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Beyin ve Sinir Cerrahisi Kliniğinde Hastane Kökenli Enfeksiyonların Risk Faktörleri

Risk Factors of Nosocomial Infections in a Neurosurgery Clinic

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Özet

GİRİŞ ve AMAÇ: Hastane enfeksiyonları hastanın hastaneye başvurusu esnasında bulunmayan veya inkübasyon döneminde olmayan, hastaneye başvurduktan 48-72 saat sonra veya hastaneden taburcu olduktan sonraki 10 gün içinde gelişen enfeksiyonlardır. Standardizasyonu sağlamak, Türkiye ve gelişmiş ülkelerin hastaneleri ile karşılaştırma yapabilmek için Beyin Cerrahisi Kliniği'ndeki hastane enfeksiyonu oranlarını, enfeksiyon etkeni mikroorganizmaları ve direnç kalıplarını belirlemek amaçlanmıştır.
YÖNTEM ve GEREÇLER: Bu çalışmada beyin cerrahisi hastalarında hastane enfeksiyonu gelişimindeki risk faktörleri hasta kayıtları gözden geçirilerek ve hasta bilgileri ile mikrobiyoloji kültür sonuçları kaydedilerek analiz edilmiştir.
BULGULAR: Çalışmada 57 hastada 78 hastane enfeksiyonu atağı belirlendi ve hastane enfeksiyonu hızı % 10,34 olarak tespit edildi. Hastane enfeksiyon ataklarının % 53,8'i pnömoni, % 15.4'ü üriner sistem enfeksiyonu, % 12,8'i cerrahi alan enfeksiyonu, % 11.5'i merkezi sinir sistemi enfeksiyonu, % 6.4'ü kateter ilişkili kan dolaşım enfeksiyonuydu. Hastane enfeksiyonlarından en sık izole edilen etkenler Acinetobacter baumanii (% 16,4), Pseudomonas aeruginosa (% 16,4) ve Metisilin duyarlı Staphylococcus aureus (%16,4) idi. Yaşın 65 üzerinde olması, sigara kullanımı, fekal inkontinans, malignite, birden fazla cerrahi girişim varlığının hastane enfeksiyonu gelişiminde risk faktörü olduğu saptanmıştır.
TARTIŞMA ve SONUÇ: Hastane enfeksiyonu gelişiminde rol oynayan risk faktörlerinin tanımlanması, etken mikroorganizmaların belirlenmesi enfeksiyon kontrol ve önleme programlarını geliştirilmesi, beyin cerrahisi hastasının değerlendirilmesi, tanı ve tedavisine yaklaşımda önemlidir.

Anahtar Kelimeler: Nozokomiyal enfeksiyonlar, beyin ve sinir cerrahisi, pnömoni, risk faktörleri.

Abstract

INTRODUCTION: Nosocomial infections are acquired during hospital care which were not present or incubating at the time of the patient's admission to the hospital. They occur more than 48 to 72 hours after admission and up to 10 days after hospital discharge. The aim of the present study was to determine Neurosurgery Clinic's nosocomial infection rates, infecting microorganisms, and their resistance patterns to achieve standardization and make comparisons among other Turkish and developed country hospitals.
METHODS: In this study risk factors for nosocomial infection development in neurosurgery patients were analyzed by reviewing patient cards retrospectively, and recording microbiological culture results.
RESULTS: Seventy eight nosocomial infection attacks were defined in 57 patients and the incidence of nosocomial infection attacks were 10.34%. Of the nosocomial infection attacks 53.8 % was pneumonia, 15.4 % was urinary tract infection, 12.8 % was surgical site infection, 11.5 % was central nervous system infection and 6.4 % was catheter related blood stream infection. Acinetobacter baumanii, Pseudomonas aeruginosa and Methicillin sensitive Staphylococcus aureus remained the most common pathogens isolated from nosocomial infections. Factors significantly associated with hospital acquired infection were as follows: age (>65 years), smoking cigarette, faecal incontinence, malignity and recurrent operation.
DISCUSSION AND CONCLUSION: It's important to determine the risk factors for nosocomial infection development and to identify the causative microorganisms to improve infection control and preventive programs.

