ORIGINAL RESEARCH PAPER

Microbiology

SURGICAL SITE INFECTION : BACTERIOLOGICAL, CLINICOPATHOLOGICAL PROFILE & ANTIBIOGRAM IN A TERTIARY CARE HOSPITAL IN WESTERN RAJASTHAN

KEY WORDS: Surgical site infections, E.coli, Emergency surgeries

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ABSTRACT

Introduction: Surgical Site Infections [SSIs] have plagued surgeons since time immemorial. SSIs are potential complications associated with any type of surgical procedure, known to increase morbidity, mortality, length of stay in hospital as well as the cost of treatment to the patients. The incidence varies from 1% to 20% among developed countries to as high as 40% in developing world. **Aims:** To access the prevalence and risk factors, bacteriological profile, and antibiogram for SSI at a tertiary care hospital in Western Rajasthan. **Research Design:** This prospective study was conducted in the Department of Microbiology, JLN Medical College, Ajmer from November 2022 to April 2023. **Material and Methods:** Samples, collected from patients clinically suspected to have wound infection, after bacterial identification with standard biochemical methods were subjected to susceptibility testing by Kirby Bauer disc diffusion method as per Clinical and Laboratory Standards Institute guidelines 2022 (M100-Ed32). The study was approved by our Institutional Ethical Committee. Statistical analysis was done using Microsoft Excel, SPSS version 20 Windows software program. **Results:** Incidence of surgical site infections in present study was 12.61%. Emergency surgeries showed higher rate of SSI as compared to elective surgeries As per treatment modalities, patients who had drains placed intra-operatively made up a larger majority of the total patients who had developed surgical site infections compared to those patients who did not have a drain placed. From 221 culture positive cases of SSI, 228 bacterial isolates were recovered comprising of 58(25.44%) gram positive cocci, 154 (67.54%) gram negative bacilli and the remaining mixed isolates. Highest incidence was present in dirty wounds. The most common organism recovered was E.coli followed by Klebsiella spp. **Conclusion:** The present study emphasizes the need of quality surgical care which takes into consideration all the three important factors, i.e. host, environmental, and microorganism characteristics before doing any surgery. SSI surveillance should be performed regularly to identify the common pathogens with the establishment of antibiotic policy in the hospital.

INTRODUCTION:

Infection is encountered by all the surgeons, as surgeries invariably impair the first line of host defenses between environmental microbes and the host's internal milieu leaving patient exposed to pathogenic or opportunistic microbe in the hospital environment & resulting in postoperative wound infection known as surgical site infections (SSI).[1].

Approximately 5 to 10% of patients admitted to healthcare setups in developed countries, and more than 25% of such patients in developing countries, have been found to acquire Healthcare Associated Infections (HCAI) (earlier called Hospital Acquired or Nosocomial Infections) thereby increasing the burden of re-admission, morbidity, mortality and costs of the existing illness.[2] According to definition by United States Center For Disease Control And Prevention (CDC), SSI's are defined as an" infection related to an operative procedure that occurs within 30 days of the procedure or within 90 days if prosthetic material is implanted at surgical site".[3]Depending on the depth of infection-penetration into the wounds, SSIs are divided into three categories: superficial incisional, deep incisional, and organ/space. Infectious agents may cause SSI from endogenous or exogenous sources. Endogenous sources are body sites, such as the skin, nose, mouth, gastrointestinal tract, or vagina that are usually inhabited by micro-organisms. Exogenous sources are those external to the patient, such as patient care personnel, visitors, patient care equipment, medical devices, or the health-care environment.[4] The present study was intended to access the incidence, risk factors, bacteriological profile and antibiogram of organisms causing SSIs in the General Surgery department of our hospital which would help to institute better prophylactic measures and appropriate, timely and accurate therapeutic measures to reduce the cost of treatment and morbidity of the disease.

MATERIALS AND METHODS:

A cross-sectional study, conducted in Department of Microbiology, JLN Medical College, Ajmer from November 2022 to April 2023, included 246 consecutive samples from clinically diagnosed cases of SSI admitted in General Surgery Department of our hospital (after obtaining informed consent). A structured questionnaire was used to extract the information including demographic data like age and gender of patients, any co-morbidities, e.g. anemia, smoking, and diabetes mellitus, length of preoperative hospital stay, and duration of operation. Wound samples were taken using sterile swabs under all aseptic precautions using Levine technique. Two swabs were obtained from surgical site without contaminating with skin commensals and transported to the laboratory immediately with minimum delay for processing.[5,6]

Statistical analysis

The data were tabulated and statistically analyzed using Microsoft Excel, SPSS version 20 Windows software program. Pearson's Chi-square test was used to test the strength of association between the variables with $P < 0.05$ taken as statistically significant.

