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Original Research Article

The surgical site infection following gastrointestinal surgery: a study in Sir Salimullah medical college and Mitford hospital, Dhaka, Bangladesh

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ABSTRACT

Background: Purpose of the study is to find out the causative factors, the bacteriological etiology of surgical site infection (SSI) following gastrointestinal surgery and formulate effective treatment protocol that will reduce the burden of SSI and its treatment cost.
Methods: This case control study was carried out in the surgical wards of SSMC and MH Dhaka form January 2009 to December 2009 to explore the probable causative factors, causative organisms for SSI following gastrointestinal surgery. Purposive sampling was done.
Results: A total of 122 patients were taken as sample. Out of 122 patients, elective surgery was done in 28 (22.95%) patients and emergency surgery was done in 94 (77.05%) patients. Emergency surgery was significantly associated with SSI (OR=0.38; p<0.03). The mean age of case group was 41.16+13.85 and control group was 39.72±13.82. Maximum number of patients fall into 4th and 5th decade of life. Out of 122 patients 41 (33.61%) were smoker and smoking was significantly associated with SSI (OR=1.45; p=0.44). Blood picture showed total 43 (35.25%) patients were anaemic out of 122. Out of 43 anaemic patients 28 in the case group and anaemia was significantly associated with SSI (OR=2.60; p<0.02). Site of operation that is upper or lower GIT was not significantly associated with SSI (OR 0.86; p=0.84). Length of operation of more than 2 hours was found to be significantly associated with SSI (OR 0.48; p<0.04). Dirty wound was found to be significantly associated with SSI (OR=2.86; p<0.009). Most of the SSI occurred superficial incisional 54.1% followed by deep incisional 45.9%.
Conclusions: *E. coli* was the most common causative organism 54.1% and amikacin, ceftazidime, ceftriaxone, imipenem were sensitive to *E. coli*.

Keywords: Surgical site infection, Gastrointestinal surgery, Anaemia

INTRODUCTION

Surgical infection particularly SSI has always been a major complication of surgery and has been documented for 4000-5000 years. The Egyptians had some concepts about infection as they were able to prevent putrefaction, testified by mummification skills. The concept of causative agent of infections came in the nineteenth century. Microbes were seen under microscope by Koch and he laid down the first definition of infective disease by Koch's postulates.[1] For surveillance classification purposes, SSI is divided into incisional SSI and organ/space SSI. Incisional SSI are further classified into those involving only the skin and subcutaneous tissue (called superficial incisional SSI) and those involving deep soft tissues of the incision (called deep incisional

SSI [e.g., fascial and muscle layers]). Organ/space SSI involve any part of the anatomy (e.g., organs or spaces), other than the incision, opened or manipulated during the operative procedure.[2,3] SSI accounts for about 15% of all nosocomial infections and occurs in 10%-30% of all patients undergoing gastrointestinal surgery. Surgeons either tend to ignore or are unaware of these data because of the minor impact these infections have on post-operative recovery, especially incisional SSIS. Nevertheless, a considerable number of patients suffer from the unexpected and painful complications of SSI. The severity of these complications embraces mild cases needing local wound care and antibiotics to serious cases with multiple reoperations and a high mortality rate. Thus, surgeons should be made aware of the high incidence and costs of managing SSIS.[4] SSIs result in increased postoperative morbidity and mortality rates, prolonged hospitalization and increased treatment costs.[5] Incidence of SSIS after colorectal surgery was 16.8%. Multivariable analysis identified longer operation time, preoperative obstructive lung disease and fewer postoperative days on TPN as independent predictions of SSI.[6] The average time of onset of SSI was 8.7 days (range=3-20 days) after operation.[7] Most postoperative wound infections are uncomplicated, involving only the skin and subcutaneous tissues. They infrequently progress to necrotizing infection, which may involve the fascia and muscle. Uncomplicated wound infection usually presents clinically as local incisional pain tenderness, swelling, redness and increased warmth and elevated body temperature, which most often begin between the fourth and eighth postoperative days. In clean operations in which the gastrointestinal, gynecologic and respiratory tracts have not been entered, exogenous *S. aureus* is the usual cause of infection; in contrast, polymicrobial aerobic-anaerobic flora closely resembling the normal endogenous microflora of the surgically resected organ occurs in clean-contaminated operations. SSI following gastrointestinal surgery is a great burden for local surgeons and reflects a massive economic loss for the country. But the available statistics regarding SSI in our country is not sufficient enough to formulate effective control measures.

