



An epidemiological study of nosocomial infections in the patients admitted in the intensive care unit of Urmia Imam Reza Hospital: An etiological investigation

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ABSTRACT

The prevalence of nosocomial infections in critical care units is high. Nosocomial infections are of serious hospital problems. In addition, they impose heavy costs on hospitals, causing increased hospitalization time, increased morbidity and mortality. In this study, we aimed to determine the epidemiological status of nosocomial infections in hospital ICU Imam Reza, Urmia, Iran. This study was performed on 556 patients who were admitted to ICU of Imam Reza hospital from 2006-2007. The data collected according to the questionnaire, addressing the demographic characteristics, intervention measures on patient, paraclinical reviews, and therapeutic measures on patients. The clinical signs and symptoms of patients were also controlled. In suspected patients, necessary laboratory tests and cultures were done. Data were analyzed by SPSS version 17 package. The incidence of nosocomial infections was 8.45 percent. The most common type of infections were pneumonia 59.5%, UTI 21.3%, and both 19.1% respectively. The most common microorganisms in pulmonary infections were *Pseudomonas aeruginosa*, in UTI *E. coli*, respectively. Incidence of pneumonia significantly is more than of other ($p < 0.01$). Also the correlation of ICU stay time, endotracheal tube, central venous catheter and incidence of nosocomial infection is significant ($p < 0.001$). Nevertheless, the effect of age, gender and taking corticosteroids were not statistically significant ($p > 0.05$). The prevalence of nosocomial infection in this study, was consistent with the prevalence mentioned in mentioned in the reference texts of infectious diseases (e.g. Mandel), approximately as 5-20%. We found the minimal extent of this rate the prevalence of nosocomial infections, namely nearly 5%. Here, like other studies, we reported gram-negative bacteria as the most common cause of nosocomial infections. The results of this study asserts the importance of ongoing processes in ICU for the prevention of nosocomial infections.

Keyword: Intensive care unit, nosocomial infection, device-associated infection.

INTRODUCTION

Nosocomial infections are considered as complications of patient care in the hospital, which broke through for the first time in the fourteenth century following inauguration of the first hospitals in Europe. After then, presence of intensive care units (ICUs) and development of therapeutic methods caused to save life of the patients, who would die. On the other hand, and also in spite of these measurements, elongation of the ICU stay time and using the several invasive monitoring devices and using different types of vessel catheters, increased the risk of nosocomial infections in the ICU. This will finally cause multiple organ insufficiency (1). The risk factors for nosocomial infections include: diabetes mellitus, intubation, persistent sounding, surgical drains, poor health status, lack of using gloves, irregular and inappropriate debridement and wound bandage (2). Although the number of ICU patients is less than other hospital wards, the nosocomial infections in these patients is about 5-10 times more than the patients of other hospital wards (3). This condition involves yearly about 2 millions in US and it accounts approximately for a cost of 4.5 billion dollars (4). Since we need a definition for comparing the nosocomial infections in different hospitals, we define it as follows: nosocomial infection is a local or general condition, in which occurs adverse reactions due to infectious agents or their toxins. The patients in the period of admittance are not infected with the infections. For the majority of the patients, it is 48 hours after admittance, but since the prepatent period is affected by several factors. It is better to decide separately for each patient. In general, the nosocomial infections are the conditions that are not present at the admittance time. This is confirmed by microbial cultures. For this reason, the nosocomial infections are called acquired infections. They are emerged after 72 hours as endemic or epidemic cases, and they cause high morbidity and mortality. These diseases impose high costs on patient health care systems.

The prevalence of the nosocomial infections is 5 to 10 times higher than other wards (5). These infections cause higher costs and elongation of patients' ICU stay time. These infections are contagious and may increase the mortality and morbidity in other patients (6). The literature suggested that the total costs for controlling the nosocomial infections too less costs of the therapy (2). In a study conducted in United States in 1999 on 181,993 patients of ICU revealed that the prevalence of nosocomial infections is 18%. The most common infection was reported UTI in a rate of 31% and the most common microbial pathogenic agent was reported as aerobic Gram negative strains (4). According to another study in United States in 2000, the presence of intubation and ICU stay time in ICU were considered as risk factors for nosocomial infections (7).

In another study conducted in India on 422 patients, the prevalence of nosocomial infections was reported as 38.8%. The authors reported the ages more than 60 years as an important risk factor for nosocomial infections (8). Another study, again in India on 629 patients in ICU, revealed the rate of nosocomial infections 21%, and the most common infection was reported pneumonia (with a rate of 29.5%) and Gram negative bacilli detected as the most common pathogenic microbial agents (9).

