

THE ASSESSMENT OF THE RISK FACTORS OF THE NOSOCOMIAL SEPTICAEMIA IN PATIENTS HOSPITALIZED AT ADULTS INTENSIVE CARE UNITS

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Abstract: Nosocomial bloodstream infections occur frequently in Intensive Care Units and are associated with recognized and unrecognized risk factors. The impact of these infections in the evolution of the serious ill patient has been extensively studied, with an attributed mortality rate ranging from 19% to 35%. Our main objective was to investigate the risk factors for the bloodstream infection in patients hospitalized at an Intensive Care Unit from an emergency clinical hospital. A prospective study was undertaken over a period of 4 years and 9 months. The overall incidence of nosocomial bacteraemia was 9, 7/1000 admissions. A multivariate model showed that only three factors were significantly and independently responsible for nosocomial bacteraemia: the length of intravascular catheterization ($P=0,0077$, $OR = 1,32$), the presence of other nosocomial infections ($P=0,0015$, $OR=28,67$), the length of urinary catheterization ($P = 0,02$, $OR = 1,12$). These results show that the factors which had most influence on the development of nosocomial bacteraemia were those factors associated with the treatment received by patients during their hospital stay.

Cuvinte cheie: septicemie nosocomială, factori de risc, proceduri invazive

Rezumat: Infecțiile nosocomiale ale torentului sangvin apar frecvent în unitățile de terapie intensivă și sunt asociate cu factori de risc cunoscuți sau necunoscuți. Impactul acestor infecții în evoluția bolnavului critic a fost intens studiată, având o rată atribuibilă de mortalitate care variază între 19% și 35%. Principalul nostru obiectiv a fost acela de a investiga factorii de risc pentru septicemia nosocomială la pacienți internați într-o unitate de terapie intensivă dintr-un spital clinic de urgență. A fost realizat un studiu prospectiv pe o durată de 4 ani și 9 luni. Incidența cumulativă a bacteriemiei nosocomiale a fost de 9,7/ 1000 internați. Pe un model de analiză multivariată am constatat că doar trei factori de risc au fost semnificativ și independent legați de bacteriemia nosocomială: durata cateterizării intravasculare ($P=0,0077$, $OR = 1,32$), prezența altor infecții nosocomiale ($P=0,0015$, $OR=28,67$), durata cateterizării vezicale ($P = 0,02$, $OR = 1,12$). Aceste rezultate arată că factorii care au cea mai mare influență asupra dezvoltării septicemiei nosocomiale au fost aceia asociați cu tratamentul primit de pacient pe durata spitalizării.

INTRODUCTION

Over the time, the nosocomial infections (NI) have been an important chapter of the infectious pathology, which has always developed together with the diversification of the medical assistances granted both to the ill and healthy man (1, 2 and 3).

In the United States of America, it is estimated that every year 194.000 patients (5‰) develop nosocomial bacteraemia and 75.000 of them die (4). The over estimated costs determined by these infections are about 28-86 billions of dollars. A lower rate of these bacteraemia, about 2, 8‰ was reported in Denmark (5).

The several intravascular medical devices (IMD) are essential for the modern methods of care, to give the intravenous fluids, blood products and medicines, for the nutritional support and for the hemodynamic monitoring (6). Although the bacteraemia of IMD are usually associated with signs and symptoms of sepsis, sometimes it is difficult to establish directly a bound between the uses of such device with the genesis of the nosocomial bacteraemia.

PURPOSE OF THE STUDY

The aim of the study is to achieve the identification of the main risk factors and to assess the magnitude of their occurrence in the nosocomial septicemia in intensive care units.

MATERIAL AND METHOD

The study was conducted between 01.01.2005 – 30.09.2009 by tracking patients hospitalized at ICU County Emergency Clinical Hospital Sibiu, who during hospitalization were diagnosed with nosocomial sepsis. **The criteria for inclusion in the study group** were: patients admitted during the services stated above, the minimum period of hospitalization at ICU and taken in consideration at risk is 48 hours; patient who during the hospitalization, presented clinical signs of septicemia, proven etiologically through positive blood culture of the micro-organisms which were not the cause in the relation with other patient's infections, when he is hospitalized at ICU. **The exclusion criteria of the study group** were: patients with pseudo-bacteraemia (transitory bacteraemia, or supra-infection of collected sample or transported incorrectly); the patients with positive blood culture for the germs which are the cause of the infections which are already present at the hospitalization in

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ICU or in patients at whom the septicaemia started in the first 48 hours from the hospitalization.

