



Epidemiologic and Etiologic Evaluation of Acquired Urinary Tract Infections in Cardiac Surgery ICU Patients

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ABSTRACT

Urinary tract infections (UTI) are the most common acquired infections in hospitalized patients. The most common nosocomial infections in hospitals occur in intensive care units. Occurrence of UTI in severely compromised patients significantly increases the hospitalization period and treatment costs. The aim of the present study was the epidemiologic and etiologic evaluation of acquired UTI in cardiac surgery ICU patients. In this descriptive cross-sectional study, 500 patients in the cardiac surgery ICU in Tabriz Madani hospital were evaluated for a period of 1 year. The acquired UTI was diagnosed by the positive urine culture result (number of microorganisms < 10⁵/mL) 48 hours after hospitalization or 48 hours after discharge from ICU. In patients with positive culture results, anti-bacterial sensitivity test was carried out by modified Kirby-Bauer method in relation to Amikacin, Gentamicin, Co-Trimoxazole, Ciprofloxacin and Ceftazidime. A total of 500 patients, 309 males and 191 females, with a mean age of 48.95±22.83 years were included in the study. All the patients had urinary catheters. Acquired UTI diagnosed in 8 subjects (1.6%), 7 males and 1 female, with a mean age of 62.88 years (mean standard error=40.7; age range=41-78 years). All the subjects were married. From each patient one microorganism was isolated: Enterobacter aerogenes (37.5%); Candida albicans (25%); Escherichia coli (25%) and Klebsiella pneumoniae (12.5%). Anti-microbial sensitivity test revealed only one case of E coli resistant to Co-Trimoxazole. The results of the present study showed a low prevalence of acquired UTI in the ICU under study. Although the microorganisms isolated were similar to those reported in other studies, a low rate of resistance to commonly used antibiotics was observed.

1. Introduction

Urinary tract is the most common location for acquired infections, which comprises more than 40% of acquired infections, afflicting approximately 6000 individuals each year. A total of 66-86% of patients contract a urinary tract infections (UTI) after manipulation and catheterization.¹ From an

epidemiologic viewpoint, urinary tract infections are classified into two broad categories: a) with catheter or acquired in the hospital, and b) without catheter or acquired in the community.² Studies on patients in ICU have shown that 20-40% of acquired infections in these wards are UTI. This is very important because on one hand these infections prolong the hospitalizations period in ICU and significantly increase mortality in internal

and surgery ICUs on the other.³ Despite its importance, only a limited number of studies have evaluated ICU-acquired UTI in hospitals.⁴ Although UTI is the most common acquired nosocomial infection, the epidemiology of UTI is not well known in Iran; on the other hand, the microbial infection pattern and their resistance is widely different from one hospital to another and from one region to another.⁵ Therefore, the aim of the present study was to evaluate the frequency of acquired UTI in cardiac surgery ICU patients, to determine the microorganisms involved and their antibiotic sensitivity and resistance to commonly used antibiotics, and to determine the demographic data of the patients afflicted.

2. Materials and Methods

In the present descriptive cross-sectional study, 500 patients in the cardiac surgery ICU were evaluated regarding acquired UTI. The study was carried out in the cardiac surgery ICU in Madani hospital in Tabriz. The study lasted 12 months from September 2009 to September 2010. Considering the 5% error interval, the subjects were included in the study by simple ready method. Urine samples were taken from all the patients 48 hours (the third day) after hospitalization by intermediate urine technique or through the catheters which had been placed in an aseptic manner. The samples were sent to the central laboratory in an aseptic manner and cultured under standard laboratory conditions. Then the samples were evaluated for microbial growth. The samples were taken from the catheters as follows: after catheters were cleaned with an antiseptic, the terminal segment of the catheter was cut with a sterile blade and the urine sample was retrieved from the inside of the catheter with a sterile syringe. In addition, the tip of the catheter was cut with a sterile blade and sent for culture after it was removed. Acquired UTI was confirmed in the ICU when the patient had a positive culture result, i.e. at least 10^5 microorganism in 1 mL of urine of at least one or two species of microorganisms diagnosed for the first time 48 hours (the third day) or more after hospitalization, or 48 hours after being discharged from the hospital. In order to determine the antibiotic resistance pattern of the microorganisms, after a positive culture result, an antibiogram procedure was carried out using Kirby-Bauer method. In the present study the antibiotic sensitivity of the isolated microorganisms to Amikacin, Gentamicin, Co-Trimoxazole, Ciprofloxacin and Ceftazidime was evaluated. Then the patients with positive results underwent treatment. The evaluated variables were gender, age, marital status, the reason for surgery, the duration of hospitalization in ICU, urinary catheter, history of previous UTI, fever, symptoms and signs of UTI, mortality during hospitalization, and the microorganism isolated in the group afflicted with UTI

