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Original Article

Microbiology Section

Microbiological Profile of Surgical Site Infections at a Tertiary Care Hospital in Rajasthan, India: A Cross-sectional Study

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ABSTRACT

Introduction: The high morbidity and mortality rates and economic costs represented by Surgical Site Infections (SSIs) emphasise the rationale for monitoring SSI rates, modifying antibiotic prophylaxis policies, and reducing risk factors. Hence, the present work was carried out to study the etiological microorganisms contributing to SSIs and their antimicrobial susceptibility pattern.

Aim: To study the microbiological profile of SSIs at a tertiary care hospital.

Materials and Methods: The present cross-sectional study was conducted at the Department of Microbiology, JLN Medical College, Ajmer, Rajasthan, India, from December 2019 to August 2020. A total of 1828 patients who underwent surgery in the hospital during the study period, out of which, 110 patients developed signs and symptoms of SSI, were further included in the study. Samples (pus or wound swab) were received from 110 patients clinically diagnosed with SSI and processed as per standard microbiological techniques. Antimicrobial Susceptibility Testing (AST) was done by the modified Kirby-Bauer disc diffusion method. The demographic and clinical parameters, such as age, gender, emergency, type of anaesthesia used in emergency or elective surgery and wound type, were considered; they were tabulated and expressed as frequency and percentage. The findings were statistically analysed and the p-value below 0.5 was considered statistically significant.

Results: The prevalence of SSI was 6.02%. The rate of SSI was highest in those over 60 years of age, 9/92 (9.78%); males, 41/592 (6.93%); those under General Anaesthesia (GA), 45/474 (9.50%); emergency surgery, 63/680 (9.26%); and those with dirty wound types, 23/72 (31.94%). There was a predominance of Gram-negative bacilli, 50/80 (62.5%), as the aetiological agents for SSI. The predominant organism isolated was *E. coli* 19 (23.75%), followed by Coagulase Negative Staphylococci (CoNS) 18 (22.50%), *Klebsiella spp.* 16 (20%), *S. aureus* 12 (15%), *P. aeruginosa* 7 (8.75%), Non fermenting Gram-negative Bacilli (NFGNB) 3 (3.75%), *Enterobacter spp.* 3 (3.75%), and *Citrobacter spp.* 2 (2.50%). Gram-positive cocci showed 100% sensitivity to linezolid, while in Gram-negative bacilli, imipenem 36/50 (72%) was found to be the most effective drug.

Conclusion: SSIs are mostly caused by Gram-negative bacteria, particularly *Escherichia coli* and *Klebsiella spp.*, which are the most predominant pathogens linked with SSI. The bacterial isolates detected in the present study showed a high degree of resistance for routinely prescribed antimicrobials in the facility. Therefore, a higher degree of collaboration and cooperation among hospital administration, Surgeons, and Microbiologists to formulate the effective antibiotic policy for SSI treatment based on local antibiograms and to implement stringent control measures, which are crucial for reducing SSI rates in the hospital.

Keywords: Antibiotic policy, Drug resistance surveillance, Local antibiogram

INTRODUCTION

The SSIs are healthcare associated infections in which a wound infection develops after an invasive or surgical procedure. SSI is the most frequent type of infection in low and middle-income countries, with incidence rates ranging from 1.2 to 23.6 per 100 surgical procedures, while in developed countries, SSI rates vary between 1.2 and 5.2% [1].

The SSIs are defined as infections occurring within 30 days after operation for superficial incisional SSI and for operations without an implant in place, whereas within one year if an implant is in place as per the Centre for Disease Control and Prevention (CDC) guideline 1999. However, the recent guideline states that the infections occurring within 90 days after an operation with an implant in place are considered as SSI for deep incisional and organ space SSI (CDC guideline 2015). SSIs may be superficial incisional, deep incisional or organ or body space infection [2,3].

The SSIs may be caused by exogenous or endogenous microbiota. Skin flora are responsible for most SSIs, as they are inoculated into the incision during the operation [4,5]. The microbiology of SSI depends on the nature of the surgery, the incision location, and the body cavity or hollow viscous entry during the procedure [6].

