



TO STUDY THE PATTERN OF BACTERIAL PATHOGENS ISOLATED FROM SURGICAL SITE INFECTION AND THEIR ANTIBIOGRAM AT SMS HOSPITAL, JAIPUR

Microbiology

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ABSTRACT

Background: SSIs have become a major cause of post-operative illness resulting in increased morbidity & mortality. The present study was conducted for identification of pattern of bacterial isolates from post-surgical wound infections and providing clinicians with best antimicrobial agents to which organisms are susceptible.

Materials & Methods: This study comprised of 130 patients underwent emergency or elective surgeries over a period of 1 year who developed post-operative surgical site infection. The pattern of bacterial pathogens isolated from surgical site infection and their antibiogram was studied.

Results: In our study out of 130 clinically diagnosed SSI samples, 107 were culture positive and 23 samples yielded no growth. The most common organism isolated from culture positive samples were *Escherichia coli* followed by gram positive cocci, *Staphylococcus aureus* and *Pseudomonas* spp. *Escherichia coli* showed maximum sensitivity to Polymyxin, followed by Tigecycline, Imipenem, Amikacin, Ceftazidime and Ampicillin & Piperacillin-Tazobactam. *Staphylococcus aureus* showed maximum sensitivity to Linezolid, followed by Teicoplanin & Vancomycin, Doxycycline, Piperacillin-Tazobactam, Gentamycin and Erythromycin. *Pseudomonas* spp was found to be most sensitive to Gentamycin, followed by Cotrimoxazole, Ciprofloxacin, Imipenem and Amikacin, Piperacillin-Tazobactam & Tobramycin.

Conclusion: In this study most common organisms found to be associated with SSI were *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas* spp. Most of gram negative isolates were found to be sensitive to Polymyxin, Tigecycline and Imipenem. Maximum sensitivity among gram positive isolates was seen in Linezolid, Teicoplanin and Vancomycin.

KEYWORDS

Surgical site infection, Antimicrobial sensitivity, *Escherichia coli*, *Staphylococcus aureus*

INTRODUCTION

Surgical Site Infections (SSI) is defined as a proliferation of pathogenic microorganisms which develops in an incision site either within the skin and subcutaneous fat (superficial) and musculo-fascial layers (deep) or in organ or cavity, if opened during surgery.^[1] It can occur anytime from 0 to 30 days after a procedure in which no implant is used and up to 1 year if foreign material is implanted.^[2]

These are the third most frequently reported nosocomial infections (NI), accounting for nearly 14 - 16% among hospital inpatients.^[3]

SSIs have become a major cause of post-operative illness resulting in increased morbidity, mortality and do have a major impact on the cost of health care and prolonged hospital stay and cause economic and social hardship to the family.^[4]

A spectrum of microorganisms with their antimicrobial susceptibility patterns have been identified as causative agents of SSIs which depends on various factors according to the surgery performed.^[5,6]

Hospital acquired infections are further complicated by increasing prevalence of multi drug resistant organisms owing to the widespread and irrational prescription of antimicrobial agents.^[7]

The present study was conducted for identification of pattern of bacterial isolates from post-surgical wound infections and providing clinicians with best antimicrobial agents to which organisms are susceptible.

MATERIALS AND METHODS

This study comprised of 130 patients underwent emergency or elective surgeries over a period of 1 year; all patients age above 28 days, presence of post-operative Surgical Site Infection were included in the study after taking written informed consent to participate. Infection occurring 30 days after operation in case of superficial SSI and beyond 90 days in case of deep SSI, infection on episiotomy, burn injuries and donor sites of split skin grafts, procedure in which healthy skin was not incised such as opening abscess & immuno compromised patients were excluded from study.

Specimens were collected on the first day when patients presented with clinical evidence of infection (purulent drainage or exudate from incision) taking all aseptic precautions. The area around the surgical wound was cleaned with 70% ethyl alcohol and the exudate was collected from the depth using two sterile cotton swabs without

contaminating with skin commensals. The specimens were labeled and transported with a completed request form to the microbiology laboratory.

