Surgical Site Infection in a University Hospital in Northeast Brazil

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We examined prevention of surgical site infection (SSI) in a tertiary teaching hospital in northeast Brazil, from January 1994 to December 2003. The survey included 5,742 patients subjected to thoracic, urologic, vascular and general surgery. The criteria for diagnosing SSI were those of the Centers for Disease Control, USA, and the variables of the National Nosocomial Infection Surveillance risk index were used. Data analysis revealed that anesthetic risk scores, wound class and duration of surgery were significantly associated with SSI. A total of 296 SSIs were detected among the 5,742 patients (5.1%). The overall incidence of SSI was 8.8% in 1994; it decreased to 3.3% in 2003. In conclusion, the use of educational strategies, based on guidelines for SSI prevention reduced SSI incidence. Appropriate management of preoperative, intraoperative, and postoperative incision care, and a surveillance system based on international criteria, were useful in reducing SSI rates in our hospital.

Key Words: Surgical site infection, risk factors, surveillance.

It is widely accepted that advances in medical care reduce infection complications in patients undergoing surgery, but control of infection continues to be a great challenge. Nosocomial infection is a significant health problem in Brazil, and it is a high priority for institutional surveillance [1]. In recognition of the need to control nosocomial infection, the Brazilian Ministry of Health has required active surveillance since 1992. Each private and public hospital has been required to set up a nosocomial infection control committee [2]. However, there have been only a few surveys of hospital-acquired infection in Brazil, and more information is needed.

Surgical site infection (SSI) develops in 2% to 5% of patients undergoing surgical procedures every year in the United States, resulting in at least 500,000 infections, 3.7 million excess hospital days, and $1.6 billion in extra hospital charges. SSIs are the second-most-common type of nosocomial infection, accounting for 20% to 25% of the total [3]; they have been studied in many hospitals worldwide [4-7]. Consequently, surgical infection is considered one of the most important problems in surgical wards. Although complete elimination of infection in surgical patients is impossible, a reduction in its incidence to a minimal level can produce great benefits for the patients and would economize resources. Surgical infection involves multiple factors, and the necessity to reduce and control it requires surveillance as well as a hospital-wide effort, with institutional support. We conducted a study in a university hospital in northeast Brazil to determine SSI incidence and to provide information for decisions concerning periodic program evaluations.

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Materials and Methods

Hospital Universitário Onofre Lopes (HUOL), a 200-bed tertiary care teaching hospital affiliated with the Universidade Federal do Rio Grande do Norte (UFRN), serves as a medical school, a residency training program, and a referral center for Rio Grande do Norte State in Brazil. We studied patients from the thoracic, urologic, vascular and general surgery services. Patients from the otorhinolaryngology, ophthalmology, proctology, ambulatory procedures, and obstetrics-gynecology services, and those subjected to laparoscopic surgery, were excluded. Data were collected from January 1, 1994, to December 31, 2003. All the patients were identified by name, sex, age, hospital number, ward, and operating room records. All three infection-control members visited each ward twice a week. Patient medical records, operative, anesthetic and diagnostic imaging reports, microbiology data, and other laboratory results, were considered. The duration of each operation was also recorded, using the National Nosocomial Infection Surveillance (NNIS) standard of T hours, type of operation and degree of wound contamination [1,10]. The duration of the operation in hours was calculated from incision to dressing time. The American Society of Anesthesiologists (ASA) physical status classification of patients was obtained from the anesthetic records [8]. Wounds were classified according to American College of Surgeon's criteria, divided into the following categories: clean, clean contaminated, contaminated and dirty/infected. NNIS criteria were used for diagnosing SSI [9,10].

Data were entered and analysed using Bioestat statistical software, (version 2.0, BR). Univariate analysis of the potential risk factors was carried out and assessed for statistical significance ($P<0.05$) Multivariate associations were assessed by the logistic regression model, expressed as odds ratios (OR).

Results

There were 2,974 women (51.8%) and 2,768 men (48.2%). The mean age was 54.3±22 years, age range, (14-94 years). A total of 296 SSIs in 5,742 procedures were identified between 1994 and 2003, for an overall infection rate of 5.1%. During this interval, SSI rates declined from 8.8% to 3.3% annually (Figure 1). After a continuous drop, an increase in the SSI rate was noticed in 2001; it was attributed to the admission of new staff workers without training on the principles of asepsis and about guidelines for SSI prophylaxis.

