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"TO STUDY THE PREVALENCE AND RISK FACTORS OF SURGICAL SITE INFECTIONS OF PATIENTS AT A TERTIARY CARE CENTRE, UTTAR PRADESH, INDIA".

Ambika Bhatiani[1], Ritika Tiwari[2], Mohd. Saqib Hasan[3], Nashra Afaq[4], Ajay Narang[5], Shahnaz Parveen[6], R. Sujatha[7], Deepika Shukla[8], Deepak Kumar[9]*

[1]Professor and Head, Department of Microbiology, Naraina Medical College and Research Centre, Panki, Kanpur, India.
[2]Tutor, Department of Microbiology, Uma Nath Singh Autonomous State Medical College, Jaunpur, India.
[3]Senior Resident, Department of Microbiology, King George Medical College, Lucknow, india.
[4]Research Associate, Department of Microbiology and Central Research Laboratory, Rama Medical College Hospital and Research Centre, Mandhana, Kanpur, Uttar Pradesh, India.
[5]Professor and Head, Department of Pathology, Rama Medical College Hospital and Research Centre, Mandhana, Kanpur, Uttar Pradesh, India.
[6]Assistant Professor, Department of Pathology, Al Falah School of Medical Science and Research Centre, Faridabad, Haryana.
[7]Professor and Head, Department of Microbiology, Rama Medical College Hospital and Research Centre, Mandhana, Kanpur, Uttar Pradesh, India.
[8]Assistant Professor, Department of Microbiology, Maharana Pratap Dental College and Hospital Kothi, Mandhana, Kanpur, Uttar Pradesh, India
[9*]Assistant Professor and Head, Department of Microbiology, Uma Nath Singh Autonomous State Medical College, Jaunpur, India.

***Corresponding author:** Dr. Deepak Kumar
Email: drdeepakkumar579@gmail.com

Abstract

Introduction: The problem of surgical site infection (SSI), which contributes to significant morbidity and death, lengthens hospital stays, and ultimately raises healthcare expenditures, is still widespread and common. The objective of the present study was to determine the prevalence of SSI and its risk variables among individuals who underwent any surgical procedure.

Aim and Objective: To Study the Prevalence and Risk Factors of Surgical Site Infections of the patients at a Tertiary Care Centre, Uttar Pradesh, India.

Material and Methods: This was a cross-sectional study conducted in a hospital setting over the period of 1 year i.e,, July 2022 to July 2023 at a tertiary care centre. All surgically treated adult patients of both sexes who were older than 16 years old were included. Patients who received a second surgery at the same location for any reason, patients receiving immunosuppressant medication, people with immunodeficiency diseases, people currently taking antibiotics, and people with infections elsewhere were all disqualified from participating. If there was signs of a wound infection 48 hours

after surgery, the patient was diagnosed with SSI. SPSS (Statistical Package for the Social Sciences), version 21 (IBM Corp., Armonk, NY), was used to analyse the data.
Results: A total of 170 patients underwent different types of surgeries. The prevalence of SSIs during the study period was 8.2%. SSIs were more common in abdominal surgeries with the Males (64.2%) have a higher risk of getting SSI than females (35.7%) . Patients who underwent emergency surgery have a higher risk of getting SSI than those who underwent elective surgery . Those with diabetes had a higher risk of getting SSI than those who were non-diabetics. In the present study it was also observed that *Klebsiella pneumoniae* (28.5%) was the most common isolate followed by *E.coli* , *Pseudomonas aeruginosa* with 21.4%, *S.aureus* with 14.25% and least for *Staphylococcus epidermitidis* and *Klebsiella oxytoca* with 7.14%. It was observed that the site of the infection most common affected was the superficial site with 57.1%.

Conclusion: Abdominal surgeries were more likely to result in SSIs. After any type of surgery, patients who were male, with the age group of 30 years or above , had emergency surgery, had diabetes, and/or have had a lengthy hospital stay are more likely to develop SSIs.

