



Research Article

Nosocomial Infections in a Neurological Intensive Care Unit

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Summary

Background: Nosocomial infections in intensive care units are common and associated with high morbidity, mortality. This study was planned to evaluate the occurrence and causes of site specific nosocomial infections in a neurological intensive care unit (NICU) and their relevance to underlying diseases.

Methods: Patients treated for more than 24 hours in Ege University Medical School Hospital NICU were evaluated by prospective daily surveillance for overall and site specific infections during the 12 months of the year 2005. Nosocomial infections incidence and their relation with underlying disease were investigated.

Results: Three hundred and fifty six patients were included. A hundred and ten nosocomial infections were seen. The rate of infection per 100 patients was 30.8. Site-specific infections were; urinary tract infection (49.1%), pneumonia (30.9%), catheter related blood stream infections (18.1%) and primary bacteremia (1.8 %). In univariate analysis, no differences were found between the patients with stroke and other NICU disorders in terms of risk factors for NICU-AI such as; age, gender, type of nosocomial infections, length of stay, and mortality. But the length of stay was significantly prolonged and mortality was significantly higher in patients with NICU-AI when compared with patients without NICU-AIs.

Conclusion: The incidence of nosocomial infections in our NICU was found to be as high as in other critical care units and causes higher mortality. This was supposed to be associated with prolonged hospital stay and insufficient compliance to infection control measures instead of the underlying disease of the patients.

Key words: Neurological intensive care unit, nosocomial infection

Nörolojik Yoğun Bakım Ünitesinde Nozokomial Enfeksiyonlar

Özet

Giriş: Yoğun Bakımlarda sık görülen nozokomial enfeksiyonlar yüksek morbidite ve mortalite nedenidir. Bu çalışma Nörolojik Yoğun Bakım Ünitesi (NYBÜ)'nde görülen nozokomial enfeksiyonların lokalizasyonları, nedenleri ve altta yatan hastalıklarla ilişkisinin araştırılması amacıyla planlanmıştır.

Yöntem: Ege Üniversitesi Tıp Fakültesi NYBÜ'de 24 saatten uzun süre tedavi gören olgular genel ve lokalizasyon ilişkili enfeksiyonlar yönünden 2005 yılı süresince prospektif olarak günlük değerlendirilmeye alınmıştır. Enfeksiyon sıklığı, etkenleri ve altta yatan hastalıklarla ilişkisi araştırılmıştır.

Sonuçlar: Çalışmaya 356 hasta alınmıştır. Toplam 110 nozokomial enfeksiyon görülmüştür. Enfeksiyon sıklığı % 30.8 olup enfeksiyonların lokalizasyona göre dağılımı; üriner sistem

enfeksiyonu % 49.1, pnömoni % 30.9, dammar içi kateter ile ilişkili kan dolaşımı enfeksiyonu % 18.1, primer bakteriemi % 1.8'dir. İstatistiksel değerlendirmede yoğun bakım enfeksiyonlarının altta yatan hastalıkla ilişkili olmadığı, enfeksiyon gelişen hastalarda hastanede yatış süresinin belirgin olarak uzun ve mortalitenin de yüksek olduğu görülmüştür.

Yorum: NYBU'de nozokomiyal enfeksiyon görülme oranları diğer yoğun bakımlarla benzerdir ve mortalite artışına neden olmaktadır. Bunun nedeninin altta yatan hastalıklarla ilişkili olmadığı, hastanede yatış süresinin uzunluğu ve enfeksiyon kontrol kurallarına yetersiz uyum olduğu kanısına varılmıştır.

Anahtar Kelimeler: Nörolojik Yoğun Bakım Ünitesi, nozokomiyal enfeksiyon

INTRODUCTION

Nosocomial infections in intensive care units (ICUs) are common and associated with high morbidity, mortality and hospital costs⁽¹⁵⁾. Although incidence of the ICUs infections vary from hospital to hospital and even between intensive care units, in about 30% of these patients, nosocomial infections have occurred^(10,14). Many factors such as age, underlying health status, acute disease process, invasive procedures, and infection control measures are the key factors for the development of infections in ICUs^(6,9). A few studies have investigated the relationship between nosocomial infections and underlying diseases of patients in neurological intensive care unit (NICU). The objective of this study was to identify overall and site-specific nosocomial infections and their associations with the underlying diseases of patients admitted to NICU.

