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Original Research Article

Study on Post Operative Surgical Site Infection Following Emergency Abdominal Operations in a Teaching Hospital

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Abstract

Introduction: Surgical site infections (SSIs) are a major postoperative complication, resulting from bacterial contamination during or after surgery. Despite advancements in aseptic techniques and antibiotic use, SSIs remain the most common hospital-acquired infections among surgical patients. They are classified into superficial, deep, and organ/space infections, with risk increasing from clean to dirty wounds. Various perioperative and environmental factors, such as poor wound care, prolonged surgery, and inadequate prophylaxis, contribute to infection development.

Aims: To estimate the proportion of postoperative surgical site infections following emergency abdominal operations.

Materials and Methods: This observational study was conducted in the Surgery Department of Agartala Government Medical College and G.B.P. Hospital. It spanned one and a half years, from June 2021 to November 2022. A total of 156 post-operative surgical patients were included in the study.

Results: Out of 95 patients, 17.89% developed surgical site infections (SSIs), with the highest incidence in the 40–49 age group and among illiterate patients. SSIs were more common after delayed and prolonged surgeries, dirty wounds, and in patients with comorbidities like diabetes and obesity. Escherichia coli was the most frequent pathogen, showing 100% sensitivity to Imipenem, which was the most effective antibiotic against all isolated organisms.

Conclusion: This observational study conducted at Agartala Government Medical College and G.B.P Hospital from June 2021 to November 2022 found that normal body microorganisms are the main cause of surgical site infections (SSI). Factors like malnutrition, obesity, wound condition, operation delay, and surgeon experience significantly contribute to SSI. Ensuring quality surgical care, aseptic environments, and the use of prophylactic antibiotics are crucial for preventing these infections, especially when advanced facilities are lacking.

Keywords: Surgical Site Infection (SSI), Postoperative Complications, Emergency Abdominal Surgery, Infection Risk Factors, Teaching Hospital Study.

Introduction

The infection of a wound can be defined as the invasion of the organisms through tissues following a breakdown of local and systemic host defences, leading to cellulitis, lymphangitis, abscess and bacteremia. Surgical site infection (SSI) has always been a major complication of surgery and trauma and has been documented for 4000-5000 years. Galen recognized that localization of infection in wounds, inflicted in the gladiatorial arena, often heralded recovery, particularly after drainaige. The understanding of the causes of infection came in 19th century. Microbes had been seen under microscope, but Koch laid down the first definition of infective disease known as Kochs postulates. Kochs postulates providing the agency of infective organism: it must be found in considerable numbers in the septic focus and it should be able to provide similar lesions when injected into another host. Louis Pasteur recognized that microorganisms were responsible for spoiling wines, turning into vinegar [1]. Surgical site infections (SSI), previously called as postoperative wound infections, result from bacterial contamination during or after a surgical procedure. Surgical site infections are the third most common hospital associated infection, accounting for 14-16 per cent of all infections in the hospitalized patients. Among surgical patients, surgical site infections are the most frequent cause of such infections, accounting for 38 per cent of total. Despite every effort to maintain asepsis, most surgical wounds are contaminated to some extent. However, infection rarely develops if contamination is minimal, if the wound has been made without undue injury, if the subcutaneous tissue is well perfused and well oxygenated and if there is no dead space. The criteria used to define surgical site infections have been standardized and described three different anatomical levels of infection: Superficial incisional surgical site infection, Deep incisional surgical site infection and organ/space surgical site infection [2]. According to the degree of contamination, wounds may be classified as clean, potentially contaminated, contaminated, dirty. The incidence of infection, morbidity and mortality increases from clean to dirty. The risk of infection is greater in all categories if surgery is performed as an emergency [3].

The use of antibiotic before surgery has evolved greatly in the last twenty years. It is generally recommended in elective clean surgical procedures using a foreign body and in clean contaminated procedures that a single dose of cephalosporinses as cephazolin, be administered by anesthesia personnel in the operative suit just before incision. Additional doses are generally recommended only when the operation lasts longer than two to three hours [4].

Surgical site infection is the most important cause of morbidity and mortality in the postoperative patients, but it is preventable in most of the cases if proper assessment and appropriate measures are taken by the surgeons, nursing stuffs, patients and others in the perioperative period. Surgical site infection still causes considerable morbidity and high cost to the health care system and is becoming increasingly important in medicolegal aspects. In this study we will try to find out the factors responsible for the postoperative surgical site infections following emergency nontraumatic abdominal operations that will be helpful to prevent infection in future following similar types of operations. We will also try to find out the common organism responsible for Surgical site infections and the sensitivity pattern of the microorganisms that will play an important role in reducing the infection rate and thereby reduce the mortality and morbidity.