Keywords: Nosocomial infections, neurosurgery, pneumonia, risk factors.

INTRODUCTION

Nosocomial infections are an important preventable cause of patient morbidity and mortality. They also are a major public health problem in developing countries, as well as developed countries (1). They increase the length of hospitalization and raise overall health costs (2). It should be noted that the incidence of nosocomial infections can be reduced by as much as 30 %, which would result in a substantial decline in health care costs (3). Nosocomial infections develop during hospitalization but aren't present or incubating until the patient's admission to the hospital; generally they occur more than 48 to 72 hours after admission and up to 10 days after hospital discharge or within 30

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or 90 days after operation (4).

Prevention of bacterial infections is one of the most important aspects in neurosurgery, where a highly sterile environment is very important. Patients in neurosurgery clinics have certain risk factors for nosocomial infection development like; multiple trauma, head trauma, change in consciousness, weakened preventive reflexes (5, 6). Clinical signs and laboratory findings are hard to interpret. The history is commonly limited because of the patient's impaired mental status. Knowledge of nosocomial infection rates is important for clinical treatments of these patients but also for justifying implementation and subsequent evaluation of infection control policies (7). In this study we aimed to analyze risk factors for nosocomial infection development in neurosurgery and to evaluate the approach, diagnosis and treatment of these infections with attention to the unique circumstances of the neurosurgery patient and also the aim of the present study was to contribute with evidence that can aid reflections on current practices, the implementation of infection prevention and control measures.

MATERIALS AND METHODS

A case control study was performed in Neurosurgery Clinic of Trakya University Hospital for a year. The clinic included 30 beds and four of them were intensive care beds. The presence of a nosocomial infection was determined by using CDC definitions for nosocomial infections (4). The epidemiologic, clinic and laboratory results of cases (>18 years) were evaluated. Seventy eight control-patients were selected for identifying risk factors for infection. Control patients age, gender and diagnoses were similar to the case patients. A control patient had to have no evidence of HAI at any time during hospitalization. Meningitis, ventriculitis and shunt infections were classified as central nervous system (CNS) infections. An infectious diseases physician followed all the cases and collected data in cooperation with primary physician. We abstracted data from medical files of the patients and recorded every nosocomial infection attack on standardized forms. We evaluated cases at the occurrence of infection, 48-72 hours after the infection treatment and at the end of the treatment.

We implemented the initial empiric antibiotic regimen due to the most common microorganism, if necessary, treatment was changed depending on the in vitro susceptibility tests of the microorganism. In addition, data on prophylactic antibiotics and the duration of prophylactic antibiotics were also recorded. Microbiological analysis was performed by using standard methods. We determined the minimal inhibition concentrations (MIC) of antibiotics as described in the National Committee for Clinical Laboratory Standards (NCCLS) guidelines, by using disc diffusion method (8).

We recorded the style (craniotomy or spinal surgery), type (elective or emergency), duration of the operation and presence of instruments as operative risk factors. We analyzed intensive care support, duration in the intensive care unit (ICU), invasive procedures (endotracheal intubation, mechanical ventilation, tracheostomy, nasogastric feeding, urinary catheterization, central venous catheterization, presence of external ventricular drain or a ventriculoperitoneal shunt device, C reactive protein (CRP) and white blood cell levels, isolated microorganisms and the antimicrobial susceptibility patterns, chest radiograms, administered antibiotics, clinical characteristics and the outcomes, existing head trauma or hydrocephalus and Glasgow Coma Score (Table 1).

We performed all statistical analyses with the Statistical Package for the Social Sciences (SPSS version 7.1 Inc., Chicago, IL, USA) by using x^2 test and Fisher's exact test. We gave the results as medians (range) for non-parametric data and as mean ±standard deviation (SD) for continuous data. When variance analysis showed significant differences, we applied Mann Whitney-U test to determine the origin of the difference.

