



CLINICAL AND LABORATORY CHARACTERISTICS OF ACUTE COMMUNITY- ACQUIRED URINARY TRACT INFECTIONS IN ADULT HOSPITALISED PATIENTS

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ABSTRACT

Urinary tract infections (UTI) cause a great number of morbidity and mortality. These infections are serious complications in pregnancy, patients with diabetes, polycystic kidneys disease, sickle cell anaemia, kidney transplant and in patients with functional or structural anomalies of the urinary tract. The aim of this investigation was to determine a dominant causative agents of UTI and some of the clinical and laboratory characteristics of acute community-acquired UTI in adult hospitalised patients. We studied 200 adult patients with acute community-acquired UTI hospitalised in the Clinic for Infectious Diseases Tuzla from January 2006 to December 2007. The patients were divided into two groups: a group of patients with *E. coli* UTI (147) and a group of patients with non-*E. coli* UTI (53). In these two groups, the symptoms and signs of illness, blood test and urine analysis results were analysed. Our results have shown that the patients with *E. coli* UTI frequently had fever higher than 38,5 °C ($p<0,0001$), chills ($p=0,0349$), headache ($p=0,0499$), cloudy urine ($p<0,0001$), proteinuria ($p=0,0011$) and positive nitrite-test ($p=0,0002$). The patients with non-*E. coli* UTI frequently had fever lower than 38,5 °C ($p<0,0001$) and urine specific gravity <1015 ($p=0,0012$). There was no significant difference in blood test results between patients with *E. coli* and non-*E. coli* UTI. These clinical and laboratory findings can lead us to early etiological diagnosis of these UTI before urine culture detection of causative agents, which takes several days. Early etiological diagnosis of the *E. coli* and non-*E. coli* UTI is necessary for an urgent administration of appropriate empirical antibiotic treatment. This is very important in prevention of irreversible kidney damage, prolonged treatment, complications, as well as recidives and chronicity of the illness.

KEY WORDS: clinical and laboratory characteristics, *E. coli* UTI, non-*E. coli* UTI

INTRODUCTION

Urinary tract infections (UTI) cause a great number of morbidity and mortality. These are amongst the most common bacterial infections in all age groups, from newborn to elderly, in male as well as in female population. Around 40% to 50% of all females at least once in a lifetime have uncomplicated cystitis which results in around 2 million doctor visits in the USA and around 100,000 hospitalisations a year, mostly because of pyelonephritis (1). These infections represent serious complications in pregnancy, patients with diabetes, polycystic kidneys disease, sickle cell anaemia, kidney transplant and in patients with functional or structural anomalies of the urinary tract (2). They cause around 2% to 15% of all cases of sepsis (3), 30%-40% of nosocomial infections (4), representing one of the most common reasons of mortality in intensive care unit (5). *E. coli* is the most common causative agent of UTI, but results from investigations done until now show that the prevalence of *E. coli* varies depending on geographic region and time. Thus, it is necessary that every region gain its one result about prevalence of *E. coli* as a causative agent of UTI (6). UTI with serious clinical presentation (urosepsis, acute pyelonephritis, acute prostatitis, acute exacerbation of chronic pyelonephritis and chronic prostatitis) requires hospitalisation and urgent administration of appropriate empirical antimicrobial treatment with no time to wait for identification of causative agents by urine culture (7). It is especially important in patients with urosepsis and in patients with diabetes mellitus, because it is the same risk factor for more severe clinical forms of disease. This approach to hospital treatment of UTI is important in preventing irreversible kidney damage, prolonged treatment, complications, as well as recidives and chronicity (6). The aim of our investigation was to determine the prevalence of *E. coli* as causative agent of community-acquired UTI and some of the clinical and laboratory characteristics of community-acquired *E. coli* and non-*E. coli* UTI in adult hospitalised patients, which can lead us to early correct etiological diagnosis and appropriate empirical antimicrobial treatment to be given prior to urine culture results.

