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Original Research Article

Pattern and etiological factors of surgical site infection among patients undergone surgery at Sir Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh

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ABSTRACT

Background: Surgical site infections (SSIs) has been reported to be one of the most common causes of nosocomial infections which accounting for 20% to 25% worldwide. Despite recent advances in aseptic techniques, SSIs continue to be a major source of morbidity and mortality in developing countries and continue to represent about a fifth of all healthcare-associated infections. The aim of the study was to assess the pattern and etiological factors of surgical site infection among the patients who had undergone in surgery.

Methods: This study was a cross-sectional study conducted at the department of surgery in Sir Salimullah Medical College and Mitford Hospital (SSMC and MH), Dhaka, Bangladesh from August 2017 to July 2018. Total 160 admitted patients who had undergone surgical procedures during the study period were assessed and interviewed.

Results: The mean±SD age of the participants was 51.79±11.30 SD years. About 59% were male and 41% were female. Most of them came from rural areas (61%). Surgeries were done in different indications and 21% developed SSI. Of all SSIs, 73% were superficial and 27% were deep infections. The most common organism involved in SSI was S. aureas (42.4%), followed by E. coli (27.3%), P. aeruginosa (12.1%), bacteroids (12.1%), and Klebsiella spp. (6.1%). Meropenem was the most sensitive drug followed by Ceftriaxone. Gentamycin showed cent percent sensitivity on the gram-negative organisms.

Conclusions: The incidence of SSIs was found in about one-fifth of the post-surgical cases, where Staphylococcus aureus was the most prevalent organism.

Keywords: Pattern, Etiological factors, Surgical site infection, Surgery, Meropenam

INTRODUCTION

Surgical site infection (SSI), previously called postoperative wound infections, may be defined as an infection that occurs at or near the surgical incision within 30 post-operative days of the surgical procedure, or within 1 year if an implant is left in place (eg, mesh, heart valve). SSI is further classified as- (a) superficial incisional; (b) deep incisional; and (c) organ/space SSI.[1-4] Factors for acquiring infection are host factors, surgical factors, environmental factors, and the nature of microbes. Host factors contributing to increased risk of infection are age, length of hospital stay, and concurrent infection at the other side of the body. Among surgical factors the nature and extensibility of operation, site, and depth of the wound, logistics used and continued during and after an operation, and surgeons' technical skills are remarkable.

Among microbial factors virulence and numbers of bacteria are important. Local tissue defense can combat minute inoculums of virulent bacteria. But if host damage is extensive and co-morbidity in the form of diabetes or other immunosuppressive states remains, small inoculums of virulent bacteria can ensure an overwhelming infection occurs. On the other hand, virulent bacteria of drug-resistant nature may be the single factor of overt and fulminant infection.[5-7] Environment of operation theatre (OT) and surgery ward is a crucial factor for infection.

Excess visitors in general access zone and wards, sneeze, cough, personnel carrying intranasal and facial pathogens results in spreading by droplet due to talk. On settling OT table, trolley, linens, bed etc. transmitted to the operated patients.[8] Surgery team, in the same way, transmits microbial agents to the operation wound. Unclear logistics-all as well as the dirty floor of the ward are risk factors for surgical site infection.[9] Primarily depending on the type of surgical procedure, the pathogens isolated from infections differ. In the clean surgical procedures, in which gastrointestinal, gynecologic, and respiratory tracts have not been entered, Staphylococcus aureus from the exogenous environment or the patient's skin flora is the usual cause of infection. The polymicrobial aerobic and anaerobic flora closely resembling the normal endogenous microflora of surgically resected organs are the most frequently isolated pathogens in other categories of surgical procedures including clean-contaminated and dirty.[10] The single most disadvantage with those microbes stood as their multi-drug resistance property. Newer cephalosporins and quinolones antibiotics are randomly used for prophylactic and therapeutic purposes to overcome this problem, but it is not cost-effective in developing countries.

Many times patients cannot afford those antibiotics due to poverty. So, leading to a chance of emerging resistance to that particular drug by those particular bacteria, the treatment course remains incomplete or improper. This is rather a chronic situation. Hence the high magnitude of antibiotic resistance would rightly be expected and the number of variables that can influence SSI rates is large. In the prevention of SSI, preoperative planning and intra-operative technique for both emergency and elective surgery have become important. Organism in the wound can be reduced via skilled surgical technique, judicious use of electro-cautery can reduce the risk of hematoma, adherence to the principles of prophylactic antibiotic therapy, sound infection-control practice, and better preoperative preparation of the surgical site while performing operations.