The high morbidity and mortality rates and economic costs represented by SSIs rationalise the need for monitoring SSI rates, modifying antibiotic prophylaxis policies, and reducing risk factors. Additionally, the microorganisms causing SSIs and their antimicrobial susceptibility patterns may vary from place to place and from time to time. Therefore, regular surveillance and monitoring of causative agents of SSI and their antimicrobial susceptibility patterns in a particular healthcare setting is crucial to provide clinicians with updated information regarding the most effective treatment for SSI [7,8]. Hence, the present work was carried out to study the aetiological microorganisms contributing to SSIs and their antimicrobial susceptibility pattern, so it would be helpful to clinicians in choosing the most appropriate treatment for SSI and to restrict the injudicious use of antimicrobial agents.

The present study aimed to assess the microbiological profile of SSIs at a tertiary care hospital. The primary objectives of the study were to study the prevalence of SSIs in patients who underwent surgery in the hospital, to isolate and identify the aetiological microbes causing SSIs, to find out antimicrobial susceptibility patterns of the isolated microorganism and the secondary objective of the study were to identify the various parameters associated with the development of SSIs, to identify the methicillin- resistant

isolates, to identify the Extended Spectrum β-Lactamase (ESBL) producing isolates and to identify the Metalo-Beta-Lactamase (MBL) producing isolates.

MATERIALS AND METHODS

The present cross-sectional study was conducted at the Department of Microbiology, JLN Medical College, Ajmer, Rajasthan, India, from December 2019 to August 2020. The study was approved by the Institutional Ethical Committee (979/Acad-III/MCA/2019).

Sample size calculation: The prevalence of SSI observed in the study by Negi V et al., was 17.8% [9]. Based on this study, considering p as 17.8% (p=0.178) and a 95% confidence interval (z=1.96) with the precision (d) of 2% (d=0.02), the sample size was calculated using the following formula:

$n= z^2 \times (pq)/d^2$, where q= 1-p (q=0.822)

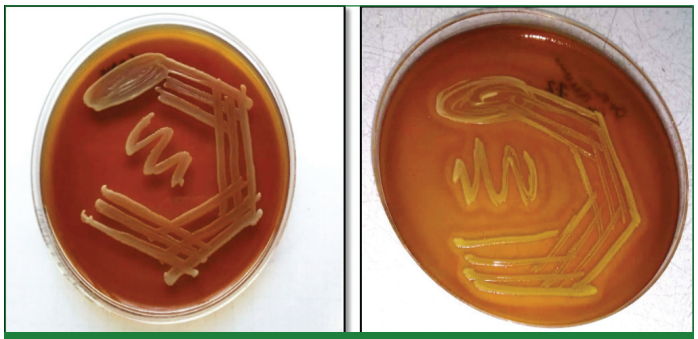
The minimum sample to be included in the study was 1405 patients. A total of 1828 cases underwent surgery (emergency or elective) during the study period, out of which 110 patients developed signs and symptoms of SSI.

Inclusion criteria: Patients who underwent surgery in the hospital and who were admitted with signs and symptoms of SSIs within 30 days after the surgeries without implant and within 90 days after the implant surgeries.

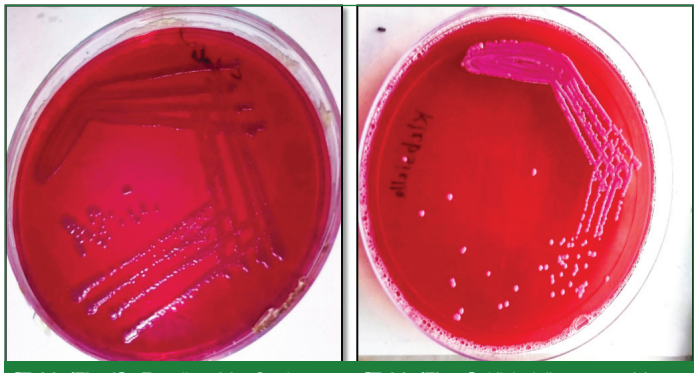
Exclusion criteria: Patient with a known preoperative infection, cellulitis at a surgical site, episiotomy and circumcision wounds, or a procedure in which healthy skin was not incised, e.g., open abscess and stitch abscesses.

