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Evaluation of healthcare-associated infections in general intensive care unit in Meram State Hospital

Meram Devlet Hastanesi genel yoğun bakım ünitesinde gelişen sağlık hizmeti ilişkili enfeksiyonlarının değerlendirilmesi

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ABSTRACT

Aim: Healthcare-associated infections are a major source of concern in all areas of hospitals, particularly in intensive care units. The goal of our study was to look at the current situation and evaluate the measures that can be taken based on the data obtained by examining the rates and factors of healthcare-associated infections in the general intensive care units of our hospital over a one-year period.

Materials and Methods: Between January 2020 and December 2020, 665 patients who were followed up and treated in the general intensive care unit of Meram State Hospital were followed up in terms of healthcare-associated infections, and their outcomes were evaluated.

Results: 5354 hospitalization days of 665 patients who were followed up in the general intensive care units for a year were evaluated, and it was determined that 53 of the patients developed healthcare-associated infections. Twenty-two (41.5%) of patients with healthcare-associated infections were female, while 31 (58.5%) were male. It was discovered that the patients' mean age was 71,7±14 (19-94). The infection rate was calculated to be 5.86 and the density to be 7.28. Furthermore, the rates of invasive device-associated nosocomial infection are as follows: 1.02 for central line-associated bloodstream infections, 0.56 for catheter-associated urinary tract infections, and 0 for ventilator-associated pneumonia.

Conclusion: Healthcare-associated infections are a significant cause of mortality and morbidity in intensive care units. Due to the improvement in medical care and the increase in life expectancy in parallel with this, effective surveillance practices are of critical importance.

Keywords: Cross infection, intensive care units, surveillance.

ÖZ

Amaç: *Sağlık hizmeti ilişkili enfeksiyonlar, hastanelerin bütün alanlarında özellikle yoğun bakım ünitelerinde ciddi bir endişe kaynağıdır. Çalışmamızda, hastanemiz genel yoğun bakım ünitesinde 1 yıllık süreçteki sağlık hizmeti ilişkili enfeksiyonlar oranları ve etkenlerini inceleyerek elde verilen veriler doğrultusunda mevcut durumun görülmesi ve alınabilecek önlemlerin değerlendirilmesi amaçlanmıştır.*

Gereç ve Yöntem: *Ocak 2020- Aralık 2020 tarihleri arasında Meram Devlet Hastanesi genel yoğun bakım ünitesinde takip ve tedavisi yapılan 665 hasta, sağlık hizmeti ilişkili enfeksiyonlar açısından izlenerek sonuçları değerlendirildi.*

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Bulgular: *Genel yoğun yakım ünitesinde 1 yıllık süre boyunca takip edilmiş olan 665 hastanın 5354 yatış günü değerlendirilmiş ve hastaların 53'ünde sağlık hizmeti ilişkili enfeksiyonlar geliştiği tespit edilmiştir. Sağlık hizmeti ilişkili enfeksiyonlar tanısı alan hastaların 22'si (%41,5) kadın, 31'i (%58,5) erkekti. Hastaların yaş ortalaması 71,74±14,08 (19-94) olarak bulundu. Enfeksiyon hızı 5,86, dansitesi 7,28 olarak hesaplandı. Ayrıca invaziv araç ilişkili hastane enfeksiyonu hızları ise; santral venöz kateter ilişkili kan dolaşımı enfeksiyon hızı 1,02, üriner kateter ilişkili üriner sistem enfeksiyonu hızı 0,56, ventilatör ilişkili pnömoni hızı 0 olarak bulunmuştur.*

Sonuç: *Sağlık hizmeti ilişkili enfeksiyonlar yoğun bakım ünitelerinde önemli bir mortalite ve morbidite nedenidir. Tıbbi bakımdaki gelişmeler ve buna paralel olarak yaşam beklentisinin artması nedeniyle etkin sürveyans uygulamaları kritik önem taşımaktadır.*

Anahtar Sözcükler: *Sağlık hizmeti ilişkili enfeksiyonlar, yoğun bakım ünitesi, sürveyans.*

INTRODUCTION

Healthcare-associated infections (HAIs) are a major source of concern in all areas of hospitals, particularly in intensive care units (ICUs). ICU patients account for 20-50 % of patients with HAIs who develop the infection due to factors such as impaired immune systems, underlying diseases, the need to use multiple invasive devices, the use of broad-spectrum antibiotics, and the need for multiple drug use, and exposure to resistant microorganisms. Etiological factors that contribute to the formation of HAIs play a critical role in treatment efficacy, duration of treatment, and infection mortality (1, 2).

