The Prevalence and Bacterial Etiology of Nosocomial Infections in Poursina Hospital of Rasht During 2013-2015

T M U

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ABSTRACT

Aims: The present study aimed to determine the prevalence of nosocomial infections and their bacterial agents in patients admitted to Poursina Medical and Educational Center of Rasht.

Materials & Methods: The present retrospective descriptive study was conducted by referring to the Infection Control Unit of Poursina hospital and investigating the records of patients with culture-positive nosocomial infections from April 2013 until the end of September 2015. Bacterial agents were diagnosed based on the standard microbiological tests.

Findings: During the research period, urinary tract and blood infections were reported as the highest and lowest nosocomial infections, respectively. The most common strains causing nosocomial infections were *Acinetobacter spp.* (24.7%) (as the most common strain causing respiratory infection), *Escherichia coli* (22.9%) (as the most common strain causing urinary tract infection), and *Enterobacter spp.* (19.9%) (as the most common strain causing postoperative infection). Based on the frequency distribution of bacterial strains in hospital wards, *Acinetobacter spp* was reported as the most common strain isolated from patients in the intensive care unit.

Conclusion: According to the present study results, *Acinetobacter spp* was the most common strain isolated, and UTIs were the most common type of infection. Due to the prevalence of UTIs and the financial, physical, and social damage they impose to the whole country and the constant change of common pathogens and their susceptibility and antibiotic resistance patterns, it is necessary to conduct studies on this issue in the academic centers of each province at regular intervals.

Keywords: Nosocomial infection; Bacterial infections; Epidemiology; Intensive care unit

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Introduction

Nosocomial infections (NIs) occur 48 to 72 hours after hospitalization and up to 6 weeks after discharge; they do not occur during the incubation period [1] and are observed in the following cases: 1) 7 to 10 days after discharge of an internal ward patient without any surgery; 2) Up to one month after discharge of patients with problems such as laparotomy, appendectomy, and hernia with no implantation; 3) Up to one year after surgery with no implantation, such as orthopedic operations [2-3].

More than 80 % of nosocomial infections are urinary, surgical, bloodstream, and respiratory infections. About 90% of nosocomial infections are caused by bacteria, indicating that fungal, viral, or protozoa agents are less involved. *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Pseudomonas spp.*, and *Proteus* species are the most prevailing causes of nosocomial infections. The widespread use of broad-spectrum antibiotics in hospitals has led to the emergence of newer organisms such as *Acinetobacter baumannii*. Also, *S. aureus* is the second leading cause of nosocomial infections after *Escherichia coli* [4-6]. Despite the low number of patients in the intensive care units (ICU), the rate of nosocomial infections in these patients is several times higher than in patients of other units. It is estimated that more than 20% of nosocomial infections occur in ICUs, and the crude deaths caused by this factor in ICUs reach 8-10%, which is most commonly observed in ICU patients attached to the ventilator and intubated [7-8]. Nosocomial infections caused by antibiotic resistant bacteria become more important when leading to mortality and morbidity, prolonged hospital stay, and increased costs associated with prolonged hospital stay. Given the studies conducted around the world including different regions of Iran and the differences in bacteria frequency and antibiotic resistance pattern, it is of great importance to study and implement a project in each region or at least province [8-10]. Publishing the results of these studies in medical and scientific journals raises the awareness of physicians, specialists, and authorities about these types of infections and could be considered as an important step in the treatment and control of infections.

Objectives: Since Poursina hospital in Gilan province has large patient centers and an active infectious disease research unit, the present study aimed to determine the prevalence of nosocomial infections and their bacterial agents in patients admitted to Poursina Medical and Educational Center of Rasht.

Materials and Methods

Study design and samples: This cross-sectional descriptive study was conducted by referring to the Infection Control Unit of Poursina hospital and investigating the records of patients with culture-positive nosocomial infections from April 2013 to the end of September 2015.

