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Study of risk factors, bacteriological profile and antibiogram of surgical site infections in a tertiary care teaching hospital

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ABSTRACT

Introduction: Surgical site infections (SSI) constitute a major public health problem worldwide and are the second most frequently reported nosocomial infections. They are responsible for increasing the treatment cost, length of hospital stay and significant morbidity and mortality.**Aim**: To isolate, identify and study bacteriological profile of surgical site infections,with antibiogram.**Materials and Methods**: Samples were collected using sterile cotton swabs from 190 patients clinically diagnosed of having SSIs and were processed as per standard microbiological techniques. Antimicrobial susceptibility testing was done using modified Kirby-Bauer disc diffusion method. This Prospective study was conducted for a period of one year (January 2016 to December 2016) in the Department of Microbiology at Yenepoya Medical college hospital, Mangalore, India.**Results**:. Out of total 190 samples, 170 (89.4%) yielded bacterial growth.Most common predisposing factors causing surgical site infections were patients having Diabetes mellitus(23.53%) followed by Smokers(14.12),Hypertension(11.76).Escherichia coli (24.12%) was the commonest organism followed by Staphylococcus aureus(18.82%), Pseudomonas aeruginosa (18.24%) and Coagulase negative Staphylococcus species (14.12%). Antimicrobial profile of gram positive isolates revealed maximum sensitivity to Vancomycin, Teicoplanin and Linezolid, whereas among gram negative isolates Imepenem, Piperacillin-tazobactam, and Amikacin were found to be most sensitive.**Conclusion**: The rate of SSI observed in this study was comparable to other similar studies, however we observed a higher degree of antimicrobial resistance. Adherence to strict infection control measures, maintenance of proper hand hygiene and optimal preoperative, intraoperative and postoperative patient care will surely reduce the incidence of SSIs.

Keywords: Antimicrobial resistance, Infection control, MRSA, Nosocomial infection, Post operative wound

INTRODUCTION

Surgical site infections (SSI), are one of the most common causes of nosocomial infections and are common complicationsin both in immediate and late post operative period. They are responsible for increasing the treatment cost, length of hospital stay and significant morbidity and mortality[1,2].

These infections are usually caused by exogenous or endogenous microorganisms 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. Majority of SSIs are uncomplicated involving only skin and subcutaneous tissue but sometimes can progress to necrotizing infections[3].

Aetiological agents of SSI include bacteria, fungi and parasites but to a large extent, majority of SSIs are bacterial in origin. These organisms could be Gram positive or gram negative in nature and they could either be aerobic or anaerobic[4,5,6].

The aetiological agents of SSI's are usually from hospital environment and resistance to antimicrobials is rapidly increasing in Gram-negative bacilli and MRS in gram positive bacteria to greater extent in hospital niche. It is important to monitor the changing trends in bacterialinfection and their antimicrobial susceptibility pattern toprovide appropriate antimicrobial therapy for both prophylactic and therapeutic use in controlling SSI's, preventing morbidity and decrease the hospital stay[7,8].

AIM AND OBJECTIVES

- To isolate, identify and study bacteriological profile of surgical site infections (SSI) at our teaching hospital.
- To study antimicrobial sensitivity pattern of isolates from surgical site infections (SSI).
- To study the risk factors for SSI's

STUDY DESIGN:

Prospective study

SOURCE OF DATA & TIME PERIOD:

Swabs from post operativewoundsreceived to microbiology department over period of one year (Jan. 2016 to Dec. 2016) at Yenepoya Medical college hospital. Both the genders of all ages with suspected SSI'swillbe included in this prospective study.

SAMPLE SIZE:170 samples using prevalence of 10% SSI cases with an effective size of 5%.

INCLUSION CRITERIA:

Surgical site infectionsin patients from 3 days to 30 days after surgery, Samples collected from surgery, orthopaedics and obstetrics & gynaecology dept are to be included in this study.

Proforma includes demographic information, present and past medical illness, prior antibiotic therapy, Microbiology laboratory parameters.

