Section: General Surgery

Original Research Article

A STUDY ON SURGICAL SITE INFECTIONS IN CLEAN AND CLEAN CONTAMINATED CASES AT A RURAL TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Surgical site infection (SSI) is a common postoperative complication causing increased morbidity, hospital stay, and healthcare costs. Despite advances in asepsis and antibiotics, it remains a concern, especially in rural tertiary care settings. This study aimed to evaluate the incidence and risk factors of SSI in clean and clean-contaminated surgical cases.The study aimed to assess surgical site infections in clean and clean-contaminated cases at a tertiary care hospital, focusing on clinical profile, risk factors, common pathogens, and outcomes at North Bengal Medical College and Hospital. **Materials and Methods:** This observational descriptive study was conducted in the Department of General Surgery, NBMCH, Siliguri from May 2020 to April 2021, including 60 patients undergoing elective and emergency surgeries. **Results:** A total of 60 patients were studied, mostly aged 20–39 years (46.7%) with slight female predominance (53.3%); acute appendicitis (23.3%) and elective surgery (71.7%) were most common. Open appendicectomy was the leading procedure (23.3%), with clean-contaminated wounds (66.7%) and diabetes as the main comorbidity (30%). Superficial SSI was most frequent (70%), E. coli was the main organism (55%), and most patients had hospital stay of 0–7 days (45%). **Conclusion:** Surgical site infections continue to be an important postoperative complication, especially in clean-contaminated surgeries. Proper preoperative optimization, strict adherence to aseptic techniques, timely antibiotic prophylaxis, and meticulous surgical technique can significantly reduce SSI rates. Strengthening infection control practices in rural tertiary care hospitals is essential to improve surgical outcomes and reduce healthcare burden.

INTRODUCTION

Surgical site infections (SSI) are defined as infections occurring up to 30 days after Surgery (or up to one year after surgery in patients receiving implants) and affecting either the incision or deep tissue at the operation site.[1] SSI are the most common nosocominal infection in surgical patients, Accounting for 38% of all such infections, they are a significant source of postoperative morbidity resulting in increased hospital length e.g. stay and increased cost.[2] Diabetes and malnutrition (defined as significant weight loss 6 months prior to surgery) are significant risk factors for SSI and postoperatively anemia is an important risk factor for SSI. In many SSIs, the responsible pathogens originate from patient's endogenous flora. SSIs are associated with substantial morbidity and mortality. Patients with SSI are twice as likely to die, 60% more likely to be admitted to the Intensive Care Unit, and more than five times more likely to be admitted to the hospital after discharge.[2] SSI is very frequently encountered in developing countries. There are so many cases of SSI found after a clean and clean-contaminated surgical procedure. The combined prevalence of SSI in elective clean and clean-contaminated surgeries in all developing countries analysed was 6% (95%CI 5-7%).[3] Chances of SSIs increase significantly with an increase preoparative stay. The increase in duration of surgery is associated with a significant rise in the rate of SSIs.[4] SSI is

much higher (22.41%) in case where drain was used than non-drained wounds (3.03%).[3] SSI is the third most commonly reported nosocomial infection and Accounts for 14-16% of all nosocomial infections among hospital patients.[5] We attend too many cases of SSI at North Bengal Medical College & Hospital (NBMCH), Surgery Out Patient Department (OPD) and In Patient Department (IPD), but there is a dearth of study on this topic inspite of the persistent huge burden of SSI. Knowledge about the different factors related to the causation of SSI in case of clean and clean-contaminated surgeries can help us to reduce the chance of development of SSI. In this context, the current study was planned to study SSI in clean and clean-contaminated cases at NBMCH, which is a rural tertiary care hospital.

MATERIALSANDMETHODS

Study Type: observational descriptive study.
Study setting: The study was conducted in the Department of General Surgery (In Patient Department and Surgery Casualty Ward) of North Bengal Medical College & Hospital (NBMCH), located near Siliguri in Darjeeling district of West Bengal.
Period of study: May, 2020 to April, 2021.
Study population: The study population were all the patients who underwent elective and emergency Surgery in NBMCH (in patient department and surgery casualty ward).
Sample size: 60

Inclusion criteria

- The patients having clean and clean contaminated operation in all age groups
- The patients having elective surgeries and emergency abdominal surgeries
- Operation carried out in General Surgery OT with antibiotic prophylaxis

Exclusion criteria

- Patients who did not consent to participate in the study
- Contaminated and dirty cases.

