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Original Article

Evaluation of the Prevalence of Nosocomial Infection in Different Wards of Be'sat Hospital of Hamedan

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Abstract

Background: The nosocomial infections are the ones that arise between 48 to 72 hours after patient's reference to hospital, shortly after hospital discharge, or 30 days after an operation. This study aimed to evaluate the prevalence of nosocomial infection in different wards of Be'sat hospital of Hamedan.

Methods: This prospective cross-sectional study was conducted (during April-July 2016) on admitted patients that suffered from nosocomial infections based on CDC (Centers for Disease Control and Prevention) criteria. During the time of the study, patients who referred to different wards of the hospital (except for the pediatric ward), showed clinical signs of nosocomial infection 48 hours after the admission. Their tracheal, urine, blood, and surgical wound samples were transferred to laboratory for culture and identification of infectious agent. Patients' demographic information were encoded as confidential records, then, the data were analyzed using SPSS software. All ethical principles of the Helsinki Declaration were observed.

Results: Out of a total of 10332 hospitalized patients, 266 (2.6%) of them acquired nosocomial infection of which 183 (69%) of them were males and 83 (31%) were females. The patients' mean age was 58.14. There was no significant relationship between the age and the type of nosocomial infections (P=0.052). The mean period of hospitalization was 28.2 days. The most common nosocomial infection was ventilator associated pneumonia (VAP) with 110 cases (41.3%) and the rarest of them was catheter associated-urine tract infection (CA-UTI) with 23 (8.64%) cases. Fifty-nine cases (53.6%) out of 110 VAP patient cases survived and 51 (46.4%) of them died. The overall mortality rate was 30%. Among 242 bacterial strains isolated, *Escherichia coli* was the most common strain with a prevalence of 61 (22.9%). Most of the death cases (57.9%) were caused by Proteus nosocomial infections.

Conclusion: The high values of nosocomial infections and mortality in Be'sat hospital represent a need to reinforce the preventive and control program on nosocomial infections. In future studies, in order for better presentation of nosocomial infection in terms of latest events, infection and organism type, and antibiotic resistance pattern, novel indexes like device utilization ratio (DUR) and incidence density of device-associated infections (IDDI) are suggested.

Keywords: Cross infection, Pneumonia, Ventilator-associated, Urinary tract infection, Urinary catheters, Catheter-related infections, Surgical wound infection

Background

The nosocomial infections are infections that arise during 48 to 72 hours following the patients' referral to the hospital, shortly after hospital discharge (3 days of discharge), or 30 days after an operation (considering the issue that the patients haven't had these infections in admission time) (1). Nosocomial infections are also referred to as hospital-acquired/associated infections, by CDC (Centers for Disease Control and Prevention) based on infection site; they are divided into 13 types with 50 infection sites, each one of which has a special criterion (2). One out of 10 patients referring to the hospital is affect by nosocomial infections and annually 5000 related deaths are occurred which impose over a billion pounds per year; a patient with nosocomial infections stay 2.5-times longer in hospital and imposes £3000 additional cost compared to uninfected patients (3). The incidence of nosocomial infections varies across the world. According to the WHO reports, 14 countries have 8.7% of hospitalized patients encountered with nosocomial infections (4). Aged patients, persons with immunodeficiency or underlying diseases, individuals under treatment with

immune suppresser drugs, or surgical operations are more susceptible to the nosocomial infection and control of these infections is difficult and costly (5). The most commonly nosocomial infections are: Urinary tract infection (UTI), bloodstream infection (BSI), surgical site infection (SSI), and respiratory infection, among which UTI is the most prevalent nosocomial infection with a prevalence of about 40% as compared to all the other nosocomial infections (6). Bacteria commonly cause nosocomial infections whereas protozoans, fungi, viruses, and mycobacteria can more or less lead to infection. The most prevalent causes of nosocomial infection are as follows:

The *Streptococcus* spp., *Acinetobacter* spp., enterococci, *Pseudomonas aeruginosa*, coagulase-negative staphylococci, *Staphylococcus aureus*, *Bacillus cereus*, Legionella, and Enterobacteriaceae family members including *Proteus mirabilis*, *Klebsiella pneumonia*, *Escherichia coli*, as well as *Serratia marcescens* out of which gram-negative bacteria including *E.coli*, *K. pneumonia*, and *P. aeruginosa* are predominant (4). Finally, with regard to the importance of nosocomial infections and their imposing burden as well as the lack of comprehensive study on nosocomial infections and related agents in Hamedan hospitals, this study aimed at evaluating the prevalence of nosocomial infection in different systematic wards of Be'sat hospital of Hamedan.

Methods

This prospective cross-sectional study was carried out (during April-July 2016) on hospitalized patients who were afflicted with four common nosocomial infections (including urinary tract infections, respiratory tract, bloodstream and surgical site) according to CDC criteria. Those patients who were admitted in different wards of the hospital (except for pediatric ward) and showed clinical signs of nosocomial infection 48 hours after the admission, were enrolled in the study and their tracheal, urine, blood as well as surgical wound samples were transferred to laboratory for culture and identification of infectious agent. Patients' demographic information such as their names, admitted wards, and hospital name were encoded to confidentiality, then, the data were analyzed using SPSS software. This study was confirmed by administration of Be'ast hospital and all ethical principles of Helsinki Declaration were observed in this regard.