EXCLUSION CRITERIA:
Patients with trauma, diabetic foot, abscesses and other with contaminated tissue before operative procedure are excluded from the study. All the wound infections other than postoperative wound and obviously pre-operatively infected patients are excluded from the study.

MATERIAL AND METHODS[9]:

Collection of sample
Pus samples/ Swabs collected from surgical sites clinically suspected of infection received to Microbiology department will be processed. Clinical data will be collected from the case files at the inpatient ward.

Transport and Processing:
Pus swabs received from suspected SSI will be processed immediately. One swab will be used to prepare a smear on a clean glass slide and is stained by Gram staining. The smear will be then screened for pus cells and presence of organisms. The Gram reaction, morphology, arrangement and types of organisms will be noted[3,4].

Aerobic culture
Another swab is inoculated on Blood agar and MacConkey agar by rolling the swab over the agar to make a primary inoculum and then streaking from primary inoculum using a sterile bacteriological loop. These plates are incubated aerobically at 37°C for 24-48 hours.
Primary plates are to be observed for any visible growth after overnight incubation and if there is no growth after 24 hours. Primary plates are further incubated for another 24 hours. Plates are observed for growth after 48 hours. If growth is seen, the isolates are then identified following standard identification procedures given as follows;

Antibiotic susceptibility testing: [10]
All samples will be processed as per standard conventional microbiological methods. Antibiotic susceptibility testing will be performed by Kirby Bauer disc diffusion method and results are interpreted following CLSI recommendations. The strengths of antibiotic discs to be used (in µg) are as follows: Ampicillin (10µg), Ciprofloxacin (5µg), Oxacillin (1µg), Cefotaxime (30µg), Cotrimoxazole (25/23.75µg), Ceftazidime (30µg), Amikacin (30µg), Meropenem (10µg), Gentamicin (10µg), and Vancomycin (30µg), Amoxycillin/Clavulanic acid (20/10µg). The antibiotic discs will be procured from Hi-Media laboratories Mumbai. The panel of antibiotics which will be used for Gram positive and Gram negative isolates is as shown in the table below;

ANTIBIOTIC PANEL FOR KIRBY BAUER DISC DIFFUSION TEST

Enterobacteriaceae members	Non Fermenters	Gram Positive cocci
Amikacin	Amikacin	Amikacin
Ampicillin	Cefepime	Ampicillin
Aztreonam	Ceftazidime	Cefoxitin
Cefipime	Ciprofloxacin	Ciprofloxacin
Cefuroxime	Tobramycin	Cotrimoxazole
Ceftazidime	Ticarcillin	Clindamycin

Cefotaxime	Imepenam	Erythromycin
Ciprofloxacin	Piperacillin	Linezolid
Cotrimoxazole	Pipercallin+tazobactam	Azithromycin
Chloramphenicol	Amoxycillin/clavulanate	Chloramphenicol
Gentamicin	Cefeperazone	Amoxycillin/clavulanate
Imepenam	Colistin	
Pipercallin+tazobactam		
Pipercillin		
Tetracycline		
Amoxycillin/clavulanate		

RESULTS

Table 1: **Distribution of predisposing factors in SSI**

Factors	Number	Percentage
Diabetes mellitus	40	23.53
Hypertension	20	11.76
Malignancy	12	7.06
Alcoholics	6	3.53
Patients on steroids	11	6.47
Smokers	24	14.12
Thyroid dysfunction	9	5.29
Dyslipidaemias	10	5.88
Total	132	

Table 2:Organisms isolated in Surgical Site Infection

Organisms	Number	Percentage
*Escherichia coli*spp	41	24.12
Staphylococcus aureus	32	18.82
Pseudomonas spp	31	18.24
CONS	24	14.12
*Klebsiella*spp	20	11.76
*Acinetobacter*spp	8	4.71
Proteus spp	6	3.53
*Citrobacter*spp	4	2.35
Enterococcus spp	4	2.35

