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Risk Prediction for Abdominal Wound Infection in Colorectal Surgery

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Abstract

Background: Post surgical wound infections are still among the most common serious complications of colorectal surgery and have serious consequences for outcomes and costs. Different risk factors may be involved including age, sex, nutrition, diabetes mellitus, type of disease, operation type and some operative factors like spillage of intestinal contents, gangrenous gut etc. This study aimed to determine the risk factors affecting abdominal wound infections in colorectal surgery and their rate at Shaheed Suhrawardy Medical College Hospital, a major referral teaching hospital in Bangladesh. **Methods:** Patients (n=50) who had undergone colorectal abdominal surgery were studied. Data were collected through pre & postoperative examinations. The subjects were followed till discharge. The relationships among variables were analyzed by percentage, ratio and odds ratio. To test the independence of the risk factors, the significant variables ($p \leq .05$) in the univariate analyses were entered into a binary logistic regression equation. **Results:** Of the 50 patients, 17 suffered from wound infection or SSI (34%). Infection subtype is as follows: superficial SSI 11 cases (64.7%), deep SSI 4 cases (23.5%), and organ/space SSI 2 (11.7%) cases. Overall mean postoperative hospital stay was 9.7 days (SD±5.9days). Additional postoperative hospital stay in patients who developed wound infection was 13.5 days. In multivariate analysis Underweight ($p<0.029$), Diabetes mellitus ($p<0.017$), Older age group ($p<0.013$) were proved to be independent risk factor for wound infection. **Conclusions:** This study suggests that, optimizing the patients' condition preoperatively by correcting anaemia, hypoalbuminaemia, controlling diabetes mellitus, reducing intraoperative spillage of intestinal contents, the SSI may be reduced to a more acceptable level. Furthermore, prospective study of larger scale in this issue has been recommended.

Keywords:- Abdomen, Infection, Wound.

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INTRODUCTION

Infectious complications are the main causes of post-operative morbidity in abdominal surgery.[1] Introduction of the principles of antisepsis decreased postoperative infectious morbidity substantially. Further advances in infection control practices include improved operating room ventilation, sterilization methods, barriers, surgical technique and availability of antimicrobial prophylaxis. Despite these activities, wound infection remains a major clinical problem in terms of morbidity, mortality, postoperative hospital stays and hospital cost.[2,3] Based on National Nosocomial Surveillance (NNIS) system reports, wound infections are the third most frequently reported nosocomial infection, accounting for 14%-16% of all nosocomial infection among hospitalized patients.[4] Among surgical patients, wound infections were the most common nosocomial infection, accounting for 38% of all such infections.[5] Infection rates in US National Nosocomial Surveillance (NNIS) system hospitals were reported to be: clean 2.1%, clean-contaminated 3.3%, contaminated 6.4% and dirty 7.1%.[6] Colorectal surgery is associated with a high risk of infection due to endogenous contamination by bacteria in the contents of the large bowel.[5] Surgery for rectal cancer is often associated with stoma formation and anastomosis close to the anal verge, all of which could lead to surgery that lasts longer and has greater bacterial contamination.[5] Therefore, colorectal surgery might have a higher risk for developing wound infection. Despite improvement in surgical technique, bowel preparation, and prophylactic antibiotics, colorectal surgery was associated with a 5% to 6% mortality rate and a 20% to 40% morbidity rate.[7] Delineation of the incidence of wound infections and their risk factors is extremely important, because there are associations between wound infection and increased length of stay and cost for colorectal surgery.[8] There are various risk factors which significantly increase the rate of wound infection in colorectal surgery. There are no available data estimates of wound infection occurrence in our country but there is little doubt that the problem is no less than anywhere else in the world. Identification of these risk factors is important to take effective measures to reduce this.[9]

Objective

The aim of this was to find the extent of wound infection following colorectal surgery and its associated risk factors.

