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Assessment of Surgical Site Infections in a Tertiary Health Care Facility: A Prospective Observational Study

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ABSTRACT

Surgical Site Infections (SSIs) continue to be a significant concern in healthcare settings, contributing to patient morbidity and healthcare-associated infections. In this prospective observational study conducted at a tertiary healthcare facility, we aimed to assess the prevalence, risk factors and microbial etiology of SSIs. We conducted a comprehensive prospective observational study from January 2018 to December 2019 in the tertiary care hospital in Gujarat and Maharashtra. A total of 390 patients who underwent clean and clean-contaminated surgeries across various surgical departments were included. Patient demographics, diagnostic criteria, associated risk factors, surgical characteristics and laboratory data were collected. Patients were monitored for signs of SSI in the post-operative period. Microbiological analysis of clinical samples was performed using standard bacteriological techniques. Antimicrobial susceptibility testing was conducted following established guidelines. Our study revealed a lower overall SSI incidence rate of 6.41%, suggesting the potential effectiveness of our infection control practices. Notably, emergency surgeries exhibited a significantly higher SSI rate (13.43%) compared to elective procedures (4.05%). Predominant microbial isolates included *Staphylococcus* and *Escherichia coli*, accounting for 44 and 31% respectively, followed by *Klebsiella* (19%) and *Acinetobacter baumannii* (6%). The study highlighted an increased SSI risk among diabetic patients. Our findings underscore the importance of stringent infection control measures, particularly in emergency surgeries and among patients with comorbid conditions such as diabetes. The predominance of specific microbial isolates emphasizes the need for targeted prophylactic interventions. Continued research and quality improvement efforts are essential to further reduce the burden of SSI and enhance patient outcomes in our healthcare facility. Understanding the dynamics of SSIs within our institution is pivotal for optimizing infection control strategies and improving patient care.

INTRODUCTION

Healthcare-associated infections (HAIs) present a formidable and pervasive threat to patients' well-being and represent a significant ongoing challenge for healthcare providers on a global scale[1]. Among the spectrum of HAIs, surgical site infection (SSI) is frequently encountered and prominently reported[2]. SSI continues to exert a substantial toll on patient health, contributing significantly to morbidity and mortality rates and constituting nearly a fifth of all HAIs[3]. Specifically, over 30% of HAIs manifest as SSIs, characterized as infections directly associated with surgical procedures occurring either within 30 days of the operation or extending up to 90 days if prosthetic materials were implanted during surgery[4]. The World Health Organization (WHO) has reported a global pooled incidence of SSI at 2.5% (95% CI: 1.6, 3.7)[1].

Research examining the contributory elements to surgical site infections (SSIs) has revealed that the majority of SSIs can be ascribed to factors associated with the patient rather than factors tied to the surgical procedure itself[5,6]. These patient-related factors exert a direct suppressive influence on the patient's immune response and their capacity to recuperate from surgical incisions[7]. Notably, these factors diminish the bactericidal activity of neutrophils, thereby compromising the body's innate defense mechanisms against microbial contaminants[8]. The encompassing factors encompass conditions such as diabetes mellitus, tobacco use, alcohol dependence, malignancies, chronic renal insufficiency, jaundice, obesity, advanced age, compromised physical condition, the use of medications such as steroids and antineoplastic agents, prior exposure to radiotherapy or chemotherapy, nutritional deficiencies, pre-existing infections, extended preoperative hospitalization, immunodeficiency and colonization by *Staphylococcus aureus* or other potential pathogens[5,6,8].

Given the crucial role that postoperative complication control plays in comprehensive quality management, it is imperative to ascertain the prevalence of surgical site infections (SSIs), evaluate the extent of this issue and establish a reasoned basis for prioritizing infection control measures within hospital settings[9]. An emphasis on the microbiological aspects of SSIs offers several additional advantages, including the potential to inform individual patient prognoses, facilitate the monitoring of regional antimicrobial resistance patterns, provide insights into the pathogenesis of SSIs and expedite the identification of localized SSI outbreaks. Moreover, such insights can guide the formulation of infection control strategies and SSI prevention initiatives that are tailored to the specific needs of the local context. The present study was undertaken with the primary objective of investigating the prevalence of SSIs and exploring associated factors at multicentric in Gujarat and Maharashtra in India.

MATERIALS AND METHODS

A prospective observational study was executed within the timeframe spanning January 2018 to December 2019, within the confines of the tertiary care teaching hospitals in Gujarat and Maharashtra. This study encompassed a cohort of 390 patients who had undergone either clean or clean-contaminated surgical procedures across various surgical disciplines. The sample size was calculated by the WHO calculator with a 95% confidence interval, 0.05 margin of error, 0.5 baseline level indicator and 1 design effect it was 384 but we took 390 sample size.

The inclusion criteria comprised patients admitted to diverse surgical wards, encompassing orthopedics, general surgery, pediatrics and obstetrics and gynecology for elective or emergent surgeries classified as clean or clean-contaminated. Patients undergoing contaminated or dirty (infected) surgeries, as per the guidelines set forth by the Centers for Disease Control and Infection (CDC), were expressly excluded from the study.

