

A Retrospective Study of Bacteriology and Antibiotic Sensitivity Pattern of Post Operative Surgical Site Infections in Orthopedics

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Abstract

Surgical Site infection (SSI) is one of the most common post-operative complications and causes significant post-operative morbidity and mortality. The global estimates of SSI have varied from 0.5% to 15%, studies in India have consistently shown higher rates ranging from 23% to 38%¹. The aim of the study was to know the etiological bacterial agents causing SSI and their antimicrobial susceptibility pattern. This retrospective study included 69 patients who developed Post-operative wound infections (SSI) during the 1-year period from April 2019 to March 2020. An analysis of SSI occurrence, the organisms isolated and antibiotic sensitivity pattern results was made. In overall surgeries conducted during the study period in orthopedics department at our institute, 69 cases were clinically diagnosed of having SSIs, including 51 males and 18 females with the mean age of 39.2 years. Out of the total 69 samples, 6 (8.69%) yielded no bacterial growth and among the rest 63 samples, *Staphylococcus aureus* 21 (30.43%) was the most common organism isolated. The other organisms isolated were *Klebsiella pneumoniae* 13 (18.84%), *Pseudomonas* 11 (15.94%), *Escherichia coli* 5 (7.24%), *Proteus* species 3 (4.34%) and *Acinetobacter* species 3 (4.34%). Mixed isolates were obtained in 2 (11.9%) specimens. Bacteriological and antibiotic susceptibility study is an important tool to treat infection timely and effectively in-turn minimizing untoward long term sequelae of surgical site infections

Keywords: Surgical site infections, Antibiotic sensitivity, orthopedics

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INTRODUCTION

Surgical Site infection (SSI) is one of the most common post-operative complications and causes significant post-operative morbidity and mortality. While the global estimates of SSI have varied from 0.5% to 15%, studies in India have consistently shown higher rates ranging from 23% to 38%¹. CDC clearly defined SSI as an infection that occurs after surgery in the part of the body where the surgery took place and classified the SSI into superficial, deep and organ specific². Surgical site infections cause increased morbidity, mortality, extended hospital stays, and additional economic burden to the hospital resources^{3,4}.

In view of this, all necessary measures need to be undertaken to prevent infection and if SSI occurs every step need to be implemented immediately to curb and treat the infection at the earliest possible time. Determination of the etiologic agent and its susceptible antibiotics becomes one of the important tools for controlling infection. Hence the present study aims to identify the causative organisms and antibiotic susceptibility pattern .

MATERIALS AND METHODS

This retrospective study included 69 patients who developed Post operative wound infections (SSI) during the 1-year period from April 2019 to March 2020. A total of 578 patients were operated during the study period.

Inclusion criteria

- clean elective surgeries of the fracture of limbs.
- Closed Injuries
- Exclusion criteria
- Emergency surgeries,
- open injuries of the limbs and
- spinal surgeries.

Patients basic demographic data and the analysis of SSI occurrence, the organisms isolated and antibiotic sensitivity pattern evaluated was collected.

Laboratory Procedures

Swabs were obtained from the post operative infected wounds. A smear was prepared and stained by Gram-staining method for presumptive diagnosis⁵. Swabs were inoculated on

blood and Mac-Conkey agar plates were incubated at 37°C overnight for 24 hours. Antimicrobial susceptibility testing was done by Kirby-Bauer disc diffusion method⁶ and interpretation was done according to Clinical Laboratory Standards Institute (CLSI) guidelines⁷.

RESULTS

From April 2019 to March 2020, a total of 69 (11.9%) patients diagnosed to have SSI out of 578 operated orthopedic patients at our hospital. The total number of Male patients 45 and female patients were 24. The mean age of the patients was 43.6 years (range 18 to 65 years). Orthopedic Surgeries included surgeries on shoulder-5, humerus-3, elbow-4, forearm bones-6, Hip -21, femur-7, knee and patella – 10, leg bones-8 and ankle-5.