Among the 296 SSIs, 191 were superficial SSIs, 58 were deep SSIs, and 47 were organ/space SSIs. The degree of wound contamination, using the ASA classification, duration of operation, and the NNIS risk-index category, were independently associated with SSI. ASA V was the only factor for which the SSI rate was not significantly ($p= 0.281$) influenced by the risk factors that contributed to the NNIS risk-Index. The patients were followed for 30 days. The SSI rate was 3.1% in patients with clean surgical sites, 5.2% in clean contaminated, 11.2% in contaminated, and 20.7% in dirty surgical sites. These differences were significant ($p<0.001$, Table 1).

Discussion

The SSI incidence varies with the definition of wound infection, the intensity of surveillance, and the prevalence of risk factors for SSI in the patient group. The US Centers for Disease Control (CDC) definitions of infection have been developed and validated over several years, and they are the most commonly used definitions for SSI diagnosis in research worldwide [10]. All surgical wounds are contaminated by bacteria, but only a minority demonstrate clinical infection. SSIs are a consequence of a summation of several factors: the inoculum of bacteria introduced into the wound during the procedure, the virulence of the contaminants, the microenvironment of each wound, and the integrity of the patient's host defense mechanisms. Factors intrinsic to the patient, as well as those related to the type and circumstances of surgery, affect the incidence of infection. Work undertaken by the NNIS program, run by the CDC, has indicated that three factors: surgical risk, as measured by the ASA, duration of surgery, and level of bacterial contamination of the wound, provide a satisfactory risk-adjusted infection rate across a wide range of surgical procedures [11]. In our study, operations for which an SSI diagnosis could not be precisely made were excluded, such as operations on the oropharynx, anorectum, and eyes. Pediatric, obstetric and gynecologic operations performed in another UFRN-hospital were also

Figure 1. Annualized total rate of surgical site infections (SSI). Rates declined from 8.8% to 3.3% from 1994 to 2003.

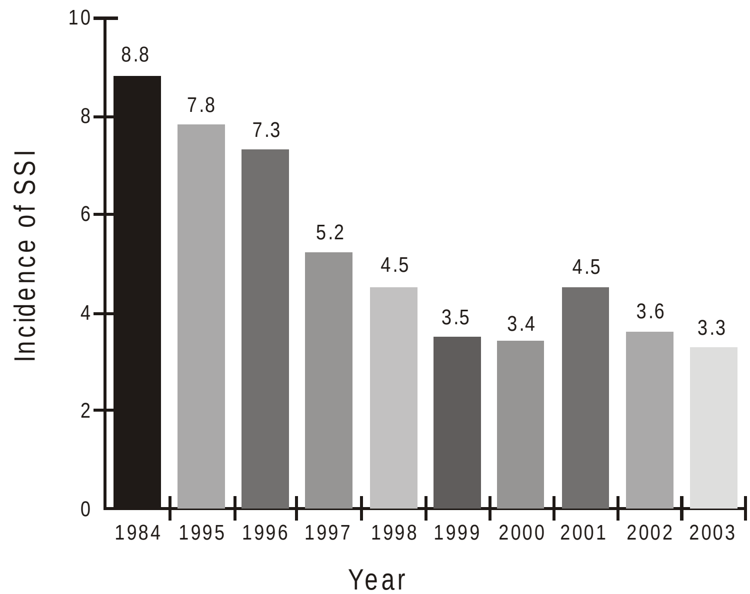

Table 1. Association between selected variables and surgical site infection rates

Risk factors	N	Infected	Rate %	OR	95% CI	p value
Wound class						
Clean	3,249	102	3.1	1	Reference	-
Clean-contaminated	1,742	92	5.2	1.7	1.2-2.2	0.0005
Contaminated	563	63	11.2	3.5	2.5-4.9	<0.001
Dirty/infected	188	39	20.7	6.6	4.4-9.8	<0.001
ASA classification						
I	1,834	38	2.1	1	Reference	-
II	2,936	140	4.8	2.3	1.6-3.3	<0.001
III	827	99	11.9	5.7	3.9-8.4	<0.001
IV	140	18	12.8	6.2	3.4-11.1	<0.001
V	5	1	20.0	9.8	1.1-84.6	0.281
Duration of operation						
≤ 2.5 hs	4,076	138	3.4	2.8	2.2-3.5	<0.001
≥ 2.5 hs	1,666	158	9.5	-	-	-
NNIS risk-index category						
0	3,293	70	2.1	1	Reference	-
1	1,823	116	6.3	2.9	2.2-4.0	<0.001
2	566	89	15.7	7.3	5.3-10.2	<0.001
3	60	21	35.0	16.4	9.5-28.5	<0.001
Total	5742	296	5.1	-	-	-