Keywords: Surgical site infection, Prevalence, risk factors, Microorganisms, Hospital stay

INTRODUCTION

The invasion of organisms into tissues as a result of a breakdown in the local and systemic host defences that causes cellulitis, lymphangitis, abscess, and bacteremia is known as wound infection. Surgical site infections (SSIs) are infections that develop in surgical sites [1]. Infections that damage either the incision or deep tissue at the operation site and happen within 30 days of surgery, or within a year if an implant is left in place after the procedure, are referred to as SSIs [2]. Organ/space infections, deep infections, and superficial infections are the three categories according to the National Nosocomial Infection Surveillance Programme (NNIS) [3].

The patient's own natural flora, germs from the hospital environment that the patient contracts during treatment, particular underlying disorders, trauma, or burns that could disrupt the mucosa or skin surface are all potential sources of SSIs [4]. SSIs are severe postoperative complications that account for 20% of infections connected with healthcare and happen in about 2% of surgical procedures. According to numerous research, SSIs are the third most frequent nosocomial infection after respiratory tract and urinary tract infections [2,5]. According to recent studies, the SSI rate varies from 19.4% to 36.5% globally, but only from 3% to 12% in India [6-8].

SSI is still a prevalent and common issue that contributes to high rates of morbidity and mortality, lengthens hospital stays, and consequently raises healthcare expenses. Length of hospital stay, obesity, diabetes mellitus, smoking, etc. are all risk factors for SSIs. The complicated interaction of numerous factors determines whether a surgical wound infection may develop. The majority of postoperative wounds have an endogenous cause of infection. Exogenous infections are typically picked up through the surgical team's noses or skin flora and spread by the surgeon's hands or inappropriate sterilisation of the operating theatre, which includes preoperative, intraoperative, and postoperative care [9].

Some significant factors that can influence the incidence of subsequent infection are surgical techniques, skin preparation, timing, the method of wound closure, and antibiotic prophylaxis after certain types of surgery. Also, many other factors have been identified as having an effect on the potential for infection, and these should be considered by healthcare professionals before, during, and after surgery [10].

Establishing worldwide incidence of SSIs in general surgical patients is imperative to understand the extent of the condition, its burden on society, and the demographic and clinical risk factors that predispose general surgical patients to develop SSIs. Such information will enable the identification of demographic and clinical trends over time, across patient subgroups and will assist decision-makers to improve the planning and delivery of surgical care. Therefore the present study was undertaken to study the prevalence and risk factors of surgical site infections at a tertiary care centre, Uttar Pradesh, India.

MATERIAL AND METHODS

Study settings and duration

This was a hospital-based, cross-sectional study carried out in the Department of Microbiology with collaboration with the Surgery Department at a tertiary care centre. The study was carried out over a period of 1 year months from July 2022 to July 2023. The Ethical clearance was duly obtained from the Institutional Ethical Committee.

Study population and sampling technique

As per the convenience sampling technique, all the cases admitted to the surgical wards (including both elective and emergency surgery) during the study period and those who met the eligibility criteria were included in the study.

Sample size calculation

The prevalence of SSI observed in the study by Tabiri et al. was 11.5% [11]. Based on this study, consideration.

SAMPLE SIZE:- SS (n)= $4PQ/L^2$ Where,**P=**Prevalence,**Q=** 100-p,**L=** Allowable error, If the allowable error is 5 % **SS (n) = 4×11.5x88.5**

Sample Size (n) = 4071/25= 162

So, in order to coverup the lost- to-follow-up, drop-out rate and non-response rate the sample size taken in our research study was 170 .

Inclusion criteria

All patients of both genders above 16 years who underwent surgery and were admitted to the surgical wards during the study period were included in the present study.

Exclusion criteria

All pediatric cases were excluded from the study. Patients who underwent second surgery at the same site for any reason, patients on immunosuppressant therapy or any known immunodeficiency disease, patients on antibiotics already for any other infections, and patients with infection elsewhere in the body were also excluded from the study.