MATERIAL AND METHODS

This observational prospective study was carried out on patients admitted to the neurological intensive care unit of Ege University Medical School Hospital between 1 January 2005 and 31 December 2005 with different neurological disorders.

The NICU at Ege University Medical School Hospital is an open unit with 12 bed. The ratio of physician:patient, and nurse: patient were 1:3 during the day shift. During the study periods patients were visited daily by Infectious Diseases and Clinical Microbiology specialist and Neurology specialist.

In this study all patients who were hospitalized for more than 24 h. and who were over 15 years of age were included. The patients who died within the first 24 h period or whose length of NICU stay was less than 24 h were excluded. The data was recorded on a form which was specially prepared for the surveillance of these patients. The record card was prepared to contain the following information; name and surname of the patient, age, sex, hospital protocol number, date of admittance and discharge from the hospital, the neurological diagnosis of the patient, the presence or absence of community-acquired and nosocomial infections on admission to the NICU, and diagnosis and prognosis of nosocomial infection during the study. Stroke patients were evaluated in terms of nosocomial infections according to their supratentorial or infratentorial localization of their lesions. The record card also contained a 15 days follow up of temperature, cardiac pulse, blood pressure, antibiotics used, laboratory findings such as routine haemogram, biochemistry and radiological study results, and invasive procedures and their duration, microbiological cultures and antimicrobial susceptibility test results. The patients were followed until death or up to the discharge from the NICU.

The diagnosis of intensive care unit (ICU) acquired infections were based on the criterion of Center for Diseases Prevention and Control (CDC) ⁽⁶⁾. An infection not present or incubating at admission to the ICU that occurred at least 24 h after admission to the ICU and on a different

site and with different microorganisms from the primary infection was called ICU-acquired infection.

ICU-acquired infection rates: These rates were calculated by dividing the total number of ICU infections by the total number of ICU patients (x100) and by patient-days (x1000), respectively. Device utilization ratio was calculated by dividing the number of device-days by the number of patient days and device associated infection rates was calculated by dividing the number of device-associated infections for a specific site by the number of device days (x1000).

The potential risk factors for NICU-acquired infections were recorded on admission and during the study periods. These factors were; the ages, gender, diagnosis on admission, presence of central venous catheter (CVC), urinary catheter, nasogastric catheter, intubation, mechanical ventilation (MV), length of ICU stay.

Data was analyzed with chi square and Student's t-tests. P values less than 0.005 were considered to be significant.

RESULTS

During this 12 months period, 356 patients were involved. Among these patients 185 (52%) were males and 171 (48%) were females, mean age was 65.8 ± 14.7 years. The diagnoses of the patients on admission are shown in Table-1. Total length of stay of 356 patients in the NICU was 2382 days and mean length of stay in the NICU of patients was 6.69 ± 6.74 .

One hundred and ten ICU-acquired infections were observed in 88 (24.7%) of 356 patients. The overall rate of ICU-acquired infection was 30.8/100 patients and 46.1/1000 patient-days. The characteristics of the patients both with and without ICU-acquired infections (AI) were shown in Table-2. No patients had nosocomial or community acquired infections on admission to the NICU. The nosocomial infections detected in the

NICU were; 54 (49.1%) urinary tract infection, 34 (30.9%) pneumonia 20, (18.2%) catheter related blood stream infection and 2 (1.8%) primary bacteremia consecutively. One infection in 67 patients, two infections in 20 patients, and three infections in 1 patient were observed.

Site-specific incidence rates and incidence densities were; 49.0 urinary tract infections per 100 patients and 59.3 urinary catheter-related urinary tract infections per 1000 urinary catheter days, 30.9 pneumonias per 100 patients and 58.4 ventilator-associated pneumonias per 1000 ventilator-days, 18.1 catheter related blood stream infections per 100 patients and 22.4 catheter related blood stream infection per 1000 central-line days and 1.8 primary bacteremia per 100 patients. ICU-acquired infections were most common in male gender (p: 0.001). ICU-AI were summarized in Table-3.

