Acta Neurochir (Wien) (1999) 141: 1303–1308

Acta Neurochirurgica

Nosocomial Infections in a Neurosurgery Intensive Care Unit

M. Dettenkofer[1], W. Ebner[1], F.-J. Hans[2], D. Forster[1], R. Babikir[1], J. Zentner[2], K. Pelz[3], and **F. D. Daschner[1]**

[1] Institute of Environmental Medicine and Hospital Epidemiology, University Hospital Freiburg, Freiburg, Germany
[2] Department of Neurosurgery, University Hospital Freiburg, Freiburg, Germany
[3] Institute of Medical Microbiology, University Hospital Freiburg, Freiburg, Germany

Summary

In order to identify overall and site-specific nosocomial infection (NI) rates in patients receiving neurosurgical intensive care therapy, a prospective study was started in February 1997 in the eight-bed neurosurgical ICU of the University Hospital of Freiburg, Germany. Case records were reviewed twice a week, all microbiology reports were reviewed and ward staff was consulted. NI were defined according to the CDC-criteria and were categorised into specific infection sites. Within 20 months, 545 patients with a total of 5,117 patient days were investigated (mean length of stay: 9.4 days). 113 NI were identified in 90 patients (72 pts. with one, 13 with two and 5 with three infections, respectively). A moderate to high overall incidence (20.7/100 pts.) and a moderate incidence density (22.1/1,000 patient days) of NI in the neurosurgical ICU could be documented; these figures are well within the range of published data. Site specific incidence rates and incidence densities were: 1 bloodstream infection per 100 patients (0.9 central line-associated BSIs per 1,000 central line-days), 9 pneumonias per 100 patients (15.1 ventilator-associated pneumonias per 1,000 ventilator-days), 7.3 urinary tract infections per 100 patients (8.5 urinary catheter-associated UTIs per 1,000 urinary catheter-days). Additionally, 1.1 cases of meningitis, 0.7 brain abscesses/ventriculitis, and 1.7 other infections (surgical site infection, bronchitis, catheter related local infection, diarrhoea) were documented per 100 patients, respectively. 14.6% of isolated pathogens were E. coli, 10.2% enterococci, 9.6% S. aureus, 6.4% CNS, 6.4% Klebsiella spp., 5% Enterobacter spp. and 5% Pseudomonas spp.. In 11 cases of NI no pathogen could be isolated.

Keywords: Intensive care unit; neurosurgery; nosocomial infection; surveillance.

Introduction

A common problem in intensive care medicine is the high incidence of nosocomial infection (NI). Due to the severity of illness of the patients treated and the high number of medical devices used, in the case of surgical intensive care units (ICUs) the overall rates are as high as 36–54 per 1,000 patient-days [21]. In modern hospital infection control, surveillance as a programme involving the systematic collection, tabulation, analysis and feedback of data on the occurrence of NI (first introduced in the 1960s) is a common approach. However, various methods of surveillance have been applied and studied, which differ primarily in their method of data collection and performance as prevalence or incidence surveys [6, 7, 11, 12].

Surveillance of NI provides data which are useful for identifying patients who are infected, for determining the site of infection, and for identifying factors that contribute to the incidence of NI [13]. According to the 'Study on the Efficacy of Nosocomial Infection Control' (SENIC), organised surveillance and control activities, an adequate number of trained infection control staff, and a system for reporting infection rates (i.e. to surgeons) are essential for nosocomial infection control programmes to be effective [15].

Nosocomial infection rates are mainly dependent on the severity of illness and the exposure to invasive devices (especially use of ventilator, central venous catheters, urinary catheters). The US 'National Nosocomial Infections Surveillance' System (NNIS) provides regularly updated data on the use of these devices and on the incidence of NI associated with their use (pneumonia, bloodstream infection – BSI, urinary tract infection – UTI) [19]. Today surveillance according to this system is used in many countries, including Germany [14, 23, 24]. It's accuracy has been assessed in the USA [9].

For patients receiving neurosurgical intensive care there are particular risk factors (e.g. multiple trauma, head injury, and coma) of acquiring one or more nosocomial infections [1, 2, 16]. However, there are only very limited data available on the incidence of NI in

this ICU-setting in Europe. Therefore, in order to assess the incidence of NI and to identify overall and site-specific infection rates, a prospective study was started in February 1997 in the eight-bed neurosurgical ICU (NSICU) of the University Hospital of Freiburg, Germany (UHF). The UHF is a large German hospital with 1,700 beds. In 1997, 53,700 patients were admitted and the hospital had 5,490 employees.