MATERIALS AND METHODS

Patients

200 patients older than 14 years of age, of both sexes, with community-acquired UTI, serious clinical presentation and unsuccessful prior outpatient treatment,

who have been hospitalised in the Clinic for Infectious Diseases at the University Clinical Centre Tuzla from January 2006 to December 2007 were enrolled in this prospective study. All patients had clinical and laboratory characteristics of UTI, with ambulatory or hospital (up to 48 hours after admission) findings of significant bacteriuria in the performed urine culture. Since it is symptomatic UTI, we found that significant bacteriuria was $\geq 10^3$ bacteria/ml of urine. The patients with nosocomial UTI, other acute infections and patients without significant bacteriuria in the performed urine culture were excluded from this study.

Methods

Early morning mid-stream specimens of urine were collected for microbiological analysis prior to antibiotic therapy administration. The isolates identification was done in the Institute for Microbiology at the University Clinical Centre Tuzla following standard microbiological procedures. Causative agents of UTI were defined according to the results of the urine cultures. Biochemical analysis of blood and urine samples was done in the Polyclinic for Medical Diagnostic at the University Clinical Centre Tuzla. After the symptoms of disease were collected from patients, the signs of disease detected by physical examination, and the results of urine culture, blood test and urine laboratory analysis were gained, the patients were divided into two groups: patients with *E. coli* UTI, and patients with non-*E. coli* UTI. In these two groups, the following data were analysed and compared: 1. Symptoms and signs of UTI: fever up to 38,5 °C and higher than 38,5 °C, chills, headache, vomiting, diarrhoea, groin pain, lower abdomen pain, renal colic, dysuria, dark cloudy strong-smelling urine. 2. Laboratory findings: a) Blood test results; erythrocytes sedimentation rate, number of leukocytes, neutrophiles, erythrocytes, serum level of haemoglobin, C-reactive protein, urea, creatinine, aspartate aminotransferase, and alanine aminotransferase. b) Urine analysis results; cloudy urine, urine specific gravity (below 1015 and above 1030), proteinuria, hematuria, glucosuria, erythrocyturia, nitrites in the urine, leukocytes and granulated cylinders in the urine.

Statistical methods

The program used for statistical analysis was Arcus Quickstat Biomedical, Addison Wesley Longman Ltd, 1997. Data were analysed by the test of proportions, and in the hypothesis, the testing p value < 0,05 was considered statistically significant.

SYMPTOMS AND SIGNS OF UTI	<i>E. coli</i> UTI		non- <i>E. coli</i> UTI		p value
	N	%	N	%	
Fever 37,5-38,5 °C	62	42,2	41	77,4	p<0,0001
Fever >38,5 °C	85	57,8	12	22,6	p<0,0001
Chills	22	15,0	3	5,7	p=0,0349
Headache	72	49,0	19	35,8	p=0,0499
Vomiting	46	31,3	14	26,4	p=0,5065
Diarrhoea	44	29,9	18	34,0	p=0,5865
Groin pain	72	49,0	21	39,6	p=0,2416
Lower abdomen pain	76	51,7	28	52,8	p=0,8878
Renal colic	14	9,5	4	7,5	p=0,6664
Dysuria	141	95,9	53	100,0	p=0,1353
Dark and bed-smelling urine	16	10,9	2	3,8	p=0,1209
Total:	147	100,0	53	100,0	200 100,0

TABLE 1. Symptoms and signs in adult hospitalised patients with acute community-acquired urinary tract infections

RESULTS

In adult hospitalised patients with community-acquired UTI, the most common symptoms and signs of disease were: fever in 200 (100%), dysuria in 194 (97%), lower abdomen pain in 104 (52%), groin pain in 93 (46,5%) and headache in 91 (45,5%) patients. The patients with *E. coli* UTI had more often fever higher than 38,5 °C (p<0,0001), chills (p=0,0349) and headache (p=0,0499). The patients with non-*E. coli* UTI had more often fever below 38,5 °C (p<0,0001) (Table 1.).

