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Surveillance of Surgical Site Infections: A Public Health Emergency in a Regional Hospital of Northern Benin. A Prospective Observational Pilot Study

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Abstract

Background: Surgical site infections (SSIs) are considered as result of the healthcare quality in hospitals. Objective: to study SSI at Saint Jean de Dieu Hospital Tanguieta (SJDHT), prior to the implementation of a permanent monitoring system. Method: transversal, and descriptive study with prospective data collection was performed from 1 July to 31 janvier 2017 in the department of general surgery of SJDHT. The hospital lacks in a microbiology unit. All patients who underwent surgery during this period were included and the monitoring lasted one month. SSIs diagnostic was carried out according to WHO criteria as described in the Practical Guide for the Prevention of Nosocomial Infections published in 2002. Statistical tests (χ-square and Student's t-test) were applied and $p < 0.05$ were statistically significant. Results: Of 343 patients recorded, 105 (30.6%) had SSI. Their age averaged 40.3 years and the sex-ratio (men/women) was 2.8. The emergency surgery resulted in a 50.0% rate of SSI ($p = 0.00$). The SSI rate for clean and clean-contaminated surgery was 6.3% against 94.6% for infected surgery ($p = 0.00$). The SSI rates were 100% and 66.7% for NNISS = 2 and NNISS = 1 ($p = 0.00$), respectively. Superficial SSI rate was 13.3%, while deep SSI and organ/space SSI were 46.7%

and 40%, respectively. The hospital stay of patients with SSI was three times longer than the length of patients without SSI (p = 0.00). Conclusion: SSIs are real burden at SJDHT. Appropriate measures must be adopted to reduce its prevalence.

Keywords

Surgical Site Infection, Class of Surgery, Emergency, Benin

1. Introduction

Healthcare-associated infections (HAI), especially surgical site infections (SSI), are considered as a result of the healthcare quality in hospitals [1] [2]. SSI are a frequent cause of HAI in low- and middle-income countries, and their burden in Africa is particularly high [3] [4] [5]. The additional cost and load of SSIs are as heavy for LIMCs as they are for developed countries [6]. But in Benin as well as several developing countries, there is a lack of well-informed national basic data. We also notice that these infections remain the cause of prolonged admission days of patients and besides their care, while most of these patients have no health insurance cover [4].

The aim of this pilot study is to assess the epidemiology of the SSI at Saint John of God Hospital Tanguiéta (SJDHT) prior to the implementation of a permanent monitoring system adapted to local settings and in order to contribute to the reduction of the incidence of this public health problem.

2. Methods

This was a retrospective cohort study carried out in the Department of General Surgery of SJDHT (north-west of Benin) from 1 July 2016 to 31 January 2017. SJDHT receives an average of 19,000 patients each year. The Department of General Surgery has 62 beds and admits patients from 15 years old or older. The SJDHT lacks in a microbiology laboratory. The study population consisted of all patients admitted in the Department of General Surgery after a surgical operation from July to December 2016. However patient follow-up continued up to January 2017 for those operated in December 2016. The data collected included age, gender, admission and surgery dates, main intervention and operator, US National Nosocomial Infections Surveillance (NNIS) score [5], surgical class according to the classification of "Manual on control of infection in surgical patients" [7], duration of the operation compared to the 75th percentile of the standard set by the NNIS [8], whether or not SSI occurred, date of occurrence of SSI, date of discharge from hospital, length of antibiotic therapy. For each patient, the surgical wound was monitored by surgeons for one month in accordance with NNIS definitions. When SSI was diagnosed, specific data on the patient with SSI was then collected. Due to the local setting with limited resources and the lack of technical facilities, the diagnostic criteria used are those simplified for the monitoring of the SSIs published by the World Health Organization (WHO) in the Practical Guide for the Prevention of Nosocomial Infections in 2002 [9]. For this study, we considered as SSI, any purulent discharge, abscess or cellulitis occurring on the surgical site within one month following surgery.

When it occurred, the infection was classified as superficial (involving the skin and the subcutaneous tissue), or deep (affecting soft tissues such as fascia and muscles) or organ/space (affecting an organ or a space of the surgical site) [10].

An individual data collection form was designed and annexed to each patient's medical record. It was filled as monitoring continued and was removed after one month of postoperative monitoring. Data was recorded and analyzed using the Epi info 7 software. For statistical testing, χ-square and Student's t-test were performed with a p-value less than 0.05 considered as statistically significant.

As this study was considered to be the first step of a quality improvement project, no ethical approval was deemed necessary.

