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Prevalence of surgical site infection in a tertiary-level hospital in Bangladesh

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ABSTRACT

Surgical site infection (SSI) is one of the most common complications in surgery around the world. The objectives of this study were to determine prevalence rate of SSI in patients undergoing elective general and orthopedics surgical operations in a tertiary level hospital in Bangladesh and to identify their causative pathogens. The study was conducted among 828 patients recruited from those admitted to the general and orthopedics surgical departments of the hospital during a period of 5 months. A SSI surveillance record form was used for identifying and diagnosing SSI within 30 days of hospital stay. Causative pathogens were identified from laboratory results. The study revealed that the overall prevalence rate of SSI was 14.13% and that the 3 most common pathogens isolated were *Staphylococcus aureus* (41.9%); *Escherichia. coli* (30.8%); and *Enterococcus spp.* (12%). It can be concluded that the hospital has a high prevalence rate of SSI. Therefore, developing SSI preventive strategies are recommended. Research should be conducted in order to identify existing risk factors for SSI in elective cases.

INTRODUCTION

Surgical site infection is one of the most common serious postoperative complications (World Health Organization- WHO, 2009) and recognized as a health care-associated infection (Harrington, 2014). It has devastating impact on patients in terms of morbidity; mortality; and higher costs for patients and for hospitals (Lissovoy et al., 2009). The results of one study reported that SSI adds to functional disability, emotional stress and anxiety, and reduced quality of life among patients (Cahill, Shadbolt, Scarvell, & Smith, 2008). Surgical site infection is an infection that occurs in surgical patients at the site of operation within 30 days, if there is no implant, or within 90 days, if there is an implant administered in the organ (Centers for Disease Control and Prevention- CDC, 2014). The criteria for diagnosis of superficial incisional SSI and deep incisional SSI are at least one of the occurrences of purulent discharge from incision or yielding organism from a swab culture; at least one of the signs and symptoms of pain or tenderness; swelling, or redness and heat; and diagnosis of SSI by an attending clinician or trained nurse (CDC, 2014).

Surgical site infections are a major global healthcare problem. It was estimated that 234 million major surgical procedures were performed annually worldwide (Weiser et al., 2008). Surgical site infections account for 31% of all HAIs among hospitalized patients (Magill et al., 2012). It has been reported that the incidence of SSI rates ranged from 2.5% to 41.9% all over the world (Apanga et al., 2014). One review study reported that SSI develops around 1 in 20 surgical patients in hospitals (Tanner, Dumvile, Norman, & Fortnam, 2016). A study in Nigeria has reported that the prevalence rate of SSI was 41.5% among surgical patients (Atata et al., 2013). Another study in Saudi Arabia revealed that the prevalence rate of SSI was 2.55% in clean elective orthopedic surgical procedures (Al-Mulhim, Baragbah, Sadat-Ali, Alomran, & Azam, 2014). Also, a study in India revealed that the prevalence rate of nosocomial infections was 20% among general and orthopedic surgical patients (Saleem et al., 2012). However, prevalence rates of SSI have not been identified in Bangladesh. Furthermore, there have been no such studies conducted regarding the prevalence rates of SSI in tertiary-care Hospitals in

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Bangladesh. Moreover, surveillance systems are important for determining the incidence, prevalence, and distribution of SSIs, and they provide reliable data (Fan et al., 2014). The rate of SSI has been reduced by active surveillance systems in developed countries (Ntsama et al., 2013). However, SSI surveillance systems remain lacking in developing countries (WHO, 2009). Bangladesh, as a developing country, lacks a surveillance system for SSI in its hospitals (WHO, 2006).

Therefore, it is important to investigate the prevalence rate of SSI through a SSI surveillance system. Assessing the area in any healthcare setting is vital for helping authorities to take preventive measures in hospital settings resulting in the reduction of SSI. Thus, this study was designed to determine the prevalence rate of SSI in patients undergoing elective general and orthopedics various surgical procedures, and to identify their causative pathogens, in a tertiary-care hospital. The results from this study will be added to the existing literature that could be used among other researchers as a reference for policymakers for developing SSI preventive strategies in Bangladesh.

MATERIALS AND METHODS

This cross-sectional study was conducted among patients who were admitted to the general and orthopedic surgical wards of a tertiary-level hospital in Bangladesh between June and October 2015. The tertiary-level hospital in Bangladesh was chosen to identify the prevalence rate of SSI, because this hospital provides high-quality medical care to a very large segment of the population. It is one of the leading tertiary-care hospitals in Bangladesh, and more than 1000 patients per day stay in this hospital. An average of 450 surgical patients per day stays in the general and orthopedic surgical wards of this hospital, where both elective and emergency procedures are performed.