So, purpose of the study is to find out the causative factors, the bacteriological etiology of SSI following gastrointestinal surgery and formulate effective treatment protocol that will reduce the burden of SSI and its treatment cost.

METHODS

Types of study

This was a case control study.

Period of study

Study conducted from the January 2009 to December 2009.

Place of study

Study carried out at department of surgery, Sir Salimullah medical college and Mitford hospital, Dhaka, Bangladesh.

Study population

Patients who underwent operations for gastrointestinal disease in the department of surgery, SSMC and Mitford hospital, Dhaka were selected.

Sample technique

Purposive sampling technique was done.

Sample size

When we want to test hypothesis in case control study sample size should be calculated by

$$n = \frac{(\mathrm{Za}\sqrt{2\mathrm{P}\,(1-\mathrm{P2})} + \mathrm{Z}ß\sqrt{\mathrm{P}(1-\mathrm{P}) + \mathrm{P}(1-\mathrm{P}_2)}\}^2}{(P-P_2)^2}$$

With this formula calculated sample size is 133. But due to time limitation and lack of patient availability we take 122 cases as sample. Sample size calculation mentioned in appendix-II.[8]

Inclusion criteria

Patients who underwent operations in the intra-abdominal alimentary tract such as procedures for gastroduodenal, small intestinal, colorectal diseases and appendicitis were included.

Exclusion criteria

Patients who underwent esophageal, anal, pancreatic and biliary tract operations and pediatric patient were excluded.

Study methods

The present study is an observational study where socio-demographic variables were collected from all the patients by thorough history. Detailed examination was done as per proforma. In emergency cases baseline investigations like blood profile, blood grouping, serum electrolytes, serum creatinine, X-ray abdomen A/F view including diaphragms were done. In routine cases relevant investigation were done for diagnosis and assessment of general condition of the patient and fitness for general anaesthesia. There was no protocol for the administrating of antibiotics. Operative procedure, findings, time were recorded. Post-operatively the patients were followed up and also recorded. Wound swab/ pus was collected and sent for C/S. No recommendation was made prior to or during this study to decrease the incidence of SSI.

Data analysis

The collected data was compiled and statistically analyzed by using computer based programmed statistical package for social science for windows version 14. Quantitative data were analyzed by mean and slandered deviation and qualitative data were analyzed by chi-square test and odds ratio of each variable was estimated. P value equal/less than 0.05 was considered as significant and value less than 0.01 considered as very significant. Value less than 0.001 considered as highly significant. P value more than 0.05 considered as not significant.

RESULTS

Information of 122 patients following gastrointestinal surgery was recorded in different surgery units of SSMC & MH, Dhaka in the period of January 2009 to November 2009. Out of 122 patients, 61 patients taken as case where SSI developed and another 61 patients taken as control. Statistically significant difference was found between two groups in terms of type of surgery. Elective surgery is protective for SSI.

Table 1 shows age incidence. Total number of patients in this series was 122. Age varied from 15-70 years. Maximum number of patients fall into 4th and 5th decade. Mean age is 41.16±13.85 in case group and 39.72±13.82 in control group. Table 2 shows frequency and percentage distribution of male and female patients in case and control group. Statistically significant difference found between 2 groups in terms of gender, male gender is a risk factor for SSI. Table 3 shows frequency and percentage distribution of anaemic and non anaemic patients in case and control group. Statistically significant difference was found between two groups in terms of anaemia.

Table 4 shows frequency and percentage distribution of different disease conditions found in case and control group.