The necessary data (based on the Nursing Infection Clinical Guidelines in Iran) were recorded using pre-designed forms, including items such as age, sex, admission ward, invasive procedures used (intubation, catheter, intravenous and arterial catheter, and so on), culture specimens, infection type, and bacteria type. Inclusion criteria consisted of having culture-positive nosocomial infections such as UTI, pneumonia, postoperative infection, and bloodstream infection from April 2013 until the end of September 2015. The exclusion criteria included not having symptoms of nosocomial infections.

Bacteria diagnosis: After transferring all specimens to Poursina hospital laboratory and culturing them in Blood agar and MacConkey agar and incubation at 37 °C for

18-24 hrs, they were precisely diagnosed based on the standard microbiological tests [11]. Isolated strains were then identified in Trypticase Soy Broth (TSB) and stored with 15 glycerol at -70 °C.

Statistical analysis: After recording data, they were analyzed using SPSS software Ver. 21 (IBM Corp., USA). The results were presented as descriptive statistics in terms of relative frequency.

Findings

Records of 738 patients with symptoms of nosocomial infection and positive culture were examined during the study period. Among them, 412 cases were man, and 316 cases were woman. The mean age of patients was 53 years. The age distribution of participants indicated that 34 patients were in the age group of 31-50 years, 31 patients in the age group of 71 years and older, 21 patients in the age group of 51-70 years, and 14 patients (the lowest number) in the age group of 1 month to 30 years. According to the results (Table 1), urinary tract and bloodstream infections were reported as the highest and lowest nosocomial infections, respectively. In this study, the highest incidence of nosocomial infections was observed in the adult and neonatal intensive care units, and the lowest incidence was observed in the general surgical ward. Furthermore, UTIs were reported as the most common nosocomial infections in the adult and neonatal intensive care units. Table 2 presents the complete frequency of nosocomial infections based on the admission wards. The most common strains causing nosocomial infections were *Acinetobacter spp.* (24.7%) (as the most common strain causing respiratory infection), *E. coli* (22.9%) (as the most common strain causing UTI), and *Enterobacter spp.* (19.9%) (as the most common strain causing postoperative infection). *Acinetobacter spp* was reported as the most common strain isolated from patients in the intensive care unit based on the frequency distribution of bacterial strains in admission wards. Tables 3 and 4 present the frequency of bacterial strains according to the hospital admission wards and type of infections, respectively. In addition, Table 5 presents the frequency of nosocomial infections in terms of the type of invasive measures used.

Table 1) Distribution of nosocomial infections based on the infections years

Infections Years	UTI		Surgery		RI		BSI		Total
	No.	%	No.	%	No.	%	No.	%	No.
2013-2014	105	33/8	66	21/2	93	29/9	47	15/1	311
2014-2015	102	36/6	57	20/4	88	31/5	32	11/5	279
2015	53	35/8	34	23	44	29/7	17	11/5	148
Total	260	35/2	157	21/3	225	30/5	96	13	738

UTI: Urinary tract infection, RI: Respiratory infection, BSI: Blood stream infection

Table 2) Distribution of nosocomial infections based on the hospital admission wards.

Wards Infections	Trauma No. (%)	Internal No. (%)	Surgery No. (%)	ICU No. (%)	Total No. (%)
UTI	30 (11.5)	136 (52.3)	29 (11.1)	65 (25)	260
RI	19 (8.5)	44 (19.5)	34 (15.1)	128 (56.9)	225
Surgery	7 (4.5)	45 (26.7)	80 (51)	25 (15.9)	157
BSI	8 (8.3)	20 (20.8)	3 (3.1)	65 (67.8)	96
Total	64 (8.7)	245 (33.2)	146 (19.8)	283 (38.3)	738 (100)

Table 3) Distribution of the clinical isolates based on the hospital admission wards

