Spectrum and antimicrobial resistance of uropathogens from patients with urinary tract infection in urology and non-urology departments

Qingmei Wang, MD, Xiaobing Zhang, MD, Peiyuan Xia, PhD, Yongchuan Chen, MD, Qian Wang, PhD, Wei Feng, MD, Fengjun Sun, PhD.

Urinary tract infection (UTI) is one of the most frequently occurring nosocomial infections.[1] Patients with UTI are usually treated with antibiotic therapy. Unfortunately, the extensive and inappropriate use of antimicrobial agents has invariably resulted in the development of antibiotic resistant uropathogens. Hence, discovery of the etiology and antimicrobial resistance patterns of uropathogens is important for rational empirical therapy of nosocomial UTI. Patients with UTI in different departments of a hospital may have quite different trends in terms of uropathogens and their susceptibilities to antimicrobial agents.[2] However, there are very few studies that concentrate on the change of spectrum and antimicrobial resistance of uropathogens in UTI patients from different departments, and we could not source a single study carried out in Chinese patients. The objective of this study was to compare the spectrum and antimicrobial resistance patterns of uropathogens isolated from hospitalized patients with UTI at the department of urology with those from other non-urology departments of Southwest Hospital in Chongqing, China.

This retrospective study included all patients with UTI at 33 departments of the Southwest Hospital, the Third Military Medical University in Chongqing, China from January 2003 to December 2010. Individual patients were subjected to the routine procedures of urine microscopy and the isolation and identification of organisms in the Diagnostic Microbiology Laboratory. Isolates were identified by the Vitek system and conventional biochemical methods, and tested against various antibiotics by the disk diffusion method. The categorical variables were statistically analyzed by the chi-square and Fisher's exact tests using the Statistical Package for Social Sciences version 13 (SPSS Inc., Chicago, IL, USA). A 2-tailed $p<0.05$ was considered statistically significant. This study was carried out according to the principles of the Helsinki Declaration, and the Ethics Committee of the Third Military Medical University approved the experimental protocol.

A total of 12796 samples from 8922 patients were examined and 1578 culture-positive isolates were obtained. The isolation rate was 12.8% (1310/10197) in non-urology departments and 10.3% (268/2599) in the urology department during the 8-year study period ($p=0.000$). Characterization of these isolates revealed that *Escherichia coli (E. coli)* (24.3%) were the most common isolates, followed by *Candida albicans* (7.54%), *Candida tropicalis* (7.41%), *Enterococcus faecium* (6.46%), and *Pseudomonas aeruginosa (P. aeruginosa)* (6.27%). Stratification analysis revealed that the isolation rate of Candida species in non-urology departments was higher than that in the urology department, while the isolation rate of Gram-negative organisms in non-urology departments was lower than that in the urology department. There was no significant difference in the distribution of the most common pathogenic microorganisms between the non-urology and urology departments, except for the *Candida glabrata* (5.27% versus 2.24%) and *Enterobacter cloacae* (1.68% versus 4.85%).

The susceptibilities of Gram-negative isolates to antimicrobial agents are showed in **Table 1**. The resistance rates of *E. coli* and *Klebsiella pneumoniae* isolates from the urology department were significantly higher than that in the non-urology departments. On the contrary, the resistance rate of *P. aeruginosa* isolates from the urology department was significantly lower than that from the non-urology departments. There was no apparent difference in the sensitivity of Gram-positive bacteria to antibiotics tested between the urology and non-urology departments. All the Enterococcus isolates were sensitive to vancomycin, and most isolates, except for 2 *Enterococcus faecium* isolates, was sensitive to teicoplanin. The resistance rate of *Enterococcus faecium* isolates to ciprofloxacin and erythromycin, were almost 100%. Characterization of the susceptibility of *Candida spp* to antimycotic agents revealed that there was not a single isolate resistant to Amphotericin B and most *Candida spp* isolates retained sensitive to 5-fluorocytosine, fluconazole, itraconazole, and ketoconazole.

In this study, the *Enterobacteriaceae* strains were the predominant bacterial species isolated from urine cultures, which is consistent with previous studies from other countries.[2,3] According to previous research, *Enterococcus spp.* is still the most common gram-positive bacteria.[3,4] One major feature in this study

Disclosure. Authors declare no conflict of interests, and the work was not supported or funded by any drug company.

was the high isolation rate of *Candida spp*. Our study showed that *Candida albicans* and *Candida tropicalis* were the second and third most common isolates from patients, which is higher than that of other studies (less than 15%).[2,3] The high prevalence of yeast isolates from UTI patients may be related to bladder catheter usage, excessive use of broad-spectrum antibiotics, and use of immunosuppressive regimens. Analysis of the common uropathogens in different departments indicated that the distribution of the most common pathogenic microorganisms had a statistical difference. The isolation rates of Gram-negative bacterial isolates from UTI patients in the urology department were higher than that in the non-urology departments, while the isolation rate of *Candida spp* isolates from UTI patients in the urology department was lower than that in non-urological departments. The difference may be associated with the variable diseases, surgical, and medical management of these patients.

Antibiotic resistance of uropathogens is a major clinical problem in the treatment of UTI. In this study, the resistant rate of Gram-negative bacteria was higher than that of other reports during the same period.[2-4] The resistant rate of *Enterobacteriaceae* isolates in the urology department was higher than that of the non-urological departments. On the contrary, the *P. aeruginosa* isolates in non-urological departments have more resistance. Most patients in the urology department had urinary diseases, including complicated UTI and many of them have been treated with antibiotics, according to the uropathogen spectrum. In non-urological departments, more attention might have been focused on systemic infections. These may explain the higher resistance of *Enterobacteriaceae* and the lower resistance of *P. aeruginosa* in the urology department. Gram-positive bacteria were more resistant to erythromycin, but were sensitive to teicoplanin and vancomycin, which is similar to previous reports.[2,4] All fungous isolates were sensitive to the antimycotic agents, particularly to Amphotericin B, similar to another report,[5] suggesting that we still can use common antimycotic agent for the treatment of UTI patients with fungous infection.

