Rev. Inst. Med. trop. S. Paulo
39 (6): 333-336, November/December, 1997

RELATIVE FREQUENCY OF NOSOCOMIAL MICROORGANISMS AT UNICAMP UNIVERSITY HOSPITAL FROM 1987 TO 1994

Antonia Teresinha TRESOLDI, Maria Luíza Moretti BRANCHINI, Djalma de Carvalho MOREIRA FILHO, Maria Clara PADOVEZE, Sonia P. Evangelista DANTAS, Luciene REGINATO, Angela von NOWAKONSKI, Ulysses Moraes de OLIVEIRA & Plínio TRABASSO

SUMMARY

The frequency of microorganisms identified in nosocomial infections at Unicamp University Hospital from 1987 to 1994 was analysed. The most common microorganism was *S. aureus* (20.9%), which was found in surgical wound, bloodstream and arterial-venous infections. In urinary tract infections (UTI), gram-negative rods (56.5%) and yeasts (9%) predominated. *A. baumannii* isolates were observed to have increased in the last three years. There was a gradual increase in the frequency of coagulase-negative staphylococci and *A. baumannii* in bloodstream infections but there wasn't any change in *Candida sp.*

KEYWORDS: Nosocomial infections; Pathogens; Microorganisms.

INTRODUCTION

The spectrum of nosocomial microorganisms varies among hospitals and depends greatly on the severity of the infection, on the patients' immunity, on the use of broad-spectrum antibiotics and on the agressivity of the diagnostic and therapeutic procedures employed. Knowledge acquired about the relative frequency of nosocomial pathogens may help the clinician treat his patients empirically until the causative agent is isolated. In this context an understanding the principal sites of nosocomial infections is important for the effective treatment.

During the last decade, the predominant microorganisms isolated from nosocomial infection have been gram-positive bacteria and yeasts, specially from bloodstream infections[1, 11, 14]. There has also been an increase in the incidence of multiresistant gram-negative rods[2].

In this report we have examined the relative incidence of the various microorganisms identified in nosocomial infections at Unicamp University Hospital from 1987 to 1994.

METHODS

Unicamp University Hospital is a regional reference center which, during the period of this study increased its capacity from 200 to 400 beds, including the intensive care units (20 beds for adult patients and ten beds for children) and bone marrow transplantation wards (10 beds activated in September 1993). The hospital does not care for Gynaecology, Obstetric and Neonatology patients.

The Nosocomial Infections Control Committee (NICC) carries out active surveillance of nosocomial infections for all of the beds and currently includes three nurses and one infectologist, all of whom are under full-time employment. The Committee has been responsible for the control of antibiotics in the hospital since October, 1989. All material for culturing is processed in the hospital's microbiology laboratory which then reports the results directly to the NICC. The diagnosis of nosocomial infection in this study was based on the criteria proposed by the CDC[3, 4]. The microorganisms identified in respiratory secretions were not considered as etiologic agents and have therefore not been included here. All A-V (arterial-venous) infections were related to vascular site (purulent drainage) and intravascular cannulas tips. All microorganisms were identified by classical identification according to Manual of Clinical Microbiology (American Society for Microbiology). Blood samples were inoculated in blood culture bottles with Brain Heart Infusion agar and broth (Castañeda method).

It was done a retrospective analysis of the diagnosed infections and the isolated microorganisms at each site.

The Nosocomial Infection Control Committee. University Hospital, Microbiology Laboratory, Faculty of Medical Sciences, State University of Campinas (UNICAMP) 13081-970 Campinas, SP, Brazil.
Correspondence to: Antonia Teresinha Tresoldi. Rua José Paulino, 1875 apto. 43A, Guanabara 13013-002 Campinas, SP, Brasil.