Materials and Methods

Type of study: Observational Study.

Place of study: Surgery department of Agartala government medical college and G.B.P. Hospital.

Study Duration: One and half years (June 2021-November 2022).

Sample Size: 95 Post Operative Surgical patients.

Inclusion Criteria

- The patients who will undergo emergency abdominal operations.
- Operations carried out in surgery department of Agartala government medical college and GBP hospital.

Exclusion Criteria

- Patients with immunocompromised states
- Hepatitis B, Hepatitis C, HIV infections and those unwilling to give consent for study will be excluded from the study.

Statistical Analysis: For statistical analysis, data were first entered into a Microsoft Excel spreadsheet and subsequently analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Continuous numerical variables were summarized as mean ± standard deviation, while categorical variables were expressed as counts and percentages.

The Z-test (Standard Normal Deviate) was employed to assess significant differences between proportions. For comparisons involving means, the student's t-test was used, with the corresponding p-value obtained from the t-distribution table. A p-value ≤ 0.05 was considered statistically significant, indicating rejection of the null hypothesis in favor of the alternative hypothesis.

Results

Table 1: Distribution of Surgical Site Infection (SSI) Status According to Demographic, Clinical, Surgical, and Microbiological Variables

		SSI Status Yes	SSI Status No	Total
Age in years	10–19	2 (18.18%)	9 (81.82%)	11 (100.00%)
	20–29	2 (6.67%)	28 (93.33%)	30 (100.00%)
	30–39	4 (13.33%)	26 (86.66%)	30 (100.00%)
	40–49	7 (77.77%)	2 (22.22%)	9 (100.00%)
	50–59	1 (11.11%)	8 (88.88%)	9 (100.00%)
	60–69	1 (16.66%)	5 (83.33%)	6 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)
Sex	Male	10 (16.67%)	50 (83.33%)	60 (100.00%)
	Female	7 (20.00%)	28 (80.00%)	35 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)

Educational Status	Illiterates	7 (28.00%)	18 (72.00%)	25 (100.00%)
	Primary	2 (22.22%)	7 (77.78%)	9 (100.00%)
	Secondary	6 (17.14%)	29 (82.86%)	35 (100.00%)
	HSC	1 (16.67%)	7 (83.33%)	8 (100.00%)
	Graduation or above	1 (5.56%)	17 (94.44%)	18 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)
Types of Operations	Appendicectomy	4 (10.00%)	36 (90.00%)	40 (100.00%)
	Adhesiolysis or resection and anastomosis	2 (20.00%)	8 (80.00%)	10 (100.00%)
	Repair of ileal perforation / Ileostomy and thorough peritoneal toileting	2 (10.00%)	18 (90.00%)	20 (100.00%)
	Repair of duodenal ulcer perforation and thorough peritoneal toileting	5 (55.56%)	4 (44.44%)	9 (100.00%)
	Appendicectomy with peritoneal toileting	3 (33.33%)	8 (66.66%)	11 (100.00%)
	Resection of volvulus of sigmoid colon and primary anastomosis / Hartmann's procedure	1 (33.33%)	2 (66.67%)	3 (100.00%)
	Herniotomy and herniorrhaphy	–	1 (100.00%)	1 (100.00%)
	Emergency splenectomy	–	1 (100.00%)	1 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)
Category of Surgeons	Junior Resident Surgeons	14 (20.00%)	56 (80.00%)	70 (100.00%)
	Senior Resident Surgeons	3 (15.00%)	17 (85.00%)	20 (100.00%)
	Professor	–	5 (100.00%)	5 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)
Type of Incisions	Extended lower midline	1 (50.00%)	1 (50.00%)	2 (100.00%)
	Mid midline	1 (16.67%)	5 (83.33%)	6 (100.00%)
	Lower right para-median	1 (50.00%)	1 (50.00%)	2 (100.00%)
	Rutherford Morison	2 (40.00%)	3 (60.00%)	5 (100.00%)
	Upper midline	2 (40.00%)	3 (60.00%)	5 (100.00%)
	Extended upper midline	6 (21.42%)	22 (78.57%)	28 (100.00%)
	Grid Iron	4 (10.00%)	36 (90.00%)	40 (100.00%)
	Lenz	0 (00.00%)	5 (100.00%)	5 (100.00%)
	Inguinal	0 (00.00%)	2 (100.00%)	2 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)
Delay to Initiate Operations (in hours)	< 6	1 (9.09%)	10 (90.91%)	11 (100.00%)
	6 – 12	2 (10.53%)	17 (89.47%)	19 (100.00%)
	12 – 24	1 (10.00%)	9 (90.00%)	10 (100.00%)
	24 – 48	10 (26.32%)	28 (73.68%)	38 (100.00%)
	48 – 72	2 (19.35%)	14 (80.65%)	16 (100.00%)
	> 72	1 (100.00%)	0 (00.00%)	1 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)
Duration of Operation	Less than 1 hour	2 (5.00%)	38 (95.00%)	40 (100.00%)
	1 to 2 hours	5 (14.29%)	30 (85.71%)	35 (100.00%)
	More than 2 hours	10 (50.00%)	10 (50.00%)	20 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)
Types of Wounds	Clean	1 (5.00%)	19 (95.00%)	20 (100.00%)
	Clean contaminated	2 (8.00%)	23 (92.00%)	25 (100.00%)
	Contaminated	1 (10.00%)	9 (90.00%)	10 (100.00%)
	Dirty	13 (32.50%)	27 (67.50%)	40 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)
Co-morbidity Status	With Co-morbidity	12 (40.00%)	18 (60.00%)	30 (100.00%)
	Without Co-morbidity	5 (7.69%)	60 (92.31%)	65 (100.00%)
	Total	17 (17.89%)	78 (82.11%)	95 (100.00%)
Types of Co-morbidity	Malnutrition	2 (20.00%)	8 (80.00%)	10 (100.00%)
	COPD	2 (25.00%)	6 (75.00%)	8 (100.00%)