Study Procedure

Specimens were collected on the day when patients presented with clinical evidence of infection (purulent drainage or exudate from an incision), taking all aseptic precautions. The specimens were labelled and transported with a completed test requisition form to the Microbiology Laboratory. Samples collected were inoculated on 5% sheep blood agar and MacConkey agar by rolling the swab over the agar and streaked [Table/Fig-1-4].

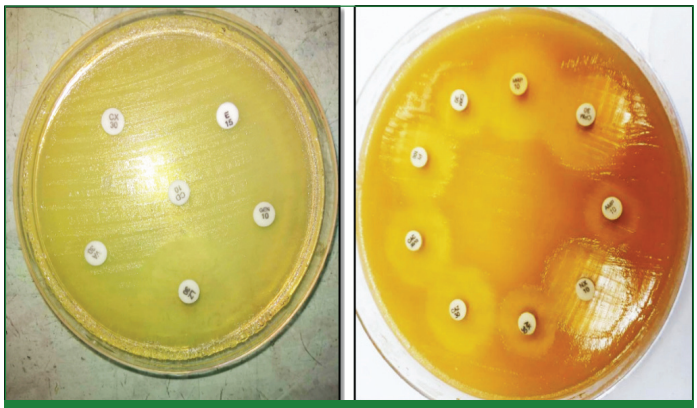


[Table/Fig-1]: Non haemolytic colony of CoNS on Blood agar. **[Table/Fig-2]:** Beta haemolytic colony of *S. aureus* on Blood agar. (Images from left to right)

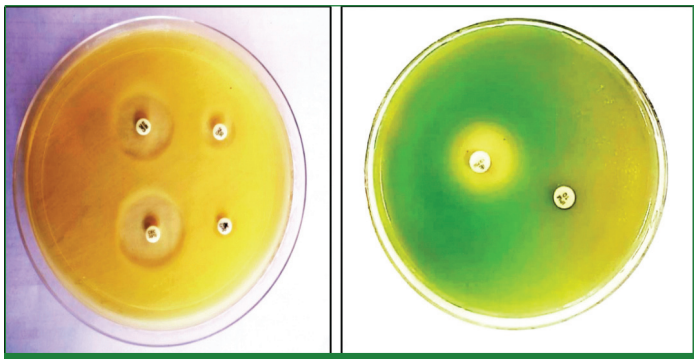


[Table/Fig-3]: *E. coli* on MacConkey agar. **[Table/Fig-4]:** *Klebsiella spp.* on Mac-Conkey. (Images from left to right)

Inoculated plates were incubated at 35-37°C aerobically for 18 to 24 hours. Simultaneously, the specimen was inoculated in the liquid media, Brain Heart Infusion broth (BHI broth). The subculture was done at 24 hours and, if indicated, at 48 hours and 72 hours. The isolates were identified based on colony gram staining, hanging drop method, catalase test, coagulase test, oxidase test and other standard biochemical tests such as indole test, citrate test, urease test, triple sugar iron test, Oxidation Fermentation (OF) test and methyl red test and simultaneously AST was done on Mueller Hinton agar (MHA) by the modified Kirby-Bauer disc diffusion method [Table/Fig-5-8].



[Table/Fig-5]: AST of *S. aureus* (MRSA) on MHA. **[Table/Fig-6]:** AST of *E. coli* on MHA. (Images from left to right)



[Table/Fig-7]: ESBL- producing *E. coli* on MHA. **[Table/Fig-8]:** MBL production by *P. aeruginosa* on MH. (Images from left to right)

For AST, Clinical and Laboratory Standards Institute (CLSI) guideline 2019 [10] was used. The CDC's guidelines for categorising surgical wounds are as follows [3]:

Class I: A clean surgical wound characterised by the absence of inflammation, a maintained sterile procedure, and no involvement of the respiratory, alimentary, or genitourinary tracts.