ASA, American Society of Anesthesiologists; NNIS, National Nosocomial Infection Surveillance; OR, Odds Ratio; CI, confidence interval.

excluded in order to improve the accuracy of the results. The exclusion of laparoscopic surgery was opted for in this study because of decreased SSI incidence and because it required a modification of the NNIS risk classification, which was not used in our study. Among 54,504 inpatient cholecystectomy procedures reported by Richards et al. [12], the overall SSI rate was significantly lower for laparoscopic cholecystectomy (0.62%) than for open cholecystectomy (1.82%). Even after controlling for other significant factors, SSI risk was lower in patients undergoing the laparoscopic technique than with the open technique.

SSI stratification was accomplished by risk factor analysis, as has been used in other studies [13,14]. Using this process, each operation was scored according to four factors: ASA classification, wound class, duration of the operation and NNIS risk-index category. It is known that there is a direct relationship between duration of the operation and postoperative infection risk. The risk doubles with each additional operative hour [15]. Our results agree with this finding, as the SSI rates were 3.4% for operations lasting 2.5 hs and 9.5% for those of more than 2.5 hs duration. The OR was 2.8, with $p<0.001$.

This study was performed in a tertiary teaching hospital, which is continuously adopting well-established perisurgical prophylactic measures. According to NNIS classification, the SSI risk becomes elevated with increasing numbers of risk factors, irrespective of the contamination of the incision. Our overall SSI incidence in clean wounds was 3.1%, in clean-contaminated it was 5.2%, 11.2% in contaminated and 20.7% in dirty wounds. These figures were greater than comparable data from developed countries reported by NNIS (2.1%, 3.3%, 6.4% and 7.1%, respectively) [11,16]. The SSI rates in our series may reflect the fact that our hospital is a tertiary care teaching institution to which complex surgical cases are referred. In Mexico, the SSI infection rates for clean, clean-contaminated, contaminated, and dirty procedures were 12.4%, 24.4%, 14.3% and 32.4%, respectively [17], greater than those observed in our study. The SSI incidence in our Hospital has dropped dramatically over the years, from 8.8% in 1994 to 3.3% in 2003. Other authors have reported incidences of 1.2% [18], 4.4% [19], 5.7% [20], 6.2% [21], and up to 12% [22].

In 1994, the hospital had a high SSI rate (Figure 1). This may be a result of the lack of equipment and personnel in the institution that year. These figures alerted us to the fact that we had to strive for improved quality. A study of 5,031 patients who underwent non-cardiac surgery from 1995 to 2000 showed an overall SSI incidence of 3.2%, approximately the same as that observed in our study in 2003 [23]. The drop in the SSI rate is attributed to the widespread application of perisurgical prophylactic measures, despite the progressive increase in the age of the patients, and the use of normal operating rooms and 10-bed wards in our hospital. Adherence to infection control guidelines in the surgical services of HUOL was good, and improved compliance with infection-control practices was considered the most important intervention strategy. Surgical personnel have proven to be an important component of our strategies to reduce SSI risk. We have tried to improve adherence by educating health care workers and reporting back on surveillance data to the surgical team regularly. Furthermore, a system of active surveillance was introduced to monitor SSI incidence after elective surgery. It involved medical students, interns, residents, professors, nurses and support workers. Education on the principles of asepsis for all personnel was reinforced annually. In addition, technical issues of infection control followed the guidelines for SSI prevention [24], as well as recommendations related to patient preparation, hand/forearm antisepsis for surgical team members, antimicrobial prophylaxis, ventilation, cleaning and disinfection of environmental surfaces, microbiologic sampling, sterilization of surgical instruments, asepsis, surgical technique and surveillance. All of these technical interventions were put into practice during the study.

In conclusion, measures taken at our hospital reduced SSI rates after 10 years of surveillance from 8.8% to 3.3%. This successful program involved staff, residents and students, used a variety of processes to document and provide timely feedback to the participants, and it was able to rapidly identify and deal with deviations from the desired goal.

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