3. Result

From 1 July to 31 December 2016, 343 patients underwent surgery in the Department of General Surgery of SJDHT. The mean age of the patients with SSI was 40.3 ± 16.6 years. The youngest was 16 and the oldest 65 years old. The sex ratio (male/female) was 2.8. The mean time prior to admission to the operating room for patients with SSI was 23.6 ± 23.1 hours versus 29.3 ± 27.4 hours for patients without SS (p = 0.48). Emergency surgery resulted in a 50.0% rate of SSI (49 out of 98 patients in emergency surgery), while among the 245 patients with non-emergency surgery, 56 (22.9%) developed SSI (p = 0.000, Risk Ratio = 2.2; confidence interval = [1.6, 3.0]). The most common surgical interventions were: laparotomy (28 cases, 26.7%), limb fracture osteosynthesis (21 cases, 20.0%), prostate adenomectomy by transvesical procedure (14 cases, 13.3%). Characteristics of all patients by variables are given in **Table 1**.

Overall, out of 343 patients, 105 (30.6%) were found to develop SSI. In terms of the NNIS Risk Index variables (**Table 2**), the American Society of Anesthesiologists (ASA) score was 1or 2 in 77/301 patients (25.6%) and 3 or more in 28/42 (66.7%) (p value = 0.000, Risk Ratio = 2.6; confidence interval = [1.9, 3.5]). Of the 343 patients monitored, 112 were operated on clean or clean-contaminated surgery and 7 (6.2%) had SSI, 231 patients had been operated on contaminated surgery or dirty/infected surgery, of whom 98 (42.4%) presented SSI (p value = 0.000; Risk Ratio = 6.8; confidence interval = [3.3, 14.1]). For 14 patients, the operation length had exceeded the normal limit (p value = 0.02, Risk Ratio = 1.73; confidence interval = [1.15; 2.60]). Combining the information for these variables in the standard NNIS Risk Index model, these three variables were highly predictive of the occurrence of SSI. All 35 patients in whom the NNIS was 2 developed SSI; whilst 70/105 (66.7%) of patients in whom the NNIS was 1 developed SSI; none of the remaining 203 patients with NNIS 0 developed SSI (p value = 0.000).

Table 1. Characteristics of all patients according SSI (343 patients, 1 July 2016 to 31 January 2017, Department of General Surgery of SJDHT).

	Surgical Site Infection	
	Yes (%)	**No (%)**
Operation procedure	**105 (30.6)**	**238 (69.3)**
Gender		
Masculin	84 (24.5)	168 (49.0)
Féminin	21 (6.1)	70 (20.4)
Emergency surgery		
Yes	49 (12.3)	49 (12.3)
No	56 (16.3)	189 (55.1)
Surgical interventions according to each procedure		
Laparotomy for peritonitis	28 (93.3)	2 (6.7)
Osteosynthesis	21 (33.3)	42 (66.7)
Adénomectomy tansvesical	14 (40.0)	21 (60.0)
Amputation of limb	13 (44.8)	16 (55.2)
Séquestrestomy	11 (37.9)	18 (62.1)
Extraction of osteosynthesis material	9 (25.0)	27 (75.0)
Mastectomy	5 (26.3)	14 (73.7)
Others	4 (3.9)	98 (96.1)
ASA Score		
1	28 (8.2)	140 (40.8)
2	49 (14.3)	84 (24.5)
3	28 (8.2)	14 (4.1)
Class of surgery		
Clean	2 (0.1)	70 (20.4)
Clean-contaminated	5(1.4)	35 (10.2)
Contaminated	28 (8.2)	129 (37.6)
Dirty/infected	70 (20.4)	4 (1.2)
Duration of surgery exceeded		
Yes	14 (4.1)	14 (4.1)
No	91 (26.5)	224 (65.3)
NNIS		
0	00 (0.0)	203 (59.2)
1	70 (20.4)	35 (10.2)
2	35 (10.2)	00 (0.0)
SSI		
Superficial	14 (13.3)	-
Deep	49 (46.7)	-
Organe/space	42 (40.0)	-

Table 2. Characteristics of patients according to NNIS items of SSI risk factors (343 patients, 1 July 2016 to 31 January 2017, Department of General Surgery of SJDHT).