RESULTS

During the study period 754 patients were hospitalized in Neurosurgery Clinic. Fifty seven studied patients developed 78 nosocomial infection attacks: 42 pneumonias, 12 urinary tract infections, 10 surgical site infections (SSI), 9 CNS infections and 5 central venous catheter related infections. The incidence of CNS infection was 11.5 % and the distribution was as follows: 6.4 % meningitis, 2.6 % ventriculitis, 2.6 % shunt infections.

Among the included 57 cases the mean age was 54.03 (range, 18–85 years; 41 men and 16 women). While 37 patients had a single episode, 20 patients had >1 nosocomial infection attack. The incidence and incidence density of nosocomial infection attacks were 10. 34 per 100 patients and 4.15 per 1000 patient days. Mean hospital stay in the neurosurgery clinic (± SD) was 14.95±9.38 days before infection development.

The indications for hospitalization were intracranial haemorrhage (57.7 %), intracranial malignant tumours (20.5 %) and spinal surgery (21.8 %). Thirty (51.7 %) emergency and 28 (48.3 %) elective surgical operations were performed; of the patients 43 had craniotomy and 15 had a spinal procedure. Underlying diseases of patients were as follows: 41 (52.6 %) hypertension, nine (11.5 %) extracranial malignancy, eight (10.3 %) diabetes mellitus, seven (9 %) heart disease. In our study 42 (53.8 %, p<0.001) patients had head trauma, 24 (30.8 %, p<0.001) had previous neurosurgical operation, 7 (9%, p:0,011) had implantation of foreign body, 30 had (51.7 %, p: 0,01) emergency surgeries. Also the age of 36 patients was more than 65 years (46.2 %, p: 0.001), 38 patients were smoking (48.7 %, p< 0.001), 31 had ICU support (39.7 %, p<0.001). Risk Factors case versus control patients for hospital acquired infections(HAI) by univariate analyses is shown on Table 1.

Tablo 1. *Risk Factors case versus control patients for hospital acquired infections (univariate analyses)*

	Case patients n=78 (%)	Control patients n=78 (%)	p^* value
Age>65	36 (46,2)	16 (20,5)	0,001
Smoking	38(48,7)	8(10,3)	<0,001
Alcohol use	19(24,4)	2(2,6)	<0,001***
Malignancy	9(11,5)	1(1,3)	0,018***
Head trauma	42(53,8)	20(25,6)	<0,001
Neurologic deficit	71(91,0)	36(46,2)	<0,001
Fecal incontinence	47(60,3)	7(9,0)	<0,001
Hydrocephalus	49(62,8)	9(11,5)	<0,001
Tracheotomy	23(29,5)	1(1,3)	<0,001***
Mechanical ventilation	41(52,6)	8(10,3)	<0,001
ICU support	31(39,7)	5(6,4)	<0,001
Parenteral nutrition	46(59,0)	7(9,0)	<0,001
Enteral nutrition	48(61,5)	14(17,9)	<0,001
Nasogastric tube	53(67,9)	15(19,2)	<0,001
Shunt device	12(15,4)	1(1,3)	0,002***
CSF drain	18(23,1)	4(5,1)	0,001
Urinary catheter	62(79,5)	31(39,7)	<0,001
CVC	45(57,7)	6(7,7)	<0,001
MV time(mean±SD)	7,74±10,647	0,26±0,904	<0,001**
GCS(mean±SD)	10,94±3,866	14,13±2,110	<0,001**
Operation	58(74,4)	72(92,3)	0,003
Recurrent operation	24(30,8)	4(5,1)	<0,001
Operation time >2 hours	42(53,8)	49(62,8)	0,009
Foreign material	7(9,0)	8(10,3)	0,011
Emergency procedure	30(51,7)	39(54,2)	0,010
Craniotomy	43(74,1)	54(75,0)	0,011
Preoperative prophylaxis with Sefazolin	32(41)	53(67,9)	0,001