The EPIC II study found that ICU patients who developed HAIs had a worse prognosis and that mortality in ICU patients who developed HAIs was twice as high as in ICU patients who did not develop HAIs (3). As a result, early detection and treatment of HAIs in ICU patients reduces mortality and morbidity rates. An effective diagnosis and treatment process are only possible as a result of an active surveillance study that determines the microbial flora and antibiotic resistance patterns in the study area (4).

The goal of our study was to look at the current situation and evaluate the measures that can be taken based on the data obtained by examining the rates and factors of HAIs in the general intensive care units (GICUs) of our hospital over one year.

MATERIALS and METHODS

The study included 665 patients who followed up in Konya Meram State Hospital's GICU due to COVID-19 between January 1, 2020, and December 31, 2020. The infection control committee's active prospective surveillance records of patients recorded between these dates reviewed retrospectively. The study was approved by the ethics committee on September 2, 2021, with decision number 2021/003. The patients in the study were all over the age of 18. Blood, catheter, urine, tracheal aspirate and throat cultures, and bronchoalveolar lavage specimen were obtained from the patients based on clinical and physical examination findings. The cultures of patients whose fevers remained above 38°C, repeated at appropriate intervals. Sterile samples were incubated in the BACTEC 9240 (Becton Dickson, Diagnostic Instrument System, Spark, USA) device, and the necessary sowing and bacteriological identification procedures were carried out by microbiology specialists at our hospital. The Centers for Disease Control and Prevention (CDC) and Turkish Ministry of Health, ventilator-related event guide diagnostic criteria, which are universally accepted, are used in the diagnosis and definition of HAIs (5,6). HAIs were diagnosed by combining the patient's culture results, laboratory tests, and radiological imaging methods.

The following formula to calculate the rates of invasive device-associated nosocomial infection was VAP rate=VAP number/ventilator days x 1000, CA-UTI rate=CA-UTI number/UT days x 1000, CLABSI number/CLA days x 1000, and device usage rate=device days/patient days.

Statistical Analyses

In the descriptive statistics of the data, mean, standard deviation, minimum, maximum, median, frequency, and ratio values were used for statistical analysis. The IBM SPSS® 23.0 program was used in the analyses.

RESULTS

5354 hospitalization days of 665 patients who were followed up in the GICUs for a year were evaluated, and it was determined that 53 of the patients developed HAIs. Twenty-two (41.5%) of patients with HAIs were female, while 31 (58.5%)

were male. It was discovered that the patients' mean age was 71.74±14.08 (19-94).

The COVID-19 diagnosis was confirmed by PCR or thoracic tomography report in all of the patients who were admitted to the ICU. When 32 (60.4 %) of the patients were diagnosed with COVID-19, one or more underlying comorbid diseases were discovered. These comorbid conditions and their rates are shown in Table-1.

During the one-year study period, the GICU infection rate was calculated to be 5.86, and the density was calculated to be 7.28. Furthermore, the rates of invasive device-associated nosocomial infection (IDANI) (central line-associated bloodstream infections [CLABSI], catheter-associated urinary tract infection [CA-UTI], and ventilator-associated pneumonia [VAP]) are shown in Table-2.

When the HAIs that developed during the follow-up period were examined, it was discovered that pneumonia was the most common infection, accounting for 47.2% (n:25) of all infections. It was noticed that 88% (n:22) of these cases were healthcare-associated pneumonia diagnosed by specific laboratory findings, while the remaining 12% (n:3) were clinically diagnosed with healthcare-associated pneumonia (Table-3).

Secondary bloodstream infection was observed in 11 (20.8%) of the patients who developed HAIs. Furthermore, these patients have a variety of risk factors for the development of HAIs. Even though only one patient had no risk factors, HAIs developed, and Acinetobacter baumannii was identified as the causative agent. The following risk factors were found in the patients in our study in Table-4.

Acinetobacter baumannii, Klebsiella pneumoniae, Enterococcus faecium, Pseudomonas aeruginosa, Stenotrophomonas maltophilia, Enterobacter cloacae, and *Staphylococcus aureus* were identified as HAIs factors in our study, and their rates are shown in Table-5.

Table-6 shows the distribution of agents based on the types of HAIs.

Table-1. Concomitant diseases and the distribution of patients with healthcare-associated infections.

Comorbid conditions	**n**	**%**
Hypertension	11	20.8
Coronary artery disease	9	17.0
COPD	12	22.6
Diabetes mellitus	8	15.1
Other	15	28.3
Total	55	100

COPD: Chronic obstructive pulmonary disease

Table-2. Rates of invasive device use and invasive device-associated nosocomial infections

	Day of use	**Usage rate**		**Number of infections**	**Infection rate**
Mechanical ventilation (MV)	2238	0.42	VAP	0	0
Urinary catheterization (UC)	5326	0.99	CA-UTI	3	0.56
Central venous catheterization (CVC)	1943	0.36	CLABSI	2	1.02

VAP: ventilator-associated pneumonia CA-UTI: catheter-associated urinary tract infection CLABSI: central line-associated bloodstream infections

Table-3. Number and distribution of healthcare-associated infections.