Out of the total 69 samples, 6 (8.69%) yielded no bacterial growth and among the rest 63 samples, *Staphylococcus aureus* 21 (30.43%) was the most common organism isolated. The other organisms isolated were *Klebsiella pneumonia* 13 (18.84%), *Pseudomonas* 11 (15.94%), *Escherichia coli* 5 (7.24%), *Proteus* species 3 (4.34%) and *Acinetobacter* species 3 (4.34%). Mixed isolates were obtained in 2 (2.89%) specimens. Table 1 shows the various bacterial isolates obtained from patients with SSIs.

Table 1. Total organisms isolated from SSI

Isolated Organisms	Number (Percentage)
<i>Staphylococcus aureus</i> (Including Coagulase negative <i>Staphylococcus</i>)	21(30.43%)
<i>Klebsiella pneumonia</i>	13 (18.84%)
<i>Pseudomonas aeruginosa</i>	11 (15.94%)
<i>Escherichia coli</i>	5 (7.24%)
<i>Acinetobacter</i> species	3(4.34%)
<i>Proteus</i> Species	3(4.34%)
Mixed growth	2(2.89%)
1. Specimen-3 isolates (<i>E.coli</i> , <i>Acinetobacter</i> , <i>Proteus</i> species)	(Total -7 isolates)
2. Specimen-4 isolates(<i>E.coli</i> , <i>klebsielka</i> , <i>Acinetobacter</i> , <i>Proteus</i> species)	
No growth	6 (8.69%)

Table 2. Antibiotic sensitivity (resistance in percentage) pattern among isolates

Antibiotics	Organisms resistant to the antibiotic (in Percentage)					
	<i>Staphylococcus aureus</i>	<i>Klebsiella pneumoniae</i>	<i>Pseudomonas aeruginosa</i>	<i>Escherichia coli</i>	<i>Acinetobacter</i> species	<i>Proteus</i> species
Pencillin	100	NoT	NoT	NoT	NoT	NoT
Amoxicillin	90.2	100	100	85.3	86.82	100
Amoxicillin-clavulanate	45.67	97.2	88.2	79.3	70.8	76.4
Ciprofloxacin	44.5	37.5	86.2	22.9	35.8	55
Ofloxacin	37.6	25	56.8	17.3	24.72	45.86
Gentamycin	21.4	18	78.4	36.4	45.65	52.12
Amikacin	18.9	0	41.2	13.2	34.58	32.8
Cefotaxime	NoT*	88	83.7	NoT	NoT	56.8
Cefazolin	18.2	82	72.6	NoT	29.22	48.42
Cotrimoxazole	49.3	53	79.3	44.9	83.1	52.64
Linezolid	0	NoT	NoT	NoT	NoT	NoT
Meropenem	NoT	0	16.2	11	0	0
Imepenem	NoT	0	2.3	0	0	0
Piperacillin	NoT	2	28.7	22.2	43.98	32.9
Piperacillin-tazobactam	NoT	28.2	11.1	9.8	12.24	6.4
Clindamycin	0	NoT	NoT	NoT	NoT	NoT
Vancomycin	0	NoT	NoT	NoT	NoT	NoT

*NoT- Not Tested

Antimicrobial susceptibility testing was done for all 63 isolates and the results obtained shown in Table-2. Staphylococcal isolates were completely resistant to penicillin and high degree of resistance to amoxicillin, ciprofloxacin, ofloxacin and mildly resistant to gentamycin and amikacin, Co-Trimaxozole. All the strains were sensitive to Linezolid, clindamycin and vancomycin.

Gram negative isolates which predominantly includes *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Acinetobacter* species, *Proteus* Species were uniformly resistant to regularly prescribed antibiotics like Amoxicillin, Ciprofloxacin, Ofloxacin, Gentamycin, Amikacin, Cefotaxime, Cefazolin, Cotrimoxazole in varying proportions. Most of these isolates were sensitive to Imepenem and Piperacillin-Tazobactam. (Table-2)

DISCUSSION

Surgical site infections cause increased morbidity, mortality, extended hospital stays,

and additional economic burden to the hospital resources^{3,4}. In addition, patients may have physical limitations and significant reduction in the quality of life⁸. Hence utmost precautions and necessary steps has to be taken to prevent SSI. In event of any SSI, early aggressive treatment with antibiotics becomes an important step. Bacteriological and antibiotic susceptibility study is an useful tool.