Further reducing the rate of SSI, enhancement of host defenses by increasing oxygen delivery, better core body temperature control during the perioperative period, and rigorous blood glucose control in surgical patients are new areas that have the potential to even. Consistent application of proven methods of prevention, continued progress in the biology of infection at the site will allow us to further reduce the frequency, cost, and morbidity associated with SSI.[11]

Objectives

General objective

The objective of this study was to assess the pattern and etiological factors of surgical site infection among patients undergone surgery at Sir Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh.

Specific objectives

The objectives of this study were (a) to find out the frequency of SSI among patients undergone surgery at SSMC and MH, Dhaka, Bangladesh; (b) to identify the factors responsible for surgical site infection following surgery; and (c) to identify the causative organism for SSI.

METHODS

This cross-sectional study was conducted in the department of surgery, SSMC and MH, Dhaka, Bangladesh during the period from August 2017 to July 2018. Through purposive sampling technic, in total 160 admitted patients who had undergone surgical procedures at the mentioned hospital were enrolled as the study population. According to the exclusion criteria of this study patients presented with infected wounds, needed drainage of abscess, patients of road traffic accident, patients below 12 years of age, and patients having prosthetic surgery were excluded. The study protocol was accepted by the ethical review committee of SSMC before commencing. The patients who were admitted into the department of surgery for undergoing elective surgery were approached for inclusion criteria.

All patients were screened according to inclusion and exclusion criteria prior to final selection. Formal permission was taken from each subject. All patients were interviewed by the researcher for baseline data like age, sex, socioeconomic status, BMI, and co-morbid disease after inclusion and assessment. Moreover, they were investigated for anesthetic fitness as well as to identify comorbidities. All patients were followed up for 30 days following the operation. As mentioned in the operational definition, wound infection or surgical site infection were defined by standard criteria. These infections were managed by both use of proper antibiotics and regular surgical dressing. Before that swabs and blood culture were sent for confirmation of infection and culture sensitivity. Antibiotics were chosen according to the sensitivity report after collection of the culture sensitivity report. Data analysis was done by SPSS 22.0.

RESULTS

A total of 160 different types of surgery patients were included. The mean age was 51.79±11.30 years and the age range was 27-72 years. Among the total participants, 51- 60 years (36.3%) belonged the majority. Male (59%) patients were the majority. Females constituted 41% of the study population. Regarding the residence, 61% came from rural and 39% came from urban areas. Lower socio-economic class (52.5%) were the majority followed by the middle class (33.8%) and upper class (13.8%). The most common surgical procedure performed was cholecystectomy (31.9%), followed in decreasing order by mastectomy (21.9%), gastrectomy (17.5%), genioplasty (10%), Whipple's procedure (5%), prostatectomy (4.4%), abdominoperineal resection (3.8%), colectomy (3.8%) and splenectomy (1.9%). Among all patients, 21% developed SSI. Among cases of SSI, 73% were superficial infections and 27% were deep infections. The most common risk factors for SSI were HTN (29.4%), followed by anaemia (28.7%), DM (24.4%), jaundice (21.3%), age >60 years (19.4%), smoking (15%), obesity (15%), nutritional status below average (13.8%), and renal failure (6.3%). The proportion of HTN, DM, older age (>60 years.), anemia, and below-average nutrition was significantly higher in patients who had SSI (p<0.05). Among patients who had SSI, 75.8% required more than one hour of operation time and among patients who did not have SSI, 57.5% required operation more than one hour. The difference was significant (p<0.05). The most common involved in SSIs was S. auereas (42.4%), followed by E. coil (27.3%), P. aeruginosa (12.1%), bacteroids (12.1%) and (42.4%), followed by E. coil (27.3%), P. aeruginosa (12.1%) and Klebsiella sapp. (6.1%).

Table 1: Distribution of surgical procedures among participants (N=160).

Indications	N	Percentage (%)
Cholecystecomy	51	31.9
Mastectomy	35	21.9
Gastrectomy	28	17.5
Hernioplasty	16	10.0
Whipple's procedure	8	5.0
Prostatectomy	7	4.4
Abdominoperineal resection	6	3.8
Colectomy	6	3.8
Splenectomy	3	1.9

Table 2: Risk factors responsible for SSI (N=160).

Risk factors	SSI present (N=33)		SSI absent (N=127)		Total (N=160)		P value
	N	%	N	%	N	%	
HTN	22	66.7	25	19.7	47	29.4	<0.001[s]
DM	21	63.6	18	14.2	39	24.4	<0.001[s]
Obesity	7	21.2	17	13.4	24	15	0.262
Older age (>60 years)	15	45.5	16	12.6	31	19.4	<0.001[s]
Nutritional status below average	8	24.2	14	11.0	22	13.8	0.049
Anaemia	17	51.5	29	22.8	46	28.7	0.001[s]
Jaundice	11	33.3	23	18.1	34	21.3	0.057
Smoking	8	24.2	16	12.6	24	15.0	0.09

Note: S- significant.

