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Original Research Article

Analysis of Demographic and Microbiological Characteristics of Surgical Site Infection

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Abstract

Introduction: An infection at the surgical site that affects the incision or deeper tissues within 30 days of the procedure (or within a year if the implantation is left in place just after the procedure) is referred to as a surgical site infection (SSI). The prevalence of postoperative SSI varies significantly across procedures, hospitals, doctors, patients, and geographical locales. Staphylococcus aureus infection accounts for a significant number of SSIs that occur in hospitals. Again, gram-negative bacilli, Pseudomonas aeruginosa, Klebsiella, as well as Escherichia coli are frequently isolated from SSIs. SSIs contribute to post-surgical complications significantly. However, with proper characterization of the infection demographically and microbiologically and its related factors, SSIs can be properly controlled.

Aims and Objectives: To study the demographic and microbiological characteristics of Surgical Site Infection in patients.

Methods: This is a prospective study conducted on 430 patients for assessing SSI post-surgery. The demographic and microbiological characteristics were determined in each patient after the surgery. The infected wound was regarded when it appears to be serous or non-purulent discharge, pus discharge, or the presence of inflammation (oedema, redness, warmth, raised local temperature, tenderness, induration).

Results: The study found that it was found that 9.35% of surgeries were on abdominal sites, while 8.30% of surgeries were Spinal surgeries and 12.5% were hysterectomy, based on General Surgery, Orthopedics and Obstetrics and Gynecology ward, respectively. The study has shown that diabetes was present in 23.8% of the patients followed by obesity (19.37%) and Anemia (18.20%). In the whole sample, 14.70% of the patients had comorbidities.

Conclusion: The study also found that most of the patients who had SSI, were infected with *Klebsiella* spp. (34%), followed by *E. coli* (22%) and *S. aureus* (17%). The study concluded that *Klebsiella pneumonia* was the most isolated pathogen and the highest number of isolates were obtained from abdominal surgeries, spinal surgeries, and hysterectomy.

Keywords: Surgical Site Infection, Klebsiella, Nosocomial, Infection.

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Introduction

An infection at the surgical site that affects the incision or deeper tissues within 30 days of the procedure (or within a year if the implantation is left in place just after the procedure) is referred to as a surgical site infection (SSI) [1]. These infections could involve an organ or bodily space, a shallow or deep incisional infection, or both. The third most frequently reported nosocomial infection in the hospital population, postoperative SSI is one of the most frequent issues for patients who receive cesarean sections. Following a cesarean section, postoperative SSI is linked to higher rates of morbidity and death, extended hospital stays, secondary infertility, and higher patient care costs [2]. The prevalence of postoperative SSI varies significantly across procedures, hospitals, doctors, patients, and geographical locales. It makes things more difficult in Ethiopia (21%), India (2.85%), and Nigeria (7-9.6%) [3,4]. *S. aureus*, which accounts for 20–30% of SSIs that occur in hospitals, is a frequently isolated bacteria in SSIs. Additionally, gram-negative bacilli, *P. aeruginosa*, *Klebsiella*, as well as *E. coli* are frequently isolated from SSIs [4].

Improved operating room airflow, sterilization techniques, the utilization of barriers, surgical techniques, and the provision of antimicrobial prophylaxis are some of the SSI control strategies that have advanced. Despite this, SSIs continue to happen and are frequently the cause of mortality and morbidity in hospitals, primarily in developing nations. The rise of pathogenic microorganisms that are resistant to antibiotics is one factor in this. According to reports, protracted labour before a cesarean section, prolonged membrane rupture, frequent vaginal examinations, being unlooked, and protracted obstructed labour are major risk factors for cesarean wound infection [5,6]. Other factors include the surgeon's lack of experience or poor technique, the length of the operation, the length of the labour's obstruction, the postoperative anaemia, the patient's high BMI, the presence of diabetes mellitus, the presence of immunosuppressive disorders, and some medications, such as steroid [7]. Additionally, our environment has a greater prevalence of surgical infections due to lax infection control and prevention procedures in operating room [8]. The following have been highlighted as potential sources of infection: polluted air, antiseptic solutions, patient transportation, the surgical team, crowded operating rooms, theatre gowns, poorly sterilized equipment, polluted environment, and severely contaminated surfaces. SSI complications include pelvic abscess, necrotizing fasciitis, ruptured abdomen, wound dehiscence, and protracted wound healing [9]. Among the others include protracted admission, a protracted duration of antibiotics, the potential for re-admission, second repair surgery, post-operative hernia, permanently damaging scar, and in rare circumstances, can result in severe sepsis and death. The physical, emotional, social, and financial facets of life are all negatively impacted by surgical site infections [9].

