

Epidemiology and Risk Factors of Nosocomial Infection among Trauma Patients Hospitalized in Kashan Shahid Beheshti Hospital

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Abstract:

Aim: Nosocomial infection is one the most important health problem in the world. In trauma patients, nosocomial infection is one the most important factor of morbidity and mortality, increased hospitalization days, economic costs, and patient dissatisfaction. This study aimed at assessing the frequency of nosocomial infection and its related factors in hospitalized trauma patients in Beheshti Hospital in Kashan, Iran. **Materials and Methods:** This descriptive study was conducted on 338 trauma patients who had been admitted to Kashan Beheshti Hospital during 2015. Data were collected using the questionnaire containing demographic and paraclinical results in trauma patients. The patients were examined for fever and nosocomial infection daily. The data were analyzed using *t*-test and Chi-square by the SPSS software version 16. **Results:** Twenty-one (6.2%) out of 338 trauma patients had nosocomial infection. There were 7 (33.3%) surgical site infections, 5 (23.8%) pneumonia, 5 (23.8%) soft-tissue infection, and 3 (14.2%) urinary tract infection and 4 (19.04%) fever with of unknown origin. There was a significant statistical association between underlying disease, duration of hospitalization, multiple trauma, surgical intervention, using the device, and history of admission to ICU with the rate of the infections. However, there was no significant association between sex, age, body mass index, and smoking with the rate of the infection. **Conclusions:** The rate of nosocomial infection was 6.2% and it was lower than other studies. The nosocomial infection is more frequent in patients with underlying diseases, with surgical intervention, admission in ICU, using device, multiple trauma, and more duration of hospitalization.

Keywords: Epidemiology, nosocomial infections, risk factor, trauma

INTRODUCTION

Nosocomial infections are referred to the infections that occur 48–72 h after the admission to hospital, if the patient is not in the latent period at the time of admission, or the hospital-acquired infection occurs after discharge, for example, surgical site infection or infections related to the orthopedic devices which can occur after several months.^[1]

Nosocomial infections or healthcare-associated infections occur in patients under medical care. They account for 7%

in developed and 10% in developing countries and cause prolonged stay, disability, and economic burden. Frequently, most common infections include central line-associated bloodstream infections, catheter-associated urinary tract infections, surgical site infections, and ventilator-associated pneumonia.^[2]

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The inevitable factors that affect the risk of nosocomial infections, even with the best medical care, are old age and serious underlying diseases. The nosocomial infection risk factors that can be minimized with planned actions are long-term hospitalization, applying improper catheters, using wide-spectrum antibiotics, long-term use of catheters, and noncompliance with hand washing. Lifeless environment (contamination of radiators' water with *Legionella* spp.) and living environment (personnel or patients contaminated or colonized with microorganisms) also affect the incidence of nosocomial infections.^[1] Immune system disorder is one of the outcomes of trauma injuries; the disorder starts with an early period of increased activity and follows a substantial drop in the activity of the immune system. Hence, the trauma patients are at high risk of nosocomial infections.^[3] As nosocomial infections are often caused by antibiotic-resistant bacteria, using new synthetic antibiotics is necessary, although this method imposes skyrocketing costs to the patients and health-care system; for example, in the study conducted by Yalcin in Turkey, each nosocomial infection case imposed US\$ 1570 to the health-care system more than the ones without such infections.^[4]

Multiple traumas, prolonged hospitalization, numerous invasive diagnostic, and therapeutic actions expose patients to the risk of nosocomial infections, for example, the following risk factors are involved in nosocomial pneumonia: Prolonged hospitalization, intubation, and long-term antibiotic therapy.^[5] Regarding nosocomial urinary tract infection, the following factors are involved: Female gender, duration of catheterization, infection associated with urine drainage bag, old age, diabetes, and high creatinine at the time of catheterization.^[6] The risk factors associated with the nosocomial surgical site infections are as follows: The underlying diseases such as diabetes, malnutrition, obesity, history of radiotherapy, and using immunosuppressive drugs.^[7] Nosocomial infections may cause serious consequences in patients with trauma. To reduce the complications that result from such infections, it is necessary to investigate the associated risk factors. The current study aimed at investigating the epidemiology and risk factors of nosocomial infections in patients with trauma admitted to Kashan Shahid Beheshti Hospital, Iran.

MATERIALS AND METHODS

Study population and setting

The current study was conducted on 338 trauma patients admitted to Kashan Shahid Beheshti hospital. The cases hospitalized in surgery ward or the ones with 2 days admission to the intensive care unit (ICU) were enrolled into the current study. A researcher developed questionnaire including demographic data and nosocomial-associated risk factors were completed for each patient. The cases were examined daily for nosocomial infections and those who had fever 2 days after the admission were visited by an infectious disease specialist; if noninfectious causes of fever were rejected, the patient was assessed for nosocomial infections and considered as the case

with nosocomial infection. To define nosocomial infections, the risk indices of the National Nosocomial Infections Surveillance System were used. The inclusion criterion was: Patients with trauma and at least 2 days of admission to hospital. The patients discharged in <2 days of hospitalization were excluded from the study.

