

Prevalence of nosocomial infections in Covid-19 patients admitted to the intensive care unit of Imam Khomeini complex hospital in Tehran

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Received: November 2021, Accepted: December 2021

ABSTRACT

Background and Objectives: Nosocomial infections (NIs) are an important cause of mortality and morbidity in intensive care units (ICU). Pneumonia is the most common serious manifestation of infection in Covid-19 patients. The aim of this study was to investigate the prevalence of pneumonia in Covid-19 patients admitted to the ICU.

Materials and Methods: In this cross-sectional study, 1240 Covid-19 patients admitted for more than 48 h in the ICUs of Imam Khomeini Complex Hospital (IKCH) in Tehran for seven months in 2020 were included in the study with initial diagnosis of Covid-19 (PCR test and chest imaging). Data were collected regarding severity of the illness, primary reason for ICU admission, presence of risk factors, presence of infection, length of ICU and hospital stay, microbial type and antibiotic resistance. In this study, the pattern of antibiotic resistance was determined using the disk diffusion method.

Results: In this study, 289 (23.3%) out of 1320 patients experienced NIs. 221 (76.4%) out of 289 patients had underlying diseases and the most common of which were hypertension, diabetes and heart disease, respectively. 163 patients (56.4%) were RT-PCR COVID-19 positive and 200 patients (69%) died. The majority of patients with NIs (71%) were over 55 years old. The most common type of nosocomial infection (66%) was ventilator-associated pneumonia (VAE). The most common microorganisms that cause pneumonia were *Acinetobacter baumannii*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*, respectively.

Conclusion: Pneumonia infection is high in Covid-19 patients admitted to the ICU, it needs to be planned with the diagnosis and measures related to the control and prevention of this infection.

Keywords: Pneumonia infection; COVID-19; Intensive care unit

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INTRODUCTION

Nosocomial infections, especially in intensive care units (ICUs), are associated with different risk aspects such as increased mortality rates and hospitalization costs and are considered one of the important health problems and the successful management of which requires awareness of hospital-related problems and proper planning (1). Today, nosocomial infection management is one of the global priorities. Various factors contribute to the spread of this infection, including the expansion of hospitals, emerging diseases and increased microbial resistance (2-4). According to the world health organization (WHO), the highest rate of nosocomial infections is in the hospitals of the Eastern Mediterranean areas and South-east Asia, whereas the lowest rate is in the western Pacific and Europe (5). In ICUs, patients are extremely vulnerable and more susceptible to infection because of general weakness due to disease, weakening of defense mechanisms and length of hospitalization, catheter placement and insertion of the endotracheal tube into artificial ventilation, urinary catheterization and central vein. On the other hand, nosocomial infection-causing organisms have become resistant to common antibiotics and therapies (1).

Numerous patients get nosocomial infections all over the world, and this type of infection has been recognized as an important cause of mortality of patients admitted to ICUs. In addition, they are regarded as major health problems in hospitals of the world. Despite the attempts made to prevent such infections, this problem is still causing death in ICUs and is increasing health costs around the world. Studies show that while ICU beds make up only 5% of hospital beds, and less than 10% of patients are admitted to these wards, nosocomial infections account for more than 20% of nosocomial infections (6). In a report, the rate of nosocomial infections in general wards and ICUs are between 5-15% and more than 50%, respectively (7). The WHO estimates that 1.4 million people suffer from hospital-acquired infections every year worldwide (8). In December 2019, an outbreak of pneumonia-like illness caused by a novel coronavirus (SARS-CoV-2) occurred in Wuhan, China. In February 2020, the WHO called the disease Covid-19 (9). Pneumonia seems to be the most common serious manifestation of the infection in patients, which is primarily diagnosed by symptoms such as cough, sneeze, shortness of breath, and bilateral infiltrates

on chest radiography (10). Management of such patients involves ensuring proper infection control and providing supportive care. In addition, these patients require more serious care and intubation during the treatment stages. Meanwhile, there is a possibility of nosocomial pneumonia infection in these individuals depending on the disease and method of care (11). With this background in mind, the present study aimed to evaluate the “prevalence of nosocomial infections in Covid-19 patients admitted to ICUs”.

MATERIALS AND METHODS

This was a cross-sectional study performed on Covid-19 patients admitted to the ICU of IKCH in Tehran, Iran. The participants, who were all patients admitted to the ICU of the mentioned hospital and met the inclusion criteria, were selected by census sampling. The research setting was the ICU of Imam Khomeini Hospital, which is affiliated with Tehran University of Medical Sciences. The inclusion criteria were referring to this healthcare center for the first time and being admitted to the ICU. Data were obtained from the Iranian Nosocomial Infections Surveillance (INIS), Covid Online System of the Ministry of Health, and medical files of the patients. In addition, data were collected using a demographic characteristics questionnaire, which included name, age, gender, date of hospitalization, hospital ward (ICU), underlying diseases, date of discharge and date of (death or discharge), sample submission date, and PCR results. Moreover, the standard form of the Ministry of Health was used to diagnose NIs in patients admitted to medical centers with questions such as type of NIs, date of nosocomial infection, type of microorganism, and type of antibiogram. In this research, the antibiotic resistance pattern was carried out by applying the disc diffusion method. To confirm adherence to ethical considerations, the participants were ensured of the confidentiality terms regarding their personal information. Furthermore, research objectives were explained to the subjects, and informed consent was obtained prior to the research. The study was also approved by the research council and ethics committee of TUMS (code of ethics: IR.TUMS.VCR.REC.1399.169). Data analysis was performed in SPSS version 22 using descriptive (Tables and diagrams) and inferential statistics.