Table 5 shows frequency and percentage distribution of upper and lower GIT surgery in case and control group. Statistically no significant difference was found between two groups in terms of site of operation.

Table 6 shows frequency and percentage distribution of duration of operation <2 hrs and >2 hrs in case and control group. Statistically significant difference found between 2 groups in terms of time taken for operation.

Table 7 shows frequency and percentage distribution of type of wound in case and control group. Statistically significant difference was found between two groups in terms of dirty wound.

Table 8 shows most of the SSI occurred superficial incisional 54.1% followed by deep incisional 45.9%. Table 9 shows *E. coli* was the most common organism isolated from SSI 54.10%, followed by *S. aureus* 26.23%, *Pseudomonas* 8.20% and *Klebsiella* 4.92%. Table 10 shows the sensitive pattern of isolated organisms to some commonly used antibiotics.

Table 1: Age incidence in various decades of life in case and control group.

Age (in years)	Case, N (%)	Control, N (%)	Total, N (%)
15-20	06 (9.84)	07 (11.48)	13 (10.66)
21-30	08 (13.11)	09 (14.75)	17 (13.93)
31-40	14 (22.95)	20 (32.79)	34 (27.87)
41-50	19 (31.15)	14 (9.84)	33 (27.05)
51-60	08 (13.11)	06 (9.84)	14 (11.48)
61-70	06 (9.84)	05 (8.20)	11 (9.02)
Total	61 (100)	61 (100)	122 (100)
Mean±SD	41.16±13.85	39.72±13.82	

Table 2: Comparison of gender between case and control group.

Gender	Case, N (%)	Control, N (%)	Total, N (%)	Odds ratio	P value
Male	36 (59.02)	27 (44.26)	63 (51.64)	1.81	
Female	25 (40.98)	34 (55.74)	59 (48.36)	(0.83-3.97)	0.14
Total	61 (100)	61 (100)	122 (100)		

Table 3: Comparison of anaemia between case and control group.

Anaemia	Case, N (%)	Control, N (%)	Total, N (%)	Odds ratio	P value
Anaemia	28 (45.90)	15 (24.59)	43 (35.25)		
Nonanaemic	33 (54.10)	46 (75.41)	79 (64.75)	2.60 (1.13-6.06)	0.02
Total	61 (100)	61 (100)	122 (100)		

Table 4: Distribution of different disease conditions in case and control group.

Diseases	Case, N (%)	Control, N (%)	Total, N (%)
Duodenal ulcer perforation	15 (24.69)	10 (16.35)	25 (20.45)
Ileal perforation	12 (19.67)	04 (6.56)	16 (13.11)
Acute intestinal obstruction	9 (14.75)	8 (13.11)	17 (13.95)
Acute appendicitis	07 (11.48)	13 (21.31)	20 (16.35)
Burst appendix	04 (6.56)	04 (6.56)	8 (6.56)
Rectal carcinoma	04 (6.56)	05 (8.19)	9 (7.38)
Sigmoid volvulus	04 (6.56)	03 (4.92)	7 (5.74)
Carcinoma caecum	02 (3.28)	05 (8.19)	7 (5.74)
Carcinoma stomach	02 (3.28)	06 (9.84)	8 (6.56)
GOO due to pyloric stenosis	01 (1.64)	03 (4.92)	4 (3.28)
Perforation of transverse colon	01 (1.64)	0 (0)	01 (0.82)
Total	61 (100)	61 (100)	122 (100)

Table 5: Comparison of site of operation between case and control group.

Site	Case, N (%)	Control, N (%)	Total, N (%)	Odds ratio	P value
Upper GIT	18 (29.51)	19 (31.15)	37 (30.33)	0.86 (0.37-1.98)	0.84
Lower GIT	43 (70.49)	42 (68.85)	85 (69.67)		
Total	61 (100)	61 (100)	122 (100)		

Table 6: Comparison of time taking for operation between case and control group.