and the antibiotic sensitivity of the isolated microorganism. Data was presented as means±standard deviation or mean standard error, frequency and percentage. SPSS 15 software was used for statistical analyses.

3. Results

Based on the presence or absence of acquired UTI (according to urine culture) the 500 patients in ICU were divided into two groups of urinary infection (n=8) and healthy (n=492) (Graph 1). All the patients had urinary catheters. The subjects' demographic data are presented in Table.

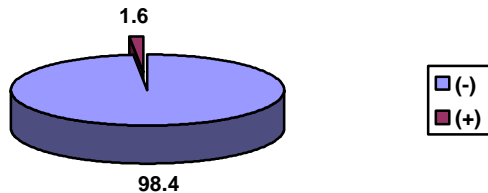
Table - The subjects' demographic data and the variable evaluated.

Variable		Urinary infection group (n=8)	Healthy group (n=492)	Total (n=500)
Gender	Male	7(87.5)	302(61.4)	309(61.8)
	Female	1(12.5)	190(38.6)	191(38.2)
Age (year)		*62.88±4.07	48.72±22.89	48.95±22.83
Marital status	Married	8(100)	400(81.2)	408(81.6)
	Single	0(0)	92(18.8)	92(18.4)
Reason of surgery	CAD	5(62.5)	305(62)	310(62)
	VHD	1(12.5)	49(10)	50(10)
	ASD/VSD	1(12.5)	39(7.9)	40(8)
	Pericardioentesis/ Pericarditis/Car diac Tamponade	0(0)	15(3)	15(3)
	TOF	0(0)	12(2.4)	12(2.4)
	Pulmonary Artery Banding	0(0)	7(1.4)	7(1.4)
	Aneurysm/Ao rtic Dissection	0(0)	5(1)	5(1.4)
	TGA	0(0)	4(0.8)	4(0.8)
	Bentall	0(0)	3(0.6)	3(0.6)
	Other	1(12.5)	53(10.8)	54(10.8)
Duration of hospitalization in ICU (day)		*8.25±4.07	3.78±2.27	3.85±2.33
History of previous UTI		6(75)	3(0.6)	9(1.8)
Fever		8(100)	22(4.5)	30(6)
Symptoms and signs of UTI		7(87.5)	0(0)	7(1.4)
Mortality during hospitalization		1(12.5)	10(2)	11(2.2)

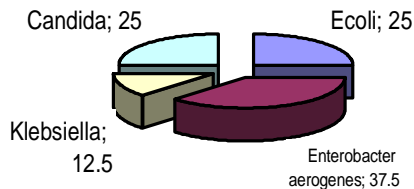
Data were presented as means±standard deviations or * mean standard error and frequency (%).

CAD: Coronary Artery Disease, **VHD:** Valvular Heart Disease, **ASD:** Atrial Septal Defect, **VSD:** Ventricular Septal Defect, **TOF:** Tetralogy of Fallot, **TGA:** Transposition of Great Arteries.

The microorganisms isolated in the urinary UTI group were *Enterobacter aerogenes* in 3 cases, *Candida albicans* in 2 cases, *E coli* in 2 cases and *Klebsiella* in 1 case (Graph 2).



Graph 1- Percentage of cases with (+) and without (-) urinary tract infection.



Graph 2- Percentage of microorganisms responsible for urinary tract infection.