MATERIAL AND METHODS

This cross sectional study was conducted in the Department of Surgery of Shaheed Suhrawardy Medical College Hospital, Dhaka from July 2019 to January 2020. Patients who underwent colorectal surgery in the Department of Surgery of Shaheed Suhrawardy Medical College Hospital, Dhaka were considered as study population. Total 50 consecutive patients were enrolled purposively as study sample. The independent risk factors analyzed, were divided into demographic and anthropometric variables which include Age, Sex and BMI. Disease and management related variables include type of disease (Benign/malignant), type of surgery (Elective/ Emergency). Presence of risk factors for poor wound healing includes diabetes, anaemia, hypoalbuminaemia. Operative characteristics were intra-operative spillage of intestinal

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content, operation upon gangrenous gut. Surgical site was checked up on third postoperative day and every two days thereafter till discharge of the patient from hospital. The observation schedule was increased to more frequent intervals when surgical site had shown any signs of infection. The CDC NNIS definition was followed to define surgical site infection. Bacteriological culture and sensitivity test of fluid or tissue from incisional site/organ/space was performed as and when required. Infection occurring after discharge was not surveyed. Statistical analysis of the results was obtained by using window based computer software devised with statistical packages for social sciences (SPSS-23). Both descriptive & inferential statistics are used in process of data analysis.

RESULTS

In the study period, 17(34%) out of 50 patients developed post-operative wound infection. Mean age of patients was 45.02 years, with a range of 16-70 years. Among them 33(66%) patients were of 50 years or younger. In 17(34%) patients, age was more than 50 years. Among patients aged less than 50 year 27.7% patients developed wound infection and it was 47.05% in patients aged more than 50 years. The ratio of wound infection between these two groups was 1:1.72. 56% (28) of the patients were male and 44% (22) were female. Here male: female ratio was 1.27:1. Among the male patients post-operative wound infection developed in 10 patients (35.7%), whereas in females, infection developed in 7 patients (31.8%). So, the rate was little bit higher in male (35.7% versus 31.8%) with a ratio of 1.12:1.Mean BMI of patients were 21.6±2.6571 SD in kg/m², with a range of 15.8-33.8. Based on BMI, patients were divided into three categories: normal weight (BMI 18.5-30), obese patients (BMI>30) and underweight (BMI up to 18.5). 34 patients were within normal range, among them 10(29.4%) patients developed wound infection. Among the 5 obese patients 2(40%) were infected. 11 patients were underweight, among them 5(45.5%) patients developed wound infection. So the ratio of wound infection among normal, obese and underweight was 1:1.36:1.55. In the study, 13 patients (26%) were anaemic (Hb% <10gm/dl). Among them 9 (69.23%) patients developed post operative wound infection. Among the nonanaemic, infection rate was 21.62%.The ratio of wound infection in between anaemic and nonanaemic patients was 2.88:1.7 patients (14%) were diabetic (fasting>7 mmol/l or random>11 mmol/l). Among them 4 (57.14%) patients developed post operative wound infection. Among the nondiabetic, infection rate was 30.23%. The ratio of wound infection among diabetic and non-diabetic was 1.89:1 which is nearly double in diabetic patients [OR = 3.07 i.e>1]. 10 patients (26%) of this study population were hypoalbuminaemic (serum albumin <30gm/L). Among them 8 (80%) patients developed post-operative wound infection. Among the non hypoalbuminaemic patients, infection rate was 22.5%. The ratio of wound infection between these two groups was 3.56:1 which revealed that wound infection is more than three and half times higher among hypoalbuminaemic patients [OR =13.78 i.e>1]. Of the 50 patients, 19 (38%) patients underwent laparotomy for benign disease and 31 (62%) for malignant. Wound infection developed in 6 (31.58%) patients in the benign group and 11 (35.48%) patients in malignant group. The ratio between these two