Inclusion criteria :

I- Both sexes, all age groups (except paediatric cases) ii- Patients developing post- surgical site infection within 30 days (without implant) or 1 year (with implant). iii- No previous infection at the site before surgery.

Exclusion criteria :

I- Burn patients
ii- Infections at surgical site caused by anaerobic bacteria and fungal isolates
iii- Surgeries done outside our hospital & admitted following infections
iv- Patients refusing to give written consent

Processing & Identification of bacterial pathogen-
Gram-stained smear was prepared directly from a sample using the first swab. It was screened for the presence of pus cells, morphology, and arrangement of microorganisms. Culture was done from the 2nd swab. Colony morphology, Gram staining, and conventional standard biochemical tests were used for the final identification of bacterial species. [5,6]

Control strains used :
Escherichia coli ATCC 25922 Staphylococcus aureus ATCC 25923 Enterococcus faecalis ATCC 29212 Pseudomonas aeruginosa ATCC 2753

Antibiotic susceptibility test -
Antibiotic susceptibility test was performed by Kirby-Bauer disk diffusion method & susceptibility was tested against several antibiotics procured commercially from Hi-Media Laboratories Ltd, Mumbai. The diameter of the zone was measured and interpreted according to the CLSI guidelines. [7]

OBSERVATIONS & RESULTS :
A total of 1950 patients underwent different types of surgeries comprising of elective as well as emergency during this period. The most frequently received sample was pus swab 157(63.83%) followed by pus aspirate 78(31.70%) and purulent discharge from drain 11(4.47%) respectively. Out of these, 1248 were Elective cases & 702 were Emergency cases. 246 surgical site infections were documented and hence, the overall prevalence of surgical site infection rate during the study period was 12.61%(n=246) Fig-1.

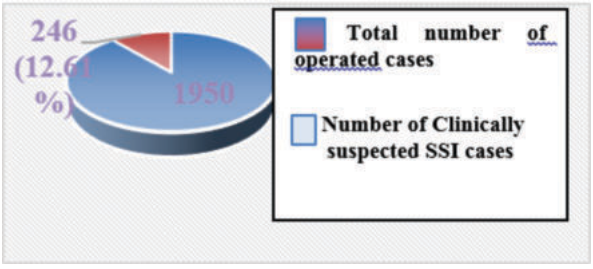

Fig-1: Prevalence os SSI

The SSI incidence varied among different age groups as shown n Table -1

Table -1 Age wise incidence of SSI			
Age	21-30	N	29
		%	11.8%
	31-40	N	41
		%	16.7%
	41-50	N	50
		%	20.3%
	51-60	N	59
		%	24.0%
	61-70	N	48
		%	19.5%
	71-80	N	14
		%	5.7%
	81-90	N	5
		%	2.0%
Total		N	246
		%	100.0%

Of 246 clinically diagnosed cases of SSI, 67 cases belonged to class I wound, 40 cases to class II. 83 cases to class III & 56 cases to class IV (Figure 2).

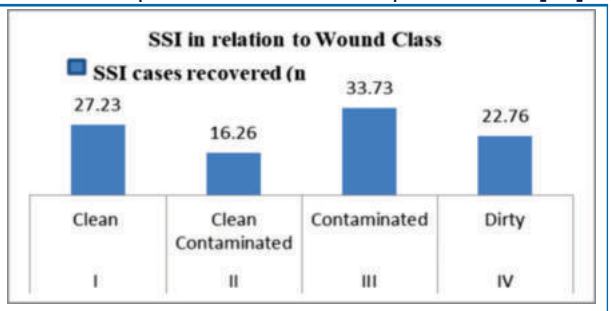

Fig-2 Comparison of SSI in relation to Wound Class

Of 246 clinically diagnosed cases of SSI 221 were culture positive (89.8%) and 25 (10.2%) were culture negative. (Table -3)

Table -3 Culture Positive versus Culture Negative

Number of Clinically suspected SSI cases	No. of Cases Positive for Culture		No. of Cases Negative for Culture	
	No.	(%)	No.	(%)
246	221	89.8	25	10.2

P value=0.001 (S)
Of 246 clinically diagnosed cases, 107 cases belonged to elective surgery and 139 cases belonged to emergency surgery. SSIs in elective surgeries were 47.7% (21 of 44) and emergency surgeries were 84% (47 of 56). Microscopic studies of the gram stained smear showed isolation of total 228 microbial pathogens from 246 cases. Among them 58 gram positive cocci 27(11.84%) were *Staphylococcus aureus,* 21 (9.21%) were *Coagulase negative staphylococcus aureus* (CONS) and 10 (4.38%) were *Enterococcus* spp. (Fig-3).

