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Original Research

Nosocomial Infection Agents of Şişli Hamidiye Etfal Training and Research Hospital: Comparison of 1995 and 2017 Data

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Abstract

Objectives: Healthcare-associated infections (HCAI), which are important causes of mortality and morbidity, are high cost but preventable infections. This study aimed to determine hospital infections and isolates in Şişli Hamidiye Etfal Training and Hospital and to determine our local data. The changes in the distribution of the isolates in this process were evaluated by comparing the data of 1995 and today.

Methods: Materials sent to the microbiology laboratory of our hospital in 1995 and 2017 from the patients hospitalized in the period between June 1-December 31 were evaluated concerning hospital infection. The standard manual methods were used in 1995, while in 2017, MALDI-TOF MS was used for identification and BD Phoenix automated system for antibiotic susceptibility.

Results: In 1995, in total, 100 bacteria were isolated from pediatric and adult patients, of which 48 *Pseudomonas aeruginosa* (48/100), 37 *Klebsiella spp* (37/100). In 2017, *Acinetobacter baumannii* causing an important resistance problem was found to be increased in number. The main hospital infection causes were *Acinetobacter baumannii* (37/179), *Klebsiella spp* (41/179). In 2017, bacterial diversity was also increased.

Conclusion: Isolated strains, as in the past, are gram-negative bacteria, Pseudomonas spp decreased in 2017, and Acinetobacter spp increased. The findings suggest that the automated systems used in microbiology laboratories may have a role in the detection of bacterial diversity.

Keywords: Nosocomial infection; surveillance; infection control.

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Hospital-acquired Infections (HI) are preventable infections that develop within 48-72 hours after hospitalization and within 10 days after discharge. They are not present during the incubation period of microorganisms and do not manifest symptoms and signs of infection. Their treatment is challenging and very costly with higher mortality rates.[1,2] The term "nosocomial infection", which we often use instead of hospital-acquired infection (HI), consists of the words "noso" meaning disease in ancient Greek and "komein" mening care.[3] HI continues to be a very important health problem in our country like in the whole world.[4] As a result of development of HI, the patient's hospital stay is prolonged, and morbidity and mortality rates increase.[5] Knowing and monitoring causative factors of hospital-acquired infections over the years is an important indicator concerning directing infection control policies and quality of service in hospitals.[4]

Professor Ignaz Philipp Semmelweis, MD, defined the hos-

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pital infection with scientific methods for the first time in 1847, and determined that cases of mortality occurred after postpartum fever in the birth clinic he was working, arose from medical students who had performed autopsy and vaginal examinations consecutively.[3] Semmelweis made it necessary for his students to wash their hands after autopsy and before birth, thus reducing the mortality rates from 22% to 3%. This intervention is the first evidence indicating that compliance with hygiene is effective in preventing hospital infections.[6]

The importance of surveillance in the control of hospital-acquired infections has been clearly demonstrated in studies conducted by "The Study on the Efficacy of Nosocomial Infection Control and Prevention Project "(SENIC). The results of the SENIC project have shown that one third of HIs can be prevented if effective measures are taken.[2] In a prevalence study conducted in 55 hospitals of 14 countries representing the four regions of the World Health Organization (Europe, East Mediterranean, South East Asia and West Pacific), development of HI was determined in an average of 9% of inpatients. The highest incidence rates of HI were determined as 12% and 10%, in the Eastern Mediterranean and South East Asia, respectively. Incidence rates of HI were found to be 8% in Europe and 9% in the West Pacific[7] HI prolongs hospital stay, and leads to work loss, increased drug use, need for isolation, and additional laboratory or other diagnostic methods which also increase the economic burden.[7]

Surveillance of hospital infections is useful in detecting infected patients, determining the frequency of infection and revealing the causative factors.[3] Efforts to prevent HI in Turkey are directed, and organized by the Department of Health Services within the General Directorate of Health.[1] Input of data was realized by all hospitals in Turkey through the system maintained by the National Nosocomial Infections Surveillance Network (NNSISN) and Surveillance Data Analysis Reports are published periodically.[8,9] In this surveillance system, invasive device -related infections are followed in the intensive care units in all hospitals in Turkey based on active contact with the patients and notifications are made from certain centers. In other clinics, the decision to conduct active or passive surveillance procedures is left up to the hospital infection control committees.

While HI occurs in approximately 2-8% of the hospitalized patients in industrialized countries, it rises to 21% in inpatients in the intensive care units.[10] HI is 5-10 times more frequent in the patients hospitalized in the HI intensive care units (ICUs) than in the other clinics.[11] It has been reported that the incidence of HI varies between 3.1% and 14.1% in different studies.[12] The etiologic factors of hospital infections developing in ICUs may differ between hospitals and even between different ICUs of the same hospital and the distribution of causative microorganisms in bacteremia may change over time.[13]

With this study, we aimed to investigate the infections and their etiologic factors and our local data at Şişli Hamidiye Etfal Training and Research Hospital. Also, by comparing the current data with the data of 1995, the change in the distribution of factors in this process was examined.