Methods

Study Ward and Study Population

This prospective study was carried out on the eight-bed NSICU of the University Hospital of Freiburg. The NSICU is a referral centre that serves approx. 1.5 million people in South-West Germany. The main primary diagnoses of patients treated include intracranial bleeding and malformation, neoplasia, trauma (head or spinal cord injury), hydrocephalus, and infection. All patients with a stay of at least 24 hours were included in the survey. From February 14 1997, to October 10 1998, a total of 545 patients were enrolled.

Surveillance

The surveillance method used has previously been described in detail [7, 20]. A fully trained and experienced infection control practitioner visited the ward twice a week in the morning. General data obtained included name, age, sex, reason for hospitalisation and type of operation for all patients. Nursing notes, medical notes, microbiology reports, temperature charts and antibiotic treatment charts were reviewed to determine if a patient had symptoms and signs of infection. In addition, the nursing and medical staff were consulted if any queries regarding such symptoms and signs arose. The number of urinary catheter-days, central line-days, and ventilator-days were recorded. The surveyor filled out a worksheet for every patient (infected and not infected) and once a week these worksheets were reviewed together with a physician trained in infection control. Because of limited resources it was not possible to carry out a post-discharge follow-up.

Within the study period, the time required for data collection and analysis with this reference surveillance method was assessed in comparison with a selective method derived from the NNIS Intensive Care Unit (ICU) component [3].

Definition of Nosocomial Infection

All infections which occurred during the study period were categorised into specific infection sites using standard CDC-definitions that include clinical and laboratory criteria [10, 13]. In accordance with these definitions results of chest radiographs were taken into account for the diagnosis of nosocomial pneumonia. To classify an infection as nosocomial there must be no evidence that it was present or in the incubation at the time of admission to the ICU. Thus, each infection had to be assessed for evidence linking it to hospitalisation. Infections occurring at more than one site in the same patient were reported as separate infections.

Statistics

We calculated device utilisation ratios, site specific incidence rates per 100 patients, and site specific incidence densities per 1,000 days at risk (use of urinary catheter, central line, and ventilator, respectively) or per 1,000 patient days (see Fig. 1) [19].

$$\text{Device utilisation ratio (DU)} = \frac{\text{Number of device-days}}{\text{Number of patient days}}$$

$$\text{Device-associated infection rates} = \frac{\text{Number of device-associated infections for a specific site}}{\text{Number of device-days}} \times 1000$$

Fig. 1. Formulas used to calculate device utilisation ratios and device-associated infection rates [NNIS 1998]

Table 1. *Primary Diagnoses (545 Patients)*

Vascular malformations (VW)	204
– Aneurysmal subarachnoid haemorrhage (SAH)	104
– Arteriovenous malformations (AVM)	5
– Intracerebral bleedings (ICB)	71
– Others	24
Intracranial neoplasia (tumours) (IT)	158
Spinal lesions (SL)	64
– Spinal tumours (SPR)	28
– Spinal trauma (SPT)	15
– Others	21
Intracranial trauma (ICT)	27
Hydrocephalus (HYD)	22
Inflammatory disease (ID)	18
– Meningitis	8
– Brain abscess	7
– Others	3
Diverse neurological diseases (DIV)	52

Table 2. *Device Utilisation (DU) Ratios*

Urinary catheter utilisation	0.85 (urinary catheter-days/patient days)
Central line utilisation	0.88 (central line-days/patient days)
Ventilator utilisation	0.26 (ventilator-days/patient days)

Results

In the 20-month study period, 545 patients with a total of 5,117 patient days were investigated. Of these patients 295 were female and 250 male. The mean age was 56.7 years (range: 6–98) and the mean length of stay in the NSICU 9.4 days (range: 2–75). The patients' primary diagnoses are shown in Table 1.

Nosocomial Infections/Device Utilisation

The ratios for urinary catheter utilisation, central line utilisation, and ventilator utilisation are shown in Table 2.