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Page no- 255-265 | Section- Research Article (Surgery)

groups was 1:1.2. 21 patients (42%) underwent emergency surgery and among them 9 patients (42.8%) developed wound infection. In contrast 8 patients (27.5%) out of 29 elective cases developed wound infection. The ratio of wound infection among emergency and elective surgery was 1.56:1. In the study, during operative procedure, there was spillage of intestinal content in 7(14%) patients. Wound infection developed in 5 (71.4%) patients. On the other hand 12 patients (27.9%) out of 43 patients developed wound infection, where there was no spillage [OR=6.46]. Most [11(64.7%)] of the wound infections involved only skin or subcutaneous tissue of the incision. In 4 (23.5%) cases, infection involved deep fascia/ muscle of the incision. In 2 cases (11.7%), infection involved organ/space manipulated during operation. Overall mean postoperative hospital stay was 9.7±5.905 SD days, in a range of 3-43 days. Postoperative hospital stay in patients who developed wound infection is 19.9±7.643 SD days whereas; it was 7.4±4.167 SD in patients with no infection. In hospital stay in patients with wound infection was 12.5 days more than the patients who did not develop SSI.

Table 1: Age group versus Wound infection Cross-tabulation.

Age group		**Wound infection**		**Total**
	Yes	**Percentage (%)**	**No**	
≤50years	9	27.27	24	33
>50years	8	47.05	9	17
Total	17		33	50

Table 2: Association between BMI and wound infection.

		Wound infection		**Total**
	Yes	**Percentage (%)**	**No**	
Normal	10	29.4	24	34
Obese	1	40	3	5
Underweight	5	45.5	6	11

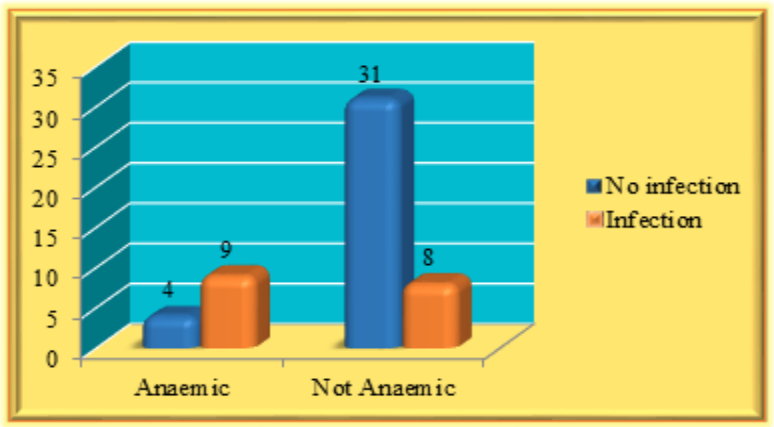

Figure 1: Anaemia versus Wound Infection.

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Vol-7, Issue-6 | November-December 2021
Page no- 255-265 | Section- Research Article (Surgery)

Table 3: Diabetes mellitus versus Wound Infection Cross-tabulatio

Diabetes mellitus	Wound infection			Total	OR
	Yes	Percentage (%)	No		
Present	4	57.14	3	7	3.07
Absent	13	30.23	30	43	
Total	17		33	50	