Site-specific incidence rates and incidence densities were; 49.0 urinary tract infections per 100 patients and 59.3 urinary catheter-related urinary tract infections per 1000 urinary catheter days, 30.9 pneumonias per 100 patients and 58.4 ventilator-associated pneumonias per 1000 ventilator-days, 18.1 catheter related blood stream infections per 100 patients and 22.4 catheter related blood stream infection per 1000 central-line days and 1.8 primary bacteremia per 100 patients. ICU-acquired infections were most common in male gender (p: 0.001). ICU-AI were summarized in Table-3.

The most common micro-organisms isolated were *Escherichia coli* (27.2%), *Acinetobacter baumannii* (16.3%), *Klebsiella* spp. (12%), coagulase negative staphylococci (12%), *Pseudomonas aeruginosa* (7.6%), *Staphylococcus aureus* (7.6%), *Enterobacter cloacae* (5.4%), *Candida* spp. (5.4%), *Enterococcus* spp. (4.3%) and *Proteus mirabilis* (2.2%) consecutively. In 17 patients nosocomial pneumonia were diagnosed based on the clinical and radiological findings.

Among stroke patients the incidence of NICU-AI were 29.1% in patients with

supratentorial localization of their lesions.
No differences were found in both groups

with supratentorial and infratentorial
localization in terms of NICU-AI.

Table 1. Diagnosis on admission

	N	%
Stroke	270	75.8
Encephalitis	25	7.0
Status epilepticus	23	6.5
Myelitis	12	3.4
Metastatic carcinoma	12	3.4
Myasthenia Gravis	5	1.4
Alzheimer Disease	3	0.8
Guillan Barré Syndrome	3	0.8
Amyotrophic lateral sclerosis	3	0.8

Table 2. The characteristics of the patients with and without ICU-acquired infections

	Patients		P	OR
	ICU-AI (+)	ICU-AI (-)		
N	88	268		
Male	54 (61.4%)	131 (48.9%)	0.06	1.66 [0.99 - 2.80]
Female	34 (38.6%)	137 (51.1%)	0.06	0.60 [0.36 - 1.01]
Age (mean±SD)	65.51±13.42	65.96±15.16		
Total length of stay	949 days	1433 days		
Mean length of stay	10.78±9.75	5.34±4.71	0.004	3.23 [1.38 - 7.74]
Mortality	29	54	0.02	1.95 [1.10 - 3.44]

*ICU-AI: Intensive care unit - acquired infections

Table 3. Neurological intensive care unit infections

	UTI	Pneumonia	CRBSI	Bacteremia	p	OR
N	54	34	20	2		
%	49.1	30.9	18.2	1.8		
< 60 years	13	12	7	0	0.9	0.99 [0.59-1.67]
≥ 60 years	41	22	13	2		
Male	32	24	11	-	0.001	2.13 [1.31-3.46]
Female	22	10	9	2		

*UTI: Urinary tract infection; CRBSI: Catheter related blood stream infections

Table 4. The characteristics of the stroke patients

	Total	Supratentorial	Infratentorial	P	OR
N	270	206	64		
Male	136 (50.4%)	100 (48.5%)	36 (56.3%)		
Female	134 (49.6%)	106 (51.5%)	28 (43.8%)		
Means of age	65.85±14.73	69.83±12.45	65.82±12.48		
Length of stay	6.88±6.46	7.14±6.24	6.04±7.13		
Length of stay	1859	1472	387		
NICU-AI					
UTI		31	9	0.99	1.00 (0.46-2.62)
Pneumonia		18	5	0.98	1.13 (0.37-3.65)
CRBSI		10	6	0.30	0.49 (0.16-1.60)
Bacteremia		1	1	0.96	0.31 (0.01-11.42)
Incidence of NI		29.1%	32.8%		
Length of stay	708	562	146	0.91	1.02 (0.80 – 1.29)
Incidence					
density of NI		10.6/1000	14.3/1000		
Exitus		45	17	053	077 (0.39-1.55)