A total of 113 nosocomial infections were identified in 90 patients (72 patients with one, 13 with two and 5 with three infections, respectively). The overall incidence of NI in the neurosurgical ICU was 20.7 per 100

Table 3. *NI in a German Neurosurgical ICU: Site Specific Incidence Rates and Incidence Densities (NNIS-Data for Comparison)*

Type of NI	No.	NI/100 patients	NI/1000 days at risk[X]	NNIS (median)	X
Bloodstream infection	5	1	0.9	4.4	$\frac{\text{central line-associated BSIs}}{1,000 \text{ central line-days}}$
Pneumonia	49	9	15.1	13.8	$\frac{\text{ventilator-assoc. Pneumonias}}{1,000 \text{ ventilator-days}}$
Urinary tract infect.	40	7.3	8.5	7.8	$\frac{\text{urinary catheter-assoc. UTIs}}{1,000 \text{ urinary catheter-days}}$
Meningitis	6	1.1	1.2	–	$\frac{\text{nosocomial infections}}{1,000 \text{ patient days}}$
Brain abscess/ventriculitis	4	0.7	0.8	–	$\frac{\text{nosocomial infections}}{1,000 \text{ patient days}}$
Others (surgical site infection, bronchitis, catheter related local infection, diarrhoea)	9	1.7	1.8	–	$\frac{\text{nosocomial infections}}{1,000 \text{ patient days}}$
All NI	113	20.7	22.1	–	$\frac{\text{nosocomial infections}}{1,000 \text{ patient days}}$

Table 4. *Primary Diagnoses (Patients with NI; n = 90)*

Vascular malformations (VM)	*44 (48.8%)*
– Aneurysmal subarachnoid haemorrhage (SAH)	24
– Intracerebral bleedings (ICB)	18
– Others	2
Intracranial neoplasia (tumours) (IT)	*16 (17.8%)*
Spinal lesions (SL)	*4 (4.4%)*
Intracranial trauma (ICT)	6 (6.7%)
Hydrocephalus (HYD)	*6 (6.7%)*
Inflammatory disease (ID)	*5 (5.6%)*
Diverse neurological diseases (DIV)	*9 (10.0%)*

patients and the incidence density 22.1 per 1,000 patient days. Site specific incidence rates (NI/100 patients) and incidence densities (NI/1,000 days at risk) are shown in Table 3. 29 of the 49 nosocomial pneumonias documented were not ventilator-associated. This figure corresponds to 59%.

As reported elsewhere in detail, the time required to collect data in the NSICU using the reference surveillance method and to analyse these data was calculated to be 150 minutes per week (3.3 h per 10 beds per week) [3].

As shown in Table 4, the primary diagnoses of patients with one or more nosocomial infections were mainly vascular malformations and intracranial tumours.

Microbiology

A total of 157 pathogenic micro-organisms were isolated, which are shown in descending order of frequency and related to the site specific infections (Table 5). In 11 cases of nosocomial infection no pathogen could be isolated (pneumonia: 3; meningitis: 3; UTI: 3; ventriculitis: 1, surgical site infection: 1).

Discussion

Information on the occurrence of nosocomial infections in neurosurgical intensive-care patients is limited. The most important database regarding this setting is provided by the US 'National Nosocomial Infections Surveillance'-system (NNIS) [19]. Pooled data of the surveillance activities (urinary catheter-associated UTI, central line-associated BSI, and ventilator-associated pneumonia) in participating US neurosurgical units are published annually (42, 41, and 41 units, respectively, with a total of 216, 562 patient-days [status 1998]).

Regarding the problem from a German (European) perspective, a retrospective analysis of 314 patients treated longer than 48 h in a neurosurgical ICU was performed by Laborde *et al.* [17], who recorded an infection rate of 36.3% (114 NI).

The study presented here was carried out to assess more detailed data on the incidence of nosocomial infection in patients receiving neurosurgical intensive-care. As a referral centre the study ward (NSICU of the University Hospital of Freiburg) represents one of the 40 institutions of its kind in Germany. The main primary diagnoses of the patients treated include vascular malformations, intracranial tumours, and spinal lesions (table 1). Patients with NI (table 4) also mainly suffered from vascular malformations (n = 44) and