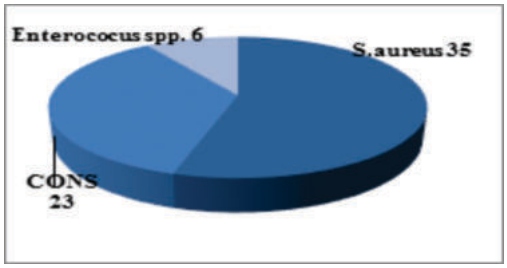

Fig-3 -GPC Isolates 64 (29.09%)

Among the 154 gram negative bacilli, *62* (62.22%) were *E.coli*, 50 (21.92%) *Klebsiella spp.*, 6(2.63%) Enterobacter spp., 3 (1.31%) *Proteus spp* and 1 (0.43%) Citrobacter spp., The remaining 32 (14.03%) were Non fermenters: *Pseudomonas aeruginosa* . (Fig-4).

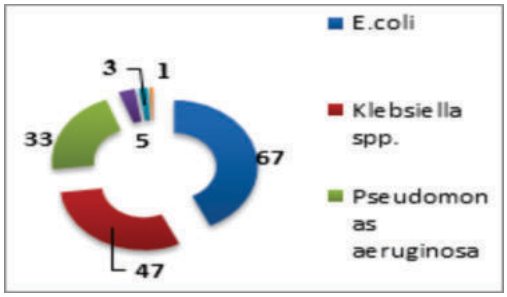

Fig-4 GNB Isolates 156 (70.91%

Table– 4 Surgical site infections with respect to associated Risk Factors

Associated Risk Factors		Total No. of Operated patients	No. of Infected patients	(%)
Duration of Surgery (in min)	≤ 60	1092	86	7.87

	61-120	796	132	16.58
	> 120	62	28	45.16
Preoperatve hospitalization duration(in Days)	< 2	621	57	9.17
	2-5	897	119	13.26
	>5	432	70	16.20
Drain used	Yes	625	168	26.88
	No	1325	78	5.88

Antibiotic resistance profiles were reported for the organisms isolated from surgical incision site of infected patient.Table-5 below shows antbotc resistance patterns of gram postve isolates.

DISCUSSION -

During the study period 246 cases developed SSI with incidence of 12.61%. Similar observations were made by other studies showing incidence SSI infection of (14.45%) by Narula, *et al.* & (20.6%) by Thakur N et al. [1,8]. A comparatively low SSI rate was observed in an Indian study done by Sankalp G.et al (6.99%) [9] The difference in incidence is probably due to differences in the characteristics of the hospital populations, the underlying diseases, differences in clinical procedures, the extent of infection control measures, variation in risk factors associated with SSI and in addition the hospital environment.

Taking the host factors into consideration, SSI incidence was maximum among patients of the age 51-60 years (24.0%) in the study. Similar findings have been reported in study by *Kumar A et al., 2017* [10] In corroboration with earlier studies, we also found that age group, gender, and type of surgery are not significant factors in the development of SSI following surgery (P >0.05). This may be due to inadequate representation of different age groups.Of the samples collected from SSI in the present study, 10.2% were culture negative, which suggests other causes of SSI such as anaerobic organisms, or fungal isolates which are not looked for routinely. Narula, *et al.*,[1] in his work also reported 13.73% SSI were labeled as culture negative. A limitation of the present study is that anaerobic & fungal causative organisms were not investigated which may have been a cause of culture-negative SSI. Gram negative bacilli (GNB) have dominated the trend in our set up accounting up to 66.97% of the total isolates, followed by Gram positive cocci (GPC) which were isolated from 28.96% of the cases. The remaining being mixed isolates (4.07%). Among GNB *E. coli* and *Klebsiella pneumoniae* belonging to Enterobacteriaceae were the commonest isolates accounting to 30.76 % and 23.07 % respectively. Other important implicating GNB was *Pseudomonas aeruginosa* isolated from 15.83 % of the cases. Similar trend has been documented by several studies as well.[11-14]

Antibiotic resistance pattern of Gram Positive Organisms

Conversely, in some studies [9, 10] *Staphylococcus aureus* has dominated the scene. GNB inherently being part of normal endogenous microbial flora are becoming the most important pathogens in causing SSIs .

