Nosocomial infections in medical-surgical intensive care units in Argentina: Attributable mortality and length of stay

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Background: Nosocomial infections are an important public health problem in many developing countries, particularly in the intensive care unit (ICU). Limited data exists on the incidence and burden of nosocomial infection in the ICU in Argentina.

Methods: We performed baseline prospective nosocomial infection surveillance of all patients for 6 months in 3 medical-surgical ICUs (MS-ICUs) in Argentina (2 months in each ICU). Nosocomial infections were identifed using the Centers for Disease Control and Prevention National Nosocomial Infections Surveillance definitions. Overall and site-specific nosocomial infection rates, attributable mortality, and excess length of hospital stay were calculated.

Results: The overall nosocomial infection rate was 27% and 90 per 1000 patient-days. The most common site of infection was catheter-related bloodstream infection (32%), followed by ventilator-associated pneumonia (25%), and catheter-associated urinary tract infection (23%). The rate of central catheter-associated bloodstream infection in the MS-ICU was 44.61 per 1000 device-days, with an atttributable mortality of 25%, and 12 attributable extra days of hospital stay. The urinary catheter-associated urinary tract infection rate in the MS-ICU was 22.55 per 1000 urinary catheter-days, with an attributable mortality of 5%, and 5 excess extra days of hospital stay. The ventilator-associated pneumonia rate in the MS-ICU was 50.87 per 1000 ventilator-days with an attributable mortality of 35%, and 10 attributable extra days of hospitalization.

Conclusion: Our study finds high rates of nosocomial infections in ICUs in Argentina, associated with a considerable attributable mortality and excess length of stay. Ongoing targeted surveillance and implementation of infection control strategies is necessary to control this growing problem. (Am J Infect Control 2003;31:291-5.)

Intensive care units (ICUs), which have revolutionized the care of patients with multiple trauma, shock, and other life-threatening conditions, are unfortunately the epicenters of nosocomial infection. Rates of nosocomial infection in patients requiring more than 1 week of advanced life support within an ICU in the United States are 3 to 5 times higher than in patients who are hospitalized but do not require ICU care.[1,2] More than one half of all nosocomial epidemics now occur among the 10% of patients confined to an ICU. Nosocomial infections are emerging as an important problem in many developing countries as well,[3] although data on epidemiology of nosocomial infections in developing countries is limited. Previous studies have reported high rates of antimicrobial resistance among organisms causing nosocomial infection in Argentina[4,5]; however, limited literature exists on the rates, types, and costs of nosocomial infections in Argentina.[6,7] We performed prospective surveillance of selected nosocomial infections in 3 ICUs in Argentina for 6 months (2 months in each ICU) in the years 1998, 1999, and 2000.

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METHODS

Setting

This study was conducted in 3 hospitals in Buenos Aires, Argentina. Each hospital has an infection control team comprised of a medical doctor (with formal education and background in internal medicine, infectious diseases, and hospital epidemiology), an infection control nurse, and personnel support. Each team has informatics and microbiologic support within its institution.

Hospital A is a public, 250-bed hospital situated in the province of Buenos Aires, Argentina, with one medical/surgical ICU (MS-ICU) (10 beds). Baseline nosocomial infection surveillance was performed during July and August of 1998.

Hospital B is a private, 150-bed hospital situated in the province of Buenos Aires, Argentina, with one MS-ICU

Table 1. Overall nosocomial infection rates by hospital

Hospital	Hospital discharges, n	Patients with NI	Patients with NI, %	Patient-days	No. of NI	NI per 1000 patient-days
A	23	10	43.0	293	20	68.0
B	101	18	17.8	527	26	49.3
C	89	29	53.9	602	82	136.21
Total	213	57	26.76	1422	128	90

NI, Nosocomial infection.

(10 beds). Baseline nosocomial infection surveillance was performed during April and May of 1999.

Hospital C is a private, 180-bed hospital situated in the city of Buenos Aires, Argentina, with one MS-ICU (10 beds). Baseline nosocomial infection surveillance was performed during September and October of 2000.

Each ICU provides tertiary care to patients with a wide range of medical and surgical issues, including cardiac bypass operation, and neurosurgical and orthopedic procedures.

Surveillance

Standard Centers for Disease Control and Prevention (CDC) National Nosocomial Infections Surveillance (NNIS) definitions for nosocomial infections were used.[8] Surgical site infections were excluded. We performed active prospective surveillance for nosocomial infections in the MS-ICUs. The data collected on each infection included the date; infection site; patient demographic information; and ventilator, central venous catheter, and urinary catheter use.