Patient

The sample population was the patients who had been admitted to the General or Orthopedic Departments of the chosen hospital to take surgical treatment and care. The patients were enrolled in the study from the selected wards, based on the inclusion and exclusion criteria, in order to identify the prevalence rate of SSI. The study was carried out from June to October 2015. The following inclusion and exclusion criteria were used to select the patients for this study. The inclusion criteria were: 1) Those patients with clean wounds who had been admitted to either the general or orthopedic surgical unit during the study period. 2) Those patients with elective surgery who had been admitted to either the general or orthopedic surgical unit. 3) Those patients who had been readmitted to either the general or orthopedic surgical unit within 30 days of their previous operation. The exclusion criteria were: 1) Those patients with emergency surgical cases who had been admitted to either the general or orthopedic surgical unit. 2) Those patients with trauma- and wound-contaminated cases who had been admitted to either the general or orthopedic surgical unit.

Identifying the prevalence of SSI

The SSI Surveillance Record Form was developed, based on the SSI definition of the CDC, which was used to identify the prevalence of SSI and to determine the causative pathogens. It consisted of two parts: patient profile data and clinical diagnostic criteria for SSI. Among the patient profile data was included patient general information and operation data. Each clinical diagnosis of SSI included the CDC Surveillance Criteria for diagnosis SSI. In order to be considered to have a case of SSI, a patient had to have at least one the following criteria: (1) purulent drainage from the incision; (2) the incision yielding organisms from the pus culture test; (3) at least one the following clinically indicated infection signs and symptoms: fever; pain; swelling; warmth; redness; or tenderness to palpation; and (4) diagnosis of infection by an attending clinician or trained nurse (CDC, 2014). In addition, the SSI Surveillance Record Form was validated by five experts in the fields of surgery and infection control. This instrument was revised two times, based on the experts' comments, until the final version used in the study was prepared.

Identification of causative pathogens

The data regarding causative pathogens was obtained from medical records and laboratory results. In each SSI case, the pathogens were isolated using a swab culture test. Pus was taken from the infected surgical sites; then the specimens were gram-stained and examined for the presence of organisms and cultured aerobically.

Ethical considerations

Prior to data collection, the study was approved by the Institutional Review Board of the Faculty of Nursing at Chiang Mai University in Thailand. Official permission was also obtained from the Medical Director of the hospital.

Data collection

For data collection the patients from the general and orthopedics wards were chosen, based on the adopted inclusion and exclusion criteria. A total of 2,191 patients underwent general and orthopedic surgery during the study period. Out of them, 828 patients met the criteria, and they constituted the sample for this study. All the SSI cases were identified by use of the SSI Surveillance Record Form. 3. Three times per week, the researcher directly observed the incision sites of those patients in which he/she had recognized some signs and symptoms of SSI. Those patients still staying in the hospital were then observed once more, and they were investigated within 30 days after the operation for detecting SSI. Those patients who had been discharged from the hospital after their operations were not followed up on by the researcher. However, those discharged patients who were re-admitted to the hospital within 30 days after the operation were observed and monitored by the researcher for the occurrence of signs and symptoms of SSI. Each incision was observed and analyzed for recognizable signs and symptoms of SSI, using a culture fluid test. The researcher obtained any relevant and necessary data from each patient's medical records; nursing documents; and laboratory findings. Finally, the numbers of patients with SSI were recorded during the period of June to October 2015, for the purpose of calculating the rate of SSI occurrence.

Statistical analysis

The prevalence of SSI was calculated by dividing the number of SSI (numerator) by the number of operative patients (denominator) of the general and orthopedic surgical procedures conducted between June and October 2015. The result was expressed as a percentage.

RESULTS AND DISCUSSION

A total of 2191 operations were done - including various types of procedures at the selected hospital in the Barisal District of Bangladesh. In all, 828 clean and elective operations were performed. Among those procedures included in the study were: hernioplasty; cholecystectomy; laparotomy; prostatectomy; mastectomy; appendisectomy; choledecholithotomy; nephrolithotomy; ORIF (Open Reduction Internal Fixation); and various unclassified others.

The mean age of the patients in the study was 44.69 (SD=19.16); more than half of the patients (68.4%) were male. During the study period, 170 SSI were detected, and the overall prevalence rate was 14.13%. Table 1 shows the prevalence rate of SSI among various surgical procedures. The results show that the four surgical procedures with the highest prevalence rate of SSI were: laparotomy (20.5%); hernioplasty (19.7 %); ORIF (17.9%); and appendisectomy (11%). In addition, it was shown that, among SSI cases, the prevalence superficial SSI rate was 58.1% and the prevalence deep rate was 41.9%.

Table 1
Prevalence Rate of SSI among Various Surgical Procedures (n = 117).