Based on these criteria, during the studied period, we identified a number of **32 patients with nosocomial septicaemia, who constituted the study group.**

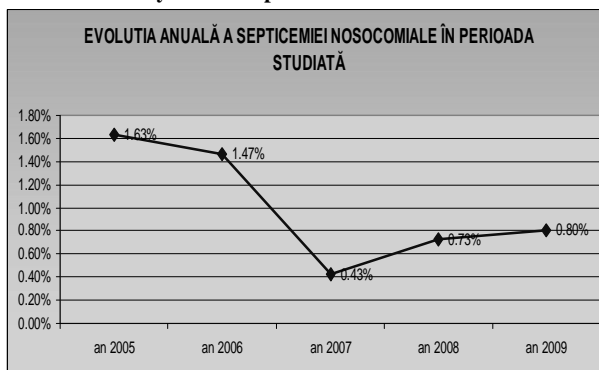
The group was constituted of 32 patients (matched controls) who were hospitalized in the same time at ICU, Emergency County Hospital of Sibiu, who did not have nosocomial septicaemia and whose main criterion of "matching" with the study group was **the similar diagnosis when they were hospitalized.**

The data of interest were pointed out from the patients' case report forms, which were supplemented by the analyses from the laboratory and radiological and imagistic analyses: age, sex, period of hospitalization before admission to ICU, the ICU period of hospitalization (for batch study – number of days until the onset of the septicaemia), the presence of death, if any, the use of the antibiotics before the hospitalization in ICU, the presence of trauma, the presence of surgery, data on ventilator support (presence, duration), the central venous catheterization data (presence, duration and number of catheters mounted during hospitalization in ICU), bladder catheterization data (presence and duration during hospitalization in ICU), the presence of anaemia, the concomitant presence of other infections during hospitalization in ICU. The results were statistically analyzed by applying the tests of comparison between the variables presented in the two groups (Student T test or Wilcoxon, Fisher test), Spearman test to evaluate the correlations between this septicaemia and the risk studied factors, the logistic regression test to quantify the magnitude of the association between sepsis and those potential risk factors.

RESULTS

A number of 3297 of patients were hospitalized and whose minimum period of hospitalization was 48 hours in the ICU section, in the period January 2005-September 2009. Respecting the case definitions, in this period we identified a number of 32 de septicaemias. The incidence of the nosocomial septicaemia in the studied period was of **0.97% (or 9.7 cases per 1,000 hospitalized persons)**. The annual trend of the evolution is presented in Fig No.1

Figure no. 1. The Incidence of the Nosocomial Septicaemia between January 2005 – September 2009



The average interval until the beginning of the septicaemia was of **13, 98±8, 3 days** from the moment of the hospitalization.

The compared variables at the cases batch and at the witness batch are gathered in the grid 1.

We calculated the coefficients of Spearman correlation

to appreciate the correlations between the presence of the septicaemia and the potential risk factors (grid 2).

Table no 1. The main compared variables at the two batches and the statistical signification

Variable	Cases Batch (N=32)	Witness Batch (N=32)	P (T student test/ Wilcoxon, Fisher test)
Age	55,96 ± 18,66 a	58,81± 17,02 years	P=0,55
The number of the days of the hospitalization before the internment in the ICU section	1,098±2,95 days	1,56±5,63 days	P=0,84
The total number of days of hospitalization in ICU (until the beginning of the septicaemia, in the case of study batch)	20,81±10,97 days	8,93±6,72 days	P<0,0001
Patients with antibiotic treatment a the hospitalization in ICU (%)	34,3%	31,25%	P=1,00
Present ventilator support (%)	87,5%	81,25%	P=0,73
The length of the ventilator support	8,4 ±9,74 days	3,34 ±3,13 days	P=0,006
The presence of the Central venous catheter (CVC) (%)	75%	34,37%	P=0,002
The total number of mounted catheters	30	15	P = 0,0014
The length CVC	10,84± 8,78 days	1,81 ± 3,17days	P<0,0001
The present urinary survey (%)	96,87%	93,75%	
The length of the urinary catheter	19,68±10,89 days	8,12±7,005 days	P < 0,0001
Registered deaths (%)	50%	25%	P=0,06
Other nosocomial infections (appeared before the hospitalization in ICU or during the hospitalization but before the septicaemia and without any cause relation with it) (%)	56,25%	9,37%	P= 0,0001
Present anaemia (%)	34,37%	15,62%	P = 0,14

Table no 2. The main correlations between the presence of the septicaemia and the studied risk factors