Table 5. *Isolated Pathogens of Nosocomial Infections in the NSICU*

Pathogen	Total no. (%)	BSI	Pneumonia	UTI	Meningitis	Brain abscess ventriculitis	Other
E.coli	23 (14.6%)	0	3 (3.2%)	20 (48.8%)	0	0	0
Enterococci	16 (10.2%)	2 (28.6%)	4 (4.3%)	10 (24.4%)	0	0	0
S. aureus	15 (9.6%)	3 (42.8%)	10 (10.6%)	0	0	0	2 (33.3%)
CNS	10 (6.4%)	2 (28.6%)	0	2 (4.9%)	2 (66.7%)	2 (50.0%)	2 (25.0%)
Klebsiella spp.	10 (6.4%)	0	9 (9.6%)	0	0	0	1 (12.5%)
Enterobacter spp.	8 (5.1%)	0	7 (7.4%)	1 (2.4%)	0	0	0
Pseudomonas spp.	8 (5.1%)	0	6 (6.4%)	2 (4.9%)	0	0	0
Proteus spp.	7 (4.5%)	0	6 (6.4%)	1 (2.4%)	0	0	0
Streptococci	6 (3.9%)	0	5 (5.3%)	0	0	1 (25.0%)	0
H. influenzae	6 (3.9%)	0	6 (6.4%)	0	0	0	0
Acinetobacter	6 (3.9%)	0	5 (5.3%)	1 (2.4%)	0	0	0
Stenotrophomonas malt.	2 (1.3%)	0	2 (2.1%)	0	0	0	0
Serratia spp.	2 (1.3%)	0	1 (1.1%)	1 (2.4%)	0	0	0
Citrobacter spp.	2 (1.3%)	0	1 (1.1%)	0	0	0	1 (12.5%)
Bacteroides spp.	3 (1.3%)	0	3 (2.2%)	0	0	0	0
Corynebacterium spp.	2 (1.3%)	0	0	1 (2.4%)	0	1 (25.0%)	0
C. difficile	2 (1.3%)	0	0	0	0	0	2 (25.0%)
Hafnia alvei	1 (0.6%)	0	1 (1.1%)	0	0	0	0
Yeasts[a] (Candida spp.)	27 (17.4%)	0	25 (26.6%)	2 (4.9%)	0	0	0
Herpesvirus	1 (0.6%)	0	0	0	1 (33.3%)	0	0
Total (=100%)	155	7	94	41	3	4	8

[a] The majority of yeasts were isolated together with other microorganisms.

intracranial tumours (n = 16). Spinal lesions (n = 4) were represented less often.

A moderate to high overall incidence (20.7%) and a moderate incidence density (22.1/1,000 patient days) of NI in the NSICU was documented. These figures are well within the range of published data regarding the neurosurgical setting: 13.9% [5]; 36.3% [17]. Compared to data reported by NNIS, the device-associated infection rates (Table 3) were in the median range (pneumonia and UTI) or in the lower range (BSI: below the 10%-percentile) [19]. We found a moderate to high incidence of meningitis, brain abscess and ventriculitis. Data regarding these infections are probably recorded, but not published by NNIS.

In case of ventilator-associated pneumonia, Berrouane *et al.* [2] calculated a higher incidence density and device-utilisation ratio (30.5/1,000 ventilator-days; 0.76 ventilator-days/patient days). Given the comparably low device-utilisation ratio in our NSICU (0.26: 25% percentile NNIS-data), most cases of nosocomial pneumonia were not ventilator-associated (n = 29, see table 3) – a finding that was not expected. However, data regarding non ventilator-associated pneumonia in neurosurgical ICUs are not published by NNIS.

The very low incidence of bloodstream infections may be partly due to the fact that the majority of central venous catheters are in place for a short time only (less than one week) and that they may be used frequently in patients who are not critically ill (high device-utilisation ratio: >90% percentile NNIS-data). However, because blood cultures have been missed in some cases of a febrile episode of NSICU patients with a CVC in place, a certain underreporting is likely.

In addition, the fact that no post-discharge follow-up was performed in this study may have led to underreporting. However, patients who developed an NI after being discharged from the neurosurgical ICU were transferred back to the NSICU for control of this infection, and that it was then detected and categorised as nosocomial. Additionally, it has been shown previously that only approx. 11% of all ICU-associated NIs are missed if no post-discharge follow-up is undertaken, however because it is very labour-intensive, a follow-up cannot be recommended [14].

The distribution of the broad spectrum of micro-organisms isolated from patients with NI shows for the most part findings as expected (Table 5). However, there are only few published data for comparison representing neurosurgical ICUs [2, 17]. The relatively high figure of Enterococci (10%) mainly represents urinary tract infections (in UTI Enterococci are one of

the leading pathogens). All but one of the frequent Candida isolates (n = 25) in patients with pneumonia were isolated together with other micro-organisms and most likely represent contaminants in the tracheal aspirate.