Higher incidence of wound infections was seen in emergency operations (19.80%) in the present study than the elective operations (8.57%) which was significant statistically (p<0.01). This is in accordance to previously reported studied wherein emergency surgeries have shown higher rate of SSI .[10.,15] This may be attributed to combination of various factors: low patient's general condition, inadequate preparation, operations performed usually on potentially contaminated or contaminated sites & longer duration of surgery as compared to elective surgeries. Surprisingly higher infection rate in patients with elective surgery was seen in few studies.[16.] Each patient undergoing surgery was assessed for the nature of their wound.

There are 4 types of wound a patient can have, clean, clean contaminated, contaminated and dirty. The most common type of wound was contaminated at 33.73 % (n=246) followed by clean contaminated wound at 27.23%. Dirty wounds were present in 22.76 % of patients and clean wounds which developed surgical site infections was only 16.26 % of patients. This is an expected observation & similar results were also seen in various studies.[9,18] Mawalla et al..[16] did not have any dirty cases in their study, however their results were trending in the opposite direction with most surgical site infection occurring in clean cases and least in contaminated cases.Various risk factors which could be related to SSI were assessed in this study. Table 5 showing comparison of various risk factors for SSI revealed statistically significant results. Use of drains was associated with higher number of SSI cases compared to when the drain was not used.A few studies do suggest an increased risk of SSI associated with drain placement, but are usually associated with open drainage and not the use of CSDs (closed-suction drains). [19] No studies whatsoever attribute a decrease in the incidence of SSI (including organ/space SSI) to drain placement. Furthermore, prolonged preoperative hospital stay leads to colonization with antimicrobial resistant micro - organisms and directly affects patient's susceptibility to infection either by lowering host resistance or by providing increased opportunity for ultimate bacterial colonization. [20]. Such an effect was also noticed in the present study wherein 16.20% of the patients were in housed in the hospital for >5 days. Badia JM et al [21] also reported the same association leading to financial burden and negative impact on patient's quality of life.

Our study reveals a clear cut increased number of SSI cases i.e.45.16% cases (n=62), where surgery has been prolonged ≥ 120 mins. (Table-4). Prolonged duration of operation results in increased exposure of operation site to air, prolonged trauma, stress of prolonged anaesthesia and sometimes blood loss. [13] AST was performed for all bacterial isolates. The antibiogram of Gram Positive Organisms showed maximum susceptibility to vancomycin(90.48 to 93.34%) & linezolid (76.20% to 93.34%), whereas they were highly resistant to ampicillin (80% to 95.23%) and amoxycillin-clavulanic acid (53.34% to 76.19%). (Table-5) These findings were similar with a study by Thakur N et al. [22], which reported *S. aureus* isolates with maximum sensitivity to linezolid and vancomycin. High sensitivity to linezolid and vancomycin may be due to the limited exposure of these drugs. The antibiogram of Gram-negative isolates showed resistance to amoxycillin-clavulanic acid and cephalosporins, moderate susceptibility to fluoroquinolones and aminoglycoside, and good susceptibility to carbapenems.

CONCLUSION -

SSI continues to be an important clinical challenge despite the modern surgical and sterilization techniques and the use of prophylactic antimicrobials. With this background, the present study was conducted to study the incidence of surgical site infection in our set up, to assess the possible risk factors and to analyze the measures to prevent surgical site infection.Each hospital has its own unique bacterial flora to which patients are at risk for acquiring infection during hospitalisation. Our study has thoroughly observed the microbiological and antibiotic sensitivity pattern of all SSI cases & hence emphasizes that when such epidemiological data are available can the surgeon employ a logical approach towards SSI control.

Understanding the factors leading to surgical site infection will help in rationalising the use of antimicrobials as it now appears that the wheel has rotated a full circle and fear is rightly being expressed that we will soon have the same conditions of wound infection as before Lister's era, if not judiciously used. The present study thus calls for intensive infection control practices, and continuous antibiotic

surveillance along with an effective antibiotic policy are required to address the problem. However, molecular studies are necessary to evaluate the various emerging resistance mechanisms.

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Conflicts of interest -There are no conflicts of interest.

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