Ethical clearance

The study was carried out after getting ethical approval from the Institutional Ethical Committee and written consent was obtained from every study subject.

Data collection procedure

Data about the age of the patients, gender, demographic details, clinical details including the name of the procedure, date and duration of surgery, the experience of surgeons, preoperative hospital stay, nature of the surgery, postoperative hospital stay, and the onset of illness (SSI) were collected by reviewing the patient's case sheet.

The surgical wound dressings were removed 48 hours after the procedure. Indications of a wound infection was taken into account if the patient displayed local inflammatory changes at the wound site, such as edoema, redness, warmth, or discharge. If before applying the bandage, samples were taken to determine if there had been any discharge. Inflammatory changes alone were present but did not have any discharge, the wounds were watched for the emergence of until the patient was sent home, the wound. If inflammatory symptoms emerged within 48 hours, patients were followed with the assistance of the corresponding surgeons. These patients also received education and followed up for the creation of SSIs through mobile phone for the development of SSIs over a period of 30 days. The suspected wound infections were cleaned with sterile normal saline, followed by 70% alcohol, and then the specimen was collected using a sterile swab. Two swabs were taken from the depth of the wound, and/or the aspirates were collected in a sterile disposable syringe and transported to the laboratory within two hours. The color, consistency, and odor of the samples were observed and recorded.

A direct thin smear was made from each wound swab and/or aspirates on a clean grease-free glass slide and was air dried. It was then heat-fixed, and Gram staining was done with positive and negative control (American Type Culture Collection [ATCC] *Staphylococcus aureus* 25923 and *Escherichia coli* 25922). The presence of pus cells and microorganisms was observed under the oil immersion (100X) objective. The samples were cultured onto nutrient agar, 5% sheep blood agar, and MacConkey agar plates by adopting standard microbiological techniques. After 24 hours of incubation aerobically at 37°C, plates were read, and the isolates were identified based on colony morphology, Gram stain, motility, and biochemical tests.

Data analysis

The data obtained were entered in Microsoft Excel (Microsoft Corp., Redmond, WA), and the results were analyzed using SPSS (Statistical Package for the Social Sciences) version 21 (IBM Corp., Armonk, NY). All the data collected in the current study was categorical, so they were expressed in a table as frequency and percentage. Also, the figures were expressed as a pie chart. The association between risk factors 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.

RESULTS

A total of 170 patients underwent different types of surgeries, including elective as well as emergency procedures, during the study period. About 14 SSIs were documented, and hence, the overall prevalence of SSI rate during the study period was 8.23%