In a study done on 895 patients of ICU in Mexico, the rate of nosocomial infection has been reported as 32.2%. The pneumonia had also the higher rate in this study (39.7%). There was also again a significant relationship between ICU stay time and infection occurrence (10). In a study conducted in Italy in 2001 the rate of nosocomial infection has been reported as %31.4. The most common infection was pneumonia and the most common pathogen was reported as Gram negative bacilli. There was also a significant relationship between ICU stay time and infection associated with the tracheostomy (11). There are also some studies done within this country,

namely, a study performed in Imam Hospital of Tabriz on 783 patients of ICU, then the rate of nosocomial infection reported as 17.1%. The most common infection reported as pneumonia, there was a significant relationship between ICU stay time and the rate of nosocomial infections (12). In a study conducted in Rasul-e-Akram Hospital of Teheran in 2002 the most common pathogen strains were reported as Gram negative bacilli, and there was a significant relationship between the group ages and the rate of nosocomial infections (13). In addition, in a study conducted in Sanandaj during 2002-2003, on ICU and Post-ICU patients (n=160), the rate of nosocomial infection reported as 15.6%. The most common infection were pneumonia (68%), urinary tract infections (19.2%), bed sore (7.8%), sepsis (3.8%) and idiopathic (i.e. of unknown origin) infections (3.8%). In this study the most common pathogens were reported as *Klebsiella pneumoniae*, *E. coli*, and species from *Enterobacteriaceae*. There was also a significant relationship between age, intubation and tracheostomy with the rate of nosocomial infections (14). In another study conducted on 155 patients of ICU in Baghiyyat-Allah Hospital of Teheran in 2005, the rate of multi-drug resistant occurrence rate reported as 3.4%, and the most common pathogen strains were reported as *Staphylococcus aureus* (38.1%), and *Pseudomonas aeruginosa* (31%). These germs were collected primarily from the pneumonia (74.8%) and wound (16.9%) specimens. The urinary infections were the most common condition. The most infected patients were in the age range of more than 50 years (15).

MATERIALS AND METHODS

This is a descriptive-analytical study conducted on 556 patients in ICU during 1999 to 2001. For confirming the nosocomial infections, we used the following criteria: fever, urinary culture, chest X-ray radiography, physical examination by pulmonologist, phlegm culture, blood culture, detection of leukocytosis and testing other body discharges. The data were collected as a checklist by the observer of the reception. The dates of the microbiological information of the patients were collected and checked for the date of admission in ICU, the date of specimen culture, and the results of the cultures. The patients were visited by a specialist of infectious diseases, and all clinical manifestations of the patients were listed in the checklist. All data were statistically analyzed by SPSS version 17 package. The statistical method used was chi square and the p value more than 0.05 was considered significant.

RESULTS

During a nearly one year 556 patients were accepted, of which 289 cases were male (53.6%) and 258 cases were female (46.4%). The 63.5% of the cases were surgical and 36.5% cases were internal cases. Already, we had designed the ICU for surgical patients; however some internal cases needed acceptance in the unit. Of them, 47 cases affected by infectious diseases. Statistically, the affecting factors and their significant differences were tabulated in **Table 1**.

During the period of the study, there was a single case associated with surgical wound (infected by *Klebsiella*), which has been occurred due a fistula through the pleural cavity in a patient with esophageal cancer. There was also a single case of septicemia due to persistent central vein catheter (i.e. subclavian) infected with *Staphylococcus epidermis*. It is noteworthy that because the infection rates are higher in these cases (up to 75%), we considered them as outlier data and we omitted them from our calculations. The mean ICU stay days were 20.49 days, ranging from 15.62 to 25.35 with a confidence interval (CI)=95%. This value was 2.57 days (2.21 to 2.94; with CI=95%.) for the patients without nosocomial infections (See **Figure 1**). Of 47 patients with nosocomial infections, 28 cases (60%) were with pulmonary parenchymal infections, 10 cases with urinary tract infections (21%) and 9 cases (19%) had both infections (pulmonary

parenchymal and urinary tract infections). The patients in our study were in age groups ranging from 11 to 94 years old (average= 55.69). The average age for patients with nosocomial infections was 55.64 (ranging from 49.32 to 61.95; with CI=95%). The rates of nosocomial infections in our patients for age groups 61-70 and 71-80 years old, were 17% and 21%, respectively. However, we did not find a significant relationship between age of the patients and the occurrence of nosocomial infections in our study ($p=0.807$). The average ICU stay time in this study was 4 days.