Methods

Materials sent from inpatients between the years 1995 and 2017 and encompassing the time period between June 1, and December 31 of 1995 and 2017 at the Şişli Hamidiye Etfal Training and Research Hospital Microbiology laboratory were evaluated concerning HI. In 1995, the total bed capacity of our hospital was 800, including four beds in ICU, while in 2017, the total bed capacity was 690, including 76 intensive care beds. Culture samples obtained from inpatients in 1995 were studied in the Microbiology Laboratory using traditional manual methods.

Conventional monophasic brain-heart infusion medium was used for blood culture. Blood culture agar and eosin methylene blue agar media were used for cultivation and IMVIC (Indol, Methyl Red, Voges-Proskauer, Simmons Citrate Agar) media were used for identification of isolates. Risk factors, such as the inpatient clinic and the longevity of hospital stay, the age, the gender of the patients, number of days of infection, underlying diseases, catheter application, endoscopic application, previous and present metabolic diseases, diabetes mellitus, malignancy and burns, were evaluated concerning HI and recorded.

In 2017, for identification of samples obtained from inpatients MALDI-TOF MS (Bruker Daltonics, Germany), for blood cultures, BD Bactec FX (Becton Dickinson, Diagnostic Instrument system, Sparks, USA), for antibiotic susceptibility tests BD Phoenix automated AST system (Becton Dickinson, USA) were used together with EUCAST limit values. Patients diagnosed by infectious diseases specialists and infection control nurses as HI, according to the Centers for Disease Control and Prevention-CDC criteria, were enrolled in the surveillance system.[14] Active surveillance was performed for intensive care units and designated surgeries and laboratory-based surveillance for other clinics.

Results

In the infection data of our hospital in 1995, in cultures of 100 patients, including pediatric and adult cases that developed hospital-acquired infections, a total of 100 pathogens of hospital-acquiired infections were isolated, and the number of isolates climbed to 179 cases in 2017. From the

year 1995 to 2017, the average age of the pediatric patients decreased, while adult patients increased. Average ages of the pediatric group were 2.85, and 1.49 years, and in the adult group, the corresponding average ages were 55.68., and 62.53 years as detected for the years 1995, and 2017, respectively.

Distribution of causative pathogens of hospital-acquired infections according to types of samples for the year 1995 is shown in Table 1. The most frequently isolated pathogens in HIs were *Pseudomonas aeruginosa* in 48, and *Klebsiella spp* in 37 samples.

Distribution of causative pathogens of HIs for the year 2017 according to sample types is shown in Table 2. The most frequently isolated pathogens were *Klebsiella spp* in 41, Acinetobacter spp in 39, *E. Coli* in 28, and *Pseudomonas aeruginosa* in 15.

It was determined that, in 1995, pediatric and adult groups were diagnosed with HI approximately on the third day of their admission, while in 2017, pediatric and adult groups were diagnosed with HI within on an average of 30 and 14 days following their admissions.

Discussion

Hospital-acquired infections have become a very important health problem in the world in the last 30 years.[12] Studies make important contributions in monitoring and preventing the development of HIs. In our study, when the data were evaluated, it was seen that the average duration of infection development was increased due to the prolonged hospitalization that arises from a higher number of intensive care patients.

Thanks to the development of medical technologies and intensive care services, the life span of many patients who may have been exited in the past before been prolonged. However, invasive interventions, trauma, underlying serious diseases, and therapies applied for diagnosis and treatment weaken the immune system of patients and prepare the ground for the development of hospital infections.[5] This situation can also be considered as one of the reasons for the increase in bacterial diversity in the year 2017 compared to 1995. The increase in diagnostic power with the use of automated systems and new technologies used in the microbiology laboratories contribute significantly to

Table 1. Distribution of the causative microorganisms of nosocomial infections in 1995

Urine (51/100)	Blood/catheter (32/100)	Wound (15/100)	Fistula (2/100)
Pseudomonas aeruginosa (31)	*Klebsiella spp. (28)*	*Pseudomonas aeruginosa (12)*	*Pseudomonas aeruginosa (2)*
Klebsiella spp. (6)	*Pseudomonas aeruginosa (3)*	*Klebsiella spp. (3)*	
Enterobacter spp. (9)	*MRSA (1)*		
E. coli (4)			
Proteus spp. (1)			

MRSS: methicillin resistant *S. aureus.*

Table 2. Distribution of the causative microorganisms of nosocomial infections in 2017