It is common sense that in clinical practice total surveillance should be replaced by surveillance systems targeted to specific outcome objectives. This 'surveillance by objectives' has been adopted increasingly by US-hospitals and is practised in most European hospitals [7, 15]. With the reference surveillance method used in this study the time required for data collection in the NSICU and for data analysis (3.3 h per 10 beds per week) was more than four times higher than that required by a selective method [8] derived from the NNIS ICU-component (0.75 h per 10 beds per week) without compromising sensitivity and specificity in detecting device-related NI [3]. Since data collection is the most time-consuming element of surveillance, selective surveillance methods are the only realistic way for small infection control teams to operate on a daily basis and to optimise the cost-effectiveness of the process [6].

Because of the often severe consequences of NI in patients receiving intensive-care it seems reasonable to gain more insight on the occurrence of this problem in the neurosurgical setting. According to our findings, which are in concordance with data published in the literature [2, 5, 17, 19], the prevention of nosocomial pneumonia, not only in case of ventilator use, is a high priority objective in neurosurgical ICUs. All reasonable efforts will be made to further reduce the burden of NI to the patients, as well as the immense economic burden to the health care system [18]. To provide a firm base to implement effective measures of prevention, more detailed data regarding nosocomial infections in Neurosurgery intensive-care in Europe are needed.

Acknowledgment

The authors wish to thank Mrs. D. Lawrie-Blum for language assistance.

References

1. Antonelli M, Moro ML, Capelli O, De Blasi RA, D'Ennrico RR, Conti G, Bufi M, Gasparetto A (1994) Risk factors for early onset pneumonia in trauma patients. Chest 105: 224–228
2. Berrouane Y, Daudenthun I, Riegel B, Emery M-N, Martin G, Krivosic R, Grandbastien B (1998) Early onset pneumonia in neurosurgical intensive care unit patients. J Hosp Infect 40: 275–280
3. Boulétreau A, Dettenkofer M, Forster DH, Babikir R, Hauer T, Schulgen G, Daschner FD (1999) Comparison of effectiveness and required time of two surveillance methods in intensive care patients. J Hosp Infect 41: 281–289
4. CDC/NNIS (1991) Nosocomial infection rates for interhospital comparison: limitations and possible solutions. A report from the National Nosocomial Infections Surveillance (NNIS) System. Infect Contol Hosp Epidemiol 12: 609–621
5. Daschner FD, Frey P, Wolff G, Baumann PC, Suter P (1982) Nosocomial infections in intensive care wards: a multicenter study. Int Care Med 8: 5–9
6. Dettenkofer M, Daschner F (1996) Cost-effectiveness of surveillance methods. In: Emmerson AM, Ayliffe GAJ (eds) Surveillance of nosocomial infections. Baillieres Clin Infec Dis 3: 289–301
7. Emmerson AM (1995) The impact of surveys on hopital infection. J Hosp Infect 30 [Suppl] 30: 421–440
8. Emori TG, Culver DH, Horan TC *et al* (1991) National Nosocomial Infections Surveillance System (NNIS): description of surveillance methods. Am J Infect Control 19: 19–35
9. Emori TG, Edwards JR, Culver DH, Sartor C, Stroud LA, Gaunt EE, Horan TC, Gaynes RP (1998) Accuracy of reporting nosocomial infections in the intensive-care-units patients to the NNIS system: a pilot study. Infect Control Hosp Epidemiol 19: 308–316
10. Garner JS, Jarvis WR, Emori GT, Horan TC, Hughes JM (1988) CDC definition for nosocomial infections. Am J Infect Control 16: 128–140
11. Gastmeier P, Kampf G, Wischnewski N, Hauer T, Schulgen G, Schumacher M, Daschner F, Rüden H (1998) Prevalence of nosocomial infections in representative german hopitals. J Hosp Infect 38: 37–49
12. Gaynes RP (1997) Surveillance of nosocomial infections: a fundamental ingredient for quality. Infect Control Hosp Epidemiol 18: 475–478
13. Gaynes RP, Horan TC (1996) Surveillance of nosocomial infections. In: Mayhall CG (ed) Hospital epidemiology and infection control. Williams & Willkins, Baltimore, pp 1018–1031
14. Geffers C, Gastmeier P, Bräuer H, Daschner F, Rüden H (1998) Surveillance of ICU-associated infections: is the accuracy lower if no postdischarge follow up of patients is carried out? The Eighth Annual Meeting of the Society for Healthcare Epidemiology of America. (Abstract) 89
15. Haley RW, Culver DH, White JW *et al* (1985) The efficacy of infection surveillance and control programs in preventing nosocomial infections in U.S. hospitals. Am J Epidemiol 212: 182–205
16. Hong-Hao Hsieh A, Bishop MJ, Kubilis PS, Newell DW, Pierson DJ (1992) Pneumonia following closed head injury. Am Rev Respir Dis 146: 290–294
17. Laborde G, Grosskopf U, Schmieder K, Harders A, Klimek L, Hardenack M, Gilsbach JM (1993) Nosocomial infections in a neurosurgical intensive care unit. Anaesthesist 42: 724–731
18. McGuire A (1998) Burden and cost of LRTI: a methodologic overview. Inf Med [Suppl E] 15: 26–33
19. NNIS (1998) National Nosocomial Infections Surveillance (NNIS) System Report, Data Summary from October 1986-April 1998. Am J Infect Control 26: 522–533
20. Perl TM (1997) Surveillance, reporting, and the use of computers. In: Wenzel R (ed) Prevention and control of nosocomial infections, 3rd edn. Williams & Willkins, Baltimore, pp 127–161