Study Variables

- Age
- Sex
- Diagnosis
- Surgery type
- Surgical procedure
- Serum Albumin
- Suture material
- Stitching technique
- Drain type
- Post-operative day
- SSI Type
- Causative organism
- Post-operative hospital stay duration (days)
- Wound type
- Nutritional status
- Co-morbidities
- Position on surgery list
- Haemoglobin

Statistical analysis

For statistical analysis data were entered into a Microsoft Excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and Graph Pad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Z-test (Standard Normal Deviate) was used to test the significant difference of proportions. Once a t value is determined, a p-value can be found using a table of values from Student's t-distribution. If the calculated p-value is below the threshold chosen for statistical significance (usually the 0.10, the 0.05, or 0.01 level), then the null hypothesis is rejected in favor of the alternative hypothesis. P-value $\leq$ 0.05 was considered for statistically significant.

RESULTS

Table1:Distribution of patients according to age, sex, diagnosis and surgery type

		Frequency	Percentage
Age (years)	≤19	9	15
	20–39	28	46.7
	40–59	14	23.3
	≥60	9	15
	Total	60	100
Sex	Female	32	53.3
	Male	28	46.7
	Total	60	100
Diagnosis	Acute Appendicitis	14	23.3
	Adeno Ca at Hepatic Flexure	4	6.7
	Calculus Cholecystitis	3	5
	Carcinoma of Colon	3	5
	Cholecystoduodenal Fistula	3	5
	Choledochal Cyst	1	1.7
	Choledocholithiasis	4	6.7
	Cholelithiasis	4	6.7
	Double Barrel Stoma	2	3.3
	Inguinal Hernia (Irreducible)	3	5
	Lipoma	3	5

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	Lipoma at Neck	2	3.3
	Loop Ileostomy	7	11.7
	Malignant Melanoma of Left Foot	2	3.3
	Seminoma of Right Testis	5	8.3
	Total	60	100
Surgery type	Elective	43	71.7
	Emergency	17	28.3
	Total	60	100

Table 2: Distribution of patients according to biochemical variables

Variables	Mean	Standard Deviation (SD)
Haemoglobin (g/dl)	10.82	0.7
Serum Albumin	3.83	0.39

Table 3: Distribution of patients according to surgical procedure, wound type, nutritional status, co-morbidities, position on surgery list, and operative surgeon

		Frequency	Percentage
Surgical procedure	CBD Exploration	4	6.7
	Extended Hemicolectomy	4	6.7
	Hepaticojejunostomy	4	6.7
	Hernioplasty	3	5
	High Inguinal Orchidectomy	5	8.3
	Left Inguinal Node En-Block Dissection	2	3.3
	Lipoma Excision	5	8.3
	Open Appendicectomy	14	23.3
	Open Cholecystectomy	7	11.7
	Right Hemicolectomy	3	5
	Stoma Reversal	9	15
	Total	60	100
Wound type	Clean-contaminated	40	66.7
	Clean	20	33.3
	Total	60	100
Nutritional status	Normal	32	53.3
	Obese	12	20
	Under-nutrition	16	26.7
	Total	60	100
Co-morbidities	None	31	51.7
	Hypertension	2	3.3
	Diabetes mellitus	18	30
	Both DM & HTN	6	10
	Hypothyroid & DM	3	5
	Total	60	100
Position on surgery list	1st	22	36.7
	2nd	22	36.7
	3rd	11	18.3
	4th	5	8.3
	Total	60	100
Operative surgeon	Junior	40	66.7
	Senior	20	33.3
	Total	60	100

Table 4: Distribution of patients according to suture material, stitching technique, and drain type

		Frequency	Percentage
Suture material	Nylon	7	11.7
	Polyglactin + Nylon	36	60
	Polydioxanone + Nylon	1	1.7
	Polypropylene + Nylon	10	16.6
	Polyglactin + Polypropylene + Nylon	6	10
	Total	60	100
Stitching technique	Mattress	29	48.3
	Mattress & continuous	31	51.7
	Total	60	100
Drain type	None	25	41.7
	Abdominal drain	18	30
	Abdominal drain & T tube	4	6.7
	CRS	11	18.3
	Suction drain	2	3.3
	Total	60	100

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Table 5: Distribution of patients according to post-operative hospital stay duration and post-operative day

		Frequency	Percentage
Post-operative hospital stay duration (days)	0–7	27	45
	8–14	25	41.7
	≥15	8	13.3
	Total	60	100
Post-operative day	2	13	21.7
	3	25	41.6
	4	13	21.7
	5	9	15
	Total	60	100

Table 6: Distribution of patients according to SSI type and causative organism

		Frequency	Percentage
SSI Type	Deep	11	18.3
	Organ specific	7	11.7
	Superficial	42	70
	Total	60	100
Causative organism	E. coli	33	55
	Klebsiellapneumoniae	7	11.7
	Not available	20	33.3
	Total	60	100