Statistical analysis

After completion of the samples, the collected data were transferred to SPSS software (version 16) and analyzed statistically. All cases were divided into two groups of with and without nosocomial infections; then, the risk factors were compared between the groups. To analyze data, central tendency and dispersion measures were used; data were illustrated in tables and figures; to compare quantitative variables between the groups with and without nosocomial infections, *t*-test or the nonparametric equivalent, and to compare qualitative variables, the Chi-square test was used.

RESULTS

Out of 338 patients with trauma in the current study, only 21 (6.2%) cases had nosocomial infections; 262 (77.5%) cases were male and 76 (22.5%) were female. The mean age of the trauma cases with and without nosocomial infections was 44.2 ± 26.5 and 35.7 ± 23.9 years respectively. There was no significant relationship between age and nosocomial infection (P value < 0.118) [Table 1].

Most of the cases (200/338 cases; 59%) had normal body mass index (BMI) ranged from 18.5 to 25 kg/m², followed by the cases with overweight (99 cases; 29%) ranged from 25 to 30 kg/m².

Out of 338 trauma patients, 142 (42%) were hospitalized in orthopedic and urology, 127 (37.6%) in neurosurgery, 49 (14.5%) in gynecologic surgery, and 13 (3.8%) in general surgery wards, in addition to 4 (1.2%) cases in neurological surgery ICU, and 3 (0.9%) in surgical ICU. Furthermore, out of 21 patients with nosocomial infection, 7 cases (33.3%) were hospitalized in orthopedic and urology, 4 (19%) in neurosurgery, 3 (14.3%) in gynecological surgery wards, and 7 (33.3%) in ICU; there was a significant relationship between the incidence of nosocomial infections and history of hospitalization in different wards of the hospital and ICU ($P = 0.001$).

Out of 338 trauma patients, 311 (92%) were hospitalized for 2–10 days, 19 (5%) for 11–20 days, 4 (1.5%) for 21–30 days, and 4 (1.5%) for more than 30 days. The mean duration of hospitalization in the patients with and without nosocomial infections was 22.7 ± 20.7 and 4.1 ± 2.9 days, respectively, there was a significant relationship between the duration of hospitalization and incidence of nosocomial infections ($P < 0.001$) [Table 1].

Out of 21 patients with nosocomial infection, 16 (76.2%) cases had extremity trauma, 10 (3.2%) abdominal trauma, 9 (2.8%) pulmonary trauma, and 10 (47.6%) cranial trauma. There was

Table 1: Prevalence of risk factors of nosocomial infection among hospitalized trauma patients

Variable	Nosocomial infection		P
	Yes, n (%)	No, n (%)	
Sex			
Male	15 (71.4)	247 (77.9)	0.588
Female	6 (28.6)	70 (22.1)	
Age			
1–19	3 (14.3)	83 (26.2)	<0.118
20–39	8 (38.1)	131 (41.3)	
40–59	1 (4.8)	57 (17.9)	
60–79	6 (28.6)	32 (10.1)	
80–100	3 (14.3)	14 (4.4)	
Underlying disease			
Yes	4 (19)	13 (4.1)	0.016
No	17 (81)	304 (95.9)	
Smoking			
Yes	3 (14.3)	35 (11)	0.718
No	18 (85.7)	282 (89)	
BMI			
<25	12 (57.1)	210 (66.2)	0.492
25–30	7 (33.3)	92 (29)	
>30	2 (9.5)	15 (4.7)	
ICU stay			
Yes	7 (33.3)	6 (1.9)	0.001
No	14 (66.6)	311 (98.1)	
Type of trauma			
Blunt	8 (38.1)	270 (85.2)	0.001
Penetrating	2 (9.5)	3 (0.9)	
Multiple	11 (52.4)	44 (13.9)	
Surgical intervention			
Yes	19 (90.5)	185 (58.4)	0.004
No	2 (9.5)	132 (41.6)	
Device			
Yes	20 (95.2)	176 (55.5)	0.001
No	1 (4.8)	141 (44.5)	
Duration of hospital stay			
2–10	7 (33.4)	304 (95.9)	0.001
11–20	6 (28.6)	13 (4.1)	
21–30	4 (19)	0	
>30	4 (19)	0	
Total	21 (6.2)	317 (93.8)	

BMI: Body mass index, ICU: Intensive care unit

no significant relationship between the incidence of nosocomial infection, and extremity and cranial traumas ($P=0.378$); while, a significant relationship was observed between the nosocomial infections and abdominal and pulmonary traumas.

Out of 21 patients with nosocomial infection, 19 (90.5%), 9 (47.4%), 4 (21.1%), and 1 (5.3%) cases underwent surgery once, twice, three, and four times, respectively. There was no significant relationship among the nosocomial infection, surgical intervention, and the number of surgeries ($P=0.001$ and 0.004).

Out of 21 patients with nosocomial infection, therapeutic instruments were used for 20 of them and a significant relationship was observed between the incidence of nosocomial

infections and using therapeutic instruments such as nasogastric tube, central venous catheter, urinary catheter, chest tube, cerebrospinal fluid shunt, and prosthesis ($P=0.001$), but this relationship about ventilator and splint was insignificant ($P=0.588$).