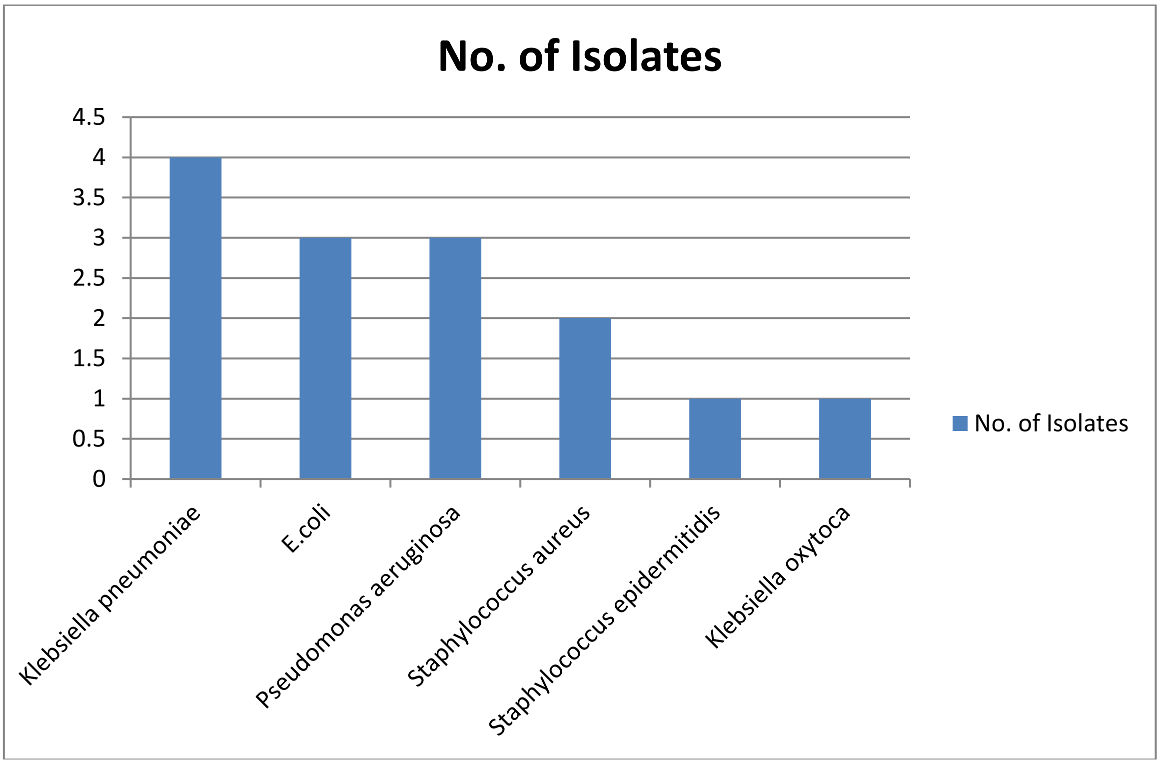
The number of cases that developed SSIs in relation to the type of surgery is shown in Table 1.

Site of Surgery	Types of Surgeries	No. of Surgeries, n (%)	SSI, n (%)
Abdomen	Appendectomy	10 (5.88%)	1(6.25%)
	Hernia repair	9 (5.29%)	2 (12.5%)
	Exploratory laparotomy	7 (4.117%)	3 (18.75%)
	Cholecystectomy	6 (3.52%)	1 (6.25%)
	Lower segment cesarian section	25 (14.7%)	1 (6.25%)
	Hysterectomy	14 (8.23%)	1 (6.25%)
Pelvis	Sphincterotomy	3 (1.76%)	1 (6.25%)
	Hemorrhoidectomy	3 (1.76%)	1 (6.25%)
	Fistulectomy	4 (2.35%)	2 (12.5%%)
	Hip replacement	3 (1.76%)	Nill
Urogenital	Transurethral resection of prostate	4 (2.35%)	Nill
	Urethroscopy lithotripsy	4(2.35%)	Nil
Breast and axilla	Modified radical mastectomy	3 (1.76%)	1(6.25%)
	Fibroadenoma excision	5 (2.94%)	Nil
Skin, bone, and joints	Knee replacement	4 (2.35%)	Nil
	Varicose vein	4 (2.35%)	Nil
	Open reduction and internal fixation	3(1.76%)	Nil
Eye	Intraocular lens implantation	40 (23.52%)	Nil
Ear, nose, throat	Tonsillectomy	12 (7.05%)	Nil
	Mastoidectomy	4 (2.35%)	Nil
Neurosurgery		3 (1.76%)	Nil
Total		170	14