Comprehensive demographic information of each patient, diagnostic criteria employed, associated risk factors, the utilization of prophylactic antimicrobial agents, the nature and duration of the surgical procedures, clinical assessments of wound condition and pertinent laboratory data were systematically recorded. Particular attention was paid to pre-existing medical conditions, with a specific focus on diabetes. Patients were vigilantly monitored during the postoperative phase, with meticulous notation of any signs indicative of SSIs.

Samples of pus or wound swabs from cases clinically suspected of SSIs, as received by the Department of Microbiology, were expeditiously inoculated and streaked onto culture media, including 5% sheep blood agar and MacConkey agar. These culture plates were subjected to aerobic incubation at 37°C for a duration of 24 hrs. Subsequently, isolated microorganisms were subjected to comprehensive processing and identification in accordance with established bacteriological techniques[10,11]. The antimicrobial susceptibility testing of the isolated microorganisms was conducted utilizing Kirby Bauer's disc diffusion test or Vitek system, adhering to the guidelines outlined by the Clinical and Laboratory Standards Institute (CLSI)[12].

The data underwent entry and subsequent analysis using the Microsoft Excel software. The resultant data is represented in numerical values alongside their corresponding percentages.

RESULTS

Of the total 390 patients who underwent surgery in the hospitals, amongst them 25 developed SSI. The incidence of SSI was 6.4% (Fig. 1).

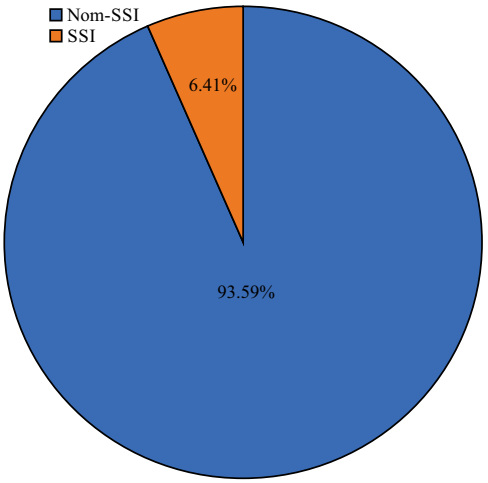

Fig. 1: Incidence of SSIs

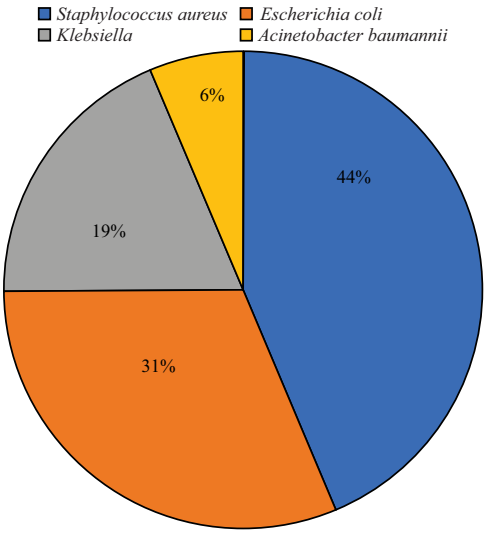

Fig. 2: Causative organism for SSIs

Among the 390 patients included in this study, 203 were male and 187 were female. Notably, there was a male preponderance among patients who developed surgical site infections (SSIs). Of the 203 male patients, 11 (5.41%) experienced SSI, while among the 187 female patients, 14 (7.48%) developed SSI. The age range of the patients spanned from 6 years to 84 years. Among the 25 patients who developed SSI, 3 were in the age group of 19-30, 8 were in the age group of 31-40, 6 were in the age group of 41-50, 3 were in the age group of 51-60 and 5 were above 60 years of age (Table 1).

The incidence of SSI in elective surgeries was 4.05%, while in emergency surgeries, it was higher at 8.43%. Surgical durations ranged from 30 min to 4.3 hrs. Among the patients with SSI, 14 had surgeries lasting for 2 hrs or more, whereas 11 had surgeries lasting for less than 2 hrs. The SSI rate was 4.91% for surgeries lasting less than 2 hrs and 8.43% for surgeries exceeding 2 hrs.

Table 1: Demographic data and factors associated with SSIs among patients

Characteristics/parameters	SSI/total	SSI% (N = 25 [100%])
Age group (years)		
0-18	0/19 (0)	0
19-30	3/51	12
31-40	8/79	32
41-50	6/89	24
51-60	3/85	12
>60	5/67	20
Gender		
Male	11/203 (5.41)	44
Female	14/187 (7.48)	56
Type of surgery		
Elective	12/296 (4.05)	48
Emergency	13/94 (13.83)	52
Duration of surgery		
<2 hrs	11/224 (4.91)	44
>2 hrs	14/166 (8.43)	56
Associated risk factor		
Diabetes	9/114	36
Anemic	07/76	28
Smoker	4/108	16
Alcohol	11/168	44
Distribution according to department		
Surgery	08/157	32
Orthopedics	07/123	28
Obs and Gynec	10/91	40
Pediatrics	0/19	0

Within the study population, 114 patients had diabetes and among them, 9 (7.89%) developed SSI. Additionally, there were 7 cases of anemia, 4 cases of smoking and 2 cases of alcoholism among patients who developed SSIs. Among the 25 SSI cases, 8 exhibited no microbial growth, while 17 displayed microbial growth.