NOTE*: ICU: Intensive Care Unit, Cerebrospinal fluid,* ***CVC****: Central venous catheter,* ***MV****: Mechanical Ventilation,* ***GCS****: Glasgow Coma Score.* ****:*** *Pearson chi-square test. ,* *****:*** *Mann Whitney U test,* ******:*** *Fisher's test.*

When nosocomial infection diagnose was made, 32 patients had antibiotic prophylaxis with cefazolin (56.2 %, p: 0,001) and mean duration of antibiotic prophylaxis was 2.44±2.305 days. Forty one of the patients (52.6 %, p<0.001) had mechanical ventilation and mean mechanic ventilation day was 7.74±10.647 days. Invasive devices of the patients were: 53 (67.9 %, p<0.001) nasogastric tubes, 62 (69.5 % p<0.001) urinary catheters, 45 (57.7 %, p<0.001) central venous catheters, 18 (23.1 %; 15 ventricular and 3 lumbar , p: 0,001) cerebrospinal fluid (CSF) drainage catheters and 12 (15.4 % p: 0,002) shunts. Shunt indications were hydrocephalus (88.9 %) and intracranial tumours (11.1 %) also all shunts were ventriculoperitoneal. External drainage indications were as follows: hydrocephalus 11 (61.1 %), intracranial tumour 2 (11.1 %), intracranial haemorrhage 4 (22.2 %) and CSF leakage 1 (5.6 %). Mean duration of operations was 2.32±1.97 hours and the duration was longer than two hours at 42 cases (53.8 % p: 0.009). Developing hospital-acquired infection among patients who had invasive devices was higher compared with patients who hadn't invasive devices. Factors significantly associated with HAI's were as follows: age (>65 years), smoking cigarette, fecal incontinence, malignity, recurrent operation (Table 2).

Tablo 2. *The results of multivariate analyses*

Risk factors	***Odds ratio***	***95 % confidence interval***
Age>65	*48,95*	*5,97 - 401*
Smoking	*81,67*	*6,01 - 1108*
Fecal incontinance	*22,63*	*2,07 - 246*
Malignancy	*4471*	*52,64 - 379736*
Recurrent operation	*32,32*	*2,49 - 418*

We determined a causative microorganism at 56 (71.8 %) of the nosocomial infection attacks. The most isolated microorganisms were Acinetobacter baumannii (16.4 %), Pseudomonas aeruginosa (16.4 %) and Methicillin sensitive Staphylococcus aureus (16.4 %). (Table 3). There were identified 61.4 % gram negative, 35.1 % gram positive bacteria and 3.5 % fungi. Fifteen (19.20 %) strains were obtained from tracheal aspirates, 12 (15.40 %) from urine, 15 (19.20 %) from blood, 10 (12. 90 %) from CSF, 3 (3.9 %) from central venous catheters.

Tablo 3. *Distribution of microorganisms*

Microorganism	**Number n ( )**	**Percent (%)**
Acinetobacter baumannii	9	16,4
Pseudomonas aeruginosa	9	16,4
Escherichea coli	5	9,1
Proteus spp.	4	7,3
Enterobacter spp.	3	5,4
Other gram negative bacteria	5	9
Methicillin sensitive Staphylococcus aureus	9	16,4
Methicillin resistant Staphylococcus aureus	7	12,7
Other gram positive bacteria	5	9
Candida spp.	2	3,6

DISCUSSION

Nosocomial infections of neurosurgical patients represent a serious problem that requires immediate attention. The knowledge of risk factors for nosocomial infection development will allow us to implement specific preventive measures to reduce the infection rate. In this study, we retrospectively reviewed the characteristics and outcomes of 57 patients with a diagnosis of nosocomial infection. The overall incidence of nosocomial infections 10.34 per 100 patients and incidence density of nosocomial infections 4.15 per 1,000 patient days in our study was low in comparison with the published data: here the overall incidence was 8.2 %, 12.2 %, 20.7 %, 28.8 % nosocomial infections per 100 patients and the incidence density was determined as 19.6 %, 16.9 %, 22.1 %, 11.6 % per 1,000 patient days (1, 5, 7, 9). We examined all neurosurgical patients in contrast with other studies that are performed only in neurosurgery intensive care units.