Class 2: A clean contaminated surgical wound includes entry into the pulmonary, alimentary, or genitourinary system under controlled conditions, without any encountered contamination.

Class 3: A contaminated surgical wound is characterised by either a significant breach in sterile technique, substantial spilling from the gastrointestinal tract, or an incision showing acute, non-purulent inflammation.

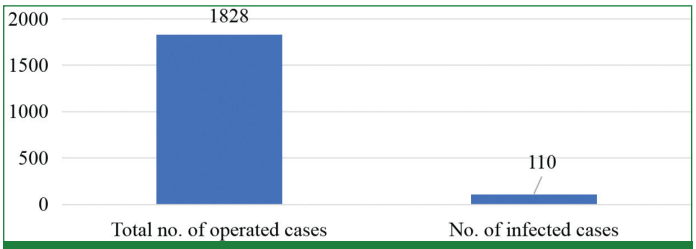
Class 4: A contaminated surgical wound is characterised by perforated viscera, acute inflammation with purulence encountered during the procedure, or traumatic wounds with delayed care exhibiting faecal contamination or devitalised tissue.

STATISTICAL ANALYSIS

Statistical analysis was performed using R software version 6.3.2. All the data collected in the current study were categorical, so they were tabulated and expressed as frequency and percentage. The association between the parameters and the presence of SSI was assessed using the Chi-square test (x^2). With a 95% confidence interval, a p-value of less than 0.05 was considered statistically significant.

RESULTS

As the total number of operated cases was 1828 during the study period, the SSI rate was found to be in 110 (6.02%) cases [Table/Fig-9]. Laryngectomy 2/3 (66.67%), exploratory laparotomy 28/84 (33.33%), and split skin graft 10/31 (32.26%) had the highest rates of SSIs compared to other surgeries [Table/Fig-10].



[Table/Fig-9]: Surgical Site Infection (SSI) cases.

No.	Surgeries	*Category of wound	Total no.	Infected	SSI (%)
1	Exploratory laparotomy	Class 3,4	84	28	33.33
2	Colorectal	Class 3	21	3	14.29
3	Cholecystectomy	Class 2,3	34	2	5.88
4	Appendectomy	Class 2,3,4	32	5	15.63
5	Hernioplasty	Class 2	104	5	4.81
6	Split Skin Grafts (SSG)	Class 1	31	10	32.26
7	Excision of cyst & lump	Class 2	82	5	6.10
8	Lower Segment Caesarean Section (LSCS)	Class 1,2,3,4	1011	39	3.86
9	Abdominal hysterectomy	Class 2,3	150	6	4.00
10	Ortho implants	Class 1,2	270	4	1.48
11	Laryngectomy	Class 2	3	2	66.67
12	Hemimandibulectomy	Class 2	6	1	16.67

[Table/Fig-10]: Distribution of Surgical Site Infection (SSI) according to surgery (n=1828).
*Class 1= Clean, Class 2= Clean- contaminated, Class 3= Contaminated, Class 4= Dirty

[Table/Fig-11] shows that the rate of infection was highest in the above 60 age group, 9/92 (9.78%), followed by a 33/541 (6.10%) rate in the age group of 41-60 years. Males 41/592 (6.93%) had a higher prevalence of SSI than females 69/1236 (5.58%). Patients who underwent emergency surgery, 63/680 (9.26%), had a higher prevalence of SSI than those who underwent elective surgery, 47/1148 (4.09%). The rate of SSI was highest with dirty wounds, 23/72 (31.94%), and in General Anaesthesia (GA), 45/474 (9.50%).