Diagnosis	**n**	**%**
Healthcare-associated pneumonia diagnosed by specific laboratory findings	22	41.5
Clinically diagnosed healthcare-associated pneumonia	3	5.7
Other infections of the respiratory system	15	23.8
Central catheter-related bloodstream infection	10	18.9
Catheter-associated urinary tract infection	3	5.7

Table-4. Factors influencing the development of healthcare-associated infections and their distribution.

Risk factors	n	%
Urinary catheterization	52	98.1
Endotracheal intubation	47	88.7
Mechanical ventilation	47	88.7
Tracheotomy	6	11.3
Central venous catheterization	45	84.9
Nasogastric tube application	42	79.2
Total parenteral nutrition	34	64.2
Transfusion	9	17

Table-5. Microorganisms in healthcare-associated infections.

Microorganism	n	%
A. baumannii	28	52.8
K. pneumoniae	23	43.4
E. faecium	3	5.7
P. aeruginosa	2	3.8
S. maltophilia	2	3.8
E. cloacae	1	1.9
S. aureus	1	1.9

Table-6. The distribution of healthcare-associated infection agents based on infection type.

Diagnosis	Microorganisms	n	%*
Healthcare-associated pneumonia diagnosed by specific laboratory findings (41.5%)	*K. pneumoniae*	11	50
	A. baumannii	11	50
	others	3	5.7
Clinically diagnosed healthcare-associated pneumonia (5.7%)	*A. baumannii*	3	100
Other infections of the respiratory system (23.8%)	*A. baumannii*	13	86.7
	K. pneumoniae	3	20
	P. aeruginosa	1	6.7
CLABSI (18.9%)	*K. pneumoniae*	5	50
	E. faecium	3	30
	others	2	20
CA-UTI (5.7%)	*K. pneumoniae*	3	100

CA-UTI: catheter-associated urinary tract infection CLABSI: central line-associated bloodstream infections. * Some HAIs were containing more than one pathogen.

DISCUSSION

According to the World Health Organization (WHO), HAIs have become the most serious threat to public health in recent years (7). Prolonged hospitalizations of ICU patients, their underlying diseases, and the increased use of invasive devices due to improved facilities have all increased the risk of HAIs development in this patient group. Furthermore, for these reasons, multi-resistant microorganisms can cause infection in the ICU patient group. As a result, mortality, morbidity, and hospital costs rise (8,9).

The rate and density of GICU infection were 5.86 and 7.28, respectively, based on surveillance studies conducted during the period studied in our study. In a third-level GICU study, Tarakci et al. discovered an infection rate of 7.98 and a density of 11.21 (10). In a study conducted by Rafa et al., the incidence of infection was found 17.8% and the density was 20.3 (11). According to data from the National Healthcare-Associated Infections Surveillance Network (NHAI-Net) of the Turkish Ministry of Health, the rate of HAIs in the country is 0.58, with a density of 0.90 (12). When the studies are compared, it is discovered that the infection rates and densities in ICUs are similar in some studies but not in others. These differences are caused by more than one factor. Each ICU has a unique patient profile and microbial flora. Furthermore, infection rates and densities vary according to a country's level of development (13).

In our study, the rate of urinary catheter use was 0.99, the rate of CA-UTI was 0.56, the rate of CVC utilization was 0.36, the rate of CLABSI was 1.02, and the rate of MV usage was 0.42, and the rate of VAP was 0. In a study conducted by Altınışık et al., the rates of urinary catheter usage and CA-UTI were 0.91 and 2.8, respectively; the rates of CVC utilization and CLABSI were 0.37 and 2.5, respectively; and the rates of MV usage and VAP were 0.38 and 9.4 respectively (14). In a more recent study, the rates of invasive device use and infection were 0.99 and 3.45, respectively; 0.72 and 8.6; and 0.46 and 1.34, respectively (15). According to the 2020 NHAI-Net data, the rate of urinary catheter usage in the same level hospitals across the country is 0.71, the rate of CA-UTI is 0.7; the rate of CVC utilization was 0.44, and the rate of CLABSI was 2.1; the rate of MV utilization was 0.49, and the rate of VAP was 1.2. (12). The GICU in our center serves as a COVID 19 pandemic ICU. Since the oxygenation of the patients hospitalized in the intensive care unit with the diagnosis of COVID-19 is poor, all patients who need MV are ventilated with 100% FIO_2 and 8-12 cm H_2O PEEP. In addition, none of our patients whom we examined during the follow-up period could meet the criteria for basal stability or recovery period required for the diagnosis of VAE. At the same time, a minimum increase of 3 cmH_2O or more in the PEEP level, which is one of the VAE. Diagnostic criteria, and a minimum 20% increase in FIO_2 were not met in any of our patients. For this reason, none of the patients can meet the CDC's and the Ministry of Health's VAP/VAE diagnostic criteria and the VAP rate is 0. As a result of this situation, the rates of lung infections other than VAP and VAE were found to be quite high. Furthermore, these patients' need for long-term non-invasive ventilation prevents them from receiving adequate oral nutrition. The use of CVC and urinary catheter to monitor the nutritional and fluid balances of COVID 19 patients is growing. The growing number of invasive interventions increases the number of infections caused directly by these devices. With proper CVC care, CLABSI can be reduced. The rate of use of urinary catheter (0.99) was found to be very high in the patients included in the study. CA-UTI develops in 95% of ICU patients who use urinary catheters (16). As a result, urinary catheters should be evaluated regularly, and urinary catheterization without an indication should be avoided.

