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Microbiology

A STUDY OF AEROBIC BACTERIOLOGICAL PROFILE OF SURGICAL SITE INFECTIONS IN A TERTIARYCARE HOSPITAL IN NORTH BIHAR

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ABSTRACT **Aim:** To determine the bacteriological profile and antibiogram of surgical site infections. **Materials and Methods:** The current prospective study was carried out at the Department of Microbiology ,Shri Krishna medical college and hospital, Muzaffarpur. 3149 operated surgical cases from variousdepartments like Surgery, Orthopaedics, and Obstetrics andGynaecology were included in this study. Two sterile cotton swabs were collected aseptically.Aspirated material was collected with help of sterile syringe. Gram stained preparation was made from one swab. The other swab was inoculated on blood agar and Mac Conkey agar and incubated for 48 hours. Growth on culture plate was identified by its colony characters and standard biochemical tests. Antimicrobial sensitivity testing was done by Kirby- Baeur disk diffusion method. **Results:**In present study a total number of 3149(100%) surgical procedures were done during the study period out of which 198 (6.28%) samples were collected from symptomatic SSI cases (table 1) and out of the samples collected from post operative cases, 89 (44.94%) samples showed growth of the single isolates whereas 44 (22.22%) samples showed multiple isolates and 65 (32.82%) did not show any bacterial growth after 48 hrs of aerobic incubation. HAI case is 112 (3.55%). In the present study out of 112 (100%) isolates 36 (32.14%) isolates were gram positive organisms and 76 (67.85%) isolates were gram negative organisms. In the present study out of 112 isolates, 76 (67.85%) were isolated from superficial SSI and 36 (32.14%) from Deep or organ/space SSI .In the present study, Gram negative organisms showed high susceptibility to polymyxin B (85.52%)followed by imipenem (69.73%) ,amikacin (59.21%), meropenem (65.78%), gentamicin (63.15%) respectively .In the present study, gram positive organisms showed high suspectibility to Vancomycin and Linezolid 100% followed by Ciprofloxacin 63.88%, Gentamicin 58.33%respectively. **Conclusion:** The prevention of surgical site infections encompasses meticulous operative technique, timely administration of appropriate preoperative antibiotics, and a variety of preventive measures aimed at neutralizing the threat of bacterial, viral, and fungal contamination posed by operative staff, the operating room environment, and the patient's endogenous skin flora.

KEYWORDS : Post-operative, Surgical infections, Bacterial pathogens, Antimicrobial sensitivity.

INTRODUCTION

SSI's are defined as infections which occur within 30 days after the operative procedure (except in case of added implants, when the duration extends to one year from operation). CDC, USA classifies SSI's into: i. Superficial incisional SSI which involves only skin and subcutaneous tissue of incision. ii. Deep incisional SSI which involves deep soft tissues of the incision. (eg: fascia and muscles layer). iii. Organ/ Space SSI includes infection apparently related to the operative procedure and infection involves any part of the body, excluding skin incision, fascia, muscle layer that is operated or manipulated during operative procedure. [1] A spectrum of microorganisms with varied antimicrobial susceptibility patterns have been identified as causative agents of SSI's, which vary with time, hospital location and with the type of surgical procedure performed. [2]

A number of local factors such as hematomas, seromas, suture material, poor surgical technique, degree of contamination and also age, nutrition, hygiene, and other associated diseases play an important role in the etiology of postoperative wound infection. The incidence of surgical site infection differs widely between surgical procedures, hospitals, patients and between surgeons [3],[4].

Aims and Objectives

To determine the bacteriological profile and antibiogram of surgical site infections.

Materials and Methods

The current prospective study was carried out at the Department of Microbiology, SKMC hospital, Muzaffarpur. 3149 operated surgical cases from various departments like Surgery, Orthopaedics, and Obstetrics and Gynaecology were included in this study.

Inclusion and Exclusion Criteria

All patients who fulfilled the criteria of surgical siteinfections were included in the study. All patients of bothgender and age were enrolled in presentstudy. Patients undergoing second surgery at the samesurgical site, patients on immunosuppressant treatment or immunocompromised patient were not included in thestudy. All patient undergoing outpatient procedures wereexcluded from SSI surveillance.

Sample Collection

Prior to sample collection all post surgical wound infections were cleaned with sterile normal saline. With the help of sterile swab sample were collected from depth of the wound. Aspirated material was collected with help of sterile syringe. All sample were immediately transported to microbiology laboratory for culture and sensitivity. All clinical samples were examined for color and consistency. All samples were cultured onto nutrient agar, blood agar, and Mac Conkeyagar plates by quantitative culture method. All culture plates were aerobically incubated at 37◦C. All bacterialisolates were identified based on morphology and cultural characteristics by conventional method . Gram staining was also carried out for direct examination of the sample. The isolates were identified initially by colonial morphology and Gram staining. The isolates were further confirmed by standard biochemical tests as per CLSI guidelines. Escherichia coli ATCC 25922 and Staphylococcus aureus ATCC 25923 were used as controls. Antimicrobial sensitivity testing was carried out by Kirby-Baeur disk diffusion method on Mueller Hinton agar as per CLSI guidelines.[5]

RESULTS

In present study a total number of 3149(100%) surgical procedures were done during the study period out of which 198 (6.28%) samples were collected from symptomatic SSI cases (table 1) and out of the samples collected from post operative cases, 89 (44.94%)samples showed growth of the single isolates whereas 44 (22.22%) samples showed multiple isolates and 65 (32.82%) did not show any bacterial growth after 48 hrs of aerobic incubation(table 2).HAI case is 112 (3.55%).