The overall rate of patients with nosocomial infection (percent) was calculated by dividing the total number of patients with nosocomial infections by the total number of patients in the ICU. The nosocomial infection incidence density rate was calculated by dividing the total number of nosocomial infections by the total patient-days. For pneumonia, bloodstream infection (BSI), and urinary tract infection (UTI), device-associated infection rates were calculated by dividing the number of device-associated infections by the total number of appropriate device-days.

Statistical methods

Data was abstracted from standard forms, and analyzed using Epi info software (v. 6.04b, CDC, Atlanta, Ga). Attributable mortality was calculated by comparing mortality in patients with >7 days of hospital stay with and without nosocomial infection (ventilator-associated pneumonia [VAP], catheter-associated [CA] BSI, CA UTI).[9] Excess length of stay was calculated by subtracting the average length of stay for patients without nosocomial infection from the average length of stay of patients with nosocomial infection, matching for length of stay >7 days.

RESULTS

For 6 months in the years of 1998, 1999, and 2000, we collected data on 57 patients with 128 nosocomial infections among 213 patients discharged from the hospital for a total of 1422 patient-days in 3 ICUs for adult patients. The overall nosocomial infection rate was 27% and 90 per 1000 patient-days as shown in Table 1.

A total of 102 (80%) nosocomial infections were device-related, including VAP, catheter-related (CR) BSI, and CA UTI. Site-specific infections are shown in Table 2. The most frequent site of infection was CR BSI accounting for 32% of all nosocomial infections, followed by VAP (25%), and CA UTI (23%). Nosocomial infections not associated with devices included pneumonia, accounting for 11% of infections. The remainder of the nosocomial infections were peripheral line-associated phlebitis, sepsis, and BSI (9%).

When infection rates were calculated by using device-days as the denominator, the rate of CR BSI was 44.61 per 1000 line-days; the rate of VAP was 51 per 1000 ventilator-days; and the rate of CA UTI was 23 per 1000 catheter-days. This is shown in Table 3.

Attributable mortality was highest for VAP (34%), followed by CR BSI (25%) and CA UTI (5.7%). The excess length of stay was 13 days for CR BSI, 10 days for VAP, and 5 days for CA UTI, as shown in Table 4.

DISCUSSION

Nosocomial infections are associated with high morbidity, mortality, and hospital costs. A key aspect of nosocomial infections control is surveillance, as shown by the Study on the Efficacy of Nosocomial Infection Control Programs, which reported that surveillance combined with an infection control program reduces noscomial infections by approximately 30%.[10]

We found high overall rates of nosocomial infection in our 3 ICUs, ranging from 18% to 54%. When compared with reports from other Latin American countries, our rates are comparable with those reported in Rio de Janeiro, Brazil[11]; however, other developing countries

Table 2. Distribution of nosocomial infection sites

Infection site	N	%
Central line-associated BSI	41	32
VAP	32	25
CA UTI	29	22.6
Peripheral line-associated phlebitis	2	1.6
Peripheral line-associated BSI	10	7.8
Non-VAP	14	10.9
Total	128	100

Table 3. Site-specific nosocomial infection rates

Infection site	Device-days	NI	Rate per 1000 device-days
CR BSI	919	41	44.61
CA UTI	1286	29	22.55
VAP	629	32	50.87

NI, Nosocomial infection.

Table 4. Attributable mortality, and average length of stay extra days

Infection site	ALOS	Attributable extra days	Mortality	Attributable mortality
CR BSI	26.08	13.94	(15/24) 62.5	25.3
CA UTI	17.50	5.36	(6/14) 42.9	5.7
VAP	22.14	10.00	(10/14) 71.4	34.2
Control	12.14	—	(16/43) 37.2	—

ALOS, Average length of stay; *NI*, nosocomial infection.

have found lower rates: Khuri-Bulos et al[12] reported an overall rate of nosocomial infection of 17% in the MS-ICU of Jordan University Hospital (Amman, Jordan).

In the United States, nosocomial rates in medical ICUs range from 7.7% to 24%.[13,14] Wallace et al[15] reported rates of 11.64% in a trauma ICU and 6.4% in a surgical ICU.

Our study found CR BSI to be the most frequent nosocomial infection. This is in contrast to other studies, in the United States and Europe, where CR BSI has been reported to be the third most common site of infection.[13,16] We used the CDC definition of CR BSI, which is also used in the European Prevalence of Infection study and NNIS surveillance in the United States. Possible reasons for our high rates include lack of maximal barrier precautions at line insertion and site care postline insertion. Implementation of standard infection control practices, including attention to strict asepsis and site care, would greatly decrease the rate of CR BSI in Argentina.