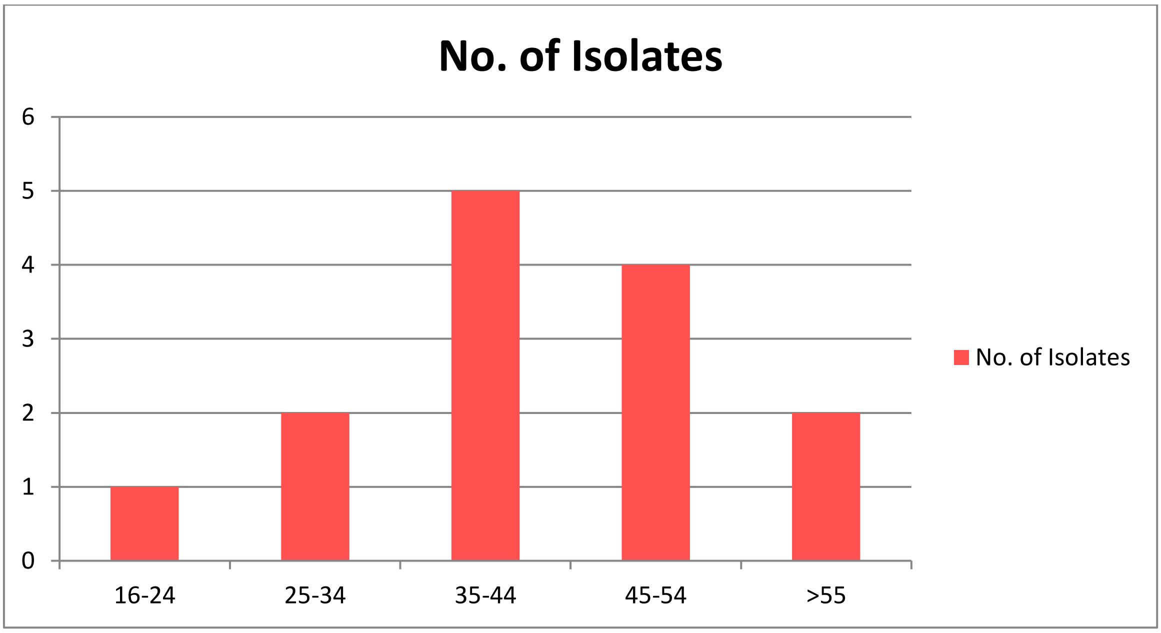
Table 1: Prevalence of SSI according to the Types of Surgery (n)

Type of organisms Isolated	Number of Isolates	Percentage
Klebsiella pneumoniae	4	28.5%
E.coli	3	21.4%
Pseudomonas aeruginosa	3	21.4%
Staphylococcus aureus	2	14.25
Staphylococcus epidermitidis	1	7.14%
Klebsiella oxytoca	1	7.14%
Total	14	100%

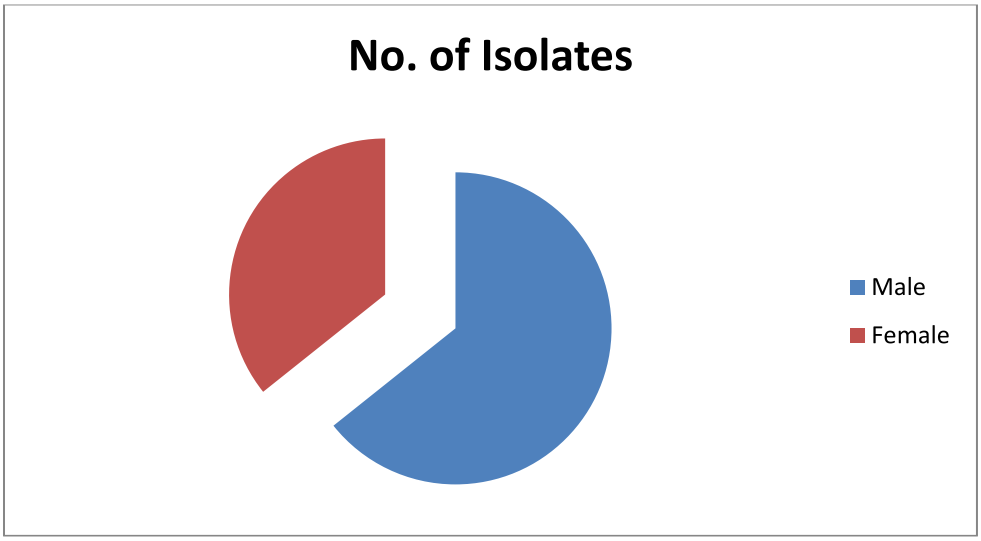
Table 2: The Type of Isolates causing SSIs