In conclusion, we found that patients with UTI in the urology and non-urology departments had different uropathogen spectrums and antibiotic susceptibilities. Because the sensitivity pattern of urinary pathogens to antibiotics varies over time and in different geographical regions, empirical antibiotic selection for the treatment protocols should be based on knowledge of the local prevalence of causative agents, antibiotic sensitivity, and resistance patterns.

Received 17th July 2013. Accepted 17th December 2013.

From the Nursing Department (Wang), Department of Pharmacy (Xia, Chen, Wang, Feng, Sun), Southwest Hospital, the Third Military Medical University, Department of Laboratory Medicine (Zhang), the First Affiliated Hospital of

Table 1 - The resistance of Gram-negative bacterial isolates to antibiotics.

Antibiotic	Resistance rate (%)									
	Escherichia.coli		*P.aeruginosa*		*Klebsiella pneumoniae*		*Proteus mirabilis*		*Enterobacter cloacae*	
	Non-urology n=305	Urology n=79	Non-urology n=80	Urology n=19	Non-urology n=59	Urology n=15	Non-urology n=39	Urology n=10	Non-urology n=22	Urology n=13
Amikacin	11.2*	19.8	31.8	10.5	21.7	38.9	17.4	18.2	37.0	33.3
Gentamicin	54.4**	74.1	48.9**	10.5	51.7	83.3	43.5	27.3	65.4	66.7
Ceftazidime	18.0	28.4	40.9*	10.5	25.0	55.6	11.1	18.2	70.4*	33.3
Cefoperazone	65.0**	83.3	48.9	31.6	63.6	85.7	34.4	57.1	58.8	62.5
Ampicillin	88.5	96.2	No data or incomplete data	No data or incomplete data	100	100	77.8	100	100	100
Piperacillin	79.8**	93.8	48.9	31.6	72.1	94.4	39.1	54.5	70.4	75.0
Ampicillin/ sulbactam	52.1**	73.1	No data or incomplete data	No data or incomplete data	52.3**	92.9	39.4	14.3	87.5	100
Piperacillin/ tazobactam	6.1	12.3	45.6**	6.7	22.6	44.4	8.5	0	44.4	41.7
Aztreonam	22.2**	40.7	40.2	26.3	31.7*	66.7	6.5	18.2	70.4	41.7
Imipenem	0.8	0	42.0*	10.5	1.7	0	0	0	3.7	0
Meropenem	0.3	0	38.6	26.3	1.6	5.9	2.2	0	15.4	0
Cyclomycin	76.3	82.7	87.0	78.6	70.5	85.7	84.8	85.7	26.7	37.5
Levofloxacin	61.0**	85.1	53.5	36.8	52.5	83.3	31.8	45.5	59.3	75.0
SMZ-TMP	69.2	70.4	96.6	100	61.0	88.9	63	72.7	63	58.3

**$p<0.01$, *$p<0.05$ versus that in the urology department. SMZ-TMP - trimethoprim/sulfamethoxazole

Chongqing Medical University, Chongqing, China. Address correspondence and reprints request to: Dr. Fengjun Sun, Department of Pharmacy, Southwest Hospital, the Third Military Medical University, Chongqing, 400038, China. Tel. +86(23)68765991. Fax. +86(23)65461719. E-mail: fengj_sun@163.com

References

1. Cairns S, Reilly J, Stewart S, Tolson D, Godwin J, Knight P. The prevalence of health care-associated infection in older people in acute care hospitals. ***Infect Cont Hosp Ep*** 2011; 32: 763-767.
2. Al Benwan K, Al Sweih N, Rotimi VO. Etiology and antibiotic susceptibility patterns of community- and hospital-acquired urinary tract infections in a general hospital in Kuwait. ***Med Princ Pract*** 2010; 19: 440-446.
3. Markovic-Denic L, Mijovic B, Jankovic S. Risk factors for hospital-acquired urinary tract infection: a case-control study. ***Int Urol Nephrol*** 2011; 43: 303-308.
4. Yamamichi F, Shigemura K, Matsumoto M, Nakano Y, Tanaka K, Arakawa S, et al. Relationship between Urinary Tract Infection Categorization and Pathogens' Antimicrobial Susceptibilities. ***Urol Int*** 2012; 88: 198-208.
5. Yuksekkaya S, Findik D, Arslan U. [Molecular epidemiology and antifungal susceptibility of Candida species isolated from urine samples of patients in intensive care unit]. ***Mikrobiyol Bul*** 2011; 45: 137-149.

Related Articles

Al-Otaibi FE, Bukhari EE. Clinical and laboratory profiles of urinary tract infections caused by extended-spectrum beta-lactamase-producing Escherichia coli in a tertiary care center in central Saudi Arabia. ***Saudi Med J*** 2013; 34: 171-176.

Sivathasan N, Rakowski KR. Microscopy, culture, and sensitive management of uncomplicated urinary tract infections in adults in the primary care setting. ***Saudi Med J*** 2011; 32: 559-562.

Rapi S, Bartolini L, Puliti D, Cambi GE, Bamoshmoosh M, Baldereschi M, et al. Conventional dipsticks in the screening of microalbuminuria and urinary tract infections. Killing 2 birds with one stone? ***Saudi Med J*** 2010; 31: 708-709.