

A survey on urinary tract infections associated with the three most common uropathogenic bacteria

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ABSTRACT

Objectives: The most common uropathogenic Gram negative bacteria are *Escherichia coli* and *Klebsiella pneumoniae*. The purpose of this study was to determine the three most frequent bacterial agents causing Urinary Tract Infections (UTI) in patients who referred to Central Laboratory of Dr. Shariati Hospital, during 2 years (January 2006- December 2007).

Materials and methods: The registered data were checked and collected by the questionnaires as a retrospective epidemiological survey. Then, the Chi Square tests were performed by SPSS software.

Outcomes: The results of the present survey revealed that, the first two bacterial agents in different seasons were similar through the surveillance while the third one was variable. The first two frequent bacteria were respectively, *Escherichia coli* and *Klebsiella pneumoniae*.

Conclusion: The gram negative bacteria of *Escherichia coli* and *Klebsiella pneumoniae* were the most common uropathogenic bacteria causing UTI. According to the statistical calculations, there was significant association between UTI caused by *Escherichia coli* and female gender ($p < 0.05$).

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OBJECTIVES

Urinary Tract Infection (UTI) is described as the microbial invasion of any tissues of the urinary tract and is the second most common clinical symptom for experimental antimicrobial treatment in primary and secondary care (1, 2). In addition, the number of urine samples in comparison with the other specimens in medical microbiology laboratories is very large (2).

Normally, the urinary tract is sterile, but urinary tract infections can be caused by a variety of conditions. They can cause complicated or uncomplicated, symptomatic or asymptomatic infections. Anatomically can be divided into upper and lower tract infections (3-6).

The international studies have shown that UTIs in women are very common; therefore, one in five adult women experience UTI in her life and it is extremely common, clinically apparent, worldwide patient problem (3, 4, 7-9).

Despite the presence of several antibacterial factors such as the pH, urea concentration, osmolarity, various organic acids, salt content of the urine, urinary inhibitors to bacterial adherence e.g. Tamm-Horsfall protein (THP), bladder mucopolysaccharide, low-molecular-weight oligosaccharides, secretory IgA and lactoferrin, the uropathogenic bacteria are able to adhere, grow and resist against host defenses that finally resulting in colonization and infection of the urinary tract (8, 10-12).

Several authors around the world have been reported the Gram negative bacteria of *E.coli* and *Klebsiella* spp. being the most frequent organisms causing UTIs (1, 3, 13-15). *E.coli* causes 70-95% upper and lower UTIs (9).

The risk factors associated with UTI include sex (distance between the anus and urethral meatus (short in women and long in men), moisture content surrounding urethra), genetic predisposition (e.g. blood group), the antibacterial activity of prostatic fluid (in men), behavioral factors (such as recent sexual intercourse, use of spermicidal agents and diaphragm, frequency of urination, aspects of personal hygiene or use of the birth control pill), low concentration of lactobacilli in elderly women, urologic structural abnormalities, diabetes, immune-suppression, pregnancy, hypertension, stone formation, nosocomial acquired infections and instrumentation like catheterization (3, 10, 16-18).

The main purpose of this research, was to determine the three most common bacterial agents causing UTI in different seasons in patients referred to Central Laboratory of Dr. Shariati Hospital, on a period of 2 years (January 2006- December 2007). □

MATERIALS AND METHODS

In this survey, cases with or without clinical symptoms of UTIs were studied retrospectively (3, 19). Data collection were conducted by a questionnaire consisting of short-answer questions including Dates, Bacterial agents (First, Second and Third Pathogen), Diagnostic techniques, Sex and Age of patients, Predisposing factors and Mortality. In the present study, the patients who referred to the Central Laboratory of Dr. Shariati Hospital were studied, on a period of 2 years (January 2006- December 2007).

The required details were acquired from documents at the Central Laboratory of hospital. There was no need for signing consent form and approval of the institutional ethical review board because, the name of patients were anonymous. At the end, the incidence of UTIs caused by pathogenic bacteria was determined and the Chi Square (χ^2) tests were performed to show the significance of the association between gender and UTI. The analysed data were processed as well through SPSS software version 15 (SPSS Inc., Chicago, IL, USA) and $p < 0.05$ was considered as statistically significant p value. □

OUTCOMES

The percentage of the three most common causative bacterial agents of UTIs and the sex of the patients in each season through the year were respectively:

Ia. January-March 2006: *E. coli* caused 43.5% of UTIs (25.2% in men and 74.8% in women) (Table 1).

Ib. January-March 2007: *E. coli* caused 36.8% of UTIs (23.9% in men and 76.1% in women) (Table 2).

Ic. April-June 2006: *E. coli* caused 36.9% of UTIs (29.2% in men and 70.8% in women) (Table 1).

Id. April-June 2007: *E. coli* caused 36.8% of UTIs (23.9% in men and 76.1% in women) (Table 2).

Ie. July-September 2006: *E. coli* caused 34.7% of UTIs (34% in men and 76.1% in women) (Table 1).

If. July-September 2007: *E. coli* caused 48% of UTIs (27.1% in men and 72.9% in women) (Table 2).

Ig. October-December 2006: *E. coli* caused 41.1% of UTIs (35.3% in men and 64.7% in women) (Table 1).

Ih. October-December 2007: *E. coli* caused 43.1% of UTIs (24.5% in men and 75.5% in women) (Table 2).

Ila. January-March 2006: *K. pneumoniae* caused 13.3% of UTIs (38% in men and 62% in women) (Table 1).

Ilb. January-March 2007: *K. pneumoniae* caused 9.3% of UTIs (57.1% in men and 42.9% in women) (Table 2).

Ilc. April-June 2006: *K. pneumoniae* caused 6.8% of UTIs (41.7% in men and 58.3% in women) (Table 1).