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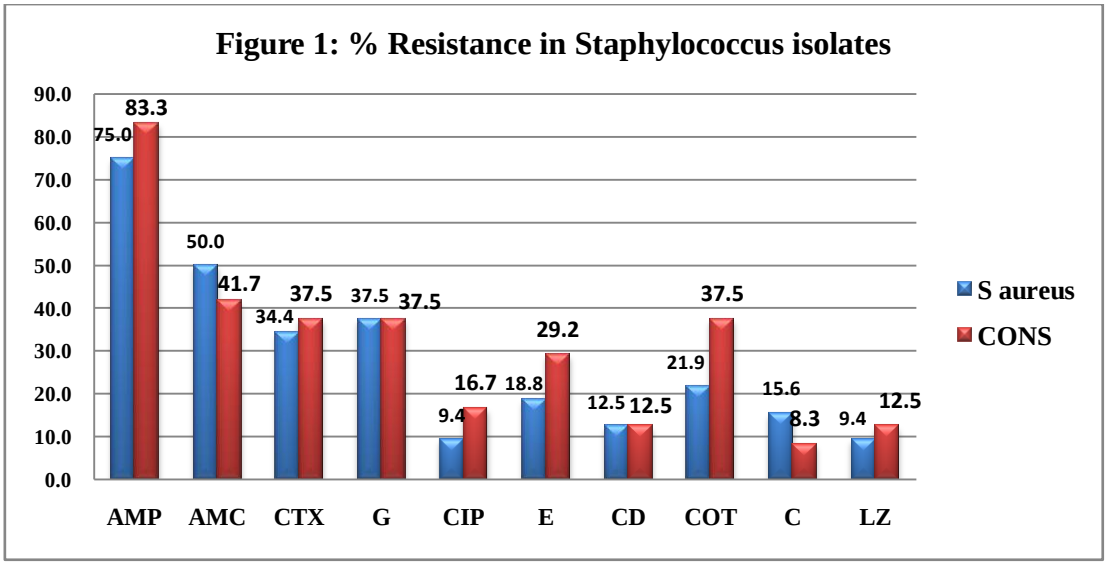

Figure 2: % Resistance in Enterococcus isolates

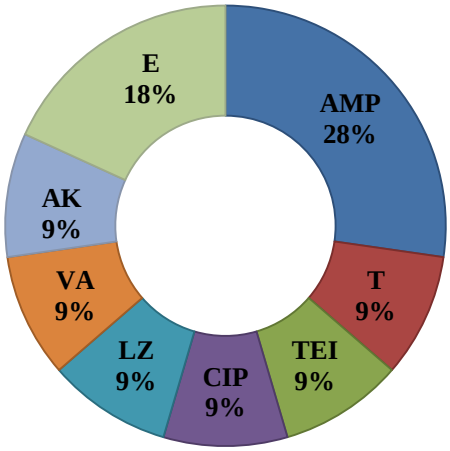

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Figure 3: % Resistance pattern in Enterobacteriaceae