	Diabetes Mellitus	5 (83.33%)	1 (16.67%)	6 (100.00%)
	Obesity	2 (66.67%)	1 (33.33%)	3 (100.00%)
	Medical Jaundice	1 (33.33%)	2 (66.67%)	3 (100.00%)
	Total	12 (40.00%)	18 (60.00%)	30 (100.00%)

Table 2: Organisms isolated and cultured from different types of discharge from wound /collection of pus

Character of Discharge/Pus	Frequency	Organism Isolated
Thin, muddy odourless pus	9	Escherichia coli
Thick creamy pus	4	Staphylococcus aureus
Yellow fishy odoured pus	2	Klebsiella pneumoniae
Blue green pus	1	Pseudomonas aeruginosa
Serosanguinous discharge	1	No growth
Total	17	—

Table 3: Sensitivity pattern of the cultured micro-organisms to various antibiotics

Microorganism (n)	Cotrimoxazole	Flucloxacin	Nitrofurantoin	Ceftriaxone	Imipenem
Escherichia coli (9)	55.55% (5)	55.55% (5)	44.44% (4)	44.44% (4)	100% (9)
Staphylococcus aureus (4)	50.00% (2)	50.00% (2)	—	75.00% (3)	100% (4)
Klebsiella pneumoniae (2)	50.00% (1)	—	—	100.00% (2)	100% (2)
Pseudomonas aeruginosa (2)	—	50.00% (1)	—	100.00% (2)	100% (2)

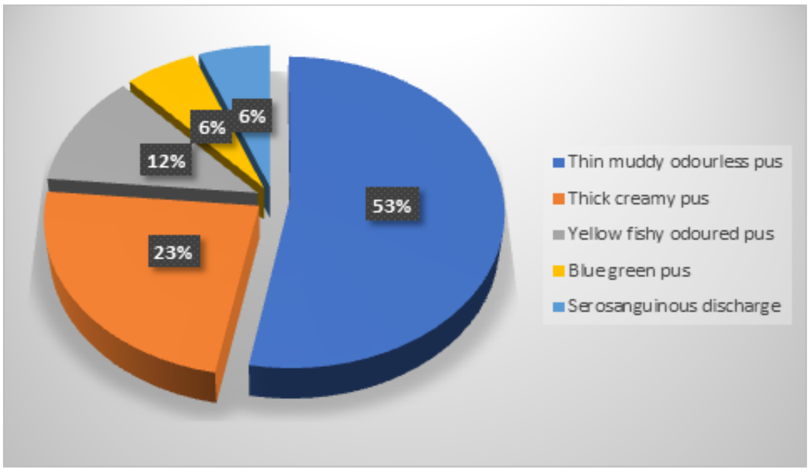

Figure 1: Organisms isolated and cultured from different types of discharge from wound /collection of pus