Wards Isolates	Trauma No. (%)	Surgery No. (%)	Orthopaedic No. (%)	Neurology No. (%)	Neuro Surgical No. (%)	ICU No. (%)	Total
Escherichia coli	25 (14.8)	6 (3.6)	7 (4.1)	90 (53.2)	9 (5.3)	32 (18.9)	169
Pseudomonas aeruginosa	7 (9.3)	5 (6.7)	4 (5.3)	8 (10.7)	8 (10.7)	43 (57.3)	75
Enterobacter spp	6 (4.1)	4 (2.7)	15 (10.2)	30 (20.4)	12 (8.2)	80 (54.4)	147
Acinetobacter	8 (4.4)	2 (1.1)	3 (1.6)	23 (12.6)	27 (14.8)	119 (65.4)	182
Staphylococcus aureus	5 (5.1)	2 (2.1)	16 (16.5)	15 (15.5)	24 (24.7)	35 (36.1)	97
Klebsiella spp	6 (8.8)	4 (5.9)	3 (4.4)	19 (27.9)	6 (8.8)	30 (44.1)	68
Total	57 (7)	23 (3)	48 (6)	185 (26.1)	86 (12.1)	339 (47.9)	738 (100)

ICU: Intensive care unit, UTI: Urinary tract infection, RI: Respiratory infection, BSI: Blood stream infection

Table 4) Distribution of the clinical isolates based on the type of infection

Isolate Infections	*Staphylococcus aureus* No. (%)	*Klebsiella spp.* No. (%)	*Pseudomonas aeruginosa* No. (%)	*Acinetobacter spp.* No. (%)	*Enterobacter spp.* No. (%)	*Escherichia coli* No. (%)	Total
UTI	25 (9.7)	33 (12.7)	10 (3.8)	23 (8.8)	33 (12.7)	136 (52.3)	260
RI	31 (13.8)	20 (8.9)	31 (13.8)	84 (37.3)	51 (22.7)	8 (3.5)	225
Surgery	40 (25.5)	15 (9.5)	20 (12.7)	16 (10.2)	56 (35.7)	10 (6.4)	157
BSI	1 (1)	0	14 (14.6)	59 (61.5)	7 (7.3)	15 (15.6)	96

UTI: Urinary tract infection, RI: Respiratory infection, BSI: Blood stream infection

Table 5) Distribution of nosocomial infections based on the type of offensive techniques used

offensive techniques / Infections	Suction No. (%)	NGT No. (%)	Surgery No. (%)	Brain shunt No. (%)	Tracheostomy No. (%)	Ventilator No. (%)	Endotracheal tube No. (%)	Intravenous catheters No. (%)	Urine catheter No. (%)	Total
UTI	131 (50.4)	110 (42.3)	66 (25.4)	10 (3.8)	46 (17.7)	70 (26.9)	85 (32.7)	260 (100)	260 (100)	260
RI	183 (81.3)	59 (26.2)	78 (34.7)	7 (3.1)	53 (23.5)	107 (47.6)	130 (57.8)	160 (71.1)	157 (69.8)	225
Surgery	23 (14.6)	25 (15.6)	157 (100)	4 (2.5)	6 (3.8)	13 (8.3)	17 (10.8)	65 (41.4)	24 (15.3)	157
BSI	52 (54.2)	7 (7.3)	0 (0)	6 (6.2)	27 (28.1)	45 (46.9)	25 (26)	96 (100)	50 (52.1)	96

NGT: Nasogastric intubation, UTI: Urinary tract infection, RI: Respiratory infection, BSI: Blood stream infection

Discussion

In the present study, records of 738 patients with nosocomial infections were studied. The prevalence of nosocomial infections was 7.5% on average, which was within the reported range of nosocomial infections in sources such as Mandel's Book, reporting the prevalence of infections between 5-20% [12-14]. In a meta-analysis study conducted in Iran, the prevalence of NIs in Iran was determined as 4.5%, which is in line with the present study results; in addition, the prevalence of NIs in developed and developing countries was determined in the range of 3.5-12% and 5.7-19.1%, respectively.