Ild. April-June 2007: *K. pneumoniae* caused 11.1% of UTIs (37.9% in men and 62.1% in women) (Table 2).

Ile. July-September 2006: *K. pneumoniae* caused 12.4% of UTIs (34% in men and 76.1% in women) (Table 1).

Ilf. July-September 2007: *K. pneumoniae* caused 11.5% of UTIs (63.2% in men and 36.8% in women) (Table 2).

Ilg. October-December 2006: *K. pneumoniae* caused 13.2% of UTIs (48.8% in men and 51.2% in women) (Table 1).

Ilh. October-December 2007: *K. pneumoniae* caused 14.5% of UTIs (15.7% in men and 84.3% in women) (Table 2).

IIla. January-March 2006: *Streptococcus* spp. caused 6.7% of UTIs (28% in men and 72% in women) (Table 1).

IIlb. January-March 2007: *Enterococcus* spp. caused 9.1% of UTIs (26.5% in men and 73.5% in women) (Table 2).

IIlc. April-June 2006: *Staphylococcus epidermidis* caused 6.6% of UTIs (48.6% in men and 51.4% in women) (Table 1).

IIld. April-June 2007: *Staph. epidermidis* caused 7.6% of UTIs (40% in men and 60% in women) (Table 2).

IIle. July-September 2006: *Staph. epidermidis* caused 11.5% of UTIs (48.6% in men and 51.4% in women) (Table 1).

IIlf. July-September 2007: *Staph. epidermidis* caused 6.1% of UTIs (35% in men and 75% in women) (Table 2).

IIlg. October-December 2006: *Pseudomonas aeruginosa* caused 60% of UTIs (40% in men and 51.2% in women) (Table 1).

IIlh. October-December 2007: *Enterococcus* spp. caused 10.6% of UTIs (43.1% in men and 56.9% in women) (Table 2).

The classical methods of microbiology used for the purpose of diagnosis; were is detection of uropathogens based on urine culture on different microbiological media including Blood Agar, ENDO Agar and Mac Conkey Agar. The diagnostic procedures consisted of direct microscopy observation, Gram staining, Biochemical tests, Antibioqram, Oxidase and Catalase tests. No molecular biology diagnostic tools were used.

Neither the age nor the risk factors of patients was available; hence, these items were excluded from the survey. However, in the registered data, the major risk factors in patients were reported as sexual activity in young women, surgical operation, diabetes, immune-suppression, transplants, pregnancy, hypertension, stone formation, hospitalization and catheter-

Bacteria	January-March 2006	April-June 2006	July-September 2006	October-December 2006
<i>Escherichia coli</i>	43.5%	36.9%	34.7%	41.1%
<i>Klebsiella pneumoniae</i>	13.3%	6.8%	12.4%	13.2%
<i>Streptococcus</i> spp.	6.7%			
<i>Staphylococcus epidermidis</i>		6.6%	11.5%	
<i>Pseudomonas aeruginosa</i>				5.6%
<i>Enterococcus</i> spp.				

TABLE 1. The name and percentage of the bacterial pathogens during different seasons of the year of 2006

Bacteria	January-March 2007	April-June 2007	July-September 2007	October-December 2007
<i>Escherichia coli</i>	36.8%	41.3%	48%	43.1%
<i>Klebsiella pneumoniae</i>	9.3%	11.1%	11.5%	14.5%
<i>Streptococcus</i> spp.				
<i>Staphylococcus epidermidis</i>		7.6%	6.1%	
<i>Pseudomonas aeruginosa</i>				
<i>Enterococcus</i> spp.	9.1%			10.6%

TABLE 2. The name and percentage of the bacterial pathogens during different seasons of the year of 2007

ization. Moreover, the personal hygiene and other social behaviors were considered. Besides, the predisposing factors for cases of *Staphylococcus epidermidis* in men were reported as catheterization and urologic procedures. During the research period, no mortality was reported. □

CONCLUSION

The healthy urinary tract like the other systems is normally able to resist bacterial infections. Numerous studies have indicated that the frequency of UTI is greater in women than in men. The large intestine and the perineal area serve as a reservoir for pathogenic bacteria such as *Escherichia coli*. Different studies have demonstrated that women who are prone to urinary tract infections possess epithelial cells with significantly more receptors for uropathogenic bacteria than healthy controls (3, 4, 7-9, 20).

UTI is one of the most common infectious diseases which have been most extensively studied in the field of clinical practices (10). Usually, UTI is caused by *Escherichia coli* and different studies have shown an alarming increase in resistance of this bacteria in invasive infections like urinary tract infections (1, 3, 13-15, 21).

Furthermore, UTI is caused by coliforms and *Enterococcus* spp. because of their presence in high numbers on the perineum (3, 22).

In this paper *Escherichia coli* has been found as the most common uropathogenic bacteria in different seasons during the two-year surveillance. Furthermore, the women are a vulnerable population infected by *E. coli*. The statistical tests of χ^2 showed significant association between female gender and UTIs caused by *E. coli* ($p < 0.05$). The second most common uropathogenic agent has been shown to be *Klebsiella pneumoniae*. In this two-year surveillance, the Gram negative bacteria of *E. coli* and *K. pneumoniae* were the most predominant bacterial agents which is completely similar to the results of the other studies that have been done in past (1, 13-15) (Tables: 1 and 2).

The third uropathogenic agent varied during the different seasons. *Streptococcus* spp. (separated apart from *Streptococcus D group*), *Staphylococcus epidermidis*, *Pseudomonas aeruginosa*, and *Enterococci* were the third pathogens in different periods during our two-year study (Tables: 1 and 2).

We suggest that these categories of studies should be done at regular intervals to follow any changes in the pathogenic agents' patterns. □

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