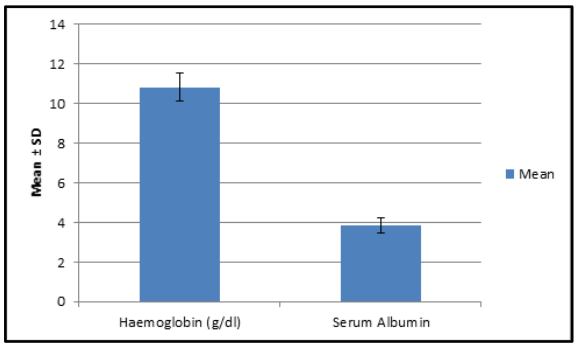

Figure 1: Distribution of patients according to biochemical variables

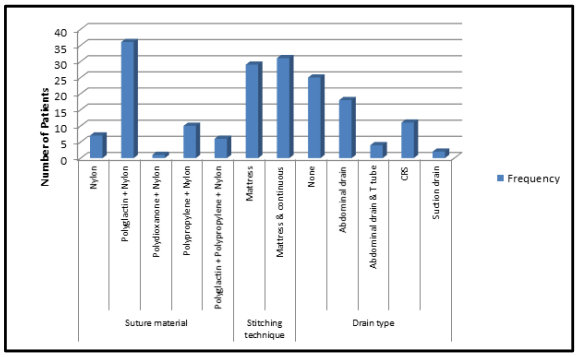

Figure 2: Distribution of patients according to suture material, stitching technique, and drain type

Distribution of patients according to age, sex, diagnosis and surgery type

Results

In the present study of 60 patients, the majority belonged to the age group 20–39 years (46.7%), followed by 40–59 years (23.3%). Both ≤19 years and ≥60 years age groups contributed equally (15% each). Females (53.3%) were slightly more than males (46.7%).

Acute appendicitis was the most common diagnosis (23.3%), followed by loop ileostomy (11.7%) and seminoma of right testis (8.3%). Other diagnoses such as choledocholithiasis, cholelithiasis, and adenocarcinoma at hepatic flexure each accounted for 6.7%, while less frequent conditions included choledochal cyst (1.7%).

Regarding surgery type, the majority of cases were elective (71.7%), while 28.3% were emergency procedures.

Interpretation

The findings indicate that the study population was predominantly young adults with a slight female preponderance. Acute appendicitis emerged as the leading diagnosis, reflecting its high prevalence in general surgical practice. Elective surgeries were more common than emergency procedures, suggesting that most cases were planned admissions rather than acute presentations.

Distribution of patients according to biochemical variables

Results

The mean haemoglobin level was 10.82 ± 0.70 g/dl, while the mean serum albumin level was 3.83 ± 0.39 g/dl.

Interpretation

The results indicate mild anaemia and borderline-normal serum albumin levels among patients, suggesting that a proportion of patients may have had suboptimal nutritional and physiological status preoperatively.

Distribution of patients according to surgical procedure, wound type, nutritional status, co-morbidities, position on surgery list, and operative surgeon

Results

Open appendicectomy was the most common surgical procedure (23.3%), followed by stoma reversal (15%) and open cholecystectomy (11.7%). Clean-contaminated wounds were more frequent (66.7%) compared to clean wounds (33.3%).

Most patients had normal nutritional status (53.3%), while 26.7% were undernourished and 20% were obese. More than half of the patients (51.7%) had no

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co-morbidities, while diabetes mellitus was the most common co-morbidity (30%).

Regarding operative positioning, 1st and 2nd cases were equally common (36.7% each). Most surgeries were performed by junior surgeons (66.7%).

Interpretation

The findings suggest that appendicectomy is the most frequent procedure in general surgical practice. The predominance of clean-contaminated wounds reflects the nature of abdominal surgeries. A considerable proportion of patients had metabolic co-morbidities, especially diabetes, which may influence postoperative outcomes. The higher involvement of junior surgeons indicates the role of trainee surgeons in routine operative workload.

Distribution of patients according to suture material, stitching technique, and drain type

Results

Polyglactin + nylon was the most commonly used suture material (60%), followed by polypropylene + nylon (16.6%). Mattress and continuous stitching techniques were almost equally used (51.7% vs 48.3%).

Regarding drains, 41.7% of patients did not require any drain, while abdominal drain was used in 30% of cases.

Interpretation

The results show preference for absorbable–non-absorbable suture combinations, likely to balance wound strength and healing. The near-equal use of stitching techniques suggests surgeon preference or case-dependent decision-making. A significant proportion of patients did not require drains, indicating uncomplicated surgical procedures in many cases.

Distribution of patients according to post-operative hospital stay duration and post-operative day

Results

Most patients had a hospital stay of 0–7 days (45%), followed closely by 8–14 days (41.7%). Only 13.3% had prolonged hospitalization (≥15 days).

Post-operatively, most observations were recorded on day 3 (41.6%), followed by days 2 and 4 (21.7% each), and day 5 (15%).