RESULTS

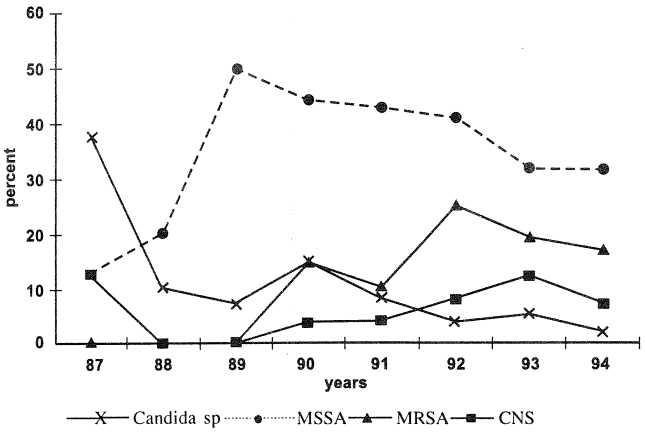
During the eigth year period examined in this study 3246 pathogens were identified. Table I shows the microorganisms isolated from four sites which where the most frequently infected. Each site might have more than one agent.

The most isolated organism was *S. aureus* (20.9%), the frequency of which was almost double that of *P. aeruginosa* (12.9%) if the *MRSA* were included (20.9%). *E. coli* was found in 11.7% of the isolates and enterococci in 9.7%. Surgical wound, bloodstream and artery-venous infections had similar profiles of Gram-positive and Gram-negative bacteria but differed from the profile for urinary tract infections. The most frequent organisms in surgical wound infections were *S. aureus* (17.5%) and enterococci (16.5%). In bloodstream infections, *S. aureus* predominated (35.2%) and in arterial-venous infections *S. aureus* (27.2%) and coagulase-negative staphylococci (16.9%) were the most common. In urinary tract infections, the most isolated pathogens were Gram-negative rods (*P. aeruginosa* 22.1%, *E. coli* 20.4% and *Klebsiela* sp 14.0%) and yeasts (9.0%).

Table 2 shows the relative frequency of the microorganisms isolated during each year. In 1991 and 1992, there was an increase in Gram-positive and a decrease in Gram-negative organisms compared to the other years (Table 2).

The frequency of MRSA peaked in 1992 and over the years accounted for 22.2% (1990), 42.0% (1991), 59.7% (1992), 54.3% (1993) and 53.2% (1994) of the total *S. aureus* isolates. Enterococci constituted the second most isolated agent in 1992 and 1994. Coagulase-negative staphylococci increased in relative frequency to became the fourth most isolated agent in 1993. There was a decrease in the relative frequency of *E. coli*, *Klebsiela* sp and *Proteus* sp and an increase in the occurrence of *A. baumannii*. There was no increase in yeast isolated during the eight year period. In all of the nosocomial sepses there was a predominance of both meticillin-sensitive and meticillin-resistant strains (Fig 1).

Fig. 1 – Etiologic agents of bloodstream infections at Unicamp University Hospital from 1987 to 1994.



MSSA: Methicillin-sensitive *S. aureus*; *MRSA:* Methicillin-resistant *S. aureus*; CNS: Coagulase-negative Staphylococci.

TABLE 1

The source of microorganisms identified in nosocomial infections, at Unicamp University Hospital from 1987 to 1994.

Microorganisms	Urine	Wound	Blood	A-V	Others	Total
Gram positive	**77(11.6)***	**516(44.0)**	**157(46.9)**	**279(54.3)**	**226(40.2)**	**1255(38.7)**
S. aureus	26(3.9)	139(11.8)	67(20.0)	85(16.5)	104(18.5)	421(13.0)
MRSA	9(1.3)	98(8.4)	51(15.2)	55(10.7)	44(7.8)	257(7.9)
CNS	11(1.7)	48(4.1)	24(7.2)	87(16.9)	28(5.0)	198(6.1)
Enterococci	27(4.1)	194(16.5)	5(1.5)	38(7.4)	50(8.9)	314(9.7)
Others	4(0.6)	37(3.2)	10(3.0)	14(2.7)	0	65(2.0)
Gram negative	**525(79.3)**	**622(53.0)**	**160(47.7)**	**219(42.6)**	**305(54.3)**	**1831(56.4)**
E. coli	135(20.4)	125(10.7)	32(9.6)	26(5.1)	62(11.0)	380(11.7)
P. aeruginosa	146(22.1)	123(10.5)	31(9.2)	52(10.1)	67(11.9)	419(12.9)
Enterobacter spp	58(8.8)	122(10.4)	29(8.6)	35(6.8)	40(7.1)	284(8.8)
Klebsiela spp	93(14.0)	61(5.2)	24(7.1)	30(5.8)	73(13.0)	281(8.7)
Proteus spp	32(4.8)	62(5.3)	5(1.5)	7(1.4)	15(2.7)	121(3.7)
Serratia spp	17(2.6)	15(1.2)	9(2.7)	12(2.3)	10(1.8)	63(1.9)
A. baumannii	28(4.2)	58(4.9)	20(6.0)	45(8.8)	37(6.6)	188(5.8)
Others	16(2.4)	56(4.8)	10(3.0)	12(2.3)	1(0.2)	95(2.9)
Yeasts	60(9.1)	35(3.0)	18(5.4)	16(3.1)	31(5.5)	160(4.9)
Total	**662**	**1173**	**335**	**514**	**562**	**3246**