Smear of the sample was made on a clean slide, 10X15mm in size. Smear was heat-fixed and proceeded for gram stain. Smear was examined using 100X objective for the presence of RBCs, pus cells, Gram positive cocci, Gram negative bacilli.

Samples collected were inoculated on 5% Sheep Blood agar and MacConkey agar by rolling the swab over the agar and streaked. Inoculated plates were incubated at 35-37°C aerobically for 18 to 24 hours. Simultaneously specimen was inoculated in the liquid media; thyoglycollate broth. Subculture was done at 24 hours, and if indicated at 48 hours and 72 hours.

After incubation for 18 to 24 hours aerobically, colonies were seen on the inoculated medium and proceeded for gram stain. By help of gram stain colonies were divided into two groups and further tested for biochemical reactions as per the standard guidelines for identification.

Antimicrobial Susceptibility Testing

Antibiotic susceptibility testing of the isolates was performed by Kirby-Bauer disc diffusion method. The antibiotic concentration of disc used and zone size interpretation was done in accordance with Clinical Laboratory Standards Institute (CLSI) guidelines.

RESULT

Among 130 clinically suspected cases of surgical site infection 107(82.30%) were culture positive and 23(17.70%) were culture negative. Among 107 bacterial culture positive cases, 78(72.1%) were males and 29(27.1%) were females.

Table no.1 shows that among 107 culture positive cases, *Escherichia coli*(25.23%) was the commonest bacterial isolate among culture positive cases followed by *Staphylococcus aureus* (23.36%), *Pseudomonas* spp (16.82%), *Klebsiella* spp (7.47%), *Enterobacter* spp (7.47%), *Acinetobacter* spp (6.54%), *Proteus* spp (5.60%), Coagulase negative *Staphylococci*(3.73%) and *Citrobacter* spp (3.73%).

According to table no.2 *Staphylococcus aureus* showed 96% sensitivity to Linezolid, 92% to Teicoplanin and Vancomycin, 88% to Doxycycline, 68% to Piperacillin-Tazobactam, 64% to Gentamicin, 48% to Erythromycin, 28% to Cefipime, 24% to Clindamycin and

Cotrimoxazole, 20% to Ciprofloxacin and least sensitivity was shown by Ampicillin(8%).

As shown in table no.3 *Escherichia coli* showed maximum sensitivity of 96.2% to Polymyxin, 85.1% to Tigecycline and 74% to Imipenem, 48.1% to Amikacin and Ceftazidime, 44.4% to Ampicillin and Piperacillin-Tazobactam, 33.3% to Ciprofloxacin, 29.6% to Gentamicin, 18.5% to Cotrimoxazole and least sensitivity was shown by Cefepime and Cefotaxime (11.1%).

As per table no.4, *Pseudomonas* spp was found to be most sensitive to Gentamicin 15(83.3%) followed by Cotrimoxazole 12(66.7%), Ciprofloxacin 11(61.1%), Imipenem 7(38.9%), Amikacin, Piperacillin-Tazobactam and Tobramycin 6(33.3%), Cefepime and

Cefoperazone- Sulbactam 5(27.8%). Least sensitivity was shown by Aztreonam 4(22.2%) and Ceftazidime 3(16.7%).

Table – 1: Various organisms isolated (N=107)		
ORGANISM	No.	Frequency
<i>Staphylococcus aureus</i>	25	23.36%
Coagulase negative <i>Staphylococci</i>	4	3.73%
<i>Escherichia coli</i>	27	25.23%
<i>Pseudomonas</i> spp	18	16.82%
<i>Klebsiella</i> spp	8	7.47%
<i>Enterobacter</i> spp	8	7.47%
<i>Acinetobacter</i> spp	7	6.54%
<i>Proteus</i> spp	6	5.60%
<i>Citrobacter</i> spp	4	3.73%

