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An evaluation of the infection agents and the demographic characteristics of patients followed up on a mechanical ventilator in neurology intensive care: A retrospective, single center, observational study

Nöroloji yoğun bakımda mekanik ventilatörde takip edilen hastaların enfeksiyon etkenleri ve demografik özelliklerinin değerlendirilmesi: Retrospektif tek merkezli gözlemsel çalışma

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Abstract

Aim: The incidence of nosocomial infections is higher than other sites of the hospitals at intensive care units (ICU) because of high frequency of invasive interventions and multidrug resistant microorganism's prevalence. Ventilator-related pneumonia cases have the highest mortality risk among the nosocomial infections. The aim of this study was to evaluate the endotracheal aspirate cultures and the demographic characteristics of patients followed up on mechanical ventilation in Neurology Intensive Care.

Methods: Our study was designed as a retrospective, cross-sectional and descriptive. Retrospective evaluation was made of 51 patients who were attached to a mechanical ventilator in the last 6 months and from whom a tracheal aspirate culture was taken. The endotracheal aspirate samples were taken under sterile conditions using a specifically designed catheter with the method of administering saline into the intubation tube and then aspiration. Blood culture results sent for analysis at the same time as the tracheal aspirate samples were also retrospectively evaluated in patients determined with positive production. A record was made of the demographic characteristics of the patients, diagnosis on admittance to ICU, risk factors, and microbial production in the tracheal aspirate culture.

Results: In the first culture, there was no production in 22 (43.1%) cases, and *Acinetobacter baumannii* was determined in 14 (27.5%) patients, *Pseudomonas aeruginosa* in 3 (5.9%), *Klebsiella pneumoniae* in 3 (5.9%), *Staphylococcus aureus* in 2 (3.9%), *Corynebacterium striatum* in 2 (3.9%), *Acinetobacter baumannii* + *Pseudomonas aeruginosa* in 2 (3.9%), *Acinetobacter baumannii* + *Klebsiella pneumoniae* in 2 (3.9%), and *Acinetobacter baumannii* + *Escherichia coli* in 1 (2.0%). The second culture was taken from patients on the mean 11th day. In 3 (10.7%) patients there was no production in the second culture and in the other patients, *Acinetobacter baumannii* was determined in 15 (53.6%) patients, *Pseudomonas aeruginosa* in 3 (10.7%), *Klebsiella pneumoniae* in 2 (7.1%), *Escherichia coli* in 1 (3.6%), *Corynebacterium striatum* in 1 (3.6%), and *Acinetobacter baumannii* + *Pseudomonas aeruginosa* in 3 (10.7%).

Conclusion: The culture results in this study of patients admitted for neurological reasons were observed to be consistent with findings in literature. The high mortality rate of 64.7% in these ICU patients is due to the majority being ischemic stroke patients. This suggests that both the severe table associated with neurological findings and agents such as *Acinetobacter baumannii* and *Pseudomonas aeruginosa* contribute to Neurology ICU patients.

Keywords: Nosocomial infection, Neurological intensive care unit, Mechanical ventilator

Öz

Amaç: Yoğun bakım üniteleri hastane geneline göre invazif girişimlerin daha sık uygulandığı dirençli mikroorganizmaların daha çok izole edildiği yerlerdir ve bu nedenle buralarda hastane enfeksiyonları daha sıktır. Ventilatör ilişkili pnömoniler mortalitesi en yüksek nozokomiyal enfeksiyonlardır. Bu çalışmada nöroloji yoğun bakımda mekanik ventilatörde takip edilen hastaların demografik özellikleri, endotrakeal aspirat kültürleri yönünden değerlendirilmesi amaçlandı.