* nº (percent)

MRSA: Methicillin-resistant *S. aureus*; *CNS*: Coagulase-negative staphylococci; A-V: arterial-venous infections.

TABLE 2
The microorganisms identified from nosocomial infections at Unicamp University Hospital from 1987 to 1994.

Microorganisms	1987*	1988	1989	1990	1991	1992	1993	1994
Gram positive	**48(29.8)#**	**147(36.8)**	**91(33.5)**	**71(36.4)**	**209(46.8)**	**220(46.9)**	**225(38.4)**	**244(34.0)**
S. aureus	28(17.4)	68(17.0)	57(21.0)	42(21.5)	76(17.0)	50.0(10.6)	48(8.2)	52(7.3)
MRSA	0	0	0	12(6.2)	55(12.3)	74(15.8)	57(9.7)	59(8.2)
CNS	9(5.6)	21(5.3)	6(2.2)	4(2.1)	25(5.6)	32(6.8)	58(9.9)	43(6.0)
Enterococci	8(5.0)	47(11.8)	26(9.5)	13(6.7)	45(10.1)	54(11.5)	45(7.7)	76(10.6)
Others	3(1.9)	11(2.8)	2(0.7)	0	8(1.8)	10(2.1)	17(2.9)	14(1.9)
Gram negative	**107(66.5)**	**239(59.9)**	**171(62.9)**	**109(55.9)**	**212(47.4)**	**220(46.9)**	**332(56.6)**	**441(61.5)**
E. coli	31(19.2)	56(14.0)	35(12.9)	28(14.4)	48(10.7)	50(10.7)	67(11.4)	65(9.1)
P. aeruginosa	26(16.1)	61(15.3)	41(15.1)	26(13.3)	44(9.8)	40(8.5)	67(11.4)	114(15.9)
Klebsiela spp	25(15.5)	43(10.8)	33(12.1)	30(15.4)	31(6.9)	30(6.4)	43(7.3)	46(6.4)
Enterobacter spp	9(5.6)	44(11.0)	29(10.7)	11(5.6)	37(8.3)	36(7.7)	52(8.9)	66(9.2)
Proteus spp	10(6.2)	23(5.8)	18(6.6)	7(3.6)	15(3.4)	12(2.6)	13(2.2)	23(3.2)
A. baumannii	2(1.3)	8(2.0)	6(2.2)	5(2.5)	10(2.2)	26(5.5)	59(10.1)	72(10.0)
S. marcecens	3(1.9)	4(1.0)	4(1.5)	0	7(1.6)	11(2.3)	8(1.4)	26(3.6)
C. freundii	0	0	5(1.8)	0	10(2.2)	7(1.5)	10(1.7)	8(1.1)
Others	1(0.6)	0	0	2(1.0)	10(2.2)	8(1.7)	13(2.2)	21(2.9)
Yeasts	**6(3.7)**	**13(3.3)**	**10(3.6)**	**15(7.7)**	**26(5.8)**	**29(6.2)**	**29(5.0)**	**32(4.5)**
Candida spp	6(3.7)	13(3.3)	10(3.6)	15(7.7)	26(5.8)	28(6.0)	25(4.3)	30(4.2)
Others	0	0	0	0	0	1(0.2)	4(0.7)	2(0.3)
Total	**161**	**399**	**271**	**195**	**447**	**469**	**586**	**717**

* May to December only.
# nº (percent); *MRSA*: Methicillin-resistant *S. aureus*; CNS: Coagulase-negative staphylococci.

