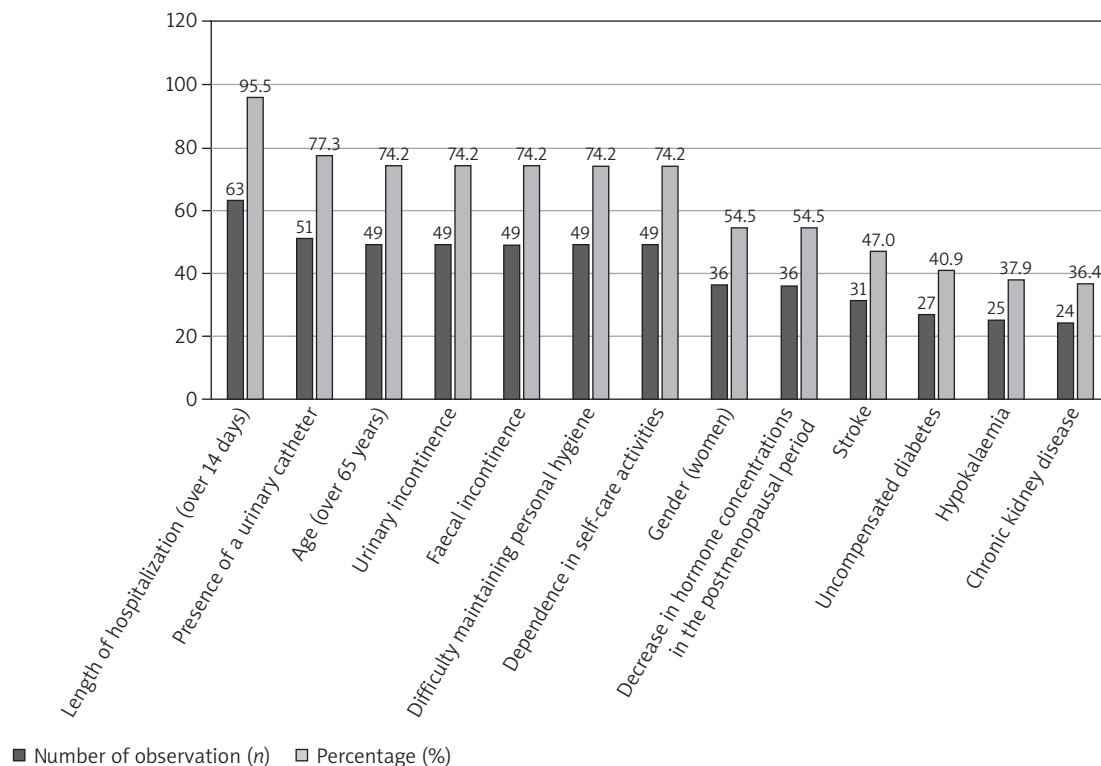


Figure 1. Selected risk factors for urinary tract infection (UTI) in the surveyed group

Table 1. Length of hospitalization

Length of hospitalization [number of days]	N	%			
1-20	17	25.8			
21-40	31	47.0			
41-60	14	21.2			
61-80	2	3.0			
81-100	2	3.0			
Total	66	100.0			
N	Mean	Me	SD	Min.	Max.
66	32.91	29.50	16.981	1	90

N – number of observations, Me – median, SD – standard deviation, Min. – minimum score, Max. – maximum score

ease was shown to affect the clinical course of urinary tract infection ($p = 0.030$). Among subjects without CKD, a slight course of infection was more frequently observed (31%). Subjects with CKD and urinary tract infection were more likely to die (12.5%) (Table 2).

DISCUSSION

A retrospective study of 99 patients in a hospital in Turkey showed over a 3-year period that the average length of hospitalization for patients who developed a urinary tract infection was 14.72 days [5]. In our study, as many as 95.5% of patients with urinary tract infections were hospitalized for more than 14 days.

In the Nicolle study, bladder catheterization was a major risk factor for urinary tract infection, with a prevalence of 70-80% in a group of 19,888 patients [17]. A systematic review by Gad and Abdel-Aziz obtained similar findings of 70-80% [18]. Over 60% of bladder catheterization was responsible for urinary tract infection according to Kranz *et al.* [19]. A United States study confirmed that 67.7% of health care patients with UTI had a urinary catheter in place [20]. The results of our own study showed that bladder catheterization was the second most common risk factor for UTI, accounting for 77.3% among a group of 66 subjects.