In our study, we report an attributable mortality of 25% with CR BSI. Data on the attributable mortality of CR BSI is conflicting, ranging from 12% to 35% in some prospective studies.[17,18] Other studies have, however, failed to show an attributable mortality with CR BSI. In a small, matched case control study of 49 patients with CR BSI, Rello et al[19] failed to show a difference in mortality as a result of CR BSI. A recent prospective cohort study that matched cases and controls on age, gender, Simplified Acute Physiologic score (SAPS) II, and duration of intravenous catheterization also did not find a statistically significant difference in CR BSI attributable mortality.[20]

Numerous studies have reported an increased length of stay with CR BSI.[18,20] We found 13 extra days of hospitalization attributable to CR BSI; this is lower than that reported by Pittet et al[18] (24 days) in their study conducted in a surgical ICU.

Most studies have found VAP to be the most frequent nosocomial infection, accounting for 17% to 47% of ICU infections.[16,21] In a study of 135 patients in a MS-ICU, Bercault and Boulain[23] found a high attributable mortality with VAP and prolonged hospital stay attributable to VAP.[22] Heyland at al[23] reported similar results in a study of 177 patients in the ICU. VAP accounted for 25% of the nosocomial infections in our study and was associated with 10 extra days of hospital stay and an attributable mortality of 34%. Possible explanations for our high rate of VAP include lack of attention to head of bed elevation, presence of condensate in circuit, lack of high-efficiency filters, and high patient-to-respiratory staff ratio, leading to infrequent suctioning.

CA UTI is associated with a 3-fold increase in mortality, and increased hospital costs and considerable morbidity.[24] In our study, we found that CA UTI was associated with a 5% attributable mortality and 5 extra days of hospital stay. This is in contrast to a study by Bryan and Reynolds,[25] who analyzed 1520 episodes of hospital-acquired bacteremia in South Carolina; 221 episodes were attributable to the urinary tract and 30% of patients with urinary tract-related bacteremia died with an estimated 12.7% attributable mortality of CA UTI. Implementation of measures proven to decrease the risk of CR bacteriuria, such as closed drainage systems and limiting the duration of urinary catheterization to the minimum number of days possible, is necessary to prevent CA UTI.

Data from the European Prevalence of Infection Study, on the basis of 10,038 patients in 1417 ICUs, showed that the most common sites of infection were pneumonia (47%), urinary tract (18%), and bloodstream (12%).[16] In a study of 505 patients in a neurologic ICU, Dettenkofer et al[26] reported a 24.2% overall rate of nosocomial infection; site specific infection rates were 20.4 pneumonias per 1000 ventilator-days, 10 UTIs per 1000 catheter-days, and 1.9 central line-associated BSIs. A lower overall rate

of nosocomial infection (11.2%) has been reported by Laborde et al[27] in their neurosurgical ICU; however the rate increased to 36% with prolonged ICU stay.

In our study, the majority of infections at the 3 most common sites (bloodstream, respiratory, and urinary tract) were associated with devices, emphasizing the impact of device use on the development of ICU infections.

We limited our surveillance to MS-ICUs in similar hospitals to limit confounding of nosocomial infection rates by different types of ICU, where device use and length of stay may vary considerably resulting in differing nosocomial infection rates. Limitations noted previously regarding the use of NNIS definitions also apply to our study[13]; overestimation of nosocomial infection rates may have occurred by using the overinclusive NNIS criteria.

When compared with data generated by the NNIS, our rates of CA UTI, CR BSI, and VAP are much higher and above the 90th percentile. NNIS pooled means from 1995 to 2001 for CA UTI, CR BSI, and VAP are 5.8, 5.3, and 10.5 per 1000 device-days, respectively.[28] Differences in infection control practices and lack of established infection control programs may account for our higher rates.

Establishment of multifaceted infection control programs emphasizing focused education, maximal sterile precautions at device insertion, limiting device use to only as necessary, and ongoing surveillance is needed to decrease the burden of nosocomial infection in the ICU. The development of a national program that encompasses all the aspects discussed above and monitors compliance with key aspects of infection control will be instrumental in decreasing the burden of nosocomial infection in Argentina.

CONCLUSION

Nosocomial infections are common in medical ICUs in Argentina, with rates similar to those reported from other Latin American countries. CA BSI is the most frequent site of infection, followed by VAP and UTI. These infections are associated with high attributable mortality and excess length of stay. Ongoing surveillance and infection control efforts are necessary to target areas for intervention to reduce the burden of these nosocomial infections.

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