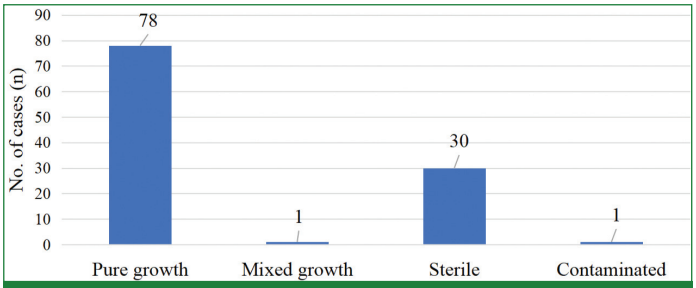
Out of 110 samples, 79 (71.82%) were found to be culture positive, and the rest of the 31 (28.18%) samples were culture negative. Out of 79 culture-positive cases, 78 cultures showed one bacterial isolate, and one culture showed two isolates (total 80 isolates) [Table/Fig-12].

Out of a total of 80 bacterial isolates, 50 (62.5%) were Gram-negative bacilli and 30 (37.5%) were Gram-positive cocci. *E. coli* 19 (23.75%) was the commonest organism isolated, followed by *Coagulase Negative Staphylococci* (*CoNS*) 18 (22.50%), *Klebsiella spp.* 16 (20%), *S. aureus* 12 (15%), *P. aeruginosa* 7 (8.75%), *NFGNB* 3 (3.75%), *Enterobacter spp.* 3 (3.75%), and *Citrobacter spp.* 2 (2.50%) [Table/Fig-13]. AST was carried out for all 80 isolates and the results are depicted in [Table/Fig-14-16].

Gram-positive cocci showed 100% sensitivity to linezolid and were found to be the least sensitive to penicillin 8/30 (26.67%). In Gram-negative bacilli, Imipenem 36/50 (72%) was found to be the most effective antimicrobial agent. Out of 12 *S.aureus*, 5 (41.67%) isolates were Methicillin-resistant (MRSA) [Table/Fig-17].

Parameters	No. of cases	Infected	Non infected	Chi-square value (x^2)	p-value
Age (in years)					
0-20	132	8	124	2.57	0.462
21-40	1063	60	1003		
41-60	541	33	508		
>60	92	9	83		
Gender					
Male	592	41	551	1.28	0.258
Female	1236	69	1167		
Elective and emergency surgery					
Elective	1148	47	1101	19.28	<0.0001
Emergency	680	63	617		
Wound types					
Clean	797	10	787	127.55	<0.0001
Clean-contaminated	828	62	766		
Contaminated	131	15	116		
Dirty	72	23	49		
Type of anaesthesia					
Spinal	1354	65	1289	12.86	0.00034
General	474	45	429		

[Table/Fig-11]: Association between various parameters and SSIs among study population (n=1828).
*The association between the parameters and the presence of SSI was assessed using the Chi-square test. With a 95% confidence interval, a p-value of less than 0.05 was considered statistically significant.



[Table/Fig-12]: Bacterial isolates from clinically infected cases (n=110).

No.	Organism	No. of isolates (n)	Percentage (%)
1	Coagulase Negative Staphylococci (CoNS)	18	22.50
2	*Staphylococcus aureus*	12	15
3	*Escherichia coli*	19	23.75
4	*Klebsiella spp.*	16	20
5	*Pseudomonas aeruginosa*	7	8.75
6	Non fermenting Gram-negative bacilli (NFGNB)	3	3.75
7	*Enterobacter spp.*	3	3.75
8	*Citrobacter spp.*	2	2.50

[Table/Fig-13]: Various organisms isolated from samples of SSIs cases (n=80).

Antibiotics	*S. aureus* (n=12)	Resistance (%)	CoNS (n=18)	Resistance (%)
Cotrimoxazole	10	83.33	12	66.67
Clindamycin	2	16.67	6	33.33
Ciprofloxacin	11	91.67	11	61.11
Cefoxitin	5	41.67	11	61.11
Erythromycin	5	41.67	12	66.67
Gentamycin	8	66.67	9	50
Linezolid	0	0	0	0
Penicillin-G	9	75	13	72.22
Quinupristin-dalfopristin	3	25	11	61.11

[Table/Fig-14]: Antibiotic resistance pattern of Gram-positive cocci (n=30).