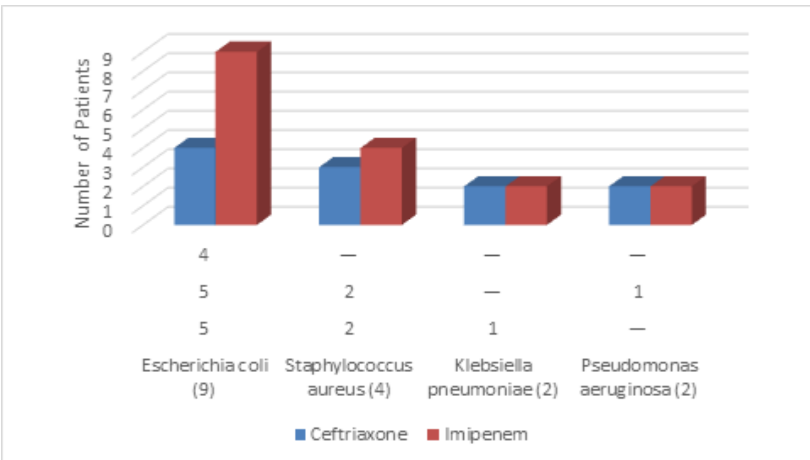

Figure 2: Sensitivity pattern of the cultured micro-organisms to various antibiotics

Out of a total of 95 patients studied, 17 (17.89%) developed Surgical Site Infections (SSIs), while 78 (82.11%) did not. The incidence of SSI was highest among the 40–49 age group (77.77%), followed by those aged 60–69 (16.66%), while the lowest incidence was observed in the 20–29 age group

(6.67%). Males accounted for a slightly lower SSI rate (16.67%) compared to females (20.00%).

With respect to educational status, the highest incidence of SSI was observed among illiterates (28.00%), decreasing progressively with higher education, reaching as low as 5.56% among those who had graduated or studied above. Among the types of operations, SSI was most frequent in procedures like repair of duodenal ulcer perforation and thorough peritoneal toileting (55.56%), and appendicectomy with peritoneal toileting (33.33%). Herniotomy, herniorrhaphy, and emergency splenectomy had no reported cases of SSI.

Junior resident surgeons performed the majority of surgeries and accounted for the highest proportion of SSIs (20.00%), whereas surgeries by professors resulted in no infections. Regarding incision types, extended lower midline and lower right para-median incisions showed the highest SSI rates (50.00% each), while grid iron incisions had the lowest (10.00%). Delays in initiating operations significantly influenced infection rates. The SSI rate rose markedly in patients operated after 24 hours, peaking at 100% in those who had surgery delayed for more than 72 hours. Similarly, longer operation durations were associated with higher infection rates—50.00% for surgeries lasting more than 2 hours. Dirty wounds accounted for the highest SSI rate (32.50%) compared to clean (5.00%) and clean-contaminated (8.00%) wounds. Patients with co-morbidities experienced a much higher infection rate (40.00%) than those without (7.69%). Among specific co-morbidities, diabetes mellitus was most strongly associated with SSI (83.33%), followed by obesity (66.67%) and medical jaundice (33.33%).

Among the 17 cases of Surgical Site Infections (SSI), the most common type of pus observed was thin, muddy odourless pus in 9 cases (52.94%), all of which grew Escherichia coli on culture. Thick creamy pus was seen in 4 cases (23.53%), predominantly associated with Staphylococcus aureus. Yellow fishy odoured pus was reported in 2 cases (11.76%) and yielded Klebsiella pneumoniae, while blue green pus, noted in 1 case (5.88%), was caused by Pseudomonas aeruginosa. Serosanguinous discharge was present in one case, but no microbial growth was detected. These findings indicate a correlation between the physical characteristics of discharge and specific microbial pathogens. Among the bacterial isolates from Surgical Site Infection (SSI) cases, Escherichia coli was the most frequently isolated organism (n=9). It showed 100% sensitivity to Imipenem, moderate sensitivity to Cotrimoxazole and Flucloxacin (55.55% each), and lower sensitivity to Nitrofurantoin and Ceftriaxone (44.44% each). Staphylococcus aureus (n=4) also exhibited 100% sensitivity to Imipenem, with 75.00% sensitivity to Ceftriaxone, and 50.00% to both Cotrimoxazole and Flucloxacin.

