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Clinical Study of Various Risk Factors Associated with Surgical Site Infection

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ABSTRACT
For surgical patients, surgical site infections (SSI) are the most common nosocomial infection, frequently cause morbidity and mortality among inpatients of hospitals and they have been shown to be the leading cause of operation-related adverse events. Present study was aimed to study various risk factors of surgical site infections at a tertiary hospital. To assess the significance of various risk factors using statistical analysis to prioritize interventions aimed at reducing SSI incidence. The present study was a hospital based, prospective, observational study, conducted in patients 15-70 years age, this study was conducted from 18 months(April 2023 to October 2024) at Murshidabad Medical college and Hospital in Department of General Surgery of gender, underwent non-traumatic exploratory laparotomy, had surgical site infections following laparotomy. 22 (22.00%) patients had Appendicectomy and peritoneal lavage, 12 (12.00%) patients had Open appendicectomy, 10 (10.00%) patients had Adhesiolysis/Resection Anastomosis, 9 (9.00%) patients had Peritoneal lavage, 11 (11.00%) patients had Hernia repair, 16 (16.00%) patients had Ileal repair/ileostomy, 3 (3.00%) patients had Exploratory laparotomy with mental patch repair, 5 (5.00%) patients had RA repair of sigmoid volvulus, 2 (2.00%) patients had Duodenal ulcer perforation repair, 5 (5.00%) patients had Liver abscess drainage and peritoneal lavage and 5 (5.00%) patients had Repair of intussusception and it was statistically significant <0.0001. Surgical site infection is a preventable morbidity. BMI >25, co-morbidities such as diabetes, smoking, dyslipidaemia, surgery >2 hours, appendicectomy were few high-risk factors noted for surgical site infections.

INTRODUCTION

For surgical patients, surgical site infections (SSI) are the most common nosocomial infection, frequently cause morbidity and mortality among in patients of hospitals and they have been shown to be the leading cause of operation-related adverse events[1,2]. The rate of SSI is higher in the developing world than that in developed countries. The post-discharge surveillance of SSI in elective clean and clean-contaminated surgical procedures was carried out during 2019 and 15% incidence was reported in LMICs[3]. Patients of SSIs are closely linked with increased length of stay, delayed wound healing, pain, discomfort, long-lasting disability and even death[4]. Numerous risk factors are involved in SSI with a complex relationship as., surgery, patients, microbial and environment related factors[5]. There are many factors that affect the susceptibility of any wound to infection. These factors include pre-existing illness, length of operation, wound class and wound contamination. Other factors are extremes of ages, malignancy, metabolic diseases malnutrition, immunosuppression, cigarette smoking, remote site infection, emergency procedures and long duration of preoperative hospitalization[6]. As SSIs continue to pose challenges in healthcare management, detailed and specific identification of the factors that may place individual patients at greater risk of infection and identification of the gaps in currently-available prevention options could help to minimize morbidity, mortality and healthcare costs associated with SSI. Present study was aimed to study various risk factors of surgical site infections at a tertiary hospital.

MATERIALS AND METHODS

Study Design: Observational prospective study.

Period of Study: Duration of study is 18 months (April 2023 to October 2024).

Place of Study: Murshidabad Medical college and Hospital in Department of General Surgery.

Sample Size: 100.

Inclusion Criteria:

- **Age:** Patients aged ≥18 years.
- Patients undergoing elective or emergency surgical procedures.
- Specific surgical categories (e.g., gastrointestinal, orthopedic, or gynecological surgeries).
- Patients with a confirmed diagnosis requiring surgery.
- Patients who are medically fit for surgery based on preoperative assessments.
- Patients or their legal guardians must provide written informed consent.
- Patients who are admitted to the hospital for at least 48 hours post-surgery to monitor for SSIs.

Exclusion Criteria:

- Patients with active infections unrelated to the surgical procedure.
- HIV/AIDS, chemotherapy, or long-term corticosteroid use.
- Patients with insufficient medical documentation.
- Patients with contraindications for the surgical procedure.
- Exclude minor or outpatient surgeries with low risk for SSIs.
- Pregnant women, unless the study specifically involves obstetric surgeries.
- Patients who decline participation or with draw consent during the study.

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0., SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests, which compare the means of independent or unpaired samples, were used to assess differences between groups. Paired t-tests, which account for the correlation between paired observations, offer greater power than unpaired tests. Chi-square tests (χ^2 tests) were employed to evaluate hypotheses where the sampling distribution of the test statistic follows a chi-squared distribution under the null hypothesis., Pearson's chi-squared test is often referred to simply as the chi-squared test. For comparisons of unpaired proportions, either the chi-square test or Fisher's exact test was used, depending on the context. To perform t-tests, the relevant formulae for test statistics, which either exactly follow or closely approximate a t-distribution under the null hypothesis, were applied, with specific degrees of freedom indicated for each test. P-values were determined from Student's t-distribution tables. A p-value ≤0.05 was considered statistically significant, leading to the rejection of the null hypothesis in favour of the alternative hypothesis.