In the present study out of 112 (100%) isolates 36 (32.14%) isolates were gram positive organisms and 76 (67.85%)isolates were gram negative organisms (table 3). Gram negative organisms were more frequently isolated than gram positive organisms.

Out of 36(32.14%) gram positive isolates,13(36.11%) Staphylococcus aureus (MSSA) is the predominant pathogen followed by Coagulase Negative Staphylococci 10(27.77%). Staphylococcus aureus (MRSA) 6(16.66%), Enterococcus species 4(11.11%),Streptococcus pyogenes 3(8.33%) respectively (table 4).

Out of 76 (67.85%) Gram negative organisms isolates, 45 (59.21%)Escherichia coli followed by Klebsiella species 25 (32.89%), Pseudomonas aeruginosa 12 (15.78%), Acinetobacter baumanii 6 (7.89%) respectively (table 5).

In the present study out of 112 isolates, 76 (67.85%) were isolated from superficial SSI and 36 (32.14%) from Deep or organ/space SSI and in superficial SSI among gram positive MSSA 11 (14.47%)is the predominant pathogen and among gram negatives Escherichia coli 34 (44.73%)is the predominant pathogen and from deep or organ/space SSI also MSSA2 (5.55%) is the predominant pathogen among gram positives and Escherichia coli 11(30.55%)is the predominant pathogen among gram negatives (table 6).

In the present study, gram positive organisms showed high suspectibility to Vancomycin and Linezolid 36(100%) followed by Ciprofloxacin 23(63.88%), Gentamicin21 (58.33%), Oxacillin22 (61.11%), Cephalothin 19 (52.77%),(table 7) whereas Gram negative organisms showed high suspectibility to Neomycin66 (86.84%), Polymyxin B 65 (85.52%), Meropenem50 (65.78%), Imipenem53 (69.73%), Cefaperazone-sulbactam48 (63.15%), Gentamicin 48 (63.15%) respectively (table 7).

In the present study, Gram negative organisms showed high susceptibility to polymyxin B (85.52%)followed by imipenem (69.73%), amikacin (59.21%), meropenem (65.78%), gentamicin (63.15%), piperacillin-tazobactam (40.78%), neomycin (86.84%), cefaperazone-sulbactam(63.15%), co-amoxyclav (38.15%), cotrimoxazole(26.31%), ceftriaxone (84.21%), ceftazidime (51.31%), cephalothin (44.73%) respectively (Table 8)

Table 1: Shows Total Number Of Surgical Procedures Done During Study Period, No. Of Symptomatic SSI And Rate Of Hospital Acquired Infection (HAI) In Our Institute.

1.	No. of surgical procedures	3149
2.	No. of symptomatic SSI	198 (6.28%)
3.	HAI	112 (3.55%)

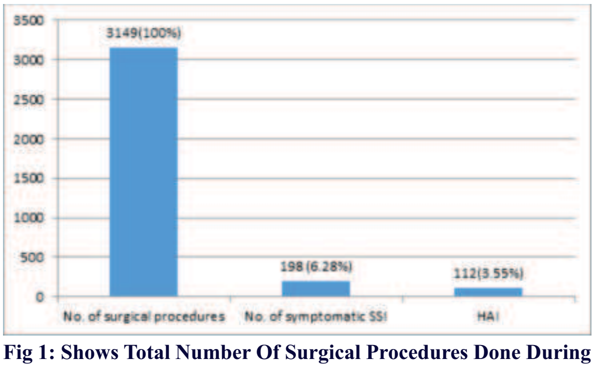

Fig 1: Shows Total Number Of Surgical Procedures Done During Study Period, No. Of Symptomatic SSI And Rate Of Hospital Acquired Infection (HAI)

Table 2: Shows Number Of Isolates From Clinical Specimens.