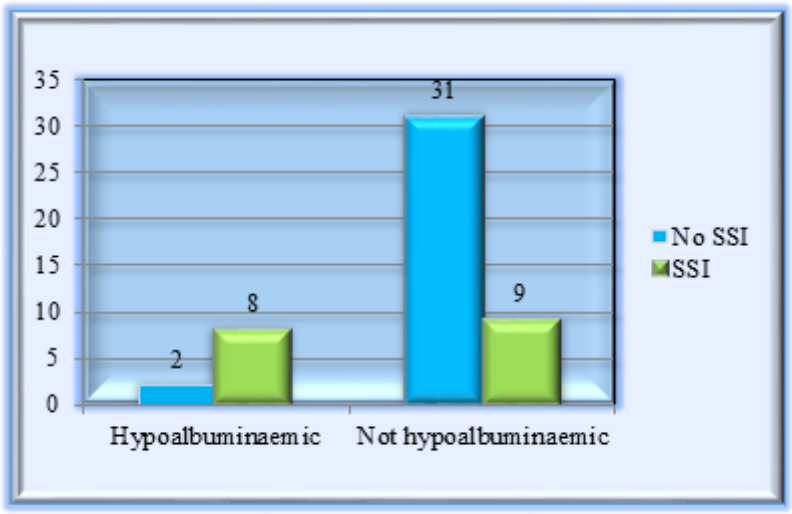

Figure 2: Hypoalbuminaemia versus Wound Infection.

Table 4: Type of disease versus Wound Infection Cross-tabulation

Type of disease	Wound infection			Total
	Yes	Percentage (%)	No	
Benign	6	31.58	13	19
Malignant	11	35.48	20	31
Total	17		33	50

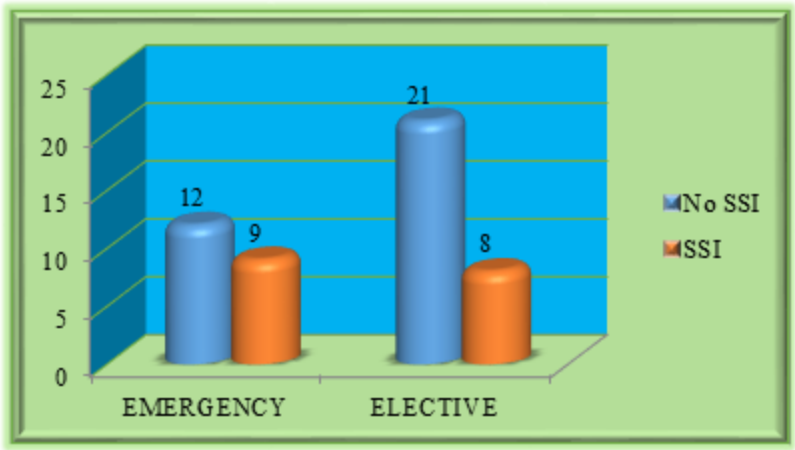

Figure 3: Type of surgery versus Wound Infection.

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Vol-7, Issue-6 | November-December 2021
Page no- 255-265 | Section- Research Article (Surgery)

Table 5: Spillage of intestinal content versus Wound Infection Cross-tabulation.

Spillage	Wound infection			Total	OR
	Yes	Percentage (%)	No		
Yes	5	71.4	2	7	6.46
No	12	27.9	31	43	
Total	17		33	50	

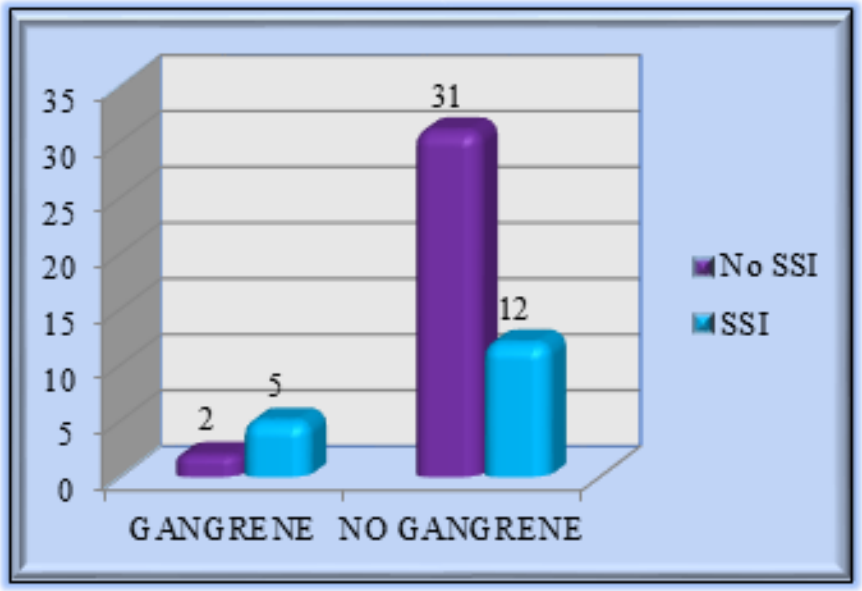

Figure 4: Gut viability versus Wound Infection.