There was a relative decrease in *Candida* sp in bloodstream infections and a gradual increase of coagulase-negative staphylococci and *A. baumannii* (Fig 1).

DISCUSSION

The most striking change in relative frequencies during the years examined here was the decrease in Gram-negative rods in 1991 and 1992. The increase in Gram positive organisms was probably related to the spread of MRSA throughout the hospital during these two years. This epidemic appears to have been brought under control after 1992 when the frequency of Gram-negative bacteria returned to pre-1991 levels. In contrast to previous report[6,14] *S. aureus* predominated in almost every year examined.

There was a slight increase in the relative frequency of coagulase-negative staphylococci as previously reported by others[1, 11, 14]. This rise was most noticeable in bloodstream infections and may be probably explained by increase in the number of patients using intra-venous devices in the latter years under investigation.

Some Gram-negative rods (*E. coli*, *Klebsiela* sp and *Proteus* sp) showed a relative decrease also described elsewehere[1,11,14] and were probably replaced by bacteria most resistant to antibiotics, including *P. aeruginosa*, *A. baumannii*, and *Enterobacter* sp. There was a significant increase in *A. baumannii* as an etiologic agent of nosocomial infections in general at all of the sites analysed. This species was the second and third most isolated microorganism in 1993 and 1994 respectively. This situation is similar to that of other hospitals where this bacterium has been identified as a nosocomial agent[7, 10]. One of the major problems with *A. baumannii* is its high resistance to antibiotics.

There were notable differences in the microorganisms responsible for urinary tract infections compared to infections at other sites. Gram-negative rods (*Enterobacteriaceae* and *Pseudomonas*) predominated in the former which frequently involved the urethral and perineal agents[13]. This result is similar to that of other reports[5], including those indicating that *Candida* sp also cause urinary tract infections[11].

The agents involved in surgical infections varied with the type of surgery. NICHOLS[9] suggests that in surgery classified

as clean there is a predominance of bacteria derived from the patient's skin flora with *S. aureus* being the usual cause of infections. For other types of surgery the bacteria would most likely derive from endogenous microflora of the surgically resected organ. The latter situation would explain the observations above on the predominance of *S. aureus*, enteric Gram-negative rods and enterococci in surgical infections.

Infections related to the use of intra-venous devices were caused mainly by staphylococci, both coagulase-negative and coagulase-positive, as has been observed by others[8]. The increase in the frequency of *P. aeruginosa* and *A. baumannii* probably reflect the greater recognition of these two agents as nosocomial pathogens in the hospital.

In nosocomial sepses, the microorganisms responsible were similar to those reported by others but with some differences. Coagulase-negative staphylococci was the fifth most isolated agent in contrast to other investigations in which they were the most identified[11]. However, there was an increase in their frequency during more recent years. A similar increase was not seen with *Candida* sp. We have no plausible explanation for the low frequency of isolations and the lack of change in the occurrence of this yeast throughout the years. Yeasts, especially *Candida* sp, have been increasing recognized as etiologic agents of nosocomial infections[11, 14].

Some reports have shown etiologic differences among sites and also among hospital units[6, 14]. Units differences in the hospital is also noted regarding to multiresistant microorganism that are prevalents at intensive care units, were the occurrence of invasive devices and use of broad-spectrum antibiotic is higher than others one[2].

Although the introduction, in 1989, of MRSA into the Hospital had lead a great increase of Gram positive relative frequency upper to half percent of cases, the epidemics was controlled and MRSA appears, now, to be endemic nosocomial flora. Furthermore, over the years, the distributions of microorganisms in Unicamp University Hospital did not differ greatly from others similar Institutions. We haven't a good explanation to the relative low frequency of *Candida* sp except the fact that physicians did not collect specimens specificaly for fungii detection.