Catheter + Blood	Urine	Respiratory Tract Samples	Samples from wounds, and surgical sites	Other
Acinetobacter (9)	*Acinetobacter (4)*	*Acinetobacter (21)*	*Acinetobacter (2)*	*Serratia marcescens (1)*
Acinetobacter corynebacterium (1)	*Acinetobacter*	*Corynebacterium stratum (1)*	*Citrobacter (1)*	*Acinetobacter (1)*
Stenotrophomonas maltophilia (1)	*Candida tropicalis (1)*	*Klebsiella oxytoca (1)*	*Enterobacter spp. (3)*	*E. coli (1)*
Candida albicans (1)	*Enterobacter spp. (2)*	*Klebsiella pneumoniae (5)*	*Enterococcus fecalis (2)*	
Candida glabrata (2)	*Enterococcus faecalis (1)*	*Serratia marcescens (6)*	*Enterococcus feacium (1)*	
Candida parapsilosis (2)	*E. Coli (10)*	*S. aureus (4)*	*E. Coli (9)*	
Enterobacter spp. (1)	*E. coli+Klebsiella (1)*	*S. aureus+E. coli (1)*	*Klebsiella oxytoca (2)*	
Enterococcus feacium (1)	*Klebsiella oxytoca (5)*	*S. aureus+S. pneumoniae (1)*	*Klebsiella pneumoniae (7)*	
E. coli (6)	*Klebsiella pneumoniae (10)*		*Klebsiella+serratia KNS (2)*	
Klebsiella pneumoniae (9)	*Proteus mirabilis (1)*		*Morganella morganii (1)*	
S. aureus (4)	*Pseudamonas aeruginosa (6)*		*Proteus mirabilis (2)*	
Koagülaz negative stafilokoklar (9)	*Serratia marcescens (1)*		*Pseudomonas aeruginosa (5)*	
Pseudomonas aeruginosa (4)	*Stenotrophomonas maltophilia (1)*		*S. aureus (2)*	
Serratia marcescens (3)				

the relative increase in diversity of etiologic factors.

Longer stay in the ICU and using various tools increase the risk of microbial colonization and subsequent infections.[15-17] In a study conducted in Europe, it was reported that 20.6% of the patients in adult ICU developed HI at least once.[18] In a study conducted in our country, it was found that 49% of patients in the ICU developed one or more HIs.[19]

In a study of nosocomial pediatric infections, it was stated that there was an inverse relationship between age and HIs. The rates of HI were found to be 11.5% in children under the age of two, 3.6% between the ages of 2-4 and 2.6% in children over the age of five.[20] In our findings, 89% of hospital-acquired pediatric infection cases in 2017 were detected in children under the age of two. When the diagnoses of the hospital –acquired infections are examined, it is seen that urinary tract infections took first place in 1995, while bloodstream infections and respiratory tract infections came to the fore in 2017. In 2017, 58 of intensive care infections were identified as HIs related to surgical tools used in invasive procedures. In another study, it has been reported that the most common infections are bloodstream infections, catheter-related urinary tract infections, surgical site infection, and ventilator-associated pneumonia.[21]

When the causative factors of hospital-acquired infection are analyzed, it is seen that there are important differences between hospitals and years. In a study covering 2014, 2015 and 2016, the distribution of causative microorganisms isolated from ICU was in the order of decreasing frequency were as follows *E. coli* (50.54%), Acinetobacter spp. (17.93%), Pseudomonas spp. (13.04%), Proteus spp. (5.98%).[1] In another study, in the study of HIs covering the years 2004-2008, the *Acinetobacter baumannii* (18.9-39.4%) *Pseudomonas aeruginosa* (17.0-18.3%), Klebsiella pneumoniae (11.2-14.2%), Staphylococcus aureus (2.9-18.1%) were isolated in indicated percentages of samples.[5] In a study of all HI factors, *E. coli* was found in 21.5%, Klebsiella pneumoniae in 16.5%, *Acinetobacter baumannii* in13.9%, Coagulase- negative staphylococci in 10.1%, *Pseudomonas aeruginosa* in 7.6%, Staphylococcus aureus in 5.1% of the isolates.[3]

In our hospital, as in the past, gram- negative bacteria are the main causative pathogens of hospital-acquired infections and Pseudomonas spp. and *Klebsiella spp*. Acinetobacter and *Klebsiella spp*., which showed resistance to the latest drugs in hand, including carbapenems, in 2017 appears to be the most important problems we are facing.

Acinetobacter baumannii, which shows an alarming increase in antibiotic resistance, is a serious HI factor causing various infections such as pneumonia, bacteremia and skin infections.[22] Although we see members of Enterobacteriaceae spp. as causative pathogens at an increasing frequency, we have observed increasing numbers of Enterococci spp. and Staphylococci, spp. which are gram-positive bacteria and Candida spp. compared to the past.

Conclusion

Hospital –acquired infections develop in inpatients for different reasons, causing prolonged hospitalization, impaired quality of life, and they may even result in death. Surveillance studies have an important role in the control of hospital-acquired infections. The determination of microorganisms, resistance patterns and distribution of infections that make up the hospital flora of each center will be a guide in taking precautions.

Disclosures

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