RESULTS

In this study, performed on 1240 patients in the ICUs of IKCH during March-October, 2020, 298 of whom (23.3%) had NIs. In terms of gender, 58.9% of the participants were male. In addition, the majority of patients (53%) were aged above 55 years. Out of 289 NIs, 119 (41.1%) were ventilator-related events (VAEs) and 76 (26.2%) were BSI. The majority of patients with NIs (71%) were aged above 55 years. Out of 289 patients with NIs, 221 individuals had underlying diseases, the most common of which were hypertension, diabetes and cardiac diseases. In addition, 163 patients (56.4%) had positive RT-PCR COVID-19 results, and there were 200 (69.2%) mortality cases (Table 1).

The most common type of NIs (66%) was ventilator-associated pneumonia or VAE. The VAE rate in these patients was 66%. Moreover, the most common microorganisms in Covid-19 patients were *Acinetobacter baumannii* (35.98%) and *Klebsiella pneumoniae* (32.87%). The most common microorganisms involved in pneumonia are *Acinetobacter*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*, respectively (Table 2).

DISCUSSION

The present study aimed to evaluate the prevalence of NIs in Covid-19 patients admitted to ICUs. According to the results, the prevalence of pneumonia in these patients accounted for 66% of all infections. This rate was reported to be 18% and 37% in hospitals of Qom and Isfahan provinces, respectively (12, 13). In addition, it was 41.6% in two Shiraz university teaching hospitals in Shiraz, Iran (14). Overall, the

nosocomial infection rate in the ICU was estimated at 23.2% in the current research, which varied from 18% to 41.6% in other studies (12-14).

One of the causes of this inconsistency between results might be due to conducting the present research only on patients with respiratory diseases. For instance, there was no case of surgical site infection in the current research. In a study in Italy in 2001, nosocomial infection was 31.4%. The most common infection was pneumonia (45.5%), and the most common microbial infection was a nosocomial infection caused by Gram-negative bacteria. In the present research, there was a significant relationship between the duration of hospitalization and the existence of tracheostomy with nosocomial infections (15).

In a study on 895 patients admitted to ICU in Mexico, nosocomial infection was reported to be 32.2%. In addition, pneumonia had the highest prevalence (39.7%), and there was a significant relationship between hospitalization duration and infection (16). In a study on 629 patients in ICU, the prevalence of nosocomial infections was 21%. Moreover, pneumonia (29.5%) was the most common cause of nosocomial infections, and Gram-negative bacteria were the most common bacterial cause of nosocomial infections (17). In addition, the most common microorganisms isolated in the present study were *Klebsiella* and *Acinetobacter baumannii*. In another study in Iran, the most common infectious agents of pneumonia were *Acinetobacter baumannii* (16.52%), *E. coli* (12.01%), and *Klebsiella pneumoniae* (9.93%) (18). In study at Alzahra Hospital (referral hospital in Isfahan, center of Iran), data revealed that *Pseudomonas aeruginosa* (13.9%), *Klebsiella* (11%), and *Escherichia coli* (6.4%) were the most prevalent bacterial infections (13).

The present study was conducted only in a spe-

Table 1. The most common underlying diseases in Covid-19 patients in ICU with nosocomial infections

Comorbidity	Overall, No. (%)	Test Positive, No. (%)	Death, No. (%)
No comorbidity	68 (76.47)	22 (13.49)	31 (15.5)
Any comorbidity	221 (76.47)	141 (86.5)	169 (84.5)
Hypertension	106 (36.6)	101 (71.63)	94 (47)
Diabetes	92 (31.8)	64 (45.39)	73 (36.5)
CVD	78 (26.9)	63 (44.68)	61 (30.5)
Hyperlipidemia	51 (17.6)	21 (14.89)	26 (13)
Hypothyroidism	14 (4.8)	6 (4.2)	9 (4.5)
Chronic kidney diseases	27 (8.09)	19 (13.47)	21 (10.5)
Cancers	29 (10.03)	22 (15.60)	25 (12.5)

Table 2. The frequency of microbes in nosocomial infections of Covid-19 patients in ICU

Microbe	VAE	PNEU	UTI	BSI	SSI	Total	(%)
<i>Staphylococcus aureus</i>	1	0	0	9	0	10	3.46
Coagulase-negative <i>Staphylococci</i>	0	0	0	21	0	21	7.26
<i>Acinetobacter baumannii</i>	84	1	0	19	0	104	35.98
<i>Escherichia coli (Ecoli)</i>	3	0	8	2	0	13	4.49
<i>Enterococcus (Faecalis and Faecium)</i>	1	0	4	5	0	10	3.46
<i>Pseudomonas aeruginosa</i>	11	1	0	1	0	13	4.49
<i>Candida</i>	0	0	6	5	0	11	3.80
<i>Klebsiella pneumoniae</i>	81	0	1	13	0	95	32.87
Other	9	0	0	3	0	12	4.15
Total	191	2	19	76	1	289	100

cific area of Iran. On the other hand, it is considered an infectious referral in the country. Therefore, more extensive research is required in multiple and multi-central centers.

CONCLUSION

In the present research, 23.3% of the patients had nosocomial infections. In addition, 221 out of 289 patients with hospital-acquired infections had underlying diseases, the most common of which were hypertension, diabetes, and cardiac diseases. In addition, 69.2% of deceased patients had positive PCR results.

ACKNOWLEDGEMENTS

This was a research project funded by Grant Covid-19. Ethical Approval (IR.TUMS.VCR.REC.1399.169) was the reference number. The authors thank Tehran University of Medical Sciences and Imam Khomeini Hospital for their financial support for this research.

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