Regarding *Enterobacter aerogenes* all the three cases and regarding *Candida albicans* both cases were sensitive to Amikacin, Gentamicin, Co-Trimoxazole, Ciprofloxacin, and Ceftazidime; regarding *E coli*, both the cases were sensitive to Amikacin, Gentamicin, Ciprofloxacin and Ceftazidime, one case was sensitive to Co-Trimoxazole and one case was resistant to Co-Trimoxazole; regarding *Klebsiella*, the case was sensitive to Amikacin, Gentamicin, Co-Trimoxazole, Ciprofloxacin and Ceftazidime.

4. Discussion

In the present study the frequency of UTI in cardiac surgery ICU patients in Madani hospital in Tabriz, the patients' demographic data and the characteristics of the isolated microorganisms were evaluated. The frequency of UTI was 1.6% in the present study. The overall results of previous studies indicate a frequency of 1.8-39.1% for UTI in the ICU.⁶⁻¹⁶ A frequency of 21-33% has been reported in previous studies in Iran,¹⁷⁻¹⁹ indicating that the frequency of UTI in the present study is less than that reported in other studies. Several reasons are involved in explaining these differences and the broad range of UTI in the patients in ICU.

4.1. Definitions and techniques to confirm urinary tract infection

The definition of nosocomial infection and the methods to confirm UTI are important in the diagnosis. It has been demonstrated that the best method to diagnose these infections is the simultaneous evaluation of clinical and laboratory data. However, the clinical component cannot be properly evaluated due to the critical condition of the patients in ICU.²⁰ In the present study only the patients who had a positive urine culture result were reported as "having urinary tract infection".

4.2. Presence or absence of a urinary catheter

Urinary catheters have been reported as the most important risk factor for urinary tract infection.²⁰ In the present study all the patients had urinary catheters.

4.3. Diversity of the patients in ICU

Some of the most important factors for the differences in the results of different studies, are the type and severity of the background disease, and the type of ICU setting (general, medical, general surgery, cardiac surgery).²⁰ In a study the prevalence of UTI in the patients in medical, non-cardiac surgery and cardiac surgery ICUs were reported to be 9%, 6% and 2%, respectively;³ therefore, the prevalence of UTI in the cardiac surgery ICU was less than that in other patients, which best justifies the low rate of these infections in the present study. The results of the study above are consistent with the results of the present study. As far as the literature review is concerned, no other studies have evaluated this group of patients to date.

4.4. Patients' demographic data

In the present study of 8 patients with UTI, 7 (87.5%) were male and 1 (12.5%) was female. All the afflicted patients were married with the mean age of 62.88 years (41-78 years). In a study, 67.9% of the afflicted patients were male with the mean age of 51.7 years.¹⁷ In another study, 71.1% of the patients were male and 28.9% were female.²¹ In one study, only 25% of patients were male and were all over 40 years of age.²⁰ In some studies, female gender has been reported as a risk factor for UTI in patients in ICU.⁸⁻¹⁰ However, in other studies no significant relationship has been reported between gender and UTI.^{12,21} Statistical comparison was not possible in the present study because of the limited number of patients with UTI. As it can be seen, the results of other studies in this regard are not consistent. It appears the background disease, which has led to hospitalization, has a significant role in this regard. In