RESULTS AND DISCUSSIONS

In our study, 20 (20%) patients were ≤30 year of age, 16 (16%) patients were 31-40 year of age, 26 (26%) patients were 41-50 year of age, 19 (19%) patients were 51-60 year of age and 19 (19%) patients were 61-70 year of age and it was not statistically significant .027852 (52.00%) patients were Male and 48 (48.00%) patients were Female and it was not statistically significant .5686818 (18.00%) patients had Diabetes, 25 (25.00%) patients had BMI >25 kg/m2, 16 (16.00%) patients had Dyslipidaemia, 19 (19.00%) patients had Smoking, 8 (8.00%) patients had Hypertension, 8 (8.00%) patients had Chronic obstructive pulmonary disease and 6 (6.00%) patients

Table 1: General Characteristic

	Characteristic	No. of patients (n=100)	Percentage	P value
Age group (years)	≤30	20	20	.0278
	31-40	16	16	
	41-50	26	26	
	51-60	19	19	
	61-70	19	19	
	Total	100	100	
Gender	Male	52	52.00	.56868
	Female	48	48.00	
	Total	100	100.00	
Co-morbidities	Diabetes	18	18.00	.0002
	BMI >25 kg/m2	25	25.00	
	Dyslipidaemia	16	16.00	
	Smoking	19	19.00	
	Hypertension	8	8.00	
	Chronic obstructive pulmonary disease	8	8.00	
	Coronary artery disease	6	6.00	
	Total	100	100.00	
ASA grade	I	16	16.00	<0.0001
	II	55	55.00	
	III or more	29	29.00	
	Total	100	100.00	
Duration of operation (Hours)	<1 HR	13	13.00	<0.0001
	1-2 HR	44	44.00	
	>2 HR	43	43.00	
	Total	100	100.00	

Table 2: Type of Surgery

	Surgery	No. of patients (n=100)	Percentage	P value
	Appendicectomy and peritoneal lavage	22	22.00	
	Open appendicectomy	12	12.00	
	Adhesiolysis/Resection Anastomosis	10	10.00	
	Peritoneal lavage	9	9.00	
Surgery	Hernia repair	11	11.00	
	Ileal repair/ileostomy	16	16.00	<0.0001
	Exploratory laparotomy with omental patch repair	3	3.00	
	RA repair of sigmoid volvulus	5	5.00	
	Duodenal ulcer perforation repair	2	2.00	
	Liver abscess drainage and peritoneal lavage	5	5.00	
	Repair of intussusception	5	5.00	
	Total	100	100	

Table 3: SSI Related Characteristics

	Characteristic	No. of patients (n=100)	Percentage	P value
Type of wound7	Clean	38	38.00	.00046
	Clean contaminated	26	26.00	
	Contaminated	20	20.00	
	Dirty or infected	16	16.00	
	Total	100	100.00	
Type of SSI7	Type of SSI7	100	100.00	
SSI	Superficial SSI	51	51.00	<0.0001
	Deep SSI	43	43.00	
	Organ space SSI	6	6.00	
	Total	100	100.00	

Table 4: Organism Isolated

	Organism isolated	No. of patients (n=100)	Percentage	P value
	No growth	33	33.00	<0.0001
	E. coli	16	16.00	
	Pseudomonas	13	13.00	
	Streptococcus	11	11.00	
Organism isolated	Klebsiella	8	8.00	
	MRSA	8	8.00	
	Acinetobacter	4	4.00	
	Helicobacter	4	4.00	
	Providentia	3	3.00	
	Total	100	100	

had Coronary artery disease and it was statistically significant .0002.16 (16.00%) patients had I ASA grade, 55 (55.00%) patients had II ASA grade and 29 (29.00%) patients had III or more ASA grade and it was statistically significant <0.0001.13 (13.00%) patients had <1 hr Duration of operation, 44 (44.00%) patients had 1-2 hr Duration of operation and 43 (43.00%) patients had >2 hr Duration of operation and it was statistically significant <0.0001.22 (22.00%) patients had Appendicectomy and peritoneal lavage, 12 (12.00%) patients had Open appendicectomy, 10 (10.00%) patients had Adhesiolysis/Resection Anastomosis, 9 (9.00%) patients had Peritoneal lavage, 11 (11.00%) patients had Hernia repair, 16 (16.00%) patients had Ileal repair/ileostomy, 3 (3.00%) patients had Exploratory laparotomy with omental patch repair, 5 (5.00%) patients had RA repair of sigmoid volvulus, 2 (2.00%) patients had Duodenal ulcer perforation