Table 3: Duration of surgery and its relation with SSI (N=160).

Duration	SSI present (N=33)		SSI absent (N=127)		Total (N=160)		P value
	N	%	N	%	N	%	
1 hour	8	24.2	54	42.5	62	38.8	0.04[s]
>1 hour	25	75.8	73	57.5	98	61.3	

Note: S- significant.

Table 4: Organisms responsible for SSI (N=33).

Indications	N	Percentage (%)
Gram positive bacteria		
Staphylococcus aureas	14	42.4
Bacteroids	4	12.1

Continued.

Indications	N	Percentage (%)
Gram negative bacteria		
Escherichia coli	9	27.3
Pseudomonas aeruginosa	4	12.1
Klebsiella spp.	2	6.1

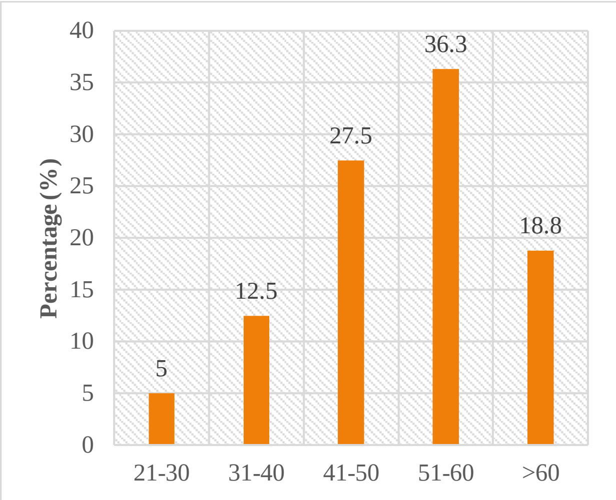

Figure 1: Age distribution of participants (N=160).

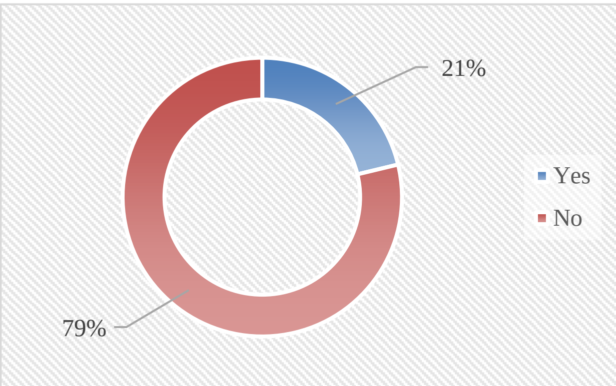

Figure 2: Frequency of surgical site infection among study population (N=160).

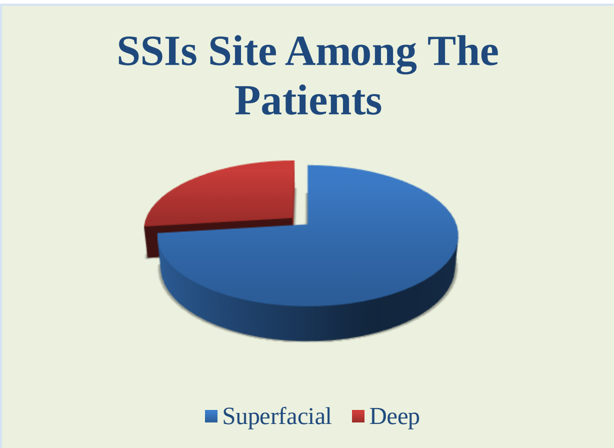

Figure 3: Frequency of SSI among study population (N=160).

DISCUSSION

In this study, all of the patients had undergone elective surgery. The most common surgical procedure performed was cholecystectomy (31.9%), most of them being laparoscopic cholecystectomy. This was followed in the second and third by mastectomy and gastrectomy. Sickder et al found hernioplasty to be the most common elective operation done in their study.[6] Also, in concordance with Laloto et al gastrointestinal surgery constituted the majority proportion of all operations in the present study (28.6% and 32% respectively).[7] SSI developed in 21% of patients in this study. This was very similar to the study of Nur-E-Elahi and colleagues done in BSMMU (20.16%), higher than Sickder (14.13%) study but lower than Mawalla et al (26%).[8,9]

Prevalence of superficial SSI was 73% and deep SSI was 27%. Sickler and colleagues found 58.1% superficial SSI and 41.9% deep SSI in comparison, another study done in a tertiary care hospital. Both emergency and elective surgery patients explaining the higher level of deep infection which could be associated with emergency surgeries included in their study.[6] For development of SSI encountered in this study common risk factors were HTN (29.4%), followed by anaemia (28.7%), DM (24.4%), jaundice (21.3%), older age >60 years (19.4%), smoking (15%), obesity (15%), nutritional status below average (13.8%), and renal failure (6.3%). Anemia (52%) was the most prevalent risk factor followed by malnutrition (44%), diabetes (38%), jaundice (30%), contaminated operation (44%) dirty operation (38%), obesity, smoking, etc in comparison in the 44 BSMMU study.