21. Pittet D, Hernald L, Massanari RM (1992) The intensive care unit. In: Bennett JV, Brachmann PS (eds) Hospital infections. 3rd edn. Little and Brown, Boston, pp 405–430
22. Pottinger JM, Herwaldt LA, Perl TM (1997) Basics of surveillance – an overview. Infect Control Hosp Epidemiol 18: 513–527
23. Soule BM, Huskins WC (1997) A global perspective on the past, present, and future of nosocomial infection prevention and control. Am J Infect Control 25: 289–293
24. Starling CEF, Counto ORGA, Pinheiro SMC (1997) Applying the center for disease control and prevention and national nosocomial surveillance system methods in Brazilian hospitals. Am J Infect Control 25: 303–311

Comments

The manuscript provides a valuable contribution to the literature, describing the overall and site-specific nosocomial infections occurring in a neurosurgical intensive care unit. The study was well designed and conducted according to currently accepted methodology in reporting infection rates. Some reservations however are appropriate when interpreting the reported infection rates. As the authors correctly state in the discussion post-intensive care follow-up was not routinely performed and consequently underreporting may have occurred. Furthermore, the data should be viewed in relation to the specific patient population studied. In neurosurgical intensive care units commonly some patients treated are severely ill and die within 24 hours to a few days and others concern 24 hours short intensive care surveillance in the postoperative period. In these patients with short-term intensive care treatment nosocomial infections will probably not occur and consequently overall infection rates may be low. The low utilization rate for ventilator use (0.26) illustrates the specifics of the neurosurgical intensive care unit, including probably many patients who in other centers might have been treated in a high care unit. It is therefore difficult to relate the reported data to those from more general intensive care units.

Nevertheless, the authors are to be congratulated on a well conducted study, which may serve as an example for other units; standardized registration such as has been utilized by the authors is a prerequisite for efforts related to quality control.

A. Maas

In a prospective study the authors have analysed overall and site-specific nosocomial infection rates in a neurosurgical intensive care unit. A moderate to high overall incidence of 20.7/100 patients was noticed. Pneumonias and urinary tract infections were predominant, CNS infections were rare as were infections of the surgical sites.

Whereas there is considerable information about the incidence of nosocomial infections in general, anaesthesiological, surgical or medical intensive care units, only little is known about neurosurgical ICUs. Thus the paper gives valuable data which allow one to focus on prevention of nosocomial infections. Obviously pneumonias and urinary tract infections are most frequent. It would be interesting to see whether there will be changes if special attention is focussed on prevention of these complications in some years.

The distribution of primary diagnoses may not be representative for most neurosurgical ICUs. There is a strong preponderance of SAH and patients with intracerebral haematomas as well as intracranial tumours whereas there are only few patients with traumatic brain injury. It is well-known that such patients may even have a higher rate of nosocomial infections, since severely head injured patients often require longterm intubation and ventilation.

It would be interesting to learn when nosocomial infections appear and whether they are more frequently seen if patients are treated longer.

Furthermore one would like to learn whether these infections can be treated and "controlled", the impact of such infections on the general course of patients, on longterm morbidity and mortality.

A. Unterberg

Correspondence: Dr. med. M. Dettenkofer, Institute of Environmental Medicine and Hospital Epidemiology, University Hospital Freiburg, Hugstetter Str. 55; 79106 Freiburg, Germany.