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Hospital urinary tract infections in surgical patients

Occurrence and multiplication of significant number of microorganisms in any part of urinary tract, except external opening of the urethra, is called urinary tract infection (UTI) (14). The number of 10^5 of bacterial cells in one ml of urine is regarded as significant, if standard urine sample is taken (morning urine collected into sterile pot, from middle urine stream, following careful washing of external genito-urinary organs) or 10^2 of bacterial cells in one ml of urine sampled by means of suprapubical puncture or sterile urinary catheter (10).

Clinical symptoms of UTI are very diverse and vary from asymptomatic bacteriuria to serious pyelonephritis complicated by signs of urosepsis. The most frequent symptoms are: fever, dysuric symptoms (difficulty or pain on urination especially at the end of micturition, pollakiuria, and sensation of incomplete urine bladder emptying after miction), pain or tenderness of suprapubical region, and positive Goldflam sign, when upper part of urinary tract is involved.

Untreated or inappropriately treated UTI may lead to serious and potentially fatal complications, such as chronic renal insufficiency in case of progression into chronic state, or sepsis. The UTI are responsible for about 35% of in-hospital septicaemia (2, 4). Therefore, they form significant clinical problem necessitating special attention and proper management.

The aim of this study is to analyse: prevalence of the UTI in patients of the surgical ward; etiological factors of the UTI, and their antibacterial drug sensitivity; correlation between the occurrence of UTI and invasive procedures undertaken on the urinary tract.

MATERIAL AND METHODS

Six hundred ninety-two patients treated surgically at the Department of General Surgery, District Hospital in Kraśnik, were evaluated in the present study. Mean age of the patients was 63.9 years. The study group comprised 47.7% males and 52.3% females. Two hundred eighty-nine patients (42%) were operated on urgently, while 403 (58%) – electively.

The diagnosis of hospital (nasocomial) infection was based on clinical symptoms and patients complaints, that was confirmed by positive urine cultures. Definition of infection was used as proposed by the Centers for Disease Control (CDC) and adopted by Polish Hospital Infections Association (10). In patients who were scheduled for elective urological procedure, routine urine cultures were done preoperatively. Final qualification for the surgical procedure was based on condition of the negative result of the urine culture. Antibiogram was done using the disc-diffusion method for antibiotic susceptibility according to the National Committee for Clinical Laboratory Standards (NCCLS) (9). The presence of the extended spectrum β-lactamases (ESβL) was confirmed by the double-disc synergy test (11).

RESULTS

Sixteen UTI were found in the study group. They constituted 21% of all hospital infections in the surgical ward and involved 2.3% of all operated patients. In 14 cases (87.5%) clinical symptoms were confined to the lower part of the urinary tract (urinary bladder and urethra), whereas in one case epididymitis occurred additionally (patient after endourological procedure). In two cases (12.5%) symptoms of acute pyelonephritis were found. Seventeen bacterial strains were cultured from urine samples. Details of these finding are presented in Table 1.

Table 1. Etiology of urinary tract infections in operated patients

Species	Number of strains	Percentage (%)
Escherichia coli	9	53
Proteus vulgaris	3	17.7
Pseudomonas aeruginosa	1	5.8
Klebsiella sp.	1	5.8
Staphylococcus coagulase neg.	3	17.7

Gram-negative bacteria were responsible for 82.3% of the UTI. Dominant strains come from *Enterobacteriaceae* family (13 strains, 76.5% of infections). There were 3 ESβL-positive strains among cultured Gram-negative bacteria. These were two *E. coli* and one *Klebsiella* sp. strains. Two out of them were cultured from patients following endourological procedures, whereas the third was found in a female patient after gastric resection due to perforation of the malignant neoplasm of the stomach. Antibacterial drug sensitivity of the cultured Gram-negative bacteria is described in Table 2.

Table 2. Antibacterial drug sensitivity of the cultured Gram-negative bacteria

	Antibacterial drug																					
	Imipenem			Gentamycin			Ciprofloxacin			Cefuroxim			Ceftazidim			Amoxicillin.+ Clav. Ac.			Nitrofurantoin		
	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
E. coli.	9	0	0	4	3	2	7	2	0	2	2	5	6	1	2	2	3	4	4	3	2
Proteus vulgaris	3	0	0	1	0	2	1	0	2	1	0	2	3	0	0	2	0	1	1	1	1
Klebsiella sp.	1	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1
Pseudomonas aeruginosa	1	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	0	0	1
Total	14	0	0	5	3	6	8	2	4	3	2	9	10	1	3	4	3	7	5	4	5

S – susceptible; I – intermediate susceptible; R – resistant

The highest effectiveness against Gram-negative bacteria was characteristic of imipenem (100% of susceptible strains), ceftazidim (79%; only ESβL-positive strains were resistant), and ciprofloxacin (71%). Poor effectiveness was found for nitrofurantoin (64% of susceptible strains), gentamycin (57%), and amoxicillin with clavulanic acid (50%).

Among three cultured Gram-positive micrococci there were no meticillin-resistant strains. These strains were also highly susceptible to other antibacterial drugs, such as sulfametoxasol + trimetoprim (66%), tetracyclines (66%), ciprofloxacin (33%), and vancomycin (100%).

In 15 patients (94%) UTI was associated with catheterisation of the urinary tract. Clinical manifestation of the UTI was present at mean on the 4th day after insertion of the urinary catheter. In three patients symptoms occurred already after (from 24 to 96, at mean 48 hrs) removal of the catheter. In six patients symptoms of UTI coexisted with other hospital infection: wound infection in four cases, and respiratory tract infection in other two cases (patients on mechanical ventilation).