Table – 2: *Staphylococcus aureus* isolates & its antibiotic sensitivity pattern

Total Isolates 25	CEFOXITIN	CEFEPIE	CIPROFLOXACIN	CLINDAMYCIN	COTRIMOXAZOLE	ERYTHROMYCIN	GENTAMICIN	PIPERACILLIN+ TAZOBACTAM	VSA	DOXYCYCLINE	LINEZOLID	TEICoplanin	AMPICILLIN
No of Sensitivity	10	7	5	6	6	12	16	17	23	22	24	23	2
% of Sensitivity	40%	28%	20%	24%	24%	48%	64%	68%	92%	88%	96%	92%	8%

Table – 3: *E. coli* isolated & its antibiotic sensitivity pattern

Total Isolates 27	AMPICILLIN	CEFEPIE	CEFTAZIDIME	CEFTAZIDIME+ CLAVULANIC ACID	CEFOTAXIME	CIPROFLOXACIN	GENTAMICIN	COTRIMOXAZOLE	AMPICILLIN	POLYMYXIN	PIPERACILLIN+ TAZOBACTAM	IMIPENEM	TIGECYCLINE
No of Sensitivity	13	3	13	25	3	9	8	5	12	26	12	20	23
% of Sensitivity	48.1	11.1	48.1	92.5	11.1	33.3	29.6	18.5	44.4	96.2	44.4	74	85.1

Table – 4: *Pseudomonas* spp isolated & its antibiotic sensitivity pattern

Total Isolates 18	AMIKACIN	CEFEPIE	CEFTAZIDIME	PIPERACILLIN+ TAZOBACTAM	IMIPENEM	CIPROFLOXACIN	GENTAMICIN	COTRIMOXAZOLE	CEFOPARAZONE+ SALBACTAM	AZTREONAM	TOBRAMYCIN
No of Sensitivity	6	5	3	6	7	11	15	12	5	4	6
% of Sensitivity	33.3	27.8	16.7	33.3	38.9	61.1	83.3	66.7	27.8	22.2	33.3

Table – 5: Antimicrobial susceptibility of other Gram negative organisms

Antibiotic	<i>Klebsiella</i> spp (n=8)	<i>Proteus</i> spp (n=5)	<i>Enterobacter</i> spp (n=8)	<i>Acinetobacter</i> spp (n=7)	<i>Citrobacter</i> spp (n=4)
Amikacin	3(37.5%)	1(20%)	4 (50%)	3(42.9%)	1(25%)
Cefepime	1(12.5%)	1(20%)	2 (25%)	2(28.6%)	1(25%)
Ceftazidime	4(50%)	4(80%)	6(75%)	5(71.4%)	3(75%)
Cefotaxime	1(12.5%)	1(20%)	0	1(14.3%)	2(50%)
Ciprofloxacin	1(12.5%)	3(60%)	0	4(57.1%)	1(25%)
Gentamicin	1(12.5%)	3(60%)	3(37.5%)	3(42.9%)	0
Cotrimoxazole	1(12.5%)	1(20%)	1(12.5%)	2(28.6%)	0
Ampicillin	NT	2(40%)	NT	4(57.1%)	NT
Polymyxin	8(100%)	NT	8(100%)	7(100%)	4(100%)
Piperacillin+tazobactam	1(12.5%)	5(100%)	1(12.5%)	4(57.1%)	0
Imipenem	7(87.5%)	5(100%)	6(75%)	5(71.4%)	4(100%)
Tigecycline	7(87.5%)	NT	7(87.5%)	7(100%)	4(100%)

DISCUSSION

In the present study out of the 130 clinically diagnosed cases of SSI, 107(82.30%) were culture positive and 23 (17.69%) samples yielded no growth. Culture negativity may be due to antibiotic therapy prior to culture of material from an apparently infected site or due to the presence of fastidious or atypical organisms that do not grow on standard culture media or grow so slowly that plates are discarded before growth is apparent.^[8]

In our study the most common organism isolated from culture positive samples were *Escherichia coli* (25.23%) followed by gram positive cocci, *Staphylococcus aureus* (23.36%) and *Pseudomonas* spp (16.82%).

Our study was found to be comparable with Walegn et al^[9] and by Rama Bastola et al^[10] who also found *Escherichia coli* (23.1% and 21.8%) respectively as most common isolate among gram negative

bacteria and *Staphylococcus aureus* (18.3% and 21.8%) respectively among gram positive isolates.