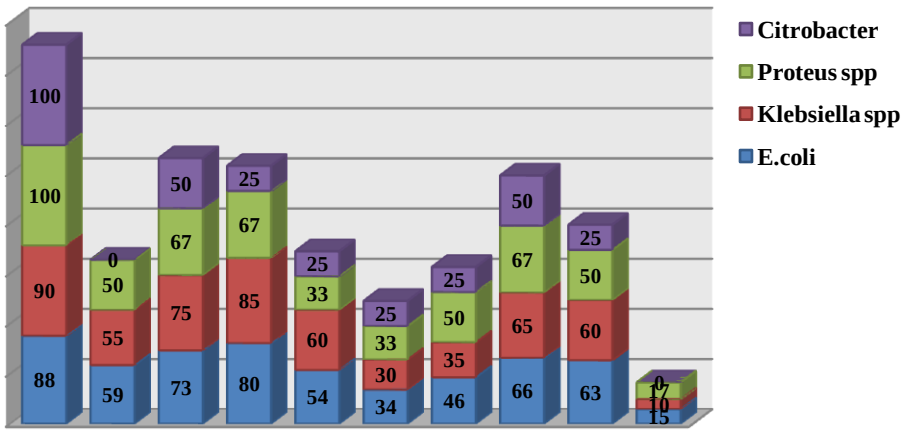
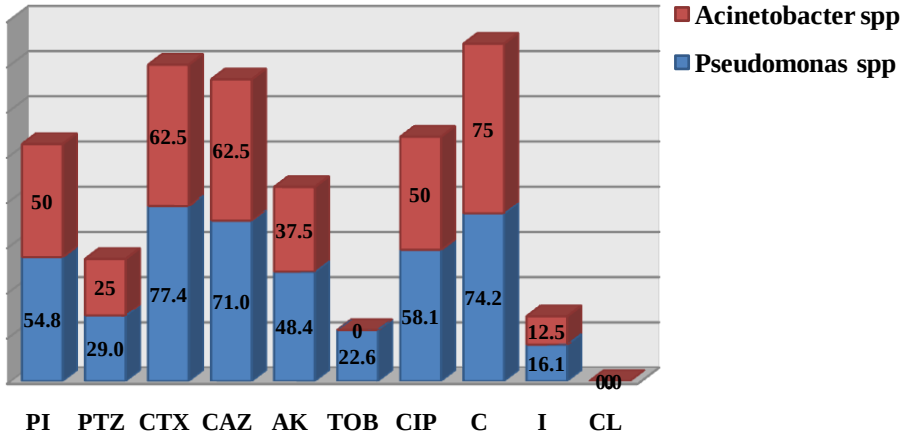


Figure 4: % Antibiotic Resistance among Non-Fermenters



DISCUSSION:

Table 5: Comparison of Demographic profile of patients with SSI in various studies

Study	Males	Females
Present study*	56.47%	43.52%
Harsha V Patil et al[1]	69.62	30.37
Vikrant negi et al[9]	74.6	25.5
JeenaAmatya et al[3]	62.5	53.1

In our study male cases predominated than female cases with SSI i.e 56.47% and 43.52% respectively which coincides with data that of studies done by, Vikrant et al and Jeena et al showing 74.6% males and 25.5% females,62.5 and 53.1% in respective studies[9,3].

Table 2: Comparison of Age distribution in SSIpatients

Age	Present study*	Vikrant et al[9]	Balachandra et al[11]	Aartijain et al[10]
10-20	5.9	6.56	10	4.0
21-30	21.8	5.8	14	25
31-40	14.7	15.32	24	-
41-50	16.5	20.23	14	14.0
>50	41.2	51.8	38	-

In present study, maximum patients with SSI belonged to age group >50yrs(41.2%) followed by 20-30 age group(21.8%) with minimum patients of age group10-20 yrs(5.9%). This is in concordance with the studies done by Vikrant et al and Balachandra et al, patients with higher age group i.e>50yrs showed SSI i.e 51.8%,38% and least cases seen from age group 10-20yrs i.e 6.56 and 10% respectively.But in another study done by Aarti et al maximum numbers of SSI cases were from age group 20-30 yrs[9-10].

Table 3: Comparison of predisposing factors in SSIpatientsin various studies

Factors	Present study*	Naveen et al[12]	Ramesh et al[13]
Diabetes mellitus	23.53	20(83.3%)	18
Hypertension	11.76	17(73.91%)	19
Malignancy	7.06	-	-
Alcoholics	3.53	-	10
Patients on steroids	6.47	-	-
Smokers	14.12	-	5
Thyroid dysfunction	5.29	-	-
Dyslipedeamia	5.88	-	-

In our study patients with diabetes mellitus, smoking and hypertension were found to be major risk factors for development of SSI i.e 23.53%,14.12% and 11.76% respectively followed by patients with malignancy(7.06%),patients on steroids(6.47%),patients with thyroid dysfunction(5.29%),dyslipedeamia(5.88%) and lastly alcoholics(3.53%).In a study done by Naveen et al[12] diabetes and hypertension were the major risk factors.Similarfindings were seen in a study done by Ramesh et al[13] where hypertension was the major risk factor followed by diabetes, alcoholics and lastly smoking with percentage of 19%, 18%, 10% and 5% respectively.