HTN, DM, older age (>60 years), anemia, and below-average nutrition carried a significant association with SSI according to this study. On a similar note, Mawalla et al, and Siddique et al and found that presence of diabetes was significantly associated with increased prevalence of SSI ($p<0.05$).[9,10] Mawalla et al also found HTN to be an important risk factor for SSI ($p<0.05$). Older age as a risk factor of increased SSI was noted by Mawalla et al (>60 years) and Siddique et al (>50 years).[9,10] Anemia was examined and found to be a risk factor for SSI by Lubega et al who reported that the chance of SSI increased with the degree of anemia.[11] In the study by Mawalla et al, smoking was significantly associated with SSI. By Laloto et al obesities were found to be associated with an increased chance of SSI.[7] To the length of operative procedures, the risk of wound infection had repeatedly been shown to be proportional. When the duration of operation was more than 60 and 150 minutes, a higher incidence of post-operative wound infection was observed

Nur-E-Elahi et al.[8] An increase in wound infections with longer procedures, roughly doubling with every hour of the procedure found by Cruse et al.[12] This may be due to several factors like doses of bacterial contamination increases with time and longer procedures are more liable to be associated with blood loss and shock, thereby reducing the general resistance of the patients. The increased amount of suture and electro-coagulation may also reduce the local resistance of the wounds.

Wound swab culture revealed an organism in 100% of cases in this study. S. aureas was (42.4%) followed by E. coli (27.3%), P. aeruginosa and bacteroids (12.1%) and Klebsiella spp (6.1%) respectively. Compeering to this study, Escherichia coli (43%) followed by Staphylococcus aureus (33%) and Pseudomonas aeruginosa (11%) were found by Nur-E-Elahi et al that the most predominant isolated organism in their study.[8] Staphylococcus aureus (41.9%) to be the most common organism isolated among patients with SSI found by Sickler et al, E. coli (30.8%), Enterococcus spp (12%); Klebsiella spp (8.5%); and P. aerginosa (6.8%) respectively.[8] Causative organisms depended on the type of surgical procedures that in study of Owens and Stoessel conducted in 2008.

The most common organisms isolated through the culture test were S. aureus, Enterococcus spp, Klebsiella spp.; and P. aerginosa.[13] 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.[14]

Drug sensitivity patterns varied depending on the organism isolated. E. coli showed resistance mostly to cloxacillin, cefixime, ciprofloxacin was sensitive to ceftriaxone, nitrofurantoin, and gentamicin. S. aureas showed high sensitivity to ceftriaxone and meropenem. P. aeruginosa showed high sensitivity to gentamicin and meropenem and complete resistance to amoxycilin, cefixime, ciprofloxacine. In 2011 the study by Nur-E-Elahi et al found that Escherichia coli was found resistant to amoxycillin in 93.02% cases followed by gentamicin in 37.21%, ciprofloxacin in 32.56%, nitrofurantoin in 25.58% and least being ceftriaxone in 11.63%, and in the case of S. aureus.[8]

Amoxycillin was (87.88%) followed by cloxacillin (63.64%), gentamicin (48.48%), ciprofloxacin (36.36%), and ceftriaxone (12.12%). P. aeruginosa remained resistant to amoxycillin in all (100%) cases also found in their study. This shows that the resistance of E. coli to ciprofloxacin has increased over time.

But the sensitivity of gentamicin was higher than in their study. Also, for S. aureas sensitivity to amoxicillin and cloxacillin remained constant over time. This was also notable that till now ceftriaxone has remained sensitive to many cases. Without appropriate use of the drug which may decrease. In this study, fortunately, meropenem was found to be 100% sensitive for all bacteria isolated.

As a special technique may not equally convenient for every operating surgeon. Sample size was small to generate representative findings. Patient outcome report could have been subjected to inter and intra observer variations.

CONCLUSION

SSI are serious postoperative complications with a significant impact on morbidity and mortality. In this study, the incidence of SSI among elective postoperative patients at SSMC and MH is high compared to that in the developing world and slightly less than developed countries. Staphylococcus aureus causes the majority of superficial SSIs, whereas E. coli is the most frequent organism isolated from deep SSIs. The development of SSI was associated with hypertension, anemia, DM, increasing age, and malnutrition. Sensitivity screening showed meropenam and gentamycin were the two most potent antibiotics against organisms that cause SSI among the patients. However, the findings provide an idea about the most recent pattern of SSI and its aetiology and further nationwide studies are recommended.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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