RESUMO

Freqüência relativa de microrganismos isolados de infecções hospitalares no Hospital Universitário da Unicamp de 1987 a 1994

Analisa-se a freqüência relativa dos microrganismos isolados das infecções hospitalares no Hospital das Clínicas da Unicamp no período de 1987 a 1994. O microrganismo mais freqüente foi o *S. aureus* (20,9%), presente nas infecções da ferida cirúrgica, nas infecções da corrente sangüínea e nas artério-venosas. Nas infecções do trato urinário predominaram os bacilos Gram negativos (56,5%) e as leveduras (9%). Foi observado aumento da freqüência de isolados de *Acinetobacter baumannii* nos últimos três anos. Dentre os microrganismos isolados das infecções da corrente sangüínea, houve aumento gradual na freqüência de *Staphylococcus* coagulase negativo e *A. baumannii*, mas não houve alteração na ocorrência de *Candida* sp.

REFERENCES

1. BANERJEE, S. N.; EMORI, T. G.; CULVER, D. H. et al. – Secular trends in nosocomial primary bloodstream infections in the United States, 1980-1989. **Amer. J. Med., 91** (suppl. 3B): 86S-89S, 1991.

2. BRYCE, E. A. & SMITH, J. A. – Focused microbiological surveillance and gram-negative β lactamase-mediated resistance in an intensive care unit. **Infect. Control Hosp. Epidem., 16**: 33-34, 1995.

3. GARNER, J. S. & SIMONS, B. P. – CDC guidelines: nosocomial infections. **Infect. Control, 4** (suppl.): 245-325, 1983.

4. GARNER, J. S.; JARVIS, W. R.; EMORI, T. G. et al. – CDC definitions for nosocomial infection, 1988. **Amer. J. Infect. Control, 16**: 128-140, 1988.

5. HALEY, R. W.; CULVER, D. H.; WHITE, J. W. et al. – The nationwide nosocomial infection rate: a new need for vital statistics. **Amer. J. Epidem., 121**: 159-167, 1985.

6. JARVIS, W. R. & MARTONE, W. J. – Predominant pathogens in hospital infections. **J. Antimicrob. Chemother., 29** (suppl. A): 19-24, 1992.

7. JOHNSON, D. R.; LOVE-DIXON, M. A.; BROWN, W. J. et al. – Delayed detection of an increase in resistant *Acinetobacter* at a Detroit hospital. **Infect. Control Hosp. Epidem., 13**: 394-398, 1992.

8. MAKI, D. G. – Infections due to infusion therapy. In: BENNETT, J. V. & BRACHMAN, P. S. Hospital infections. 3 ed. Boston, Little Brown, 1992. p. 849-898.

9. NICHOLS, R. L. – Surgical wound infection. **Amer. J. Med., 91** (suppl. 3B): 54S-64S, 1991.

10. SCERPELLA, E. G.; WANGER, A. R.; ARMITIGE, L.; ANDERLINI, P. & ERICSON, C. D. – Nosocomial outbreak caused by a multiresistant clona of *Acinetobacter baumannii*. Results of the case-control and molecular epidemiologic investigations. **Infect. Control Hosp. Epidem., 16**: 92-97, 1992.

11. SCHABERG, D. R.; CULVER, D. H. & GAYNES, R. P. – Major trends in the microbial etiology of nosocomial infection. **Amer. J. Med., 91** (suppl. 3B); 72S-75S, 1991.

12. STAMM, W. E.; WEINSTEIN, R. A. & DIXON, R. E. – Secular trends in nosocomial infections: 1970-79. **Amer. J. Med., 70**: 393-397, 1981.

13. STAMM, W. E. – Nosocomial urinary tract infections. In: BENNETT, J. V. & BRACHMAN, P. S. – Hospital infections. 3 ed. Boston, Little Brown, 1992. p. 597-610.

14. WEBER, D. J.; RUTALA, W. A.; SAMSA, G. P.; WILSON, M. B. & HOFFMAN, K. K. – Relative frequency of nosocomial pathogens at a university hospital during the decade 1980 to 1989. **Amer. J. Infect. Control, 20**: 192-197, 1992.

Recebido para publicação em 27/11/1996
Aceito para publicação em 19/12/1997