Graph No. 1: Graphical Representation of the Number and the Type of Isolates



Graph No. 2: Graphical Representation of the Agewise Distribution of the Isolates



Graph No. 3: Graphical Representation of the Genderwise Distribution of the Isolates

S. No	Risk Factors		Frequency of SSI	Percentage
1	Age group (years)	16-24	1	7.14
		25-34	2	14.2
		35-44	5	35.7
		45-54	4	28.5
		≥ 55	2	14.2
2	Gender	Male	9	64.2
		Female	5	35.7
3	Type of surgery	Emergency	12	85.7
		Elective	2	14.2
4	Extend of wound	Superficial	8	57.1
		Deep	6	42.8
		Organ	0	0
5	Diabetes mellitus	Yes	10	71.4
		No	4	28.5
6	Smoking	Yes	7	50
		No	6	42.8
7	Alcoholism	Yes	8	57.1
		No	6	42.8
8	Anemia	Yes	8	57.1
		No	6	42.8
9	Hospital stay	1-7 days	8	57.1
		>7 days	6	42.8
10	Drain	Yes	10	71.4
		No	4	28.5

TABLE 3: Distribution of Risk factors of the Study Population according to SSI (n = 14)

DISCUSSION

Surgical site infections (SSI), one of the most common causes of nosocomial infections are a common complication associated with surgery, with a reported incidence rates of 2-20% [12]. They are responsible for increasing the treatment cost, length of hospital stay and significant morbidity and mortality. Despite the technical advances in infection control and surgical practices, SSI still continue to be a major problem, even in hospitals with most modern facilities [13]. These infections are usually caused by exogenous and/or endogenous micro organisms that enter the operative wound either during the surgery (primary infection) or after the surgery (secondary infection). Primary infections are usually more serious, appearing within five to seven days of surgery [14]

Bacteriological studies have shown that SSIs are universal and the etiological agents involved may vary with geographical location, between various procedures, between surgeons, from hospital to hospital or even in different wards of the same hospital [13].

Out of the total of 170 patients showed local signs and symptoms and were suspected to have postoperative wound infections. These cases were evaluated and followed up. Among them, the culture positive was observed in 14 cases and hence was considered as cases of SSI in our hospital; thus, the overall prevalence rate of SSIs was 8.2% in the present study .. The current status of SSIs identified in their hospital concurs with the studies of Golia et al. [15] and Iqbal et al. [16]who reported the prevalence rate as 4.3%, 5.4%, and 7.3%, respectively, which were in accordance to the current study. There were other studies performed by the other research investigators which were in contrast to the present study where, Kumar et al. [8] and Al-Mulhim et al. [17] reported in their study that the overall prevalence rate of SSIs was 2.5%, which was lesser than one third of our present study rate.

There was another study which was also in contrast to the present study by Setty et al. [18] which reported the prevalence rate to be quite high with 21.66% and 22.2% respectively.

In the present study it was observed that the ratio of Males 9 (64.2%) was more as compared to that of females 5 (35.7%). This study was similar to the study performed by the other research investigator Vikrant Negi et al.,[19] where Males (74.6%) were more commonly affected than females (25.5%) and the sex ratio male: female was 2.9:1. A study by Hernandez et al., in 2005 conducted in a Peruvian Hospital reported more occurrences among males (65.6%) [20].

In contrast, a study done by Shanmugam et al. reported almost equal occurrences among females (52%) and males (48%) [21]. The increasing occurrence among males was attributable to the nature of the infected wounds with which they come to surgical departments.