Antibiotics	*E. coli* (n=19)	*Klebsiella spp.* (n=16)	*Enterobacter spp.* (n=3)	*Citrobacter spp.* (n=2)	Total resistance (%)
Amikacin	7	10	3	2	55
Ampicillin	16	16	3	2	92.5
Amoxicillin-clavulanate	10	11	3	0	60
Aztreonam	16	12	3	2	82.5
Cefepime	16	13	3	2	85
Cefixime	19	16	3	2	100
Cefoperazone	17	14	3	2	90
Cefpodoxime	18	15	3	2	95
Cefotaxime	19	15	3	2	97.5
Ceftazidime	18	14	3	2	92.5
Ceftazidime-clavulinic acid	10	11	3	2	65
Ciprofloxacin	13	11	2	1	67.5
Imipenem	4	8	1	0	32.5
Gentamycin	14	11	3	2	75
Netilimycin	15	13	2	2	80
Piperacillin – tazobactum	15	12	3	1	77.5

[Table/Fig-15]: Antibiotic resistance pattern of *Enterobacteriaceae* (n=40).

Antibiotics	*P. aeruginosa* (n=7)	Other *NFGNB* (n=3)	Total resistance (%)
Amikacin	1	1	20
Aztreonam	3	1	40
Cefepime	2	1	30
Ceftazidime	4	2	60
Ciprofloxacin	3	2	50
Gentamycin	5	2	70
Imipenem	1	0	10
Netilimycin	2	2	40
Piperacillin-tazobactam	3	2	50
Tobramycin	1	2	30

[Table/Fig-16]: Antibiotic resistance pattern of non fermenting Gram-negative bacilli (n=10).

Bacterial isolates	Total	Methicillin-resistant	Percentage (%)
S. aureus	12	5	41.67
CoNS	18	11	61.11
Total	30	16	53.33

[Table/Fig-17]: Number of methicillin-resistant isolates. (Using cefoxitin 30 µg disc).

Out of 18 CoNS, 11 (61.11%) isolates were methicillin-resistant [Table/Fig-17]. Out of 50 Gram-negative bacilli, ESBL production was detected in 11 (22%) isolates while MBL production was detected in 14 (28%) isolates [Table/Fig-18,19].

Bacterial isolates	No. of isolates	ESBL-producing isolates	Percentage (%)
Enterobacteriaceae	40	11	27.5
NFGNB	10	0	0
Total	50	11	22

[Table/Fig-18]: Number of ESBL- producing isolates. (Ceftazidime (30µg) & Ceftazidime/clavulanic acid (30/10 µg) disc).

Bacterial isolates	No. of isolates	MBL-producing isolates	Percentage (%)
Enterobacteriaceae	40	13	32.5
NFGNB	10	1	10
Total	50	14	28

[Table/Fig-19]: No. of MBL- producing isolates. (Imipenem (10µg) & Imipenem + EDTA (10 µg/750 µg).

DISCUSSION

In the present study, the prevalence of SSI was 6.02%. The rate of SSI varies greatly worldwide and from hospital to hospital, it is evident from different studies from India at different places that have shown the SSI rate to vary from 6.09 to 30.70% [4,5,9,11,12]. The infection rate in Indian hospitals is much higher than that in developed countries; for instance, in the United States of America (USA), it is 2.8% and 2-5% in European countries [13]. A high rate of infection in developing countries highlights the need for better implementation of infection control practices and a proper surveillance system for the use of antibiotics. The reduced prevalence of SSI in this study might be due to the Coronavirus Disease of 2019 (COVID-19) pandemic's impact, which resulted in the deferral of non-essential elective surgeries. Additionally, the implementation of stringent precautions such as practising proper hand hygiene and using personal protective equipment may have been crucial during the COVID-19 pandemic, which in turn prevented the development of SSI. Restricting visitors may have also been a contributing factor.