Interpretation

The findings suggest generally satisfactory postoperative recovery with most patients discharged within two weeks. The clustering of assessments around day 3 reflects standard postoperative monitoring practices.

Distribution of patients according to SSI type and causative organism

Results

Superficial surgical site infection was the most common (70%), followed by deep SSI (18.3%) and organ-specific infection (11.7%). E. coli was the most frequently isolated organism (55%), followed by Klebsiellapneumoniae (11.7%). In 33.3% of cases, no organism was identified.

Interpretation

The predominance of superficial SSI indicates that most infections were limited to skin and subcutaneous tissue. E. coli being the most common pathogen reflects gastrointestinal flora involvement in abdominal surgeries. A substantial proportion of culture-negative cases may be due to prior antibiotic use or inadequate specimen collection.

DISCUSSION

The present study analyzed 60 patients undergoing various general surgical procedures with the aim of evaluating demographic distribution, clinical profile, operative factors, and postoperative outcomes including surgical site infection (SSI). The findings provide important insights into patient characteristics and factors influencing surgical outcomes. The majority of patients belonged to the 20–39 years age group (46.7%), followed by 40–59 years (23.3%), indicating that most surgical admissions occurred in young to middle-aged adults. A similar age distribution pattern has been reported in other surgical studies, where appendicular and abdominal pathologies are more frequent in younger populations due to higher incidence of acute inflammatory conditions.[6,7] The slight female predominance (53.3%) in the present study is consistent with previous reports showing marginal female preponderance in general surgical admissions, particularly due to gallbladder and abdominal wall pathologies.[8] Acute appendicitis was the most common diagnosis (23.3%), followed by loop ileostomy and testicular seminoma. This finding is in agreement with global surgical literature where appendicitis remains the most frequent emergency abdominal condition requiring surgery.[9] The higher proportion of elective surgeries (71.7%) compared to emergency procedures reflects planned surgical management in most cases, which is similar to findings reported in elective-dominant surgical cohorts.[10] The biochemical parameters revealed mean haemoglobin of 10.82 ± 0.70 g/dl and serum albumin of 3.83 ± 0.39 g/dl, indicating mild anaemia and borderline nutritional status. Hypoalbuminemia and anaemia are well-established risk factors for poor wound healing and increased SSI risk.[11] Similar observations have been reported in previous studies where low albumin levels were associated with increased postoperative complications.[12] Regarding surgical procedures, open appendicectomy was the most frequently performed operation (23.3%), followed by stoma reversal and cholecystectomy. This distribution reflects the common spectrum of general surgical workload in tertiary care hospitals. The predominance of clean-contaminated wounds (66.7%) is expected in abdominal surgeries and aligns with CDC wound classification patterns where gastrointestinal surgeries constitute the major proportion of SSI-prone cases.[13] In terms of patient factors, more than half had normal nutritional status (53.3%), while 26.7% were undernourished.

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Diabetes mellitus was the most common comorbidity (30%), which is clinically significant as diabetes is a known independent risk factor for impaired wound healing and SSI development.[14] Similar associations between diabetes and postoperative infection risk have been widely documented. The use of polyglactin combined with nylon (60%) as the most common suture material suggests surgeon preference for absorbable reinforcement with non-absorbable skin closure. Nearly equal use of mattress and combined mattress-continuous techniques indicates variability in closure strategy based on wound type and surgeon discretion. The relatively high proportion of cases without drains (41.7%) suggests that many procedures were uncomplicated and did not require postoperative drainage. Postoperative hospital stay was mostly within 0–14 days (86.7%), indicating satisfactory recovery in the majority of patients. Similar hospital stay durations have been reported in uncomplicated general surgical procedures in other studies. The peak observation on postoperative day 3 corresponds with the usual timing of early postoperative complications such as wound discharge and SSI onset. The overall SSI rate showed predominance of superficial infections (70%), followed by deep and organ-specific infections. This pattern is consistent with literature where superficial SSI accounts for the majority of postoperative infections. E. coli was the most common causative organism (55%), reflecting endogenous gastrointestinal flora involvement in abdominal surgeries. Similar microbial patterns have been reported in SSI surveillance studies, where Gram-negative organisms dominate in intra-abdominal procedures.[15] The absence of culture growth in 33.3% of cases may be attributed to prior antibiotic exposure or inadequate sample collection.

CONCLUSION

The study concludes that young adults were most commonly affected, with acute appendicitis being the leading diagnosis and elective surgeries being predominant. Most patients had clean-contaminated wounds and mild anaemia. Open appendicectomy was the most frequent procedure, and superficial SSI was the most common type, with E. coli as the main causative organism. Overall, postoperative outcomes were satisfactory with short hospital stays, emphasizing the importance of proper perioperative care and infection control measures.

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