In the current study it was observed that the maximum number of isolates found were in the age group of 35-44 years of age followed by 45-54 years of age and least in the age group of 16-24 years of age. This study was similar to the study performed by the other author [19] where the 31 -50 years was affected the most. The patients with age >50 years had a higher incidence of SSI (51.8%) in comparison to an incidence of 12.4% among the patients who were ≤30 years of age. Advancing age is an important factor for the development of SSIs, as in old age patients there is low healing rate, low immunity, increased catabolic processes and presence of co-morbid illness like diabetes, hypertension, etc [22].

Other research investigators, Owens et al. [23] and Bharatnur et al. reported that a greater number of SSIs occurred among 36-50 years (1.3 times higher risk of acquiring SSIs than the ones who were in the age group of 10-35 years). Similarly, a high rate of infection was noted in the later age groups by Mundhada et al. [24]. It was also observed that there were increase cases in the emergency ward (85.7%). The increased rate of SSI in emergency surgeries may be due to a very narrow time span without proper patient preparation and surgical preparedness as well as contaminated wounds as in cases of road traffic accidents. The same have been cited in most of the studies done earlier on SSIs. Tabiri et al. also reported that emergency cases had a higher number of SSIs (23.8%) as compared to elective cases (7.4%)[11]. In another study done by Dessie et al., SSIs were reported in 61.7% of emergency cases and 38.3% of elective cases [25].

In the present study, it was observed that superficial and deep SSIs were observed with the ratio of 57.1% and 42.8% respectively. There was no SSIs observed in the organ site. There was another study which was similar to our study where the rate of SSI in superficial was more with 69 (59.4%) and 47 (40.5%), respectively. Superficial SSI was found to be higher. Kumar et al. [8] reported that superficial incision SSI was more prevalent (215 cases, 55.9%) followed by deep incisional SSI (169 cases, 44%), and van Walraven et al. [27] reported the same that a majority of these (n= 8188, 57.5% of all SSIs) had a superficial component. This is discordant with the study by Dessie et al., who reported superficial SSI as 42.1% and deep SSI as 57.9% (112 cases) [25].

In the present study it was observed that *Klebsiella pneumoniae* (28.5%) was the most common isolate followed by *E.coli* , *Pseudomonas aeruginosa* with 21.4%, *S.aureus* with 14.25% and least for *Staphylococcus epidermitidis* and *Klebsiella oxytoca* with 7.14%. There was the another study which was in support to the present study where *E. coli* (46.4%) was the commonest gram negative bacteria isolated followed by *P. aeruginosa* (15.9%) and *Citrobacter spp* (15.9%) [19]. Similar observations have been reported by various other authors also [28-30]. Few studies have reported *P.aeruginosa* as the most frequent isolate in SSI [31,32] which remains a third most isolated strain in this study.

Bacteriological studies have shown that SSIs are universal and the etiological agents involved may vary with geographical location, between various procedures, between surgeons, from hospital to hospital or even in different wards of the same hospital [2]. In the recent years there has been a growing prevalence of gram negative organisms as a cause of serious infections in many hospitals. In addition irrational use of broad spectrum antibiotics and resulting anti microbial resistance (AMR) has further deteriorated the condition in this regard. Although there are many programmes centered to basic key principles of surgical care and antibiotic prophylaxis, there are still some unresolved issues regarding some aspects in antibiotic prophylaxis in surgical care patients like drug dose in obese patients, specific timings of antibiotic administration, role of anti MRSA prophylaxis etc.

CONCLUSION

Surveillance of SSI along with feedback from surgeons will help to reduce the SSI rate and this surveillance system should be developed in all hospitals and also guidelines for antibiotic use among surgical patients should also be developed and strictly followed which may provide the estimate of incidence of SSI.

LIMITATION

One of the study's limitations was that the wound swabs from SSIs were not subjected to fungal cultures or anaerobic bacterial profiles. It is possible to carry out further prospective research in this area.

DECLARATIONS:

Conflicts of interest: There is no any conflict of interest associated with this study

Consent to participate: There is consent to participate.

Consent for publication: There is consent for the publication of this paper.

Authors' contributions: Author equally contributed the work.

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