*NI: Nosocomial infection

DISCUSSION

The surveillance studies regarding ICU infections have been under investigation worldwide. Different methods have been proposed and used for the surveillance. In this study the surveillance of NICU infections was both patient and laboratory based. Zollmann et al⁽¹⁷⁾. found that the incidence of infections in NICU was 18.5/100 and incidence density was 25.7/1000. In another study Dettenkofer et al⁽²⁾. declared the incidence and incidence density as 24.2/100 and 25.0/1000 respectively in NICU. When compared with these results the incidence and incidence density (30.8% and 46.9/1000) in the presented study were high.

Intensive care unit infections can affect any part of the body. Urinary tract infections, pneumonia, catheter related

blood stream infections and wound infections are the most frequent. Urinary tract infections are generally associated with the presence of a urinary catheter^(12,16). In this study UTI was the most common (49.1%) and total length of urinary catheterization was 1062 days. It is concluded that urinary catheter duration and ineffective catheter care could be the causes of the high incidence rate. Heckmann et al⁽⁷⁾ found that the incidence of pneumonia in NICU was 31.4%. Hilker et al⁽⁸⁾ reported a 21% pneumonia incidence in NICU in patients with stroke. In this study pneumonia was the second most frequent NICU infection (30.9%). Total length of ventilation was 90 days in the presented study. This higher rate can also be associated with inappropriate ventilator care. Pneumonia was diagnosed

in 14 patients with only clinical and radiological basis. It is thought that intubation and nasogastric use were the other predisposing factors of pneumonia.

The third most common NICU infection encountered in the presented study was catheter related blood stream infection. *S.aureus* and coagulase negative *Staphylococcus* were the most isolated microorganisms. The high incidence density was associated with the inappropriate catheter care since the duration of central catheter was short (65 days). Sherertz et al⁽¹³⁾. noted a decrease in incidence of catheter related blood stream infections with the infection control training course on the use of sterile procedures during the insertion of central catheter. Raad et al⁽¹¹⁾. declared that maximum sterile precautions lowered the rate of catheter related blood stream infections.

The diagnosis in two hundred and seventy patients (75.8%) was stroke and the rest were Encephalitis, Guillain Barre Syndrome, Myasthenia Gravis, Amyotrophic Lateral Sclerosis, Alzheimer Disease, Status Epilepticus and Myelitis. Stroke patients were evaluated according to their supratentorial (57.8 %) or infratentorial (17.8 %) localization of lesions. Eighty one NICU-acquired infections (AI) occurred in 270 patients. The rate of infection per 100 patients was 30 and per 1000 patient days 43.6. The most NICU-AI was urinary tract infection (14.8%). In univariate analysis, no differences were found between the patients with stroke and other NICU disorders in terms of risk factors for NICU-AI such as; age (p:0.9), gender (p:0.9), type of nosocomial infections (p:0.7), length of stay (p:0.9) and mortality (p:0.5). There was also no difference in terms of NICU infections in patients with stroke whose lesions were located supra or infratentorially located. In this study the most important differences between the patients with NICU-AI and without

nosocomial infections were mortality (p:0.02) and prolongation of hospital stay (p:0.004). The length of stay was three times prolonged and the rate of mortality was nearly two times higher in patients with NICU-AI.

In conclusion, the overall incidence of nosocomial infections was high in NICU. This was supposed to be associated with prolonged hospital stay and insufficient infection control measures. Prevention of ICU infections requires limiting transmission of organisms between patients in direct patient care through adequate handwashing and glove use, appropriate aseptic practice, and isolation strategies^(3,4). The importance of handwashing has been well demonstrated and ICU infections can be minimized with appropriate hand hygiene⁽¹⁾. Although compliance with handwashing is frequently suboptimal continuous education program about infection control aiming at NICU staff can be effective to lower the rate of infections.

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Received by: 22 April 2009

Revised by: 27 August 2009

Accepted: 01 September 2009

The Online Journal of Neurological Sciences (Turkish) 1984-2009

This e-journal is run by Ege University
Faculty of Medicine,
Dept. of Neurological Surgery, Bornova,
Izmir-35100TR

as part of the Ege Neurological Surgery
World Wide Web service.