The most common pathogenic germs of nosocomial infections in our study were found to be Gram negative strains, which is consistent with the studies conducted in USA, India, Italy, Rasul-e-Akram Hospital of Teheran, Tohid hospital of Sanandaj and Mostafa-Khomeini Hospital of Teheran (4, 9, 11, 13, 14, 24) (See **Table 2**).

DISCUSSION AND CONCLUSION

The prevalence of nosocomial infections in this study was 8.5%, which is consistent with the values mentioned in reference books of infection diseases as 5-20%, and agreed with the results of Su *et al.* as 11.4% (16). But our results were in disagreement with the results of a study in India reporting the rate as 21% (9), and the study of Luzzati *et al.* who reported it as 30.4% (11) and also disagreed with the report of Mollasadeghi *et al.* as 25% (17), Anbari *et al.* as 34.4% (18). We suppose that the causes of this disagreement and difference between our data and the formers are the followings: less usage of central vein catheterization, appropriate usage of procedures such as preoperative sterilizations and disinfections, using disposable suction, observing the expiration dates of the devices, and using a standard mouthwash solution. In our study, we did not find a significant relationship between the age of the patients and occurrence of nosocomial infections. This is also disagreed with the results of the studies conducted in Rasul-e-Akram Hospital of Teheran and Imam Hospital of Tabriz (12-13) and the studies done abroad, including Ganguly *et al.* (8) and Michael *et al.* (4). These studies reported that there is a significant relationship between the age of the patients and occurrence of nosocomial infections. However, there was not such a statistically significant difference in our study ($p=0.807$). According to our results, the most common nosocomial infections was pulmonary parenchymal infection (60%) which is consistent with reports of many other studies, namely Ganguly *et al.* as 45.5% (8), Luzzati *et al.* as 64% (11), Goarbach *et al.* (19), Richards *et al.* (20), Spencer *et al.* (21), Trivedi *et al.* (22), that they all reported the pulmonary parenchymal infection as the most common nosocomial infections in their studies. In our study there was a significant relationship between the ICU stay time of the patients and the occurrence of nosocomial infections ($p=0.000$). This result is in agreement with the studies conducted in USA (4), Mexico (10) and also the indigenous studies done in Tabriz Imam Hospital (12) and Mostafa Khomeini Hospital in Teheran (24).

In this study, however, the average days of ICU stay for the patients with infection was 20.49. This result is in disagreement with the results of studies conducted in USA (4) reported a period of more than one week as a risk factor, in Thailand (23) and in Sanandaj (14) reported a period more than two weeks as a risk factor, and in Tabriz Imam Hospital (12) reporting 8.5 days as a risk factor. This inconsistency may be due to measurements with less invasive procedures and better controlling the nosocomial infections. The average of ICU stay days for the patients with infection in our study only was consistent with the study done in Mostafa Khomeini Hospital in Teheran (24) reporting 26.44. In this study, there was a significant difference between presence of endotracheal intubation and diabetes with nosocomial infections, also with having CVA and the nosocomial infections ($p=0.001$). However, there was no significant difference between

corticoid therapy and nosocomial infections ($p=0.06$). We may enumerate the affecting risk factors in our study for nosocomial infections as follows: ICU stay period more than three weeks, presence intubation and connection to ventilation, CVA and finally diabetes. The results of our study were in agreement with the results of Mostafa Khomeini Hospital in Teheran (24) in reporting more than three weeks as a risk factor for nosocomial infections. It is also in agreement with the results of studies done in USA (4), Italy (11) and Japan (25) for reporting the presence intubation and connection to ventilation as a risk factor for nosocomial infections. Additionally, it is in agreement with the results of study done in India (9) for reporting the most common infections as pneumonia as 60% and then the infections of the urinary system as 21% and both of them (pneumonia and urinary system infections) as 19%. These results of the rate of pneumonia were in agreement with the results of the studies done in Mexico (39.7%), Italy (45.5%), USA (64%), India (29.5) and Tabriz Imam Hospital (27.3%) and Mostafa Khomeini Hospital in Teheran (77.3%) and the Towhid Hospital in Sanandaj (65.6%) and other studies that reported the pneumonia as the most common infection in the ICU (10, 11, 4, 8, 12, 25, 14). We found the most common pathogenic agents as Gram negative germs, which is in agreement with the results in the literature (4, 9, 11, 12, 14, 25). According to the results of our study the most common pathogenic agents were *Pseudomonas aeruginosa* (38.88%) and *Klebsiella pneumoniae* (27.77%), which are in agreement with the results of the studies done in USA (4) reporting the most common pathogenic agents as *Pseudomonas aeruginosa* (21%) and *Staphylococcus aureus* (20%), and the results of the study done in Italy (11) reporting *Pseudomonas aeruginosa* and staphylococci as the most common pathogenic agents. In the study conducted in India the most common pathogenic agents were reported as *Pseudomonas aeruginosa* (36.6%) and *Klebsiella pneumoniae* (20.6%). The most common pathogenic agents for UTI were reported as *E. coli* (40%) and *Klebsiella pneumoniae* (13.3%), which are in agreement with the results in the literature (11, 25-28).