In our study *Staphylococcus aureus* showed maximum sensitivity to Linezolid 96%, Teicoplanin and Vancomycin 92%, 88% to Doxycycline, 68% to Piperacillin-Tazobactam, 64% to Gentamicin, 48% to Erythromycin, 28% to Cefipime, 24% to Clindamycin and Cotrimoxazole, 20% to Ciprofloxacin and found to be least sensitivity by Ampicillin(8%)

Our study was supported by Kanwalpreet kaur *et al*^[11] which showed least sensitivity to Ampicillin (10.34%) and Ciprofloxacin (10%), maximum sensitivity to Linezolid (98.03%) whereas in a study conducted by Walelign *et al*^[12] ciprofloxacin showed 84.2% and erythromycin 78.9% sensitivity which was different from our study. This may be due to difference in resistance pattern from time to time and place to place.

In our study *E.coli* showed maximum sensitivity 96.2% to Polymyxin, 85.1% to Tigecycline, 74% to Imipenem, 48.1% to Amikacin and Cefazidime, 44.4% to Ampicillin and Piperacillin-Tazobactam, 33.3% to Ciprofloxacin, 29.6% to Gentamicin, 18.5% to Cotrimoxazole and least sensitivity was shown by Cefepime and Cefotaxime (11.1%).

Our study was comparable with Sultana S *et al*^[13] where sensitivity of *E.coli* to Piperacillin-Tazobactam was 51.61%, Ciprofloxacin 29.03% and Gentamicin 48.38%.

In our study *Pseudomonas* spp was found to be most sensitive to Gentamicin 15(83.3%), Cotrimoxazole 12(66.7%), Ciprofloxacin 11(61.1%), Imipenem 7(38.9%), Amikacin, Piperacillin-Tazobactam and Tobramycin 6(33.3%), Cefepime and Cefoperazone-Sulbactam 5(27.8%) and least sensitivity was shown by Aztreonam 4(22.2%) and Cefazidime 3(16.7%)

According to the study by Walelign *et al*^[9] the organism was susceptible to Gentamicin (100%) and Ciprofloxacin (66.7%) which was comparable with our study. A study by Joyce B *et al*^[14] showed 6% sensitivity to Cotrimoxazole and 91% to Amikacin which varies from our study.

In our study among the other gram negative isolates, *Klebsiella* spp showed high sensitivity to Polymyxin (100%) followed by Imepenem (87.5%) and Tigecycline (87.5%); *Proteus* spp was found to be 100% sensitive to Piperacillin-Tazobactam and Imepenem and least sensitive(20%) to Amikacin, Cefepime, Cefotaxime and Cotrimoxazole.

Enterobacter spp showed high sensitivity (100%) to Polymyxin followed by Tigecycline (87.5%) and was 100% resistant to Cefotaxime and Ciprofloxacin.

Acinetobacter spp showed least sensitivity to Cefotaxime (14.3%), Cefipime and Cotrimoxazole (28.6%). *Citrobacters* spp was found to be 100% resistant to Gentamicin, Cotrimoxazole and Piperacillin-Tazobactam.

CONCLUSION

The incidence of infection by Gram negative bacteria was higher than gram positive bacteria. *Escherichia coli* was found to be most common isolate among all culture positive in this study. Overall Linezolid, Vancomycin and Teicoplanin were the most sensitive and Ampicillin was most resistant antibiotic among gram positive isolates. Overall Polymyxin, Tigecycline and Imepenem were the most sensitive and Cefipime and Cefotaxime were most resistant antibiotic among gram negative isolates. It shows that sensitivity pattern differs from time to time and place to place. Knowing this change in sensitivity pattern of antibiotics helps in formation of standard guidelines for a clinician to start empirical therapy according to clinical scenario and prevents irrational use of antibiotics and their upsurge in the resistance in postoperative infected wounds. Each and every hospital should adopt an antibiotic policy and strict adherence to the same is necessary. Apart from regular review and monitoring of the implementation of guidelines is equally important.

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