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URL: <http://www.jns.dergisi.org>

Journal of Neurological Sciences (Turkish)

Abbr: J. Neurol. Sci.[Turk]

ISSNe 1302-1664

REFERENCES

1. Boyce JM, Pittet D. Guideline for hand hygiene in health-care settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *MMWR* 2002; 51[RR16]:1 – 44.
2. Dettenkofer M, Ebner W, Els T, Babikir R, Lueking C, Pelz K, Ruden H, Daschner F. Surveillance of nosocomial infections in a neurology intensive care unit. *J Neurol* 2001; 248: 959 – 964.
3. Edmond M. Isolation. *Infect Control Hosp Epidemiol* 1997; 18: 58 – 64.
4. Garner JS, Jarvis WR, Emori TG, Horon TC, Hughes JM. CDC definitions for nosocomial infections. In: Olmsted RN, ed: *APIC Infection Control and Applied Epidemiology: Principles and Practice*. St Louis: Mosby; 1996: pp. A1 – A20.
5. Garner JS, Hospital Infection Control Practices Advisory Committee. Guideline for isolation precautions in hospitals. *Infect Control Hosp Epidemiol* 1996; 17: 53 – 80.
6. Girou E, Stephan F, Novara A, Safar M, Fagon JY. Risk factors and outcome of nosocomial infections: results of a matched case-control study of ICU patients. *Am J Respir Crit Care Med* 1998; 157: 1151 – 1158.
7. Heckmann JG, Kraus J, Niedermeier W, Erbguth F, Druschky A, Schoerner C, Neundorfer B. Nosocomial pneumonias in a neurology intensive care unit. *Dtsch Med Wochenschr* 1996; 124: 919 – 924.
8. Hilker R, Poetter C, Findeisen N, Sobesky J, Jacobs A, Neveling M, Heiss WD. Nosocomial pneumonia after acute stroke: implications for neurological intensive care medicine. *Stroke* 2003; 34: 975 – 981.
9. McCusker ME, Perisse AR, Roghmann MC. Severity of illness markers as predictors of nosocomial infection in adult intensive care unit patients. *Am J Infect Control* 2002; 30: 139 – 144.
10. Morbidity and Mortality Weekly Report (MMWR). Monitoring Hospital-Acquired Infections to Promote Patient Safety-United States, 1990-1999.
11. Raad II, Hohn DC, Gilbreath BJ, Suleiman N, Hill LA, Bruso PA, Marts K, Mansfield PF, Bodey GP. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. *Infect Control Hosp Epidemiol* 1994; 15: 231 – 238.
12. Rosser CJ, Bare RL, Meredith JW. Urinary tract infections in the critically ill patient with a urinary catheter. *Am J Surg* 1999; 177: 287 – 290.
13. Sherertz RJ, Ely EW, Westbrook DM, Gledhill KS, Streed SA, Kiger B, Flynn L, Hayes S, Strong S, Cruz J, Bowton DL, Hulgán T, Haponik EF. Education of physicians in training can decrease the risk for vascular catheter infection. *Ann Intern Med* 2000; 132: 641 – 648.
14. Tasota FJ, Fisher EM, Coulson CF, Hoffman LA. Protecting ICU patients from nosocomial infections: practical Measures for Favorable Outcomes. *Critical Care Nurse* 1998; 18: 54 – 67.
15. Vincent JL. Nosocomial infections in adult intensive care units. *The Lancet* 2003; 361: 2068 – 2077.
16. Warren JW. Catheter-associated urinary tract infections. *International Journal of Antimicrobial Agents* 2001; 17: 299 – 303.
17. Zolldann D, Poetter C, Hilker R, Neveling M, Waitschies B, Klein W, Nolden-Koch M, Block F, Wenchel HM, Lemmen SW. Periodic surveillance of nosocomial infections in two neurology intensive care units. A valuable tool for quality management in intensive care. *Anaesthesist* 2003; 52: 690 – 696.