Because no such study on cesarean sections has been conducted in our centre, it is unknown what common organisms in our department cause infection after cesarean sections and what their sensitivity patterns are. The degree to which anaerobes contribute to the etiology of SSIs in Nigeria is also a subject of scant research. The clinicians' choice of empiric treatment is made more challenging by this gap [10]. Therefore, a deeper comprehension of the range of pathogens that cause SSI and their susceptibility structure in our department is crucial for prompt patient management and provides evidence-based sensitive antibiotics to also be started initially when scar disease is recognized in our wards whilst also awaiting the outcome of wound swab microscopy, culture, and sensitivity in 48–72 hours. Such information would be useful for planning the surveillance and management of this group of illnesses as well as for establishing policies for the prevention and management of SSIs [11].

Materials and Methods

Research Design

This is a prospective study conducted in the Department of Microbiology at Dr DY Patil Hospital Nerul, Navi Mumbai. The study period was from October 2020 to November 2022. A total of 430 patients were considered for this study who were admitted to our hospital for undergoing elective surgery. The patients were assessed for surgical site infection post-surgery. The demographic and microbiological characteristics were assessed in each patient after the surgery. The infected wound was regarded when it appears to be serous or non-purulent discharge, pus discharge, or the presence of inflammation (oedema, redness, warmth, raised local temperature, tenderness, induration).

Inclusion Criteria

1. Clean surgeries (Class I operative wounds), Clean-contaminated surgeries (Class II operative wounds), Contaminated surgeries (Class III operative wounds) and Dirty surgeries (Class IV operative wounds).

2. Elective surgeries.

3. Patients that signed the consent and followed up post-surgery.

Exclusion Criteria

1. Emergency surgeries.

2. Stitch abscess.

3. Patients that did not follow up post-surgery.

Sample Collection and Interpretation

If surgical wound infection was suspected, sterile cotton swabs were used for the collection of postoperative discharge. All the swabs were immediately transported to the laboratory for further processing. A smear was prepared from a post-operative wound swab. That smear was stained by the Gram staining method for preliminary identification of the bacteria. For isolation of bacterial pathogens, the swabs from postoperative wounds were inoculated on 5% Sheep Blood agar, MacConkey's agar, and Chocolate agar. The plates were incubated at 37°C overnight for 24-48 hours. A hand lens was used to inspect all plate cultures.

Results

The study considered 430 patients, of which, found 32 patients (7.47%) with SSI. In total, there were 36 isolates in these 32 patients. The study has classified SSI and its findings according to General Surgery, Orthopedics Obstetrics and Gynecology wards. Accordingly, it was found that 9.35% of surgeries were on abdominal sites, while 8.30% of surgeries were Spinal surgeries and 12.5% were hysterectomy, based on General Surgery, Orthopedics and Obstetrics and Gynecology ward, respectively (Table 1).

Table 1: Demographic Characteristics of the patients in this study

Age	Number of patients; n (%)	Male	Female	
0-20 years	2(5.5%)	2	0	
21-40 years	4(11.2%)	1	3	
41-60 years	19(52.8%)	12	7	
61-80 years	7(19.5%)	3	4	
SSI according to General Surgery Ward				
General Surgery	**Surgical Procedure**	**Total No. Of cases**	**Total No. Of Infected cases**	**Percentage of Infections**
Head and Neck surgeries	i. Craniotomy	2	0	
	ii. Thyroidectomy	26	2	7.69%%
Genito urinary tract surgeries	i. Prostatectomy	40	2	5%
Abdominal Surgeries	i. Hernia	30	0	9.35%
	ii. Hydrocoele	21	0	
	iii. Hepatobiliary	24	4	
	iv. Appendicectomy	30	2	
	v. Abdominal flap	14	0	
	vi. Large Bowel	14	3	
	vii. Exploratory Laparotomy	6	4	
Limb Amputations		27	2	7.40%
Others	Excision of Cysts (Epidermoid cysts, Lipoma, Sarcoma, Sebaceous cysts)	20	0	
Total		254	19	7.48%
SSI according to Orthopedics Ward				
Orthopaedics		**Total number of Cases**	**Total number of infected cases**	**Percentage of infections**
Upper limb fractures		18	0	0
Lower limb fracture		52	3	5.60%
Spine surgeries		12	1	8.30%
Total		82	4	4.88%
SSI according to Obstetrics and Gynecology Ward				
Surgical procedure		**Total No. of cases**	**Total number of Infected cases**	**Percentage of infections**
L.S.C.S		33	3	9.09
Hysterectomy		24	3	12.50
Total		57	6	10.53