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The studied correlation	The size of the batch (N)	Spearman coefficient of correlation (rho)	Level of statistical significance (P)	95% interval of confidence for rho
Septicaemia – the length of the hospitalization before ICU	64	-0,056	0,65	-0,297 la 0,193
Septicaemia – total number of days of hospitalization in ICU	64	0,557	P<0.0001	0.361 la 0.706
Septicaemia - death	64	0,191	P=0.1297	- 0.058 to 0.417
Septicaemia – antibiotic-therapy at the hospitalization in ICU	64	0,033	P=0.7917	- 0.214 la 0.277
Septicaemia – the presence of the ventilator support	64	0,086	P=0.4945	- 0.163 la 0.325
Septicaemia – the length of the ventilator support	64	0,219	P=0.0820 *	- 0.028 la 0.441
Septicaemia – CVC	64	0,411	P=0.0011	0.184 la 0.597
Septicaemia – number CVC	64	0,373	P=0.0031	0.140 la 0.567
Septicaemia – length CVC		0,570	P<0.0001	0.377 la 0.716
Septicaemia – the presence of the urinary survey	64	0,129	P=0.3055	- 0.121 la 0.363
Septicaemia – the length of the urinary survey	64	0,562	P<0.0001	0.367 la 0.710
Septicaemia – other nosocomial infections	64	0,499	P=0.0001	0.289 la 0.664
Septicaemia- anaemia	64	0,217	P=0.0857 *	- 0.031 la 0.439

* *Tendency of statistical signification*

Further on, through a type obtained from the method of the logistical regression, I studied the risk represented by the invasive manoeuvres done at the patients without taking in consideration the presence of other infections at the patient (grid 3).

Table no. 3. The statistical analysis of the relation septicaemia – the length of the invasive manoeuvres

Nosocomial septicaemia	Coefficient	Standard error	P	Odds ratio	95% CI
Length _ CVC	0.2199	0.0835	0.0085	1.2460	1.0578 la 1.4676
Length _ urinary survey	0.0867	0.0458	0.0581 *	1.0906	0.9970 la 1.1930
Length _ ventilator support	0.1017	0.0701	0.1468	1.1070	0.9650 la 1.2699
Constantly	-2.6100				
Length _ ventilator support	0.1017	0.0701	0.1468	1.1070	0.9650 la 1.2699
Constantly	-2.6100				
DF					3
Level of statistical signification of the type					P < 0.0001

* *Tendency of statistical signification*

The risk of these invasive manoeuvres is even bigger if in the type of regression is also introduced the variable represented by other infections at the same patients (grid 4).

Table no. 4. The statistical analysis of the relation septicaemia – length of the invasive manoeuvres and the presence of other infections at the patient through logistical regression

Nosocomial septicaemia	Coefficient	Standard error	P	Odds ratio	95% CI
Length _ CVC	0.2780	0.1043	0.0077	1.3204	1.0763 la 1.6200
Length _ urinary survey	0.1187	0.0530	0.0252	1.1261	1.0149 la 1.2494
Length _ ventilator support	-0.0032	0.0837	0.9691	0.9968	0.8459 la 1.1745
The presence of other NI	3.3561	1.0549	0.0015	28.6779	3.6274 la 226.7254
Constantly	-3.7270				
DF					4
Level of statistical signification of the type					P < 0.0001

DISCUSSIONS

Bacteraemia is associated not only with a high rate of mortality but also with an increased morbidity and additional costs of hospitalization (7, 8), the accurate and rapid diagnosis being essential in such situations. The later the therapy starts, the more difficult is the patient's healing (9), therefore it seemed to be important to identify those clinical conditions that may alert the clinicians about the risk of sepsis.

In this study, conducted over a period covering almost 5 years, I found that the incidence of the nosocomial septicaemia in ICU was of 9.7 / 1,000 hospitalizations. By comparison, a study done in the United States in the community hospitals reported incidents ranged from 3.4 / 1,000 and 10.3 / 1,000 hospitalizations (10), and another study conducted in hospitals in Denmark showed rates of 2, 8 / 1000 (5).

The nosocomial septicaemia resulted in **50% of cases** with death; we have decided to analyze the causal link between sepsis and death, but we found that there was a significant difference in death rate in patients with sepsis and the death rate in those without sepsis hospitalized in ICU in the same period (P

= 0.06). In this study, **the total number of days of hospitalization in ICU** at the control group was significantly lower than those of cases with sepsis (considering only the risk range, i.e. UNTIL the onset of the septicaemia) ($P < 0.0001$).

Another studied variable, which is the health of the hospitalized patient, was the presence of anaemia: the relationship anaemia - blood poisoning tends to be significant ($P = 0.08$).

From the risk of invasive manoeuvres, we considered the intubations and the mechanical ventilation, the central venous catheterization and the urinary survey.