the present study, a significant proportion of the patients were candidates for coronary artery bypass graft (CABG), which explains why a large number of patients were male and as a result, UTI was more prevalent in males. On the other hand, the limited number of female patients in cardiac surgery ICU explains the low prevalence of UTI in these patients. The results of the present study confirm the higher incidence of UTI in advanced age. It should be pointed out that there was a very wide age range (10 days to 85 years) in the patients in the present study. Further studies with larger study populations are required to reach definitive results. The microorganisms isolated in the present study in UTI patients were *Enterobacter aerogenes* (37.5%), *Candida albicans* (25%), *Escherichia coli* (25%) and *Klebsiella pneumoniae* (12.5%). It must be emphasized that in all the cases of UTI only one microorganism was isolated. The results of various studies in this regard are different based on the geographic location; however, there is consensus on the involvement of one etiologic agent in UTI in ICU patients.^{18,20} The most common microorganisms isolated in western countries are *Escherichia coli*, *Pseudomonas aeruginosa* and *Enterococcus*.²⁰ In a study in Spain *Candida* was isolated in one-third of the patients.²² In one other study, *Escherichia coli*, *Candida* and *Enterococcus* were isolated in 23%, 20% and 15% of the cases.³ In another study, the most common microorganisms isolated were *Escherichia coli* (29%), *Pseudomonas* (21.9%), *Proteus mirabilis* (16.1%) and *Candida* (16.1%); however, *Candida* has been reported to be the most common microorganism isolated.⁷ In a study the three most common microorganisms isolated were *Candida* (27.2%), *Escherichia coli* (27.2%) and *Staphylococcus aureus* (12.9%).¹² In another study, the most common microorganisms isolated were *Pseudomonas* (26.9%), *Escherichia coli* (23.1%), *Acinetobacter* (15.4%), *Enterobacter* (11.5%) and *Klebsiella* (7.7%).¹⁶ As it was mentioned previously, the results of different studies are not consistent. However, there is consensus on the most common microorganisms isolated in UTI. Although *Enterococcus* has been reported as the etiologic agent in these patients, it is not the most common etiologic factor. It appears that the type of background disease and the manipulation exerted are involved in the type of the dominant microorganism isolated. Since there is no similar reported study on cardiac surgery ICU patients, comparison and analysis of the results of the present study were not possible. However, the present study provides a broad view for physicians. In the present study the antibiotic sensitivity of the isolated microorganisms to Amikacin, Gentamicin, Co-Trimoxazole, Ciprofloxacin, and Ceftazidime was evaluated. Based on the results, only one case of *E coli*

resistance to Co-Trimoxazole was observed. In all the other cases the microorganisms were sensitive to the antibiotics tested. The results of other studies in this regard are different in much the same way the results about isolated microorganism are different. In a study, the resistance of *E coli* and *Enterococcus* to Ciprofloxacin, Gentamicin, Tobramycin and Ceftazidime was reported to be 33%, 21%, 9% and 13%, respectively.³ However, in another study, none of the isolated microorganisms (*E coli*, *Pseudomonas*, *Proteus mirabilis*, *Klebsiella* and *Enterococcus*) was resistant to Ciprofloxacin.⁷ Resistance of gram-negative microorganisms to Amikacin and Cefotaxime has been reported in 18.6% and 74.4% of cases, respectively. However, resistance to Imipenem has not been reported.⁸ In addition, in a study all the isolated microorganisms (*Klebsiella*, *E coli*, *Pseudomonas* and *CONS*) were resistant to Ciprofloxacin. *Klebsiella pneumoniae* was resistant to Amikacin in 8.3% of cases. *E coli* was resistant to Amikacin in 100% of cases. All the microorganisms were resistant to Ceftazidime.¹⁷ However, in another study, *E coli* isolated from in-patient and outpatient UTI cases were sensitive to Amikacin (100%), to Ciprofloxacin (64%) and to Co-Trimoxazole (27%).²³ In a study on the antibiotic sensitivity of microorganisms isolated from in-patients with UTI, sensitivity to Gentamicin, Ciprofloxacin, Co-Trimoxazole, Cefazolin and Amikacin were reported to be 75.6%, 39.2%, 63.2% and 82.7%, respectively.²⁴ Regarding the results of the studies mentioned above, it appears the antibiotic resistance of the etiologic microorganisms in UTI in cardiac surgery ICU patients is very low.

5. Conclusion

A total of 1.6% of patients in the cardiac surgery ICU were diagnosed with acquired urinary tract infection; 87.5% of UTI patients were male and 12.5% were female. The UTI patients were all married with the mean age of 62.88 (41-78 years). The microorganisms isolated from these patients were *Enterobacter aerogenes* (37.5%), *Candida albicans* (25%), *E coli* (25%) and *Klebsiella pneumoniae* (12.5%). In evaluating the sensitivity of microorganisms isolated from UTI patients to Amikacin, Gentamicin, Co-Trimoxazole, Ciprofloxacin and Ceftazidime only one *E coli* case was resistant to Co-Trimoxazole. In other cases all the microorganisms were sensitive to antibiotics. Therefore, regarding the importance of the care provided for ICU patients, further studies are required with larger study populations due to the critical conditions of the patient and their susceptibility to urinary tract infection in order to determine the risk factors of this infection.

Ethical issues

The study was approved by the Ethical Committee of the University.

Conflict of interests

No conflict of interest to be declared.

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