Researchers point to older age as a risk factor for urinary tract infections. The results indicate that cases of UTI in middle-aged people are not as common as in those over 65 years old. A UTI incident within 12 months was confirmed in 10% of elderly women. This figure rises to 30% in women over 85 years old, and up to 21.6% in men between 65 and 74 years of age [9]. A survey conducted at a geriatric hospital indicated that the average age of those who developed UTI was 85.4 years [10]. In comparison, our own results yielded a mean age of 71.70 years. Analysis of the results of our own study confirmed old age as a risk factor for UTIs; as many as 95.5% of the subjects studied were over 65 years old.

Gender is also an important risk factor for urinary tract infections, as shown in a study conducted by Necmettin Erbakan University's Department of Urol-

Table 2. Cross tabulation – relationship between the presence of a urinary catheter, age, gender, length of hospitalization, chronic kidney disease, uncompensated diabetes mellitus, and the clinical course of urinary tract infection

Clinical course of the infection	Presence of a urinary catheter		Age (divisions)		Gender		Length of hospitalization (days)		Chronic kidney disease		Uncompensated diabetes		Total						
	Yes	No	≤ 66	67-78	≥ 79	Female	Male	1-21	22-42	≥ 43	Yes	No		Yes	No				
	n	%	n	%	n	n	n	n	n	n	n	n		n	n				
Slight	10	5	15	7	4	4	15	6	15	4	9	2	15	2	13	15	6	9	15
	19.6	33.3	22.7	31.8	18.2	18.2	22.7	25.0	20.0	22.7	25.0	26.5	22.7	8.3	31.0	22.7	22.2	23.1	22.7
Mild	31	9	40	12	12	16	40	22	18	40	10	17	40	16	24	40	17	23	40
	60.8	60.0	60.6	54.4	54.4	72.7	60.6	61.1	60.0	60.6	62.5	50.0	60.6	66.7	57.1	60.6	63.0	59.0	60.6
Severe	7	1	8	2	5	1	8	5	3	8	2	5	8	3	5	8	3	5	8
	13.7	6.7	12.1	9.1	22.7	4.5	12.1	13.9	10.0	12.1	12.5	14.7	12.1	12.5	11.9	12.1	11.1	12.8	12.1
Death	3	0	3	1	1	1	3	0	3	3	0	3	3	3	0	3	1	2	3
	5.9	0.0	4.5	4.5	4.5	4.5	4.5	0.0	10.0	4.5	0.0	8.8	4.5	12.5	0.0	4.5	3.7	5.1	4.5
Total	51	15	66	22	22	22	66	36	30	66	16	34	66	24	42	66	27	39	66
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
χ^2 test	2.321	3	0.509	5.250	6	0.512	3.988	3	0.263	6.216	6	0.399	8.921	3	0.030	0.157	3	0.984	
N	66		66		66		66		66		66		66		66		66		66

n – number of observations, *df* – degrees of freedom, *p* – significance level

ogy on 59 patients with UTIs, in which 59.3% of the study group were women [11]. A study conducted on patients admitted in October 2019 and February 2020 to Bu Ali Hospital in Iran registered 56 patients with UTIs, including 35 women (61.4%) [12]. Similar results were obtained in our own study, in which women accounted for 54.5% of the study group. With regard to gender, attention has been paid to the decline in hormones in postmenopausal women, as some researchers, i.e. Cagnacci *et al.*, indicate that about 80–85% of postmenopausal women develop UTIs [13]. Compared to our study, all women in the study group (54.5%) were postmenopausal.

A study conducted at the Tomioka Clinic and Tokyo Women's Medical University Centre East between May 2020 and June 2021 on a group of 100 haemodialysis patients with CKD showed that 26 of them (26%) developed UTIs. Most of them were women (61.5%) [15]. The results of a study conducted at the King Fahd Specialist Hospital in Saudi Arabia from March to December 2020 on a group of 754 patients with CKD at any stage, are very different from the results obtained in a group of haemodialysis patients. It was proven that urinary tract infection developed in only 22 subjects (2.9%) with CKD [16]. The result obtained in our study indicated that 36.4% of subjects with CKD had a urinary tract infection. Subjects without CKD were more likely to have a slight urinary tract infection (31%), and those with CKD and a urinary tract infection were more likely to die.

CONCLUSIONS

Prolonged hospitalization, bladder catheterization, and old age are risk factors for urinary tract infection.

Comorbidities, i.e. diabetes mellitus and CKD, favour the development of urinary tract infection.

Disclosure

The authors declare no conflict of interest.

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