In the present study, the frequency distribution of nosocomial infections was determined as follows: UTI, 35.2%; respiratory infection, 30.5%; postoperative infection, 21.3%; and bloodstream infection, 13%. Accordingly, the highest infection rate was associated with UTIs (35.2%) and respiratory infection (30.5%), and the lowest infection rate was associated with bloodstream infection (13%). These results were consistent with the results of other studies by Mythri et al. (2014) in

India, Zahraei et al. (2012), and Sheikh et al. (2008) in Pakistan[12, 15-16]. However, they were inconsistent with the results of other studies by Falahi et al. (2017) in Mashhad, Rahimi Bashar et al. (2018) in Hamadan, and Davoudi et al. (2014) and Behzadnia et al. (2014) in Mazandaran [1, 17-19] because in their studies, pneumonia was reported as the most common nosocomial infection. Ghashghaee et al. (2018) in a comprehensive study demonstrated that bloodstream infection, surgical site infections, and pneumonia were the most common nosocomial infections in Iran [20].

In this study, 64.7% of patients were hospitalized in both intensive care and internal nervous units, which is justified by their long stay, older age, and greater use of invasive measures in these units. No significant correlation was found between age, sex, and nosocomial infections in the present study, consistent with the studies by Rahimi Bashar et al. (2018) [17], and Dasgupta et al. (2015) in India [21]. However, there was a statistically significant correlation between age and nosocomial infections in the studies by Ecknrod et al. (2014) [22] and Li et al.

(2019) in China [23]. This inconsistency may be due to the high average age of patients admitted to the intensive care unit, making it difficult to statistically compare patients' age groups. Almost all patients had intravenous catheters; 85% had urinary catheters, 51.4% had endotracheal tubes, and 52.4% had a surgery. In the present study, there was a significant correlation between the nosocomial infections and procedures such as intubation, the use of urinary and vascular catheters and NGT, suctioning, and shunting; this result was consistent with the result of a study by Babazono et al. (2008) in Japan [24], but inconsistent with the result of another study in Italy [25].

About 50.7% of UTIs were associated with the internal nervous unit, and 25% were associated with ICU, which is justified by the greater use of urinary catheter in these units. The prevalence of respiratory infections was 56.8% in ICU and 19.1% in internal nervous unit, which is due to the patients' older age, illness, and greater use of invasive procedures such as endotracheal tube and ventilator in these units.

The high prevalence of *Acinetobacter spp* in ICU (65.3%) and the internal nervous unit (12.6%) is attributed to higher respiratory infections and greater use of invasive devices such as endotracheal tubes and ventilators in these units. The highest incidence of surgical infections was 31.8% in neurosurgical ward, followed by 28.6% in orthopedic ward and 19.1% in surgical ward, covering 79.6% of patients. Furthermore, 15.9% of surgical infections were in the intensive care unit, and 4% were in the trauma unit. It could be concluded that all the surgical infections emerged in units where surgeries were performed or patients were transferred, probably due to the surgery and length of stay. The isolation rate of *S. aureus* was 36% in ICU, 20% in neurosurgical ward, and 16% in orthopedic ward. Furthermore, 67.7% of bloodstream infections were in ICU, 20.8% in the internal nervous unit, and 8% in the trauma unit, indicating the greater use of invasive measures for older and ill patients. The most common underlying diseases were hypertension and diabetes, which are most frequently observed in older patients admitted to the internal nervous unit and ICU. These underlying diseases were less frequent in the orthopedic, surgical, and trauma wards where patients were younger. According to the present study results, *Acinetobacter spp*. was the most common strain isolated, and UTIs were the most common type of infection. Due to the prevalence of UTIs and the financial and social damage they impose to the country and the constant change of common pathogens and their susceptibility and antibiotic resistance pattern, it is necessary to conduct studies in academic centers of each province at regular intervals. It is also important to find the number of patients with urinary catheters in order to reduce the duration of urinary catheter use.

Conclusion

According to the present study results, *Acinetobacter spp* was the most common strain isolated, and UTIs were the most common type of infection. Due to the prevalence of UTIs and the financial, physical, and social damage they impose to the whole country and the constant change of common pathogens and their susceptibility and antibiotic resistance patterns, it is necessary to conduct studies on this issue in the academic centers of each province at regular intervals.

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