Yöntemler: Çalışmamız retrospektif, kesitsel, tanımlayıcı olarak dizayn edildi. Son 6 ayda mekanik ventilatöre bağlı ve trakeal aspirat kültürü alınan 51 hasta retrospektif olarak değerlendirildi. Endotrakeal aspirat örnekleri; steril şartlarda, örnek almak için tasarlanmış özel kateterler kullanılarak, entübasyon tüpünün içinden serum fizyolojik verilip aspire edilmesi yöntemiyle elde edildi. Üreme saptanan hastaların trakeal aspirat örnekleri ile eş zamanlı gönderilen kan kültür sonuçları da geriye dönük olarak değerlendirildi. Hastaların demografik özellikleri, yoğun bakıma yatış tanıları, risk faktörleri, trakeal aspirat kültür mikrobiyal üremeleri kaydedildi.

Bulgular: İlk kültürde 22 (%43,1) hastada üreme yoktu, 14 (%27,5) hastada *Acinetobacter baumannii*, 3 (%5,9) hastada *Pseudomonas aeruginosa*, 3 (%5,9) hastada *Klebsiella pneumoniae*, 2 (%3,9) hastada *Staphylococcus aureus*, 2 (%3,9) hastada *Corynebacterium striatum*, 2 (%3,9) hastada *Acinetobacter baumannii* + *Pseudomonas aeruginosa*, 2 (%3,9) hastada *Acinetobacter baumannii* + *Klebsiella pneumoniae*, 1 (%2,0) hastada *Acinetobacter baumannii*+ *Escherichia coli* saptandı. Hastaların ikinci kültür alınma süresi ortalama 11. gün idi. İkinci kültürde 3 (%10,7) hastada üreme yoktu. 15 (%53,6) hastada *Acinetobacter baumannii*, 3 (%10,7) hastada *Pseudomonas aeruginosa*, 2 (%7,1) hastada *Klebsiella pneumoniae*, 1 (%3,6) hastada *Escherichia coli*, 1 (%3,6) hastada *Corynebacterium striatum*, 3(%10,7) hastada *Acinetobacter baumannii* + *Pseudomonas aeruginosa* saptandı.

Sonuç: Yaptığımız çalışmada nörolojik nedenlerle yatan hastalarda da literatürle uyumlu olarak benzer kültür sonuçları izlenmiştir. Büyük çoğunluğunu iskemik inme hastalarının oluşturduğu yoğun bakım hastalarımızda mortalite oranımız %64,7 gibi yüksek oranda idi. Bu duruma hem nöroloji yoğun bakım hastalarının nörolojik bulgularına bağlı ağır tablosunun olması hem de *Acinetobacter baumannii* ve *Pseudomonas aeruginosa* gibi etkenlerin birlikte katkısı olduğu düşüncesindeyiz.

Anahtar kelimeler: Nazokomial enfeksiyon, Nörolojik yoğun bakım ünitesi, Mekanik ventilatör

Introduction

Nosocomial infections are most frequently seen and the greatest cause of mortality in Intensive Care Units (ICU). Serious infections, primarily sepsis, are responsible for 60% of mortality in ICUs and 40% of the costs. Ventilator-associated pneumonia, urinary tract infections, bacteremia and catheter infections and surgical site infections are the most common nosocomial infections in intensive care units [1]. The aim of this study was to evaluate the endotracheal aspirate cultures and the demographic characteristics of patients followed up on mechanical ventilation in Neurology Intensive Care.

Materials and methods

Our study was designed as a retrospective, cross-sectional and descriptive. From a total of 119 patients followed up in the Stroke and Neurology ICU of Gaziantep University Medical Faculty Hospital between January and December 2017, retrospective evaluation was made of 51 patients who were attached to a mechanical ventilator in the last 6 months and from whom a tracheal aspirate culture was taken. The endotracheal aspirate samples were taken under sterile conditions using a specifically designed catheter with the method of administering saline into the intubation tube and then aspiration. Blood culture results sent for analysis at the same time as the tracheal aspirate samples were also retrospectively evaluated in patients determined with positive production. A record was made of the demographic characteristics of the patients, diagnosis on admittance to ICU, risk factors, and microbial production in the tracheal aspirate culture.

Statistical analysis

Statistical evaluation was performed using SPSS 19.0 software (IBM, New York, USA). Descriptive statistics were given as statistical mean, standard deviation, number and percentage values.