The study has shown that diabetes was present in 23.8% of the patients followed by obesity (19.37%) and Anemia (18.20%). In the whole sample, 14.70% of the patients had comorbidities. Table 2 shows the detailed findings of SSI correlated with other comorbidities.

Table 2: Correlation of Surgical Site infection with other comorbidities

Comorbidities	No. of cases	No. of cases Infected	Percentage
Diabetes	42	10	23.80%
Anaemia	22	4	18.20%
Obesity	31	6	19.37%
Tobacco consumption	109	10	9.17%
Total	204	30	14.70%

The study also found that most of the patients who had SSI were infected with *Klebsiella spp.* (34%), followed by *E. coli* (22%) and *S. aureus* (17%). Figure 1 shows the detailed findings of the distribution of organisms isolated in this study.

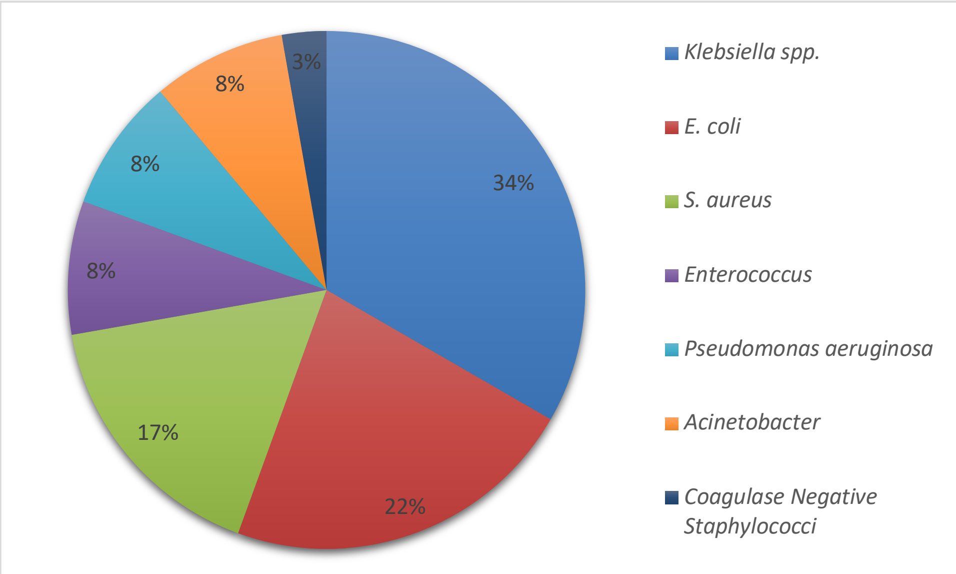

Figure 1: Distribution of organisms isolated in the sample

Discussion

The major reason for SSI in the U.S. is *S. aureus*. Particularly, SSI brought about by methicillin-resistant *Staphylococcus aureus* (MRSA) has evolved into a severe complication, increasing fatality rates, length of hospital stays, and expenses. Addressing modifiable factors and choosing and administering antibiotic prophylaxis at the proper time are effective strategies for preventing SSI caused by *S. aureus*. Vancomycin usage and other methods like decolonization are still debatable [12].

In a medical centre in Gondar, northwestern Ethiopia, surgical wound infections were observed over a year to determine their frequency and pattern. In fifty (38.9%) of the 129 abdominal surgery incisions from 130 patients, harmful organisms were found. On purely clinical criteria, the wound rate of infection was 22.7%. With the highest prevalence of infection being 61.7% for polluted or filthy wounds, wound class was substantially linked with infection rates. Both emergency or elective operations had the same infection rate. Many pathogenic isolates were caused by *S. aureus* and *E. coli* 13.9% of patients' delays in being discharged were due to surgical wound infection [12].