The most prevalent microbial isolates associated with surgical site infections (SSI) were *Staphylococcus aureus*, accounting for 7 out of 18 cases (44%) and *Escherichia coli*, also constituting 5 out of 18 cases (31%). This was followed by occurrences of *Klebsiella* and *Acinetobacter baumannii*, found in 3 and 1 cases, representing 19 and 6% of the total SSI cases, as depicted in Fig. 2.

DISCUSSIONS

Post-operative wound infection continues to represent a significant contributor to both mortality and morbidity rates, constituting a prevalent nosocomial infection[13]. In a study conducted by Kumar and Rai[14] the reported incidence rate of surgical site infections (SSI) reached as high as 12.5%. However, in our investigation, the SSI incidence was notably lower, at 6.41%. It's noteworthy that SSI rates have varied considerably in previous research, ranging from 20% to as high as 76.9%. Our findings align more closely with studies conducted in the United Kingdom (3.1%) and the Netherlands (4.3%)[15,16], underscoring the potential impact of robust infection control practices in mitigating SSI rates.

Specifically, among the 203 male patients in our study, 11 (5.41%) developed surgical site infections, while among the 187 female patients, 14 (7.48%) experienced SSI. Our investigation also revealed a higher prevalence of infections in obstetrics and

gynecology surgeries, a trend that is consistent with findings from other studies[17]. Furthermore, our study demonstrated that the highest incidence of infections (32%) occurred within the age group of 31-40. This outcome may be attributed, in part, to a greater number of lower-section cesarean sections (4 cases), total abdominal hysterectomies (4 cases) and bilateral salpingo-oophorectomies (2 cases) in this age group, potentially contributing to the observed higher infection rates.

In our study, we observed a notably higher incidence rate of surgical site infections (SSI) in emergency surgeries (13.83%) in comparison to elective surgeries (4.05%). Similar findings have been reported in previous studies, with rates even reaching as high as 17.7%. Further investigations have consistently demonstrated that emergency surgical procedures are associated with a significant increase in the risk of SSI. This heightened risk in emergency surgeries can likely be attributed to the absence of routine pre-operative preparations that are known to reduce SSI rates (e.g., measures to control diabetes). Additionally, many emergency surgeries involve anatomical areas that are inherently more prone to contamination, such as the bowel and perianal region[18].

In our current study, the SSI rate for surgeries lasting more than 2 hrs was 8.43%, while for surgeries lasting less than 2 hrs, it was 4.91%. These findings are consistent with a study conducted by Ansul *et al*.[19] Prolonged surgical durations expose the surgical site to extended periods of air exposure, heightened trauma, the stress of prolonged anesthesia and sometimes, significant blood loss.

Regarding associated risk factors in our study, we observed a significantly higher SSI incidence among diabetic patients (5.1%) in comparison to non-diabetic patients (3.8%). This finding aligns with the results reported by Rao *et al*.[20] who similarly identified a higher incidence of SSI among diabetic patients.

The most prevalent microbial isolates associated with surgical site infections (SSI) were *Staphylococcus aureus*, accounting for 7 out of 18 cases (44%) and *Escherichia coli*, also constituting 5 out of 18 cases (31%). This was followed by occurrences of *Klebsiella* and *Acinetobacter baumannii*, found in 3 and 1 cases, representing 19 and 6% of the total SSI cases. This finding differs from the results reported by NINSS[15] who noted *E. coli* (20.8%) as the most common organism isolated, followed by *S. aureus* (16.1%), in SSI cases. Other studies in accordance with our study indicated that *Staphylococcus aureus* is the most frequently isolated organism from SSI cases[16].

The high incidence of gram-negative organisms in post-operative wound infections can likely be attributed to acquisition from the patient's normal endogenous microflora. Notably, the antibiotic susceptibility profile of these isolated organisms tends to be quite similar to that of patients with non-surgical infections.

CONCLUSION

Our study identified a relatively lower overall incidence of SSI (6.41%), possibly indicating the effectiveness of our infection control measures. Notably, emergency surgeries had a notably higher SSI rate, emphasizing the importance of stringent infection prevention in urgent cases. *Staphylococcus* and *Escherichia coli* were the predominant causative agents, highlighting the need for targeted prophylaxis. Patients with comorbidities, especially diabetes, faced an increased SSI risk, underscoring the importance of careful pre-operative management. In summary, ongoing vigilance in infection control, especially during emergency procedures and among high-risk patients, is crucial. Further research and quality improvement efforts are needed to reduce SSI burden and enhance patient outcomes.

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