repair, 5 (5.00%) patients had Liver abscess drainage and peritoneal lavage and 5 (5.00%) patients had Repair of intussusception and it was statistically significant <0.0001.38 (38.00%) patients had Clean, 26 (26.00%) patients had Clean contaminate, 20 (20.00%) patients had Contaminated and 16 (16.00%) patients had Dirty or infected and it was statistically significant .00046.100 (100.00%) patients had Type of SSI7.51 (51.00%) patients had Superficial SSI, 43 (43.00%) patients had Deep SSI and 6 (6.00%) 33 (33.00%) patients had No growth, 16 (16.00%) patients had E. coli, 13 (13.00%) patients had Pseudomonas, 11 (11.0%) patients had Streptococcus, 8 (8.00%) patients had Klebsiella, 8 (8.00%) patients had MRSA, 4 (4.00%) patients had Acinetobacter, 4 (4.00%) patients had Helicobacter and 3 (3.00%) patients had Providentia and it was statistically significant <0.0001.

This table highlights the demographic and clinical profiles of the study participants. The significant distribution of patients across age groups suggests a relatively even representation, with a slight predominance in the 41-50 age groups (26%). It was statistically significant (P.0278) Gender distribution was almost equal, indicating no significant gender bias in the study population (p=.56868). Co-morbidities like diabetes and BMI >25 kg/m² showed notable prevalence (18% and 25%, respectively), with diabetes having a statistically significant association (p=.0002). This aligns with existing literature that identifies these factors as contributors to surgical complications. The high ASA grade (≥II in 84% of patients, p<.0001) and prolonged operation durations (≥1 hour in 87% of patients, p<.0001) emphasize the complexity of cases, underscoring the need for vigilant perioperative management. Despite several advancements in procedures, the optimal reduction of SSIs remains a challenge[7]. The development of SSI is multi factorial, and it may be related to patient's risk factors such as age, comorbidities, smoking habit, obesity, malnutrition, immunosuppression, malignancies and the class of contamination of the wound[8]. Primary infections are usually more serious, appearing within five to seven days of surgery. Majority of SSIs are uncomplicated involving only skin and subcutaneous tissue but sometimes can progress to necrotizing infections. The usual presentation of infected surgical wound can be characterized by pain, tenderness, warmth, erythema, swelling and pus formation[9]. This table outlines the diversity of surgical procedures undertaken, with appendicectomy and peritoneal lavage being the most common (22%). Open appendicectomy (12%) and ileal repair/ileostomy (16%) were also frequent, suggesting a significant representation of gastrointestinal emergencies. The statistical significance (p<.0001) indicates the heterogeneity in surgical presentations. Procedures like hernia repair and exploratory laparotomy reflect the acute and chronic nature of the cases. This diverse surgical profile necessitates tailored infection prevention strategies for various operative interventions. The distribution of surgical site infections (SSIs) in this cohort reflects the procedural risk and environmental factors influencing wound contamination. The predominance of clean (38%) and clean-contaminated wounds (26%) contrasts with the significant proportion of dirty or infected wounds (16%, p=.00046), highlighting the challenges of managing higher contamination risk. Superficial SSIs were most prevalent (51%), followed by deep (43%) and organ space SSIs (6%), with a significant p-value (<0.0001). These findings are consistent with known epidemiological patterns in SSI development, stressing the importance of preoperative antibiotic prophylaxis and stringent aseptic techniques. Microbial analysis of SSIs revealed a significant proportion of cases without microbial growth (33%, p<.0001), potentially due to early antibiotic administration or non-infectious etiologies. Among pathogens isolated, E. coli (16%), Pseudomonas (13%) and Streptococcus (11%) were most common, aligning with global trends in SSI microbiology. Notably, MRSA and Klebsiella accounted for 8% each, emphasizing the need for robust infection control measures to address multi-drug resistant organisms. The diversity of pathogens underscores the necessity of culture-guided antimicrobial therapy to optimize patient outcomes. The incidence of SSI in study by Prakash[10] was 25.34% with 81.58% superficial SSI and 18.42% deep SSI. Laparotomy was the common procedure and 63.2% of cases were females and 41-60 years was the most common age group. Patel[11] noted that, SSI rate was 16% (32/200).The most common organism isolated was Escherichia coli (35.7%, 10/28). Increase in pre-operative hospital stay, ASA (American Society of Anesthesiology) score >2, increase in surgical wound class, emergency surgeries, longer duration of surgery were associated with increased SSI rates. In study by Amit Agrawal[12], SSI incidence was 15.7% (59/375). In elective surgeries, the SSI rate was 5.7% and in emergency surgeries, it was 28.6%. It was found that SSI increased with increasing age linearly.

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