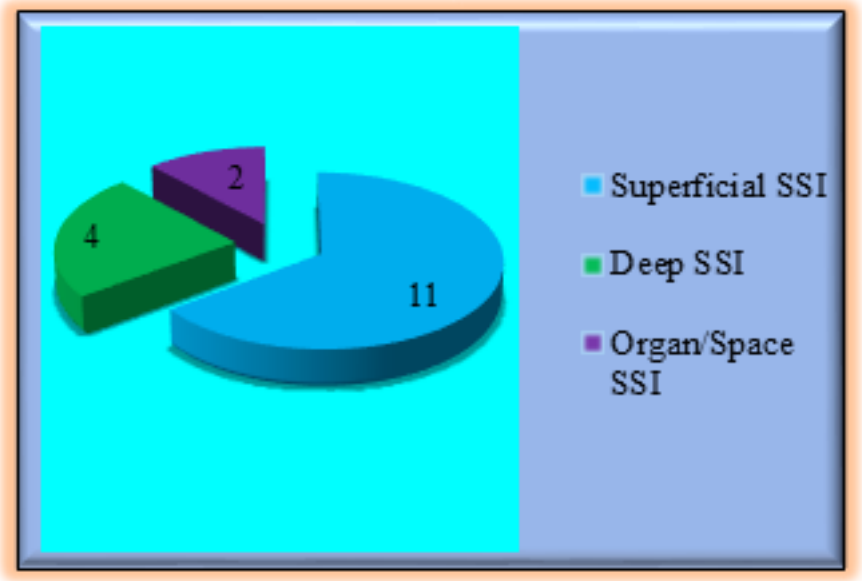

Figure 5: Types of wound infection.

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Vol-7, Issue-6 | November-December 2021
Page no- 255-265 | Section- Research Article (Surgery)

Table 6: Common indications for operation.

Name of operation	Indications		Number of patients (%)	Percentage (%)
Sigmoid colectomy	Benign	Volvulus of sigmoid colon (10)	12	24
	Malignant	Ca- sigmoid colon (2)		
Right hemicolectomy	Benign	Ileocaecal TB (3)	11	22
		Ileocaecal Crohn's disease (2)		
	Malignant	Ca right colon (7)		
Anterior resection	Ca rectum (10)		10	20
Left hemicolectomy	Ca left colon (7)		7	14
Total colectomy with ileal pouch anal anastomosis	Familial adenomatous polyposis (4)		4	8
APR	Ca rectum (3)		3	6
Others			3	6

Table 7: Comparison of Post-operative hospital stay

Wound Infection	Postoperative Hospital Stay		SD
	Mean		
	Yes	19.9	7.643
Wound infection	No	7.4	4.167