Results

In this study, out of a number of 10332 hospitalized patients in various wards of Be'sat hospital, according to CDC criterion, 266 (2.6%) of them encountered with nosocomial infection. The patients mean age was 58.14 years and 183 (69%) of them were males and 83 (31%) were females, respectively. There was no significant relationship between age and type of nosocomial infections ($\chi^2 = 16.81$, $P = 0.052$). The average period of hospitalization was 28.2 days (1-106 days) and the relationship between infections types and hospitalization days was significant (Table 1). Samples to be tested included TC (n = 110), BC (n = 46), UC (n = 23), and SC (n = 79). The most common nosocomial infection was VAP (including 110 cases,41.3%) and the rarest of them was CA-UTI (including 23 cases, 8.64%). According to the type of nosocomial infection, out of 110 VAP patient cases, 59 of them (53.6%) survived and 51 (46.4%) cases died. Of 46 patients afflicted with BSI, 35 cases (76.1%) survived and 11 of them (23.9%) died. In addition, out of 23 patients who suffered from UTI, 15 cases (62.5%) survived and 8 of them (37.5%) died, and finally out of 78 cases suffering from SSI, 71 cases (91%) survived and 7 of them (9%) died. As provided in Table 2, the VAP infections had the most number of mortality (51 cases, 46.4%). The average time of infection after using medical devices was 28.3 days. The overall mortality rate was 30%. Among 242 isolated bacterial strains, *E. coli* was the most common strain with 61 isolates (22.9%) followed by *Klebsiella* with 42 isolates (15.8%) (Table 3). The *Klebsiella* spp. with 83.3% was the prevalent causative organism of nosocomial infections in ICU ward. However, the most common organisms in other wards of the hospital are shown in Table 3. Besides, the most dominant isolated organism of VAP infection were *E. coli* and *Klebsiella* spp. (24.8%) followed by BSI (18%), UTI (27%), and SSI(17%), respectively. The *S. aureus*, *E. coli* and *E. coli* were the most frequent cases. Table 4 shows that most deaths frequencies were related to *Proteus* spp. followed by *Klebsiella* spp. that is, 57.9% and 44.1%, respectively. However, no death was related to *Citrobacter* spp., *Entrobacter* spp.,*Yersinia* spp., and *Staphylococcus*

Table 2. Frequency Distribution of Survival Statue by Sample Types

Sample Type	Alive No. %	Dead No. %
TC	59 (53.6)	51 (46.4)
BC	35 (76.1)	11 (23.9)
US	15 (65.2)	8 (34.8)
SC	71 (91)	7 (9)
Total	180 (70)	77 (30)

Table 1. ANOVA and Tukey Post Hoc Test Results for Hospitalization Time and Types of Infection

Variable	SC	UC	BC	TC	ANOVA
Hospitalization days	20.82±18.08[a]	26.18±20.5	29.22±19.05	33.78±21.91[b]	<0.001

[a] Significant compared to TC ($P<0.001$), [ba] Significant compared to SC ($P<0.001$)

Table 3. Frequency Distribution of Bacteria Type in Be'sat Hospital Wards

Microbe Types	Ward							Total No. (%)
	ICU	Burn	Surgery	Neurosurgery	Orthopedic	ENT	Internal	
Staphylococcus aureus	9	6	3	3	1	1	2	25 (10.5)
Staphylococcus epidermidis	0	2	2	0	0	0	1	5 (2.1)
Enterococci	8	0	2	0	1	1	0	12 (5)
Escherichia coli	40	2	14	1	4	0	0	61 (25.6)
Proteus	20	0	1	1	0	1	0	23 (9.7)
Acinetobacter	24	7	2	0	2	1	0	36 (15.1)
Pseudomonas aeruginosa	15	2	2	0	0	0	0	19 (8)
Klebsiella	35	1	2	1	2	1	0	42 (17.6)
Yersinia	4	1	0	0	0	0	0	5 (2.1)
Citrobacter	1	0	1	0	0	0	0	2 (0.8)
Enterobacter	1	0	1	1	0	0	0	3 (1.3)
Staphylococcus saprophyticus	0	2	1	0	0	1	0	4 (1.7)

saprophiticus isolates (Table 4).