For the mechanical ventilation, we found that the risk is not according to its presence but to its length, being a positive correlation and statistically significant trend in this respect ($P = 0.08$). The same thing is true for the urinary survey, its extended length being significantly correlated with the risk of sepsis ($P < 0.0001$). Regarding the central venous catheterization, its **presence, the length and number of fitted catheters** correlate with the presence of septicaemia ($P = 0.0011$, $P = 0.0031$, respectively $P < 0.0001$).

A significant correlation, which maintained its significance even after the adjustment for other variables in the analysis through logistic regression, was the presence of sepsis and other infections in patients at the time of internment or during internment in ICU (not related directly with septicaemia). These infections were pneumonia, urinary infections, surgical wound infections and meningitis, diseases that represent a key trigger of the inflammatory response of the infected host, the response that depends on the elimination of pathogens. Any additional invasive manoeuvres can result in an excessive inflammatory response associated with the inability to effectively eliminate other potential pathogens, with the consequent impairment of the tissue, which ultimately leads to disease. In the logistic regression analysis, I found that the major risk of sepsis depends on the concomitant presence of other infections ($OR = 28.67$, $P = 0.0015$), but also on the duration of the central venous catheterization ($OR = 1.32$, $P = 0.077$) and bladder catheterization ($OR = 1.12$, $P = 0.025$) of these patients.

CONCLUSIONS

1. The incidence of nosocomial septicaemia during the studied period was 9.7 cases per 1000 admissions, a level comparable to that seen in other specialized studies in developed countries. The average interval from admission to the onset of the septicaemia was about 2 weeks.
2. The number of deaths in patients who were hospitalized in ATI and were diagnosed with nosocomial sepsis was higher than in those without sepsis, the difference having a statistical significance ($P = 0.06$). The simple statistical analysis of the correlations between the presence of septicaemia and possible risk factors points out the existence of the statistically significant relationships between: sepsis and the presence and length of the central venous catheterization ($P = 0.002$, respectively $P < 0.0001$), the length of the urinary bladder ($P < 0.0001$), the length of the mechanical ventilation ($P = 0.006$), the length of the hospitalization in ATI ($P < 0.0001$), the concomitant presence of other infections in patients ($P = 0.0001$), the sepsis-anaemia relationship tends to be statistical ($P = 0.08$).
3. In patients who have in the same time other infections, the risk of nosocomial septicaemia is significantly influenced by the length of the central venous catheterization and of the urinary survey ($OR = 1.32$, $P = 0.0077$ for CVC and $OR = 1.12$, $P = 0.025$ for the length of the urinary survey).

BIBLIOGRAPHY

1. Ivan, A. Infecții nosocomiale: trecut, prezent și viitor. Bacteriologia, virusologia, parazitologia, epidemiologia.- 1994, Vol.39.-Nr.3-4 : 161-167
2. Azoică D., Corcaci DC., Mitrofan C., Ivan A. Risk Factors in surgery Rev Med Chir Soc Med Nat Iași, 2003, Vol.107, Nr.1, :163-172
3. Dimitriu Șt., Teodorovici G. Infecțiile nosocomiale. În: Boli infecțioase și epidemiologie, Litografia UMF Iași, 1986, : 553-556.
4. Maki DG., Nosocomial bacteremia. An epidemiologic overview, Am J Med. 1981 Mar;70(3):719-32
5. Jensen AG, Kirsten A, Jensen I, Scheibel J, Espersen F, A 6-month prospective study of hospital-acquired bacteremia in Copenhagen County, Scandinavian J of Infectious Diseases, 1996, vol 28, nr 6, : 601-608
6. Christopher J. Crnich, Dennis G. Maki, The role of Intravascular Devices in Sepsis, Current Infectious Disease Reports 2001, 3: 496-506
7. Rose R, Hunting KJ, Townsend TR, Wenzel RP. Morbidity/mortality and economics of hospital-acquired blood stream infections: a controlled study. South Med J 1977, 70: 1267-1269.
8. Scheckler WE, Bobula JA, Beamsley MB, Hadden ST. Bloodstream infections in a community hospital: a 25-year follow-up. Infect Control Hosp Epidemiol 2003, 24: 936-941
9. Takuhiro Yoshida, Kenji Tsushima, Ayako Tsuchiya, Noriko Nishikawa, Kumiko Shirahata, Kazuma Kaneko, Ken-ichi Ito, Hirotaka Kawakami, Shinichi Nakagawa, Toshiro Suzuki, Keishi Kubo and Shuichi Ikeda, Risk Factors for Hospital-acquired Bacteremia, Internal Medicine, Vol. 44 (2005) , No. 11 :1157-1162
10. W.Scheckler, W.Scheibel, D.Kresge Temporal trends in septicemia in a community hospital, The American Journal of Medicine 1991, Volume 91, Issue 3,: S90-S94.