DISCUSSION

Urinary tract infections (UTI) are one of the most frequent types of hospital infections on surgical wards. The majority of authors put them to the first, or second place according to the incidence (2, 5, 14). Proportion of UTI to all nasocomial infections detected in hospital patients ranges from 22% to 48%, and our results are concordant with these values. Few authors report lower percentages – 9% (13). This illustrates importance of the problem of hospital UTI.

The main group of pathogens responsible for UTI are Gram-negative bacteria, especially of *Enterobacteriaceae* family. The most frequent pathogen is *E. coli*, which in some centres is responsible for nearly 80% of recognised infections (2, 4). In our study, percentage of infections caused by *E. coli* was lower (53%), although Gram-negative bacteria were responsible for 87.5% of infections. We detected three ESβL-positive strains among them (21.4%). This proportion is evidence of multi-resistant strains, which became the problem also in district hospitals. The ESβL-positive strains among isolates of Gram-negative bacteria constitute approximately 14–16% (2, 3). Depending on medical centre this percentage is very variable and it may vary from 0 to 60% (3, 11). Introduction of the 3rd generation of cephalosporins into medical practice accounts mainly for this phenomenon. Their excessive and uncontrolled use is responsible for selection of multi-resistant strains (7). The ESβL-positive strains are isolated mainly from urine and blood of patients (6). Principal carriers of the plasmid are *E. coli* species (about 15% of strains) and *Klebsiella pneumoniae* (up to 60% of strains) (1, 3, 11). This is in accordance with our observations. High urine concentrations of β-lactam antibiotics and β-lactamase inhibitors, as well as various affinity of certain ESβL (heterogeneity) to certain β-lactam antibiotics, implicate the possibility of penicillin and cephalosporin use for successful therapy of ESβL-positive UTI. However, such a strategy is not recommended because of the risk of increasing antibiotic resistance (3, 7).

The investigated strains of Gram-negative bacteria were most susceptible to imipenem, and slightly less susceptible to ceftazidime and ciprofloxacin. Similar findings were published in Polish literature (8, 12). Relatively high resistance of these strains for the other antibacterial drugs (gentamycin, cefuroxim, amoxicillin with clavulanic acid and nitrofurantoin) is common in Polish hospital health service (12). Dangerous bacterial

strains are those overproducing constitutive cephalosporinase that causes total resistance to β-lactam antibiotics (except carbapenems) with cross-resistance to aminoglycosides (1).

The correlation between infection and urinary tract instrumentation is well described in the literature. Endourological procedures and catheterisation of the urinary bladder induce infection, by detrimental effect on natural defence barrier of the urinary tract. About 70% of cases of hospital UTI are caused by the presence of urinary catheter in the urinary bladder (5). The risk of infection in one-time catheterisation is 8%, and it increases at mean 5% for every day of placement of catheter in urinary tract (ranging from 4% in males to 10.4% in females). After 14 days in 55%, and after 30 days in nearly all patients with urine catheter, significant bacteriuria can be found (4, 14). In our material, 94% of recognised UTI cases were related to catheterisation. Endourological procedures were associated with the high risk of the ESβL-positive infections.

CONCLUSIONS

1. Hospital urinary tract infections are frequent and underestimated complication of surgical treatment that may lead to serious consequences.
2. Main pathogens responsible for the hospital UTI are Gram-negative bacteria with high frequency of multi-resistant strains. Especially endourological procedures are associated with high risk of the ESβL-positive UTI.
3. High proportion of bacterial strains that are resistant to drugs usually used in ambulatory and outpatient therapy, dictate the need for urine culture and antibiogram to guide the treatment of recognised infection.
4. Incidence of hospital UTI is closely related to catheterisation of the urinary bladder. To decrease UTI, caution should be paid to minimize the frequency of catheter insertions and short time of catheter stay in the urinary tract. Aseptic rules should be maintained when catheterisation and urine collection system is serviced.

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SUMMARY

The subject of the present study was evaluation of the prevalence of the urinary tract infections (UTI) in surgical patients, as well as determination of the type and susceptibility of bacterial flora responsible for the UTI. The UTI constituted 21% of all hospital infections in the surgical ward and involved 2.3% of all operated patients. The main etiological factor was Gram-negative bacteria, which were responsible for 82.3% of infections. These infections were characterised by high susceptibility to carbapenems, the 3rd generation of cephalosporins, and fluorochinolons, as well as marked resistance to nitrofurantion derivatives, aminoglycosides, second generation of cephalosporins, and amoxicillin with clavulanic acid. Over 21% of Gram-negative bacteria produced

β-lactamase of extended spectrum (ESβL). Moreover, 94% of recognised hospital UTI were associated with previous catheterisation of the urinary bladder.

Szpitalne zakażenia dróg moczowych u pacjentów chirurgicznych

Przedmiotem badania była ocena częstości występowania szpitalnych zakażeń dróg moczowych u pacjentów chirurgicznych oraz określenie rodzaju i oporności odpowiedzialnej za zakażenia flory bakteryjnej. Zakażenia dróg moczowych stanowiły 21% ogółu stwierdzonych zakażeń szpitalnych i dotyczyły 2,3% operowanych chorych. Głównym czynnikiem etiologicznym były pałeczki Gram-ujemne odpowiedzialne za 82,3% zakażeń. Cechowały się one wysoką wrażliwością na karbapenemy, cefalosporyny III generacji i fluorochinolony oraz dużą opornością na pochodne nitrofurantoiny, aminoglikozydy, cefalosporyny II generacji i amoksycylinę z kw. klawulanowym. Ponad 21% szczepów pałeczek Gram-ujemnych wytwarzało b-laktamazę o rozszerzonym spektrum substratowym (ESbL). Ponadto 94% stwierdzonych zakażeń szpitalnych dróg moczowych związanych było z wcześniejszym cewnikowaniem pęcherza moczowego.