Klebsiella pneumoniae (n=2) showed 100% sensitivity to Ceftriaxone and Imipenem, and 50.00% to Cotrimoxazole, while being resistant to other tested antibiotics. Pseudomonas aeruginosa (n=2) demonstrated complete sensitivity to Ceftriaxone and Imipenem, with partial sensitivity (50.00%) to Flucloxacin. Notably, all organisms exhibited 100% sensitivity to Imipenem, making it the most effective antibiotic against the isolates in this study.

Discussion

In this study of 95 patients, the overall Surgical Site Infection (SSI) rate was 17.89%, which is somewhat higher than rates reported in comparable studies ranging from 10% to 15% [5,6]. The peak incidence of SSI in the 40–49 age group aligns with findings from Korol et al. [11], who identified middle-aged adults as at increased risk, potentially due to accumulated co-morbidities and immunological changes. The slightly higher SSI rate among females contrasts with some literature where male sex is often cited as a risk factor [6,12], suggesting that sex-based risk may be context-specific or influenced by other factors such as type of surgery or comorbidities. Educational status showed a clear inverse relationship with SSI occurrence, with illiterates having the highest infection rates. This mirrors the socio-economic disparities documented by Bediako-Bowan et al. [10] and others [9], underscoring the role of health literacy and access in postoperative outcomes. Importantly, co-morbidities markedly increased SSI risk, especially diabetes mellitus and obesity, corroborating findings by Martin et al. [9] and Cheng et al. [5], who reported diabetes as a strong predictor of postoperative infection. Surgical factors contributed significantly to SSI rates: procedures involving repair of duodenal ulcer perforation and prolonged surgeries (>2 hours) were particularly susceptible, echoing observations by Bah et al. [6] and Cheng et al. [5] who highlighted operative duration as a modifiable risk factor. Delays in surgical intervention beyond 24 hours substantially increased infection rates, consistent with data from Bediako-Bowan et al. [10] and Korol et al. [11]. The classification of wounds correlated well with SSI risk, with “dirty” wounds exhibiting the highest infection rate, as reported by multiple authors [10,13]. Incision type also influenced infection risk, with extended midline incisions showing higher SSI rates, in line with reports by Bah et al. [6]. Sex differences in SSI risk have been variably reported, with some studies indicating higher risk in males, attributed to hormonal and behavioral factors, while others observed increased risk in females due to anatomical and immune differences [12].

Microbiological analysis revealed Escherichia coli as the predominant pathogen, followed by Staphylococcus aureus and Klebsiella pneumoniae. The association of specific pus characteristics with distinct organisms is clinically valuable, supporting targeted diagnostic considerations, as also suggested by Rahman et al. [14]. Antibiotic sensitivity profiles showed universal susceptibility to imipenem across isolates, underscoring its continued efficacy, which aligns with findings from Kaur et al. [15]. However, variable sensitivity to commonly used antibiotics such as cotrimoxazole and ceftriaxone highlights the need for local antibiogram-guided therapy.

Conclusion

This descriptive type of observational study was conducted in surgery department of Agartala Government Medical College and G.B.P Hospital, Agartala during the period from June 2021 to November 2022.

It can be concluded from the findings of the study that microorganisms that are normal inhabitants of our body are mainly responsible for surgical site infection (SSI). Various host factors like malnutrition, obesity, patients' knowledge about hygiene, presence of comorbidity etc. coupled with environmental factors such as condition of the wounds, delay to initiate operation, duration of operation, prolonged exposure of peritoneal cavity to environment, prophylactic use of antibiotics and factors associated with surgery like type of incision, type of operation and experience of operating surgeon greatly contribute to occurrences of SSI. So, quality of surgical care including immediate assessment of patients, resuscitative measures, adequate preparation of patients and aseptic environment are important for control of SSI. Moreover, in absence of highly advanced surgical amenities, preoperative resuscitative units, modern operation theatre facilities and sophisticated sterilization procedure it is necessary to use prophylactic antibiotics to encounter the various types of micro-organisms responsible for surgical site infection, particularly E. Coli and Staph. Aureus.

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