In our study, Males were the most affected compared to the females and common age group was 35-50 years with the mean age of 39.2 years. Similar findings were found in a study by Nichols et al., age group involved was 19-50 years⁹ and in another study by Koyagura B et al., The mean age of the cases with SSI was 34.12±8.01 years and males were affected predominantly¹⁰. But in a study by Jun Yang et al., there was no statistically significant correlation between sex and the SSI rate¹¹.

In our study, *Staphylococcus aureus* and gram negative (*Klebsiella* spp. and *Pseudomonas*

spp.) bacteria were the predominant isolates obtained. Similar results were obtained in studies by Kumar S et al., and Maksimovic et al.^{12,13}

Antimicrobial sensitivity testing of the isolates showed higher rates of multidrug resistant (MDR) strains of the organisms. *S. aureus* showed the high frequency of resistance towards beta-lactam antibiotics. Resistance to amoxiclav (90.2%) was found to be high. Least resistance was observed to cefazolin, gentamicin, and amikacin. The results are comparable to a study conducted by B Amare et al.¹⁴ All the *S. aureus* isolates were sensitive to linezolid and vancomycin. Similar results were obtained from studies by vikrant negi et al.¹⁵ and Roel T et al.¹⁶

In our study, *Klebsiella pneumonia* was the predominate gram negative isolate followed by *pseudomonas aeurogenosa* which is in contrast to studies by Devi PV et al.¹⁷ and Benabdelsalem A et al.¹⁸ where *pseudomonas* was the predominate isolate. In this study, *Klebsiella pneumonia* showed high resistance to Amoxicillin/clavulanic acid (97.2%), Cefotaxime (88%), cefazolin (82%), Ciprofloxacin (37.5%) and less resistance was noted for Piperacillin- Tazobactam (28.2%), Gentamicin (18%) and was sensitive to Amikacin and imepenem which is consistent by a study by Himanshu Narula et al.¹⁹

Pseudomonas aeruginosa isolates in this study showed high resistance to Amoxicillin/clavulanic acid (88.2%), Cefotaxime (83.7%) and Cefaclor (72.6.2%) Ciprofloxacin (86.2%). Moderate resistance was shown to Ofloxacin (56.8%), Amikacin (41.2%) and Piperacillin (28.7%) and less resistance was noted for Piperacillin/Tazobactam (11.1%), while imepenem (2.3%) showed least resistance of all. Similar observation was reported by Das R et al.²⁰

Antibiogram of other Gram-negative isolates showed most organisms were resistant to amoxycillin-clavulanic acid and other antibiotics of cephalosporin group and cotrimoxazole. Moderate susceptibility was seen to ciprofloxacin, ofloxacin, and amikacin. All were susceptible to Imepenem. In our study, prophylactic antibiotic inj cefotaxime 1000mg intravenous was preferred and majority of the isolates obtained were resistant to the antibiotic.

In Our study, *Staphylococcus aureus*, *Klebsiella* sps. and *Pseudomonas aeruginosa*

were the major pathogens causing Surgical site infections. By analyzing the antimicrobial susceptibility data, we suggest that vancomycin and linezolid were the most effective agents against gram positive organisms and piperacillin/tazobactam and imepenem were the most effective agents against most of gram negative bacteria. Based on antibiogram, use of the most sensitive antibiotics as earliest possible would help to control infection and avoid injudicious use of antibiotics which may lead to antibiotic resistance.

CONCLUSION

Bacteriological and antibiotic susceptibility study is an important tool to treat infection timely and effectively in-turn minimizing untoward long term sequelae of surgical site infections.

Limitations

The limitations of this study is that we did not study the risk factors, operative variables affecting the development of SSI. The other limitation in our study was that anaerobic bacterial and fungal cultures were not done.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTION

Both authors have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

FUNDING

None.

DATA AVAILABILITY

All datasets generated or analyzed during this study are included in the manuscript.

ETHICS STATEMENT

The study was approved by Institutional Ethics Committee (IEC), KRIMS, Karwar, Karnataka, India.

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