The most common orthopaedic emergency among elderly people is a femoral neck fracture. No multicenter investigation comparing antibiotic prophylaxis techniques and the frequency and microbiological features of surgical site infection (SSI) has been carried out in France, despite the high incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) transmission in this group. This concludes MRSA is the most detected causative infection and causes severe SSI following surgery for a femoral neck fracture. To ascertain if the use of MRSA-effective antibiotic prophylaxis will lower the SSI rate in this cohort, a sizable, major alternative trial is required [13].

SSI is still a major issue that can have a severe impact on clinical outcomes after surgery. Most of the time, microbiology results are comparable to those of other nosocomial diseases; nevertheless, there may be variances depending on the microbiology selected owing to drug pressure or resident flora. However, in the context of critical care, this is not well understood. Consequently, our goal was to evaluate the prevalence, epidemiology, or microbiology of SSI and its relationship to mortality in patients suffering from severe pancreatitis in the critical care unit (ICU) [13].

In secondary or tertiary pancreatitis requiring ICU admission, the incidence of SSI is very high. Although more research is required to confirm our findings because of the inherent flaws of the microbiological sampling of swabs performed in our research, doctors may take antibiotic-resistant pathogens, gram-positive cocci, and fungi into account when choosing empiric antibiotic treatment for SSI. Longer ICU stays may be linked to the prevalence of SSI, but overall mortality is unaffected [13].

To prevent bacterial infection of interior tissues, the skin serves as the primary barrier, and surgical incisions physically compromise this barrier. SSI, among the most common infectious consequences of surgical procedures, can result from bacterial migration through the epidermal barrier and carry a risk of unfavorable outcomes. SSI encompasses a variety of inflammatory reactions that range in clinical relevance from low to high, with the inflammatory response following surgical treatment being a classic example linked to higher morbidity and mortality. Even worse, SSI has the potential to spread to nearby areas and important deep structures, necessitating debridement or draining. As a result, the cost of treating SSI rises, especially when we consider the numerous sophisticated surgical procedures that are performed in a normal referral hospital [14].

There are three types of peritonitis: primary (spontaneous), secondary, and tertiary. Peritonitis is defined as inflammation of the serous membrane covering the abdominal cavity and its organs. Tertiary and secondary peritonitis is more fatal, with mortality rates ranging from 17 to 63%. With a mortality incidence of 30–60%, tertiary peritonitis typically develops in Clinical areas at least 48–72 hours after secondary peritonitis have received sufficient therapy [15]

Depending on the type of operation, the Centers for Disease Control and Prevention (CDC) predicts that the risk of SSI linked with abdominal surgery ranges from about 2 to 8%. Clean (2.7%), clean-contaminated (3.6%), contaminated (5.9%) and dirty (6.9%), are the different classifications for SSI. Before surgery, stratification could be used to find at-risk individuals who would benefit from observation [15].

Even in the ICU context, there is little information in the literature about SSI linked with severe peritonitis, despite its significant influence on public health or clinical practice. Therefore, the purpose of this study was to investigate the incidence, epidemiology, microbiology, and outcomes of SSI in patients hospitalized with secondary or tertiary pancreatitis in the ICU of major tertiary hospitals. In conclusion, individuals with secondary or tertiary pancreatitis requiring ICU admission had a very high prevalence of SSI. Although more research is required to confirm our findings due to the inherent limitations of the microbiological sampling to skin swabs performed in our research, physicians should consider that microorganisms secluded from patient populations with SSI are much more likely to include multidrug-resistant pathogens, such as Pseudomonas spp., gram-positive cocci, and fungi. We found no impact on in-hospital death in our sample, despite the possibility that the occurrence of an SSI is linked to lengthier ICU stays [15,16].

Conclusion

The study concluded that *Klebsiella pneumonia* (30.5%) was the most isolated pathogen, followed by *E. coli* (22.3%), *S. aureus* (16.7%), *Enterococcus fecalis* (8.4%), *P. aeruginosa* (8.4%), *Acinetobacter* spp (8.4%) and Coagulase Negative *Staphylococci* (2.8%). Again, the highest number of isolates were obtained from the General Surgery department and Abdominal surgeries were most associated with the development of post-operative surgical site infections. Also, patients, who underwent spinal surgeries and hysterectomy had most of the SSI cases. Postoperative wound infection increases the patient's morbidity, prolongs the hospital stay, enhances the cost of treatment, and increases the bed occupancy in the wards. Hence, this study has brought forward which presents the demographic and microbiological characteristics of Surgical Site Infection.

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