Table 4:Comparison of Distribution of SSI Cases in Various Surgeries

Surgery	Present study*	Harsha et al[1]	Vikrant et al[9]
Hysterectomy	20.5	9	30.50
Hepatobiliary	15.2	13	3.38
Appendicectomy	11.7	14	6.77
Hernia surgeries	11.7	7	23.72
LSCS	9.4	6	0
Arthroplasty	8.8	0	0
Laparotomy	8.2	17	6.77
Renal surgeries	6.4	17	13.55
Mastectomy	4.7	3	11.86
Thyroidectomy	2.3	0	0
Craniotomy	0.5	10	3.38

In our study the maximum number of SSI cases were from hysterectomy surgery i.e 20.5% followed by Hepatobiliary surgeries 15.2%, Appendicectomy and hernia surgeries 11.7%, LSCS 9.4%, Arthroplasty 8.8%, Laparotomy 8.2% and minimum cases from renal surgeries 6.4%, Mastectomy 4.7%, Thyroidectomy 2.3%, and lastly craniotomy 0.5%.

In study done by Vikrantet al[9], findings were almost similar to our study i.e maximum numbers of SSI cases were from hysterectomy surgery 30.5% and minimum cases from craniotomy 3.38%.

But in another study done by Harshaet al[1] maximum number of SSI cases were from renal surgeries 17% followed by appendicectomy14% and minimum from mastectomy and hysterectomy surgeries i.e 3% and 9% respectively.

Table 6:Organisms isolated in SSIs in various studies

Organisms	Present study*	Vikrant et al[9]	Aarti et al[10]	Harsha et al[1]	Jeena et al[3]
Escherichia coli spp	24.12	23	25.1	17.88	17.5
Staphylococcus aureus	18.82	50	26.6	13.82	15.8
Pseudomonas spp	18.24	7.9	13.6	21	33.9
CONS	14.12	0	0	4.87	1.7
Klebsiellaspp	11.76	2.9	5.7	8.93	9.2
Acinetobacterspp	4.71	5.0	7.1	4.06	14.4
Proteus spp	3.53	2.9	2.1	6.50	1.0
Citrobacterspp	2.35	7.9	2.8	13	0.7
Enterococcus spp	2.35	0	5.7	1.83	1.83

In our study the most common isolate causing SSI was E.coli 24.12% followed by Staphylococcus aureus 18.82%, Pseudomonas spp 18.24%,with less number of isolates being, Proteus spp 3.53%, followed by Citrobacterspp 2.35% and finally Enterococcus spp 2.35%.

The findings of our study were almost similar to study done by Vikrant et al and Aarti et al[10] where Staphylococcus aureus was the most common isolate i.e 50% and 26.6% followed by E.coli 23% and 25.1% ,pseudomonas spp 7.9% and 13.6% respectively.

In other studies done by Harsha et al[1] and Jeena et al[3] findings were almost similar i.e in these studies the most common isolate was Pseudomonas spp 21% and 33.9% followed by E.coli 17.88% and 17.5% , Staphylococcus aureus 13.82% and 15.8% in respective studies.

CONCLUSION

1. There was predominance of Gram negative bacilli from SSIs, with *E.coli* followed by *Pseudomonas aeruginosa and Klebsiellaspp*being the most common isolates. We found most of the Gram negative isolates were multiple drug resistant to commonly prescribed antimicrobial agents.
2. Among gram positives *S. aureus* was common isolate which not only showed potential drug resistance but also more than 30% of them were MRSA.
3. Third generation cephalosporins commonly used for antimicrobial prophylaxis to prevent SSIs were found to be ineffective against most of Gram negative organisms and MRSA isolates.
4. Among the risk factors diabetes mellitus followed by hypertension were found to be most common risk factors.

5. Another important observation was seen in this study that most of the SSIs occured between 2nd and 10th post-operative period, which can be considered for active surveillence of surgical site infections.

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