Time taking for operation	Case, N (%)	Control, N (%)	Total, N (%)	Odds ratio	P value
<2 hours	27 (44.26)	38 (62.29)	65 (53.28)	0.48	0.04
>2 hours	34 (55.74)	23 (37.71)	57 (46.72)	(0.22-1.05)	
Total	61 (100)	61 (100)	122 (100)		

Table 7: Comparison of type of wound between case and control group.

Type of wound	Case, N (%)	Control, N (%)	Total, N (%)	Odds ratio	P value
Clean	10 (16.35)	19 (31.15)	29 (23.77)	0.43 (0.17-1.12)	0.08
Contaminated	19 (31.15)	25 (42.96)	44 (36.07)	0.65 (0.17-1.12)	0.25
Dirty	32 (52.46)	17 (27.87)	49 (40.16)	2.86 (1.26-6.52)	0.009
Total	61 (100)	61 (100)	122 (100)		

Table 8: Distribution of site of infection in case group.

Site of infection	Number	Percentage
Superficial incisional	33	54.10
Deep incisional	28	45.90
Organ/space	0	00
Total	61	100

Table 9: Organisms isolated from SSI.

Organism	Frequency	Percentage (%)
E. coli	33	54.10
S. aureus	16	26.23
***Pseudomonas* spp.**	5	8.20
***Klebsiella* spp.**	3	4.92
Mixed	4	6.55
Total	61	100.0

Table 10: Percentage of drug sensitivity pattern of isolated bacteria.

Antibiotics	*E. coli*, (n=33)	*S. aureus*, (n=16)	*Pseudomonas*, (n=5)	*Klebsiella*, (n-3)
Amoxyclave	0	37.5	0	0
Amikacin	100.0	43.75	100.0	100.0
Azithromycin	60.6	56.25	20.0	0
Ceftazidime	84.84	68.75	100.0	100.0
Ceftriaxone	69.65	62.50	60.0	66.66
Ciprofloxcin	51.51	56.25	40.0	66.66
Chloramphenical	27.27	31.25	-	-
Gentamycin	66.66	37.5	80.0	100.0
Imipenem	100.0	-	100.0	100.0