There was a marginal preponderance of males 41/592 (6.93%) over females 69/1236 (5.58%) with SSI, which was not statistically significant (p=0.285). There are various studies supporting the fact that gender differences are not significant [11,14-17]. The maximum number of patients with SSI were in the age group of > 60 years, 9/92 (9.78%), whereas the lowest infection rate was in the age group of 21-40 years, 60/1063 (5.64%). Other studies also observed that older patients were more likely to develop SSI than younger patients [5,12,18]. This could be due to deteriorating immune status, existing co-morbidities in elderly patients, and reduced compliance with treatment.

The infection rate was found to be higher in emergency surgery, 63/680 (9.26%), than in elective surgery, 47/1148 (4.09%). The difference was highly statistically significant (p<0.0001). The present study results were comparable to those obtained by other studies [11,12,19-21]. The high rates of infection in emergency surgeries can be attributed to inadequate preoperative preparation, the underlying conditions that predispose to emergency surgery, the higher frequency of contaminated or dirty wounds in emergency surgeries, and the COVID-19 pandemic involvement that postpones the non-essential elective surgeries.

The lowest rate of SSI was found in clean wounds, with a subsequent increase in SSI rate in clean-contaminated, contaminated, and dirty wounds. There existed a highly significant difference in the rate of SSIs in different types of surgery (p<0.0001). Similar results were observed in other studies [4,5,11,12,14,19-21]. It is evident that there is a significant rise in infection rate with an increased degree of operative contamination because numerous bacteria, which are the source of the infection, thrive in contaminated or dirty wounds.

The higher rate of infection seen in surgeries with GA was 45/474 (9.50%) as compared to surgeries with spinal anaesthesia, 65/1354 (4.80%). The difference was highly statistically significant (p =0.00034). This finding is in agreement with the studies conducted by Mundhada AS et al., Patel SM et al., and Sutariya PK et al., [22-24]. The higher rate of SSIs with GA might be due to the invasive ventilation given during GA, which can lead to unstable haemodynamic and hypoxia in the tissue, and also because surgeries under GA tend to take longer, creating a favourable environment for bacteria to proliferate.

Out of 110 samples which were further included in the study, 79 (71.82%) were found to be culture-positive SSI, while the 31(28.18%) were culture-negative SSI. Similar results were observed in other studies [5,9,19,25,26]. The culture negative SSI can be due to either the collection of samples after the administration of antibiotics or the presence of atypical or fastidious organisms that do not grow on standard culture media or grow so slowly that plates are discarded before growth is apparent.

Out of a total of 80 isolates, 50 (62.50%) isolates were Gram-negative bacilli, while 30 (37.50%) isolates were Gram-positive cocci. Gram-negative organisms were reported to be the predominant cause of SSIs in other studies [4,12,19,27-30]. *E. coli* was the most common organism that was isolated from SSIs. Similar finding has been reported by various other studies [19,27,28]. *Klebsiella spp.* was the second commonest Gram-negative bacillus. This can be attributed to the fact that the enteric organisms, such as *E. coli* and *Klebsiella spp.*, are present in patients as normal endogenous microbial gut flora and can be introduced into the surgical site during abdominal procedures like laparotomy, hysterectomy, etc. Moreover, these bacterial strains acquire antibiotic resistance, complicating treatment, and are associated with increased morbidity, mortality, and healthcare resources.

S. aureus was reported as the most common isolate from SSIs by Lilani SP et al., and Mahesh CB et al., [5,11], while *Klebsiella pneumoniae* was reported by Anvikar AR et al., and Lubega A et al., [4,30] and *Pseudomonas aeruginosa* by Kamat US et al., and Lateef OA et al., [12,29]. The relative frequency of different isolates also varied between different studies. Thus, it can be concluded that the organisms that cause SSIs change from place to place and from time to time in the same place.