DISCUSSION

A successful outcome after surgery is highly dependent on the incidence and severity of postoperative complications. Surgical site infection is among the most common complications of intra-abdominal surgery. Post-operative wound infection not only increases morbidity, mortality, hospital stay and costs, but also compromises the cosmetic outcome. Some patients subsequently develop incisional hernia.[10] This study was conducted to identify the incidence of wound infection in colorectal abdominal surgery and to determine risk factors associated with infection. The overall infection rate for the 50 consecutive patients studied was 34%. This finding is significantly low in a study in New York conducted by Vanessa PH et.al from 2001 to 2008 where the infection rate was 22.4%.[1] As Vanessa's study was conducted in a society where, high standard of aseptic OT environment is available and most of their cases were electively operated, they got a low infection rate. Another study conducted by Robert L et. al in Virginia revealed the infection rate to be 26%.[4] In this study, mean age of patients was 45.02 years, with a range of 16-70 years. Among them 66% patients were of 50 years or younger. In 34% patients, age was more than 50 years. Among patients aged less than 50 year 27.7% patients developed wound infection and it was 47.05% in patients aged more than 50 years. The ratio of wound infection between these two groups was 1:1.72. In Vanessa's study, the mean age of patients was 59.8 (SD 17.8) years and it was 62 (1.2 SD) in Robert's study.[1,4] In this study, 56% of patients were male with a male: female ratio of 1.27:1. This finding is similar to the study

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Vol-7, Issue-6 | November-December 2021
Page no- 255-265 | Section- Research Article (Surgery)

conducted by Tsuyoshi K, where it was 65% but differ from Vanessa where it was 48%.[1,5] In this study, post-operative wound infection rate is little bit higher in male (35.7% versus 31.8% with a ratio of 1.12:1). Incidence of wound infection does not differ in sexes, in agreement with previous findings.[11,12,13,14] In this study, mean BMI of patients were 21.6±2.6571 SD in kg/m², in a range of 15.8-33.8. Based on BMI, patients were divided into three categories: normal weight (BMI 18.5-30), obese patients (BMI>30) and underweight (BMI up to 18.5). 34 patients were within normal range, among them 29.4% patients developed wound infection. Among the 5 obese patients 40% were infected. 11 patients were underweight, among them 5(45.5%) patients developed wound infection. So the ratio of wound infection among normal, obese and underweight was 1:1.36: 1.55. The mean BMI was 25±5 SD in kg/m² revealed in Arnaud's study which is markedly higher than this study.[7] In this study, 26% were anaemic (Hb% <10gm/dl). Among them 69.23% patients developed post-operative wound infection. Among the nonanaemic, infection rate was 21.62%. The ratio of wound infection in between anaemic and nonanaemic patients was 2.88:1. This finding markedly differs from the study conducted by Tsuyoshi K where 16% anaemic patients developed wound infection whereas it was 12% in nonanaemicpatients.[5] In this study, 14% cases were diabetic (fasting>7 mmol/l or random>11 mmol/l). Among them 57.14% patients developed post-operative wound infection. Among the nondiabetic infection rate is 30.23%. The ratio of wound infection among diabetic and non-diabetic was 1.89:1 which is nearly double in diabetic patients. So diabetes mellitus is a risk factor for wound infection [OR = 3.07 i.e>1] found in this study. This finding markedly differs from the study conducted by Tsuyoshi K where 24% diabetic patients developed wound infection.[5] Tsuyoshi operated upon elective cases where strict glycaemic control was achievable, whereas in this study large percentage of cases underwent emergency surgery, where it was difficult to control the glycaemic status. Twenty six percent patients of this study were hypoalbuminaemic (serum albumin <30gm/L). Among them 80% patients developed post-operative wound infection. Among the non hypoalbuminaemic patients, infection rate was 22.5%. The ratio of wound infection between these two groups was 3.56:1 which revealed that wound infection is more than three and half times higher among hypoalbuminaemic patients. So hypoalbuminaemia is a risk factor for wound infection [OR =13.78 i.e>1].[5] This finding largely differs from the study conducted by Tsuyoshi K where 47% hypoalbuminaemic patients developed wound infection.[5] As many of our cases had both anaemia and hypoalbuminaemia, the rate of wound infection was very high in this study.In this study, 38% patients underwent laparotomy for benign disease and 62% for malignant. Wound infection developed in 31.58% patients in the benign group and 35.48% patients in malignancy. The ratio between these two groups was 1:1.2. This finding is similar to the finding by Velasco E et.al where infection rate in malignant disease was 31.6%.[13] In this study, 42% patients underwent emergency surgery and among them 42.8% developed wound infection. In contrast 27.5% out of 29 elective cases developed wound infection. The ratio of wound infection among emergency and elective surgery was 1.56:1. But in Vanessa's study, most of the patients (93.08%)