Discussion

Nosocomial infections have a heavy burden on the health system and are associated with increased morbidity, mortality, length of hospitalization, and therapeutic costs. The prevalence of nosocomial infection in various geographic regions of the world is different (7). Briefly, in present study, the prevalence rate of nosocomial infections was 2.6%. The gender distribution was 183 (69%) for males and 83 (31%) for females and the mean age was 58.14 years as well. The average period of reference to hospital ward was 28.2 days. The most common nosocomial infection was VAP and the rarest was associated with UTI. Of 110 patients with VAP, 59 cases (53.6%) survived and 51 (46.4%) of them died and the overall mortality rate was 30%. Among 242 bacterial strains isolated, *E. coli* was the most common with 61 cases (22.9%). Most of the deaths were related to *Proteus* spp. (57.9%), that is due to carbapenem-resistance and natural resistance to *Colistin* among *Proteus* species, since, currently, there is no other appropriate drug for treatment of these bacterial species. Some studies reported the prevalence of nosocomial infections between 13.9%–17.9% (8, 9) which is in contrast with the results of the current study. The reasons for this difference is possibly attributed to the types of geographic regions, type of hospitals, preventive, as well as control measures used in each hospital, and the existence of health surveillance system. Some developed countries such as Norway (10), Italy (11), and France (12) reported the prevalence rate of these infections as follows: 5.1%, 5.4%, and 4.9%, respectively, which are comparable with the results of this research.

Table 4. Frequency Distribution of Survival Statue Organism Types

Microbe Types	Alive	Dead
Staphylococcus aureus	11 (91.7)	1 (8.3)
Staphylococcus epidermidis	1 (100)	0 (0)
Enterococcus	5 (62.5)	3 (37.5)
Escherichia coli	39 (76.5)	12 (23.5)
Proteus	8 (42.1)	11 (57.9)
Acinetobacter	14 (56)	11 (44)
Pseudomonas	10 (76.9)	3 (23.1)
Klebsiella	19 (55.9)	15 (44.1)
Yersinia	1 (100)	0 (0)
Citrobacter	1 (100)	0 (0)
Enterobacter	1 (100)	0 (0)
Staphylococcus saprophyticus	2 (100)	0 (0)
Total	112 (66.7)	56 (33.3)

The UTI is the most common nosocomial infection in the world (about 40% as compared to the other nosocomial infections) (6), but in our study, the most common nosocomial infection was pneumonia associated with ventilator .The frequency was higher in intensive care units (50%).

In previous Iranian studies, most incidences of disease in hospitalized patients have been reported as the percentage of suffering, in these reports, rate of VAP was between 6.8%- 47.7% and the rate of CA-UTI has been reported between 9.3% and 42% (13). Therefore, these results are in line with the findings of the present study. In the above-mentioned study, the average time of hospitalization for CA-UTI and VAP were 49 and 21.6 days, respectively. It seems that in the present study, the average time to start embedding tools for central venous catheter, ventilator, and urinary catheter infection was 28.3 days (13). According to WHO hospitalization, mean time of hospitalization is between 5-30 days which is in conformity with the results of this study. However, most common organism was *S. aureus* that is inconsistent with the results of the current study (14).

In another study, the most frequently isolated organisms were *S. aureus* (30%) and *P. mirabilis* (25%). This is consistent with our study, because we also had the most nosocomial infections in ICU, but the most common nosocomial infection was VAP. The average time of hospitalization in current study was 28.2 days, this is also in line with the study by Rhazi et al in Morocco with

an average time of 16.4 days. However, the main isolated organisms in this study were *E. coli* and *K. pneumoniae*. That is again consistent with the results of the present study (12). Similar to our study, in an another study, the most dominant infection was reported as VAP with 50% (15).

Similarly, in another study conducted in Mexico on patients hospitalized in ICU ward, pneumonia had the highest percentage (39.7%). This is in conformity with the results obtained in this study (16). The results of a comprehensive study conducted in Imam Reza hospital of Urmia are as follows the average age of nosocomial infections cases was 55.64 years (which was 58.14 years in the present study) and no significant relationship was observed between age and incidence of nosocomial infections. The most common pathogens were *P. aeruginosa* and *K. pneumoniae*, and the most prevalent nosocomial infection was VAP (17). These results are also consistent with the results of the current study. In contrast with our results, several studies in the United States (18) and Italy (19) reported *P. aeruginosa* and *S. aureus* as the most dominant pathogens, whereas in the present study, *E. coli* and *Klebsiella* spp. were reported as the most common pathogens.

As mentioned above, the VAP was the most common nosocomial infection whereas in a study it was stated that pneumonia compared to other types of nosocomial infections, totally increased the hospital cost and length of stay, 43.8% and 38.2%, respectively, (20). Higher rates of VAP infection compared to UTI may be due to non-conformity of reduced rate of VAP guidelines including regularly and properly hands washing. De-escalation therapy, selective digestive decontamination, and selective use of appropriate therapy are the good strategies that should be clearly included in all wards of the hospitals (21).

Conclusions

The high percentage of nosocomial infection mortality in Be'sat hospital can represent the need for further preventive and control measures for these infections in all hospitals in Hamedan. These results provide useful data for future surveillance regarding prevention programs in Be'sat hospital. The high values of nosocomial infections and mortality in Be'sat hospital indicate a need for reinforcement of the preventive and control program on nosocomial infections. In future studies, in order to better present nosocomial infection in terms of latest events, infections and organisms type, antibiotic resistance pattern, novel indexes like DUR and IDDI are suggested.

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Conflict of Interests

Authors declare no conflict of interests.

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