Various studies provide different rankings for the frequency of HAIs in ICUs. According to some research, pneumonia is the most common HAI (2, 7, 17). Furthermore, while Rafa et al. found BSI to be the most common HAI in his study, Dagli et al. discovered UTI to be the most common HAI (11, 18). Although the order varies depending on the study, the presence of pneumonia, BSI, and UTI is generally emphasized in the first 3 lines (19). In our study, however, pneumonia was the most common HAI (47.2%). [Healthcare-associated pneumonia diagnosed by specific laboratory findings accounts for 88% of cases, while clinically diagnosed healthcare-associated pneumonia accounts for 12% of cases.] The main reason pneumonia was thought to be the most common HAI in our patients was that pulmonary infections could develop more easily due to COVID 19-induced lung damage. Although intervention in the damaged lung is not possible, we believe that simple measures such as effective oral care, bedside position, and endotracheal tube cuff pressure control can help reduce the incidence of pneumonia. Furthermore, the rate of BSI development secondary to HAI was found to be 20.8% in our study. NHAI-Net, on the other hand, reported a 7.0% rate for 2020 (12). In light of this information, we must develop new procedures to improve catheter care.

In a multicenter point prevalence survey (EPIC II) evaluating HAI agents in ICUs, 62% of isolated agents were gram-negative microorganisms and 47% were gram-positive microorganisms (3). Gram-negative bacteria were found to be the most frequently isolated infectious agent in ICUs in two other studies (20, 21). Similarly, gram-negative microorganisms were the most common causative agents of HAIs in our study. The frequency, however, varies according to the literature. While some studies found *A. baumannii* in the first place to support our findings, others found *K. pneumoniae* first (1, 11, 20-22). In our study, *A. baumannii* (52.8 %) was found to be the most common agent of HAIs, followed by *K. pneumonia* (43.4 %). Kolpa et al. discovered that the most common agents of pneumonia in the ICU were *A. baumannii* (41.4%), *P. aeruginosa* (11.5%), and *E. coli* (9.2%). (2). Rafa et al., on the other hand, discovered *A. baumannii* (34.9%), *K. pneumoniae* (14.0%), and *S. aureus* (14%). In the same study, coagulase-negative staphylococci (CNS) was found to be the most common factor (19.6%) in CLABSI, and *E. coli* (29%) was found to be the most common factor in UTI (11). In our study, *A. baumannii* (56%) was the most common cause of pneumonia, followed by *K. pneumoniae* (44%); *K. pneumoniae* (50%) was the most common cause of CLABSI, followed by *E. faecium* (30%); and K. pneumoniae (100%) was found to be the causative agent of UTI. The most common agents for pneumonia in the NHAI-Net data were *Acinetobacter spp.* (33.2 %), *Klebsiella spp.* for CLABSI (20.2 %), and *Klebsiella spp.* for CA-UTI (29.6 %) (12). Our findings are consistent with the findings of the national assessment. However, we believe that the high *E. faecium* isolation in CLABSI is due to the patients' inability to fully comply with asepsis-antisepsis rules due to COVID 19 and the fact that they are tied to a diaper.

According to the literature, HAIs that develop with resistant microorganisms are more lethal (23). Effective surveillance is required to reduce resistance development in ICUs and to select appropriate empirical antimicrobial agents (24).

CONCLUSION

Healthcare-associated infection, which is a significant cause of mortality and morbidity in intensive care units, is a preventable condition. Due to the improvement in medical care and the increase in life expectancy in parallel with this, invasive procedures are applied more frequently in ICUs today, and the length of stay of the patients is prolonged. Invasive intervention without indication should not be performed in ICU patients, especially by informing intensive care professionals about this issue. Considering all these reasons, effective surveillance practices are of critical importance.

Conflict of interest: The authors have declared no conflicts of interest in relation to this study.

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