	Surgical Site Infection n (%)		p value	Risk Ratio [IC95%]
	Yes	No		
ASA Score			**0.000***	**2.6 [1.9, 3.5]**
1 or 2	77 (25.6)	224 (74.4)		
≥3	28 (66.7)	14 (33.3)		
Class of Surgery			**0.000***	**6.8 [3.3, 14.1]**
Clean or Clean-continimated	7 (6.3)	105 (93.7)		
Contaminated or Durty/Infected	98 (42.4)	133 (57.6)		
Long operating time			**0.020***	**1.7 [1.1, 2.6]**
Yes	14 (4.1)	20 (5.8)		
No	91 (26.5)	218 (63.6)		

*significant.

The distribution of the SSI cases according to their location is as follows: superficial: 14 (13.3%); deep: 49 (46.7%); organ/space: 42 (40.0%). The mean interval time prior to occurrence of SSI was 4.2 ± 1.6 days with extremes of 2 and 7 days. The mean duration of antibiotic therapy for the 105 patients with SSI was 19.1 ± 7.6 days with extremes of 8 and 36 days. The mean hospital stay length of patients with SSI was 16.2 ± 7.2 days with extremes of 9 and 32 days, and this was three times longer than the mean stay length of patients without SSI: 5.6 ± 2.0 days (p value = 0.000, t = 5.7).

Five deaths were recorded among 105 patients with SSI. The mortality due to surgical site infection in this study was 4.8%. These are patients operated for generalized acute peritonitis with an ASA score of 3 who died in a context of sepsis within an average of 6 days after surgery.

4. Discussion

SSI occurs at an alarming rate in SJDHT, occurring in almost a third of surgical patients. This incidence was similar to that reported in other LMIC countries such as India (30.7%) [11] and Peru (26.7%) [12]. Falcon study held in several income countries occurred with a mean rate of 22.0% [13]. However, these rates were widely higher than those observed in most of the countries where there was control and surveillance system of nosocomial infections as a whole and SSI in particular [14] [15] [16]. In addition to the lack of surveillance of SSI in our context, the severe clinical condition of operated patients, and delay in consultation may explain this high rate of SSI. It was often contaminated surgery or dirty/infected surgery (laparotomies for peritonitis and open fractures of bones) with high ASA score. In fact, 231 patients out 343 (67.3%) have been operated for contaminated or dirty/infected surgery, as evidenced by the 42.4% of SSI in their group. This study reveals that SJDHT, emergency and dirty surgery is the most common. 42 patients had bad ASA score (3 to 5) and 71.4% have developed SSI. Let's also underline the urgent character of the third party (26.8%) to the whole surgical procedures often incriminated in the occurrence of SSI [17]. Patients with an ASA score ≥ 3, a dirty wound, as well as a long duration of surgical intervention are respectively 2.6, 6.8 and 3.6 times more at risk of SSI. NNIS is proportionally at risk of SSI as reported in several studies [3] [4] [18] [19]. The SSI rate of organ/space got during this study retains (40%) attention. Many factors might explain this high rate as the main cause of the surgery which often was a deep infection (peritonitis and open fracture). Rosenthal *et al.* [20] as well as Walter [1] reported in their studies this type of SSI as more frequent.

The important limitation of this pilot study was the lack of identification of bacteria involved their antibiotic susceptibilities. This is because of the absence microbiology unit at the SJDHT. The microbial environment is poorly understood. A further study will be necessary after the installation of microbiology unit not only to know the microbial environment of the surgery but also to identify the germs involved in SSI and adapted antibiotics. However, a study carried out in a department of Borgou of a Teaching Hospital still in the northern part of the country highlights the importance of multi-resistant Gram-negative bacteria and emphasizes the importance of developing protocols for antibiotics use during the perioperative period [21].

5. Conclusion

SSI is frequent in General Surgery at the SJDHT and often affects patients who are forty years old and operated on the abdomen or for fracture of limbs with an NNIS score 1 or higher. It is discovered on the 4th postoperative day and is associated with a long duration of hospitalization and a long empirical antibiotic therapy. NNIS score should be calculated and recorded for each patient at the end of each surgical procedure to allow adequate monitoring of high-risk patients. The implementation of a "simplified" SSI monitoring system is therefore an urgent matter for the SJDHT in view of the public health challenge set by this situation.

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Availability of Data and Materials

The datasets used and/or analysed during the current study are available from the corresponding author.

Conflicts of Interest

The authors declare that they have no competing interests.

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Abbreviations

ASA: American Society of Anesthesiologists; CDC: Centres for Diseases Control and prevention; HAI: Healthcare-Associated Infections; LMIC: Lower and middle-income country; NNIS: US National Nosocomial Infections Surveillance; SJDHT: Saint Jean de Dieu Hospital of Tanguiéta; SSI: Surgical Site Infection.