Neurosurgical patients are especially prone to develop pneumonia due to micro- and macro-aspirations and postoperative pneumonia commonly occurs in a significant proportion of all neurosurgery patients (10). Mechanical ventilation and ICU support significantly increases risk of developing pneumonia. Pneumonia (53.8 %) was the most frequent nosocomial infection similar to the previous studies (7, 11, 12, 13). This could be due to the 41 patients (52.6 %) who had mechanical ventilation, and 31 patients who had ICU support (39.7 %) in our study. Nosocomial infections predominantly occur in ICUs and they are related to the duration of ICU stay; discharge of neurosurgical patients to an appropriate unit as soon as possible is likely to result in reduction of the infection rate. Supporting infection control strategies within the ICU may be estimated to further minimize the infection rate (9).

Surgical site infections are keeping the importance of mortality and morbidity under the hospital infections regardless of the surgical specialties. However using longer microsurgical methods and the implanted foreign materials (i.e: shunts, clips, spinal stabilization materials, and cranioplasty plates) increases the perioperative infection risk at neurosurgery patients. When prophylactic antibiotics are used the infection rates in clean neurosurgical operations in randomized controlled trials is 0.3 % to 3 % and 4 % to 12 % without prophylactic antibiotics. Recently, infectious complications less than 5 % is considered acceptable (14). Surgical site infections rate of 12.8 % in our study was higher than the acceptable range. The wide variation of infection rates in different series could be due to the usage of different definition of surgical site infection.

Finally, nosocomial CNS infections keep its importance in neurosurgery. They are rare among all nosocomial infections; however they cause severe infections with high mortality and morbidity. The main nosocomial CNS infections are meningitis and shunt infections. Nosocomial meningitis mostly develops postoperatively. Patients with a new onset fever or an unexplained change in neurologic status should be suspected about postoperative nosocomial meningitis. Nosocomial CNS infections are quite frequently seen in neurosurgery clinics. In our study the incidence of CNS infection was 11.5 % and the distribution was as follows: 6.4 % meningitis, 2.6 % ventriculitis, 2.6 % shunt infections. After neurosurgical operations the incidence of CNS infections is 5 %–7 % when prophylactic antibiotics were used and 10 % without prophylactic antibiotics (15). In our study all patients received prophylactic one dose antibiotics before surgery. Nosocomial CNS infection rate of 11.5 % in our study was higher than the acceptable range.

The major points to reduce nosocomial infection rate are early diagnosis and choice of appropriate antibiotics according to epidemiologic trends. A good surveillance should be made to diagnose, treat and prevent these infections in postoperative care patients. Postoperative meningitis reported incidence is 1-3.5 %. This variable incidence rates are partly relies on methodological subjects like definitions and surveillance methods. Some studies included all craniotomies (i.e. clean, contaminated, and dirty surgical sites), by contrast with others choose only clean craniotomies (16). In our study the incidence of postoperative meningitis was 2.6 % and it included all neurosurgical procedures. The most common organism in our CNS infection series was S. aureus (accounting for 22.2 % of infections) and we noticed coagulase negative staphylococci accounting for 5.6 % of infections.

The main weakness of our study is that it considers data from a short period and we couldn’t follow up the patients after discharge. Also our study included all neurosurgical procedures (spinal surgery and craniotomies) and patients who had ICU support increased the ratio of pneumonia. This study has another limitation. Some of the clinical data in the hospital recording system was incomplete. This may introduce bias in statistical analysis. The other limitation in this study was that controls did not match by diagnoses and type of surgery with cases. This may minimize the power of the study to identify risk factors.

In conclusion every hospital and clinic should develop infection control politics and conduct the treatment of hospital infections with taking care about the result of antibiotics sensivity results and infectious factors by making surveillance study for the ratio of hospital infections. Neurosurgery patients mortality, morbidity and health care costs can be reduced and this can help physicians to improve patient care.

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