DISCUSSION

SSI following gastrointestinal surgery is still a major problem of surgical practice. In spite of tremendous advances in surgical techniques, sterilization methods, operation theatre designs and use of newer antibiotics in recent years SSIs continue to play a role in postoperative morbidity. The incidence of infection varies from surgeon to surgeon, from hospital to hospital from one surgical procedure to another and most importantly from one patient to another. In this study, a total number of 122 patients were studied. Out of 122 patients, 61 patients were taken as case where SSI developed and another 61 patients were taken as control. In this study, emergency procedures strongly associated with SSI following gastrointestinal surgery rather than elective surgery and elective surgery is protective (OR=0.38; p<0.03) in accordance with the finding of other reports Sorensen, Graham et al and Makela et al.[4,9,10] But Hernandaz et al study found emergency procedures were not associated with SSI.[11] The mean age of the case group was 41.16±13.85 and control group was 39.72±13.82. Maximum number of patients fall into 4th and 5th decade of life. Sorensen et al, Cruse et al and Watanabe et al study found that chance of SSI higher in >60 years' age.[12-14] In this study male gender was associated with SSI (OR=1.81; p=0.14). Hernandez et al[11] study found gender was not associated with SSI. Smoking habit was found to be a significant risk factor for SSI following gastrointestinal surgery (OR=1.45; p=0.44) which supports the previous study results done by the Sorensen et al, Shamimi et al and Watanabe et al.[4,14,15] Hypovolemia and hypoxia are believed to be responsible for SSI. Smoking causes constriction of the peripheral blood vessels, the possible consequence of which is tissue hypovolemia and hypoxia, creating an environment conductive to SSI, Sorensen.[4] A level of Hb% 10 gm/dl was taken as standard line. Below 10 mg/dl was taken as anaemic. In this study preoperative anaemia was found to be a significant risk factor for SSI following gastrointestinal surgery (OR=2.60; p<0.02). Malone et al study shows both preoperative anaemia (p<0.001) and postoperative anaemia (p=0.001) were associated with an increased risk of SSI.[16] This finding suggests that the increased susceptibility to SSI in anaemic patients may be related to lower oxygen tension at the tissue level due to decreased plasma haemoglobin levels. Upper GIT surgery consist of gastric and duodenal surgery and lower GIT surgery consists of small intestine and colorectal surgery, appendicectomy and stoma operations including Hartman's operation. In this study no o significant difference of SSI was found between upper and lower GIT surgery. There is a relation between the length of operating time and infection rate. Risk of SSI has repeatedly been shown to be proportional to the length of operation procedures found in previous study results done by Tang et al, Cruse et al and Imai et al.[13,17,18] In agreement with previous findings the present data indicated that a length of operation of more than 2 hours is a significant risk factor for incisional SSI (OR=0.48; p<0.04). The possible explanation are-i. Dose of bacterial contamination increases with the time, ii. Wounded tissues are damaged by drying and by exposure to air and retraction, iii. Increased amount of suture and electrocoagulation may reduce the local resistance of the wounds, iv. Longer procedures are more liable to be associated with blood loss and shock, thereby reducing the general resistance of the patients. SSI rate varies according to the type of wound. In this study dirty wound (OR-2.86; p<0.009) was found significant risk factor for SSL Patter of SSI at Chittagong medical college hospital by the Ali and Khan et al the wound infection rate in clean wounds 25%, clean contaminated wound 28.6% and contaminated wound 54.8%.[19] Other studies by Weiss et al also correlate well.[20] In this study the superficial incisional SSI was the most common site of infection. Superficial incisional SSI occurred in 33 (54.1%) cases and deep incisional SSI occurred in 28 (45.9%) cases. This study has similarity with Sorensen et al studies.[4] It was observed that *E. coli* (54.1%) was the most common organism isolated from SSI followed by *S. aureus* (26.23%), *Pseudomonas* (8.2%), *Klebsiella* (4.92%). These were supported by Saha et al study at Dhaka medical college hospital.[21] Weiss et al study at Chittagong medical college hospital found that Staph. aureus was the most common organism for surgical wound infection.[20] But in this study *E. coli* replaces the staph. aureus. Zaman et al study also supports this study where *E. coli* isolated from 60% cases and staph. aureus 20% cases.[22] Antibiotic sensitivity test in this study yielded an interesting result. In most of the cases amikacin, ceftazidime, ceftriaxone and imipenem

emerged as the commonest antibiotic to which organisms were sensitive. But amoxyclave, ciprofloxacin was not so effective. But the commonly use antibiotics like penicillin, ampicillin, co-trimoxazole were ineffective. Saha et al study found that cephalexin and gentamycin were sensitive to *E. coli* but ampicillin, cephradin, co-trimoxazole, tetracycline, cloxacillin, erythromycin was ineffective.[21] They found the resistance was due to inappropriate, improper and random use of antibiotics leading to the development of a wide spectrum of resistant strains of organisms in the hospitals and societies at large.

Limitations

The study has following limitations: There was no protocol for the administrating of antibiotics. Study sample size was small.

CONCLUSION

From the observation and analysis of the collected data, comparing them with other published data on the title, it can be concluded that- The following risk factors were found statistically significant: Emergency procedures, dirty wounds, male gender, preoperative anaemia and habit of smoking. The procedures duration (>2 hours)-*E. coli* is the most common causative organism for SSI following gastrointestinal surgery. Amikacin, ceftriaxone, ceftazidime and imipenem were sensitive to *E. coli* and can be used as prophylactic antibiotic.

Recommendations

Based on the findings of the present study and analysis there of following recommendation are put forward- Further development of clinical pathways would prove valuable if the absolute risk of each patient could be estimated when planning surgery to specifically optimize the patient's preoperative condition to reduce the risk of SSI following gastrointestinal surgery. SSI surveillance should be conducted and maintained in all hospitals to promote better surgical outcomes. To establish the findings of the present study further research may be conducted in large sample size. Multi centered study may be conducted to establish these findings.

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