The most common abnormal blood test results in patients with UTI were: high erythrocytes sedimentation rate in 167 (83,5%), high C-reactive protein in 155 (77,5%), low serum level of haemoglobin and high urea in 72 (36%), leukocytosis in 71 (35,5%), erythrocytopenia in 69 (34,5%), and neutrophilia in 64 (32%) patients. No statistically significant differences were found concerning the frequency of abnormal laboratory test results between the patients with *E. coli* and non-*E. coli* UTI (p>0,05) (Table 2.). The most common abnormal urine analyses results included: cloudy urine in 180 (90%), proteinuria in 124

(62%), leukocyturia in 100 (50%), leukocytes and granulated cylinders in the urine in 93 (46,5%), nitrites in the urine in 66 (33%) and hematuria and erythrocyturia in 64 (32%) patients. The cloudy urine (p<0,0001), proteinuria (p=0,0011) and nitrites in the urine (p=0,0002) were significantly more often in patients with *E. coli* UTI. The patients with non-*E. coli* UTI had more often urine specific gravity <1015 (p=0,0012) (Table 3.).

DISCUSSION

147 (73,5%) *E. coli* UTI and 53 (26,5%) non-*E. coli* UTI were registered from January 2006 to December 2007 in the Clinic for Infectious Diseases Tuzla. Our results were suitable with data from available literature in which is *E. coli* was specified as causative agent in 80-90 % of UTI. But results from some investigations show the lower prevalence of *E. coli* as a causative agent of UTI. Its prevalence changes depending on time. This fact determined investigators from Israel who report that the prevalence of *E. coli* as most common causative agent of UTI has significantly decreased from 70,5 % in 1991 to 56 % in 2000. Therefore, a frequent re-evaluation of its prevalence as causative agent of UTI is necessary (6).

ABNORMAL BLOOD TEST RESULTS	<i>E. coli</i> UTI		non- <i>E. coli</i> UTI		p value
	N	%	N	%	
Erythrocytes sedimentation rate >20 mm/h	126	85,7	41	77,3	p=0,1600
Number of leukocytes >10×10 ⁹ /dm ³	55	37,4	16	30,2	p=0,3459
Number of neutrophiles > 6,49×10 ⁹ /dm ³	42	28,6	22	41,5	p=0,0834
Number of erythrocytes < 4×10 ¹² /dm ³	54	36,7	15	28,3	p=0,1739
Serum level of haemoglobin < 138 g/dm ³	51	34,7	21	39,6	p=0,5216
C-reactive protein > 3,3 mg/dm ³	115	78,2	40	75,5	p=0,6800
Urea > 6,4 mmol/dm ³	54	36,7	18	34,0	p=0,7185
Creatinine > 115 mmol/ dm ³	21	14,3	9	17,0	p=0,6375
Aspartate aminotransferase > 37 U/dm ³	33	22,4	10	18,9	p=0,5864
Alanine aminotransferase > 65 U/dm ³	18	12,2	3	5,6	p=0,1800
Total:	147	100,0	53	100,0	200 100,0

TABLE 2. Abnormal blood test results in adult hospitalised patients with acute community-acquired urinary tract infections

ABNORMAL URINE ANALYSIS	<i>E. coli</i> UTI		non- <i>E. coli</i> UTI		p value
	N	%	N	%	
Cloudy urine	140	95,2	40	75,5	p<0,0001
Urine specific gravity <1015	26	17,7	21	39,6	p=0,0012
Urine specific gravity >1030	18	12,2	5	9,4	p=0,5824
Proteinuria	101	68,7	23	43,4	p=0,0011
Hematuria	51	34,7	13	24,5	p=0,1738
Glucosuria	22	15,0	4	7,5	p=0,1686
Nitrites in the urine	57	38,8	6	11,3	p=0,0002
Erythrocyturia	51	34,7	13	24,5	p=0,1738
Leukocyturia	76	51,7	24	45,3	p=0,4321
Leukocytes and granulated cylinders in the urine	71	48,3	22	41,5	p=0,3955
Total:	147	100,0	53	100,0	200 100,0

TABLE 3. Abnormal urine analysis results in adult hospitalised patients with acute community-acquired urinary tract infections