In the present study, Gram-positive cocci showed 100% sensitivity to linezolid and were found to be the least sensitive to penicillin, substantiating its ineffectiveness against Gram-positive cocci. A 41.67% of *S. aureus* strains were MRSA, a similar finding seen in a study by Narula H et al., and Shah S et al., reported 43.75% and 44% MRSA, respectively [14,31]. 61.11% of CoNS strains were methicillin-resistant. In a study by Narula H et al., Shah S et al., and Amrutham R et al., CoNS was 60%, 84%, and 75.8% MRCoNS, respectively [14,31,32]. All the strains of MRSA and MRCoNS were sensitive to linezolid, as found in many studies [5,33,34]. This finding can be of relevant clinical use for the formulation of antibiotic policies in hospitals.

Antibiotic susceptibility results showed that a high level of resistance was seen in most of the bacterial isolates. The degree of resistance was even higher among the *Enterobacteriaceae*, and the commonly used drugs were found to be more resistant, with an average resistance range from 50 to 100%. Imipenem (67.5%) was found to be the most effective antimicrobial agent. *Enterobacteriaceae* showed maximum resistance to ampicillin (92.5%) and to all generations of cephalosporins (>90%) except cefepime (85%). This could be due to the overuse of these drugs and the high prevalence of ESBL-producing organisms. ESBL are enzymes capable of inactivating most beta-lactam drugs, and they usually respond to carbapenem drugs. ESBL production was detected in 22% of isolates. In a study by Mundhana AS et al., and Kaur K et al., the occurrence of ESBL-producing isolates was 35.29% and 40.38%, respectively [22,35].

Another alarming finding is that >20% of the isolates were resistant to carbapenems and the spread of these organisms or their resistance genes in and outside the hospital environment is a cause for concern. Various studies have reported similar findings [4,9,26,36]. Carbapenems were the drugs of choice for penicillin- and cephalosporin-resistant infections, but the scenario is changing with the emergence of carbapenemase-producing isolates, an emerging threat to hospital isolates. Carbapenemases were detected in a total of 14 isolates among a total of 50 isolated *Enterobacteriaceae* and non fermenters, i.e., 28%, comparable with the carbapenemase-producing isolates reported by Sarma JB et al., (27%) [37], while 79% of carbapenemase-producing isolates were detected in the Shah S et al., study [31].

Variations in drug resistance patterns between studies are due to differences in the drug prescription pattern, drug cost, and drug availability. This remarkably higher resistance may be due to their easy availability and inappropriate use of the drugs in hospitals. It is necessary to know the sensitivity of different bacteria in SSIs for two reasons: firstly, to select the appropriate antibiotics to avoid the emergence or overgrowth of resistant bacteria to currently used antimicrobial agents, and secondly, these resistant bacteria can cause cross-infection with other patients.

Antimicrobial resistance is increasing day by day and spreading worldwide, resulting in treatment failure. Moreover, the emergence of multidrug-resistance microorganisms further complicates the therapy by posing a significant therapeutic challenge to the clinician. Hence, periodic and continuous surveillance of the causative agents of SSI and their antimicrobial susceptibility patterns needs to be carried out so clinicians have the current information regarding the most appropriate treatment for SSI and to prevent the injudicious and misuse of antibiotics.

Limitation(s)

The present study was limited in its ability to identify most of the isolated organisms up to the species level due to reallocation of manpower and resources towards the COVID-19 pandemic. Anaerobic bacteria were not cultured. Hence, SSI with a negative culture may have been positive for anaerobic bacteria.

CONCLUSION(S)

The SSI significantly contributes to mortality, morbidity and economic burdens. SSIs are mostly caused by Gram-negative bacteria, particularly *Escherichia coli* and *Klebsiella spp.*, which are the most predominant pathogens linked with SSI. The bacterial isolates detected in the present study showed a high degree of resistance for routinely prescribed antimicrobials in the facility. Although SSIs cannot be entirely eliminated, minimising their prevalence can significantly conserve healthcare resources and lower patient morbidity and mortality. To achieve this goal, a higher degree of collaboration and cooperation among hospital administration, Surgeons, and Microbiologists to formulate the effective antibiotic policy for SSI treatment based on local antibiograms and to implement stringent control measures such as proper hand hygiene and using personal protective equipment, are crucial for reducing SSI rates in the hospital.

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