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Vol-7, Issue-6 | November-December 2021
Page no- 255-265 | Section- Research Article (Surgery)

underwent elective surgery. This is the reason of dissimilarity of findings between these two studies. In this study, during operative procedure, there was spillage of intestinal content in 14% patients. Wound infection developed in 71.4% patients. On the other hand 27.9% out of 43 patients developed wound infection where there was no spillage. So intraoperative spillage is a risk factor for wound infection [OR=6.46]. This finding is comparable to both Vanessa's and Tsuyoshi's findings where infection rate was 62.56% and 53.21% respectively.[1,5] In the study, 14% patients were found to have gangrenous gut on exploration of abdomen. Of them, 71.4% developed wound infection. In contrast, 86% patients were operated upon healthy gut. Among them 27.9% developed wound infection. So operation upon gangrenous gut is a risk factor for developing wound infection [OR=6.46]. The rate of wound infection in patients having gangrenous gut was four times greater than that of viable gut revealed in a study conducted by Raveenthiran V in India which was similar to our study.[16] Overall mean postoperative hospital stay was 9.7±5.905 SD days, in a range of 3-43 days. Postoperative hospital stay in patients who developed wound infection is 19.9±7.643 SD days whereas; it was 7.4±4.167 SD in patients with no infection. In hospital stay in patients with wound infection was 12.5 days more than the patients who did not develop SSI. In a study conducted by Reddy KM in London revealed that the mean post-operative hospital stay was 14 days; this study also revealed that wound infection increases this stay by 11.7 days 17. Both of these results are very similar to this study.In this series, common indications for operation in descending order include carcinoma of colon, volvulus of sigmoid colon, and carcinoma of left colon, carcinoma of right colon, familial adenomatous polyposis and inflammatory bowel disease (Table 7). Common operations include sigmoid colectomy, right hemicolectomy, anterior resection, left hemicolectomy, total colectomy, APR etc.Of the 17 cases of SSI, in 11 cases (64.7%), infection were limited within skin and superficial tissue, in 4 cases (23.5%) it involved deeper incisional tissue and organ/space infection occurred in rest 2(11.8%) cases.Among the ten pre and preoperative risk factors, eight risk factors for postoperative wound infection have been identified: age>50 years, being underweight, anaemia, diabetes mellitus, hypoalbuminaemia, emergency surgery, operation upon gangrenous gut and intraoperative spillage of intestinal contents.Wound infection was not correlated with sex and type of disease (benign or malignant).Because of the advances in surgery and anaesthesia, older and sicker patients are now being more often considered for surgical treatment than in previous years. Age is a risk factor for postoperative infectious complication, commonly reported in the medical literature.[18] Increasing age is correlated with greater likelihood of certain chronic conditions, e.g. malnutrition and a fall in the body's immunological efficiency, causing more extensive SSI.[19,20]

Limitation of the Study

The study had a very short duration with a small sample size. This study gives no idea about post discharge SSI, whereas post discharge SSI surveillance is strongly recommended for procedures, where post-operative hospital stay is too short (<5days).

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Page no- 255-265 | Section- Research Article (Surgery)

CONCLUSIONS

This study provided information on rate and risk factors for abdominal wound infection in colorectal abdominal operations in the Department of Surgery of Shaheed Suhrawardy Medical College. Eight independent risk factors are identified in this study both univariate and multivariate analysis.With the aim of reducing the rate of infectious complications, the risk factors can be divided into the following two categories: Unmodifiable factors: age, emergency surgery, gangrenous gut.Factors those can be modified before or during surgery: anaemia, diabetes mellitus, hypoalbuminaemia, body weight and intraoperative spillage of intestinal contents.

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