Results

The patients comprised 29 (56.9%) females and 22 (43.1%) males with a mean age of 64.1±15.9 years. Diagnoses were determined as ischemic stroke in 34 (66.7%) patients, subarachnoid bleeding in 4 (7.8%), encephalitis in 4 (7.8%), Guillan-Barre syndrome in 3 (5.9%), intracerebral hemorrhage in 3 (5.9%), Parkinson's disease in 1 (2%), myasthenia gravis in 1 (2%) and dementia in 1 (2%). Risk factors were present as hypertension in 40 (78.4%) patients, diabetes in 20 (39.2%), coronary artery disease in 20(39.2%), smoking in 34 (66.7%), heart failure in 8 (15.7%) and chronic obstructive pulmonary disease in 6 (11.8%) (Table 1). The mean time to taking the first culture from the patients was 5 days.

In the first culture, there was no production in 22 (43.1%) cases, and *Acinetobacter baumannii* was determined in 14 (27.5%) patients, *Pseudomonas aeruginosa* in 3(5.9%), *Klebsiella pneumonia* in 3 (5.9%), *Staphylococcus aureus* in 2(3.9%), *Corynebacterium striatum* in 2(3.9%), *Acinetobacter baumannii* + *Pseudomonas aeruginosa* in 2(3.9%), *Acinetobacter baumannii* + *Klebsiella pneumonia* in 2 (3.9%), and *Acinetobacter baumannii* + *Escherichia coli* in 1 (2.0%). The second culture was taken from patients on the mean 11th day. In 3 (10.7%) patients

there was no production in the second culture and in the other patients, *Acinetobacter baumannii* was determined in 15 (53.6%) patients, *Pseudomonas aeruginosa* in 3(10.7%), *Klebsiella pneumonia* in 2 (7.1%), *Escherichia coli* in 1 (3.6%), *Corynebacterium striatum* in 1 (3.6%), and *Acinetobacter baumannii* + *Pseudomonas aeruginosa* in 3 (10.7%) (Table 2). 33 (64.7%) patients whose tracheal culture was positive deceased during follow-up.

Table 1: Patient Characteristics

| Patients | Total n=51 n (%) |
|---------------------------------------|---------------------|
| Age (yrs) mean±standard deviation | 64.1±15.9 |
| Diagnosis | |
| Ischemic stroke | 34 (66.7%) |
| Subarachnoid hemorrhage | 4 (7.8%) |
| Encephalitis | 4 (7.8%) |
| Guillain Barre syndrome | 3 (5.9%) |
| Hemorrhagic stroke | 1 (2.0%) |
| Parkinson's disease | 2 (1.9%) |
| Myasthenia gravis | 1 (2.0%) |
| Dementia | 1 (2.0%) |
| Risk factors | |
| Hypertension | 40 (78.4) |
| Diabetes | 20 (39.2) |
| Chronic obstructive pulmonary disease | 6 (11.8) |
| Smoking | 34 (66.7) |
| Heart failure | 8 (15.7) |
| Coronary artery disease | 20 (39.2) |

Table 2: Causative microorganisms

| Causative microorganisms n =51 | Initial culture n (%) | Second culture n (%) |
|--|--------------------------|-------------------------|
| <i>A. baumannii</i> | 14(27.5) | 15(53.6) |
| <i>P. aeruginosa</i> | 3(5.9) | 3(10.7) |
| <i>K. pneumonia</i> | 3(5.9) | 2(7.1) |
| <i>S. aureus</i> | 2(3.9) | - |
| <i>Corynebacterium striatum</i> | 2(3.9) | 1(3.6) |
| <i>A. baumannii</i> + <i>P. aeruginosa</i> | 2(3.9) | 3(10.7) |
| <i>A. baumannii</i> + <i>K. pneumonia</i> | 2(3.9) | - |
| <i>A. baumannii</i> + <i>E. coli</i> | 1(2.0) | - |
| <i>E. coli</i> | - | 1(3.6) |