In patients with nosocomial infection, the frequency of clinical symptoms was as follows: Fever 21 (100%), cutaneous symptoms 11 (52.3%), impairment of consciousness 6 (28.5%), weakness 2 (9.5%), and respiratory symptoms. 1 (94.7%).

The most common nosocomial infections were: Surgical-site infection (SSI), 7 (33.3%), pneumonia and soft-tissue infection each with 5 (23.8%), urinary tract infection 3 (14.2%), prosthetic joint infection 1 (4.7%), and fever with unknown sources 4 (19.04%).

Out of 21 patients with nosocomial infections, urine culture was positive in 4 (19.04%) cases (*Escherichia coli*, and *Enterobacter*) blood culture in 1 (4.7%) case (*Staphylococcus aureus*), and culture test of other specimens were positive in 8 (38.09%) cases (*S. aureus*, *Pseudomonas*, *Acanitobacter*, *Klebsiella*).

Out of all cases with nosocomial infection, the minimum and maximum rates were 5400 and 29,800 cell/ μ L for white blood cell count, 2 and 125 mm/h for erythrocyte sedimentation rate, and 8 and 128 mg/L for C-reactive protein.

Out of 21 patients with nosocomial infections, 19 (90.04%) cases relatively improved and 1 (4.7%) case developed vegetative state, and 1 (4.7%) case died

DISCUSSION

In the current study, out of the 338 trauma patients, 21 (6.2%) cases had nosocomial infection. Studies in other parts of Iran show different rate of nosocomial infection, for example, 17% Shiraz, 18.2% Ardabli, and 25.6% Sanandaj.^[8-10] In another study by Lazarus on 5537 trauma patients, 501 (9.1%) cases had nosocomial infections.^[11] In a study by Cooper, 358 patients with spinal cord trauma underwent surgery, out of which 14 cases developed surgical-site infection.^[12] Another study by Dossett on 2037 patients, 1436 infection episodes were reported.^[13] In a study by Colpan in Turkey, the prevalence of nosocomial infection in 334 patients was 31.1%.^[14] In another investigation by Richards *et al.*, from 1995 to 2000, the prevalence of nosocomial infection in trauma ICUs was 15% to 20%.^[15] Comparison of the results of the above-mentioned studies indicated the low prevalence of nosocomial infection in our hospital, and the reason can be that the trauma patients in the current study were limb fracture cases, which commonly develop nosocomial osteomyelitis after several months or even a year, but these studies only investigated the patients during the hospitalization. On the other hand, pneumonia and intubation were not included in the risk factors of patients with extremity traumas.

Patients with trauma events are more at the risk of nosocomial infections due to multiple manipulations and catheterization.

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A trauma injury is followed by immune system disorder, where a primary increase in the activity of the immune system is followed by a period of immune function decrease, which exposes trauma patients to the risk of nosocomial infections.^[3]

The most prevalent infections among the current study cases were surgical site infection, pneumonia, and soft-tissue infection. In some studies the most common nosocomial infections were pneumonia.^[9-11,16] In other studies like our study SSI has been reported as nosocomial infection.^[12,17-19]

In this study, there was a significant relationship between the incidence of nosocomial infection and underlying diseases, type of trauma, multiple trauma, intervention and number of surgeries, and use of therapeutic instruments but it was not found significant relationship between the gender and incidence of nosocomial infection; however, in the study by Ortega on 252 187 trauma patients under 19 years old, 1925 cases with nosocomial pneumonia were observed and most of them (66.3%) were male.^[20] Gannon also showed the higher prevalence of nosocomial pneumonia among male patients.^[21] Higher Acute Physiology and Chronic Health Evaluation II scores, lower Glasgow Coma Scale scores, longer duration of hospitalization, numerous surgical procedures, severity of loss of consciousness, higher age ranges, history of blood transfusion, and severe traumas, multiple comorbidities, obesity (BMI >30) are the other predisposing factors which have been reported in other studies.^[9,11-13,18,19,22-25]

Results of the above-mentioned studies were consistent with those of the current study indicating the severe and multiple traumas, long hospital stay, increase the risk of nosocomial infections in patients due to longer exposure to hospital environment, other patients, and hospital staff and therapeutic instruments, different invasive measures, wide-spectrum antibiotics, or surgeries which cause disorder in the anatomical and functional immune system.

CONCLUSION

According to the results of the current study, incidence of nosocomial infections in our trauma patients was 6.2% which was lower than those of other studies. Underlying diseases, multiple traumas, and admission to ICU, undergoing surgery, and therapeutic instruments were the most risk factors for nosocomial infections. Efforts to reduce the risk factors of nosocomial infections, including reducing the length of hospital stay and use of devices to diminish the rate of nosocomial infections are effective

Study limitations

Cross-sectional design of this study and lack of control for factors affecting nosocomial infections are limitations of this study.

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Conflicts of interest

There are no conflicts of interest.

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