Name of Surgical Procedure	Frequency	Prevalence
Laparotomy	24	20.5
Hernioplasty	23	19.7
ORIF	21	17.9
Appendisectomy	13	11.1
Mastectomy	10	8.5
Cholecystectomy	9	7.7
Prostatectomy	6	5.2
Choledecholithotomy	5	4.3
Nephrolithotomy	2	1.7
Others	4	3.4
Total	117	100.0

Table 2 shows the distribution of frequency and the percentage of susceptibility of gram-positive and gram-negative isolated organisms, as revealed in the swab culture tests conducted on all the SSI cases. Out of all the culture positives, the findings showed that *Staphylococcus aureus* (41.9%) was the most common organism isolated among patients with SSI, followed by *E. coli* (30.8%); *Enterococcus spp.* (12%); *Klebsiella spp.* (8.5%); and *Pseudomonas aerginosa* (6.8%).

Table 2
Different Types of Organisms Isolated from SSI Cases.

Name of Organism	Frequency	Percentage
Gram-Positive Organisms		
Staphylococcus Aureus	49	41.9
Enterococcus spp.	14	12.0
Gram-Negative Organisms		
E. coli	36	30.8
Klebsiella spp.	10	8.5
Pseudomonas Aerginosa	08	6.8
Total	117	100.0

Hospital infection control programs are a crucial component of the quality of health care. Surgical site infection is one of the most common types of hospital-acquired infection, and the feedback regarding SSI rates from hospital authorities to the health-care personnel has been associated with the improvement of quality of care (Anderson et al., 2014).

In our study, it was found that 117 patients with SSI were detected during the study period. The overall prevalence rate of SSI was 14.13%. O'Grady and Backer stated in 2011 that the SSI rate among clean and elective cases varies from 1%-2%., and that the SSI prevalence rate of the study is above the infection rate (O'Grady & Backer, 2011). The present study showed a higher prevalence rate of SSI (14.13%) than the report from a study which was conducted in Cameroon. The study found that the prevalence of SSI to be 9.16% (Ntsama et al., 2013). The incidence rate of SSI among general surgical patients in India was found to be 3.63% (Reddy et al., 2012). This rate seems to be higher than that found in developed countries, as a study conducted on surgical wounds from orthopedic surgical procedures in the USA showed an SSI rate of 4.2% (Pullter & Cohen, 2009). It is, however, similar to a rate found in a study in Nigeria, showing a 13.8% occurrence of SSI among abdominal surgical patients (Amoran, Sogebi, & Fatugase, 2012).

There are multiple factors that could have contributed to the high proportion of SSI in the present study. The high prevalence rate of SSI found can probably be explained by poor preventive strategies for SSI in the hospital. In 2008, Kamat et al. explained the SSI rate by attributing it to different characteristics of patients; hospital preventive measures; and varying hospital environments. In the same vein, the present study found in the qualitative data that proper SSI preventive policies and guidelines were lacking in the hospital setting. It is important to note that SSI impacts on both patients and on hospital management. Therefore, it is imperative to suggest that preventive strategies of SSI require urgent attention, and that all professionals should take active roles in reducing the occurrence of SSI to an acceptable level.

In regard to the causative pathogens isolated in the culture test from infection site, the data in this study showed that *Staphylococcus aureus* (41.9%) was the most common organism to be isolated among patients with SSI, followed by *E. coli* (30.8%); *Enterococcus spp.* (12%); *Klebsiella spp.* (8.5%); and *Pseudomonas aerginosa* (6.8%). In 2008, Owens and Stoessel concluded in their literature that the causative organisms depended on the type of surgical procedures. The most common organisms isolated through the culture test were *Staphylococcus aureus; Enterococcus spp.; Klebsiella spp.;* and *Pseudomonas aerginosa* (Owens & Stoessel, 2008). The above results are similar to the findings in a study in India, which reported that the most common organisms of SSI were *Staphylococcus aureus* (38.09%); *Klebsiella spp.* (21.14); and *E. coli* (16.67%) (Bandaru, Prasad, & Murty, 2012). Another study in India, however, revealed contrasting results. This one was conducted by Saleem et al. in 2012; they found that *E. coli* (77.8%) was the most common organism discovered among the patients, followed

by *Staphylococcus aureus* (57%); *Acinetobacter baumaii* (53.3%); *Pseudomonas aerginosa* (37.8%); and *Klebsiella spp.* (28.9%). The etiology of SSI may be normal patient flora contaminated either through the surgical equipment or through the environment of entry. Gram positive pathogens such as *Staphylococcus aureus and Enterococcus spp.* colonize the skin above the waist. On the other hand, both gram-positive pathogens and gram-negative pathogens normally colonize the skin below the waist. The microbiology of SSI may vary with the particular entry route (Ki & Rotstein, 2008).

CONCLUSION

The findings of the study demonstrate that 117 SSI were identified among the patients during the study time, yielding an overall SSI prevalence rate of 14.13%. The rate of SSI was high in the concerned hospital, and this may be related to many factors which are host, procedures and environment. Based on this study, it is clear that various strategies towards improving infection prevention practices for decreasing SSI rate to an acceptable level should be taken in the hospital. A proper antibiotic policy should be established, regarding the most commonly isolated pathogens and their antibiotic susceptibilities. Moreover, the study suggests that research should be conducted, in order to identify existing risk factors for SSI in elective cases.

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