A. baumannii: *Acinetobacter baumannii*, *P. aeruginosa*: *Pseudomonas aeruginosa*, *E. coli*: *Escherichia coli*, *K. pneumonia*: *Klebsiella pneumonia*, *S. aureus*: *Staphylococcus aureus*

Discussion

Nosocomial infections are a significant cause of morbidity and mortality throughout the world. ICU is the department where hospital-acquired infections are seen most often and with the highest mortality rates [2]. Infection complications have been reported in 36% of patients staying more than 48 hours in ICU [3]. Changes in consciousness in patients in Neurology ICU increase the risk of aspiration pneumonia and other infections with the need for nasogastric catheter and the application of percutaneous endoscopic gastrostomy. Invasive interventions such as the application of mechanical ventilation, tracheostomy and catheter, the use of broad-spectrum antibiotics and the length of stay in ICU are significant reasons for the development of difficult-to-treat infections with resistant pathogens in ICU [4].

Ventilator-associated pneumonia is the most common nosocomial infection with the highest mortality rate in intensive care units. Ventilator-associated pneumonia accounts for 70% of hospital-acquired pneumonia in intensive care units. Mechanical ventilation increases the risk of pneumonia seven times. Mechanical ventilation pneumonia cases constitute about 10-20% of nosocomial infections. When ventilator-associated

pneumonia develops in patients, the mortality ranges from 27 to 76% [5].

In the diagnosis of ventilator-related infections, as the sensitivity and specificity of clinical and radiological findings are low, gram staining and cultures from respiratory tract samples such as endotracheal aspirate, broncho-alveolar lavage and dry-brush samples, are of guidance in diagnosis and treatment. Correct determination of the etiological agent is extremely important for the early initiation of antimicrobial treatment. A 4-8 -hour delay in the start of treatment has been shown to increase mortality. Therefore, empirical antibiotic treatment is started by the clinician without waiting for laboratory results [6,7]. At the same time, early diagnosis and treatment directed at the agent in ventilator-related infections shortens the length of hospital stay, and reduces mortality rates, the rates of resistant strains and costs. Moreover, the determination of the local antibiotic resistant profile contributes to the rational use of antibiotics. Gram-negative, non-fermentative bacteria such as *Pseudomonas* and *Acinetobacter* have been reported to be the leading agents resulting in infections in ICU and extremely high rates of morbidity and mortality have been reported in the diseases they cause [2,8].

In the current study, production was determined in the first blood culture in 56.9% of all the patients and the pathogen showing most frequent production was *Acinetobacter baumannii* at 27.5% followed by *Pseudomonas aeruginosa* at 5.9%. In the second blood culture, there was production in 89.3% of the patients and again the most common pathogen was *Acinetobacter baumannii* at 53.6% followed by *Pseudomonas aeruginosa* at 10.7%. These findings were consistent with previous reports in literature. However, in studies conducted in recent years, there has been observed to be an increase in the frequency of *Staphylococcus aureus* together with the gram negative bacteria isolated in ICUs [9]. *Staphylococcus aureus* was determined in 3.9% of the current study patients. The majority of the patient group followed up in ICU in this study comprised ischemic stroke patients. Of the risk factors that play an important role in the prognosis of ischemic stroke, hypertension was determined in 78.4% of the patients and diabetes in 39.2%, the high mortality rate of 64.7% in these ICU patients is due to the majority being ischemic stroke patients. This suggests that both the severe table associated with neurological findings and agents such as *Acinetobacter baumannii* and *Pseudomonas aeruginosa* contribute to Neurology ICU patients [10,11].

The low number of cases and the presence of data from a single center are limitations to the generalization of the results.

In conclusion, nosocomial infections are a significant problem in Turkey, just as they are throughout the world. Ventilator-associated pneumonia is the most common nosocomial infection in intensive care units. The culture results in this study of patients admitted for neurological reasons were observed to be consistent with findings in literature. Advanced age, the application of an endotracheal tube and comorbidities in patients requiring follow-up in ICU are reasons that increase mortality rates. The fact that the neurological pattern of the patients is advanced, and the coexistence of the infections increases this rate much more.

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