The results of our study showed that the most common antibiotics used for treating the nosocomial infections are imipenem and vancomycin (48.9%) and ceftriaxone and clindamycin (14.9%), meropenem (12.8%) and ciprofloxacin and clindamycin (10.6%).

The prevalence of nosocomial infection in this study, was consistent with the prevalence mentioned in mentioned in the reference texts of infectious diseases (e.g. Mandel), approximately as 5-20%. We found the minimal extent of this rate the prevalence of nosocomial infections, namely nearly 5%. Here, like other studies, we reported gram-negative bacteria as the most common cause of nosocomial infections. The results of this study asserts the importance of ongoing processes in ICU for the prevention of nosocomial infections.

Table 1: The affecting factors on nosocomial infections and the statistical relevance. Abbreviations: CVA: cardio-vascular accident, brain stroke; DM: diabetes mellitus; CVC: central vein catheterization

Affecting factors		Frequency	P Value
Gender	male	30 (64%)	0.142
	female	17 (36%)	
Cases	Internal	25 (53%)	0.013
	Surgical	22 (47%)	
CVA		8 (35%)	0.000
DM		13 (19%)	0.001
Corticoid Therapy		23 (13.3)	0.006
CVC		9 (75%)	0.000
Intubation		42 (37.2)	0.000
ICU stay time (more than 2 weeks)		22 (78.5)	0.000
Age more than 60		24 (9%)	0.809

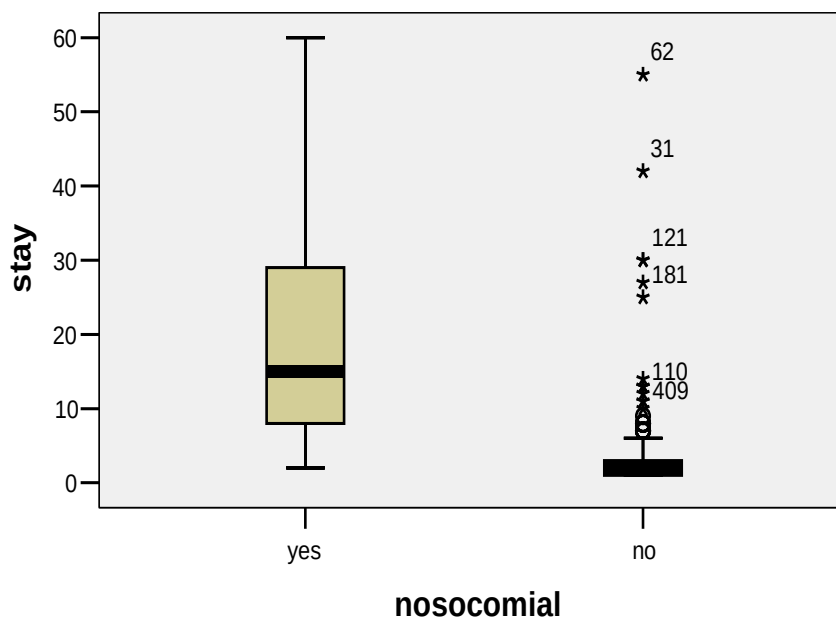


Figure 1: The boxplot graph, depicting the relationship between ICU stay time and the rate of nosocomial infections in the patients studied in this study.

Table 2: The percentage of pathogenic agents of nosocomial infections, according to the results of this study; UTIs: Urinary Tract Infections

pathogenic agent	Pulmonary Infections	UTIs
<i>Pseudomonas aeruginosa</i>	38.88%	20%
<i>Klebsiella pneumoniae</i>	27.77%	13.33%
<i>Acinetobacter</i>	16.66%	6.66%
<i>E. coli</i>	16.66%	40%
<i>Candida</i>	No results	6.66%
<i>Enterobacteriaceae</i>	No results	6.66%

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