This study has shown that the leading symptoms and signs of disease in adult hospitalised patients with community-acquired UTI included: fever in 200 (100%), dysuria in 194 (97%), lower abdomen pain in 104 (52%), groin pain in 93 (46,5%) and headache in 91 (45,5%) patients. Similar findings were reported in Israeli study, where dysuria, frequent urination, urgent urination, and groin pain were the most common symptoms in patients with UTI (6). Also Fahey et al. report the results of their study where more than a half of patients had dysuria, frequent and urgent urination, while smaller number of patients had nocturia, abdominal and groin pain and vomiting (12). The patients with *E. coli* UTI had more often fever higher than 38,5 °C (p<0,0001), chills (p=0,0349) and headache (p=0,0499). It has been reported that high fever was present more often in patients with *E. coli* UTI because of the high virulent effect of *E. coli* that causes the strong inflammatory host response with clinical manifestations such as poor general condition, high fever and chills (13). According to data from available literature the most common serotypes of *E. coli* which causes UTI are: O1, O2, O4, O6, O7, O8, O75, O150, I O18ab (2), and strains with significant virulence which causes infection in upper urinary tract and urosepsis have P-fimbriae in most cases (14). Due to technical reasons in our institution, we had no possibility to confirm that these serotypes and strains were involved. But according to severity of clinical picture, we can assume that it is probably *E. coli*, as earlier mentioned. The most common abnormal blood test results in patients with UTI were the following: high erythrocytes sedimentation rate in 167 (83,5%), high C-reactive protein in 155 (77,5%), low serum level of haemoglobin and high urea in 72 (36%), and leukocytosis in 71 (35,5%) patients. According to reviewed literature, systemic inflammatory response in UTI is present only in upper urinary tract infections and in that case abnormal find-

ings of blood test results such as high C-reactive protein, high erythrocytes sedimentation rate, and leukocytosis could be found (15, 16). This study has shown that there was no significant difference in blood test results between the patients with *E. coli* and non-*E. coli* UTI (p>0,05). Similar studies have shown that the patients with UTI and neutrophilia had a significantly severe disease course, followed with lethal outcome (11). Interesting investigation in children showed that leukocytosis and neutrophilia are more often in *E. coli* UTI (13). There was significant difference in the urine analysis results between the patients with *E. coli* and non-*E. coli* UTI. The patients with non-*E. coli* UTI had more often urine specific gravity <1015 (p=0,0012). The patients with *E. coli* UTI had more often cloudy urine (p<0,0001) and proteinuria (p=0,0011). These findings might be caused by the great impact of *E. coli* bacteria on glomerular membrane which leads to increased glomerular membrane permeability for proteins, and the effect of non-*E. coli* bacteria on renal tubules which result in decrease of renal tubular re-absorption. To confirm these findings further investigations are necessary. There was a significantly lower rate of negative nitrite-test in the patients with non-*E. coli* UTI. These may present false negative results because the non-*E. coli* group of bacteria includes some of the bacteria with no ability to reduce nitrates to nitrites, and also the slow growing bacteria in urine media such as *Enterococcus faecalis*, *Staphylococcus aureus* and *Staphylococcus saprophyticus* (17,18). Similar studies show a high correlation between leukocyturia, positive nitrite test and UTI (13,19,20). Based on these clinical and laboratory parameters, which can be gained in couple of hours, the results of this study will help us to determine if it is the case of *E. coli* or non-*E. coli* UTI. This would enable us to administer early and adequate empirical therapy in order to prevent serious complications of disease.

CONCLUSION

Our investigation has shown that fever higher than 38,5 °C, chills, headache, cloudiness of urine samples, proteinuria and positive nitrite tests are significantly more often in the patients with *E. coli* UTI. Fever lower than 38,5 °C and urine specific gravity <1015 are indicative of non-*E. coli* UTI.

These clinical and laboratory findings can lead us to the early etiological diagnosis of UTI before urine culture detection of causative agents, which takes several days. Early etiological diagnosis of the *E. coli* and non-*E. coli* UTI is necessary for an urgent administration of appropriate empirical antibiotic treatment. This is very important in prevention of irreversible kidney damage, prolonged treatment, complications, as well as recidives and chronicity of the illness.

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