	89 (44.94%)
Multiple isolates	44 (22.22%)
No bacterial growth	65 (32.82%)
Total	198

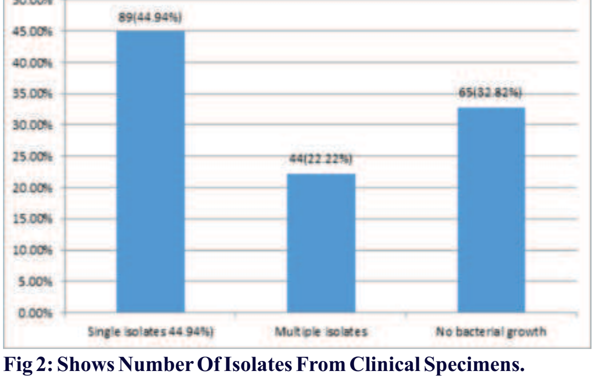

Fig 2: Shows Number Of Isolates From Clinical Specimens.

Table 3: Shows Number Of Gram Positive And Gram Negative Organisms Isolated From Clinical Specimens.

Total no. of isolates	112 (100%)
Gram positive organisms	36 (32.14%)
Gram negative organisms	76 (67.85%)

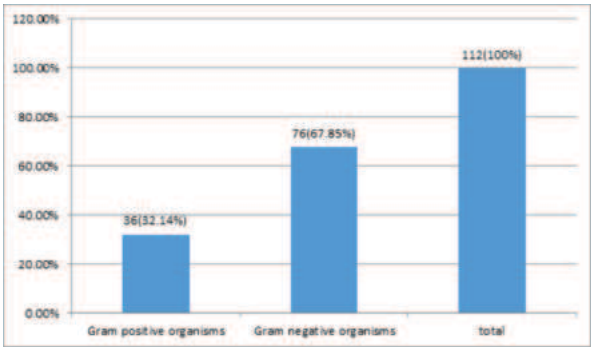

Fig 3: Shows Number Of Gram Positive And Gram Negative Organisms Isolated From Clinical Specimens

Table 4: Shows Different Types Of Gram Positive Organisms (n=36).

Organisms	No. of isolates
Staphylococcus aureus (MSSA)	13 (36.11%)
Staphylococcus aureus (MRSA)	6 (16.66%)
Coagulase Negative Staphylococci	10 (27.77%)
Enterococcus species	4 (11.11%)
Streptococcus pyogenes	3 (8.33%)
Total	36

Table 5: Shows Different Types Of Gram Negative Organisms (n= 76).

Organisms	No. of isolates
Escherichia coli	45 (59.21%)
Klebsiella species	25 (32.89%)
Pseudomonas aeruginosa	12 (15.78%)
Acinetobacterbaumanii	6 (7.89%)
Total	76

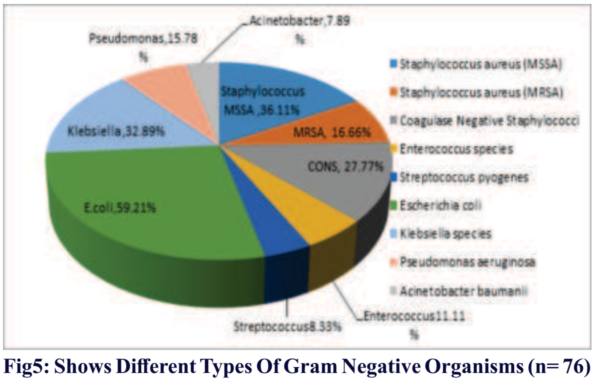

Fig5: Shows Different Types Of Gram Negative Organisms (n= 76) And Gram Positive Organisms (n=36)

Table 6: Shows Distribution Of Bacterial Isolates Based On Ssi Class.

Bacterial isolate	Superficial SSI	Deep tissue or organ/space SSI	Total
Staphylococcus aureus (MSSA)	11 (14.47%)	2 (5.55%)	13
Staphylococcus aureus (MRSA)	4 (5.26%)	2 (5.55%)	6
Coagulase Negative Staphylococci	8 (10.52%)	2 (5.55%)	10
Enterococcus species	3 (3.94%)	1 (2.77%)	4
Streptococcus species	2 (2.63%)	1 (2.77%)	3
Escherichia coli	34 (44.73%)	11(30.55%)	45
Klebsiella species	16 (21.05%)	9 (25%)	25
Pseudomonas aeruginosa	9 (11.84%)	3 (8.33%)	12
Acinetobacterbaumanii	5 (6.57%)	1 (2.77%)	06
Total	76 (67.85%)	36 (32.14%)	112

Table 7: Showing The Antibiotic Susceptibility Pattern Of Gram Positive Organisms To Various Antibiotics (n=36).

S.no	Name of the Antibiotic	No. of isolates Sensitive	Resistant
1.	Vancomycin	36 (100%)	-
2.	Erythromycin	18 (50%)	18(50%)
3.	Tetracycline	15 (41.66%)	21(58.33%)
4.	Oxacillin	22 (61.11%)	14 (38.88%)
5.	Linezolid	36 (100%)	-
6.	Co-Amoxyclav	14 (38.88%)	22 (66.11%)
7.	Cotrimoxazole	11 (30.55%)	25 (69.44%)
8.	Ceftriaxone	12 (33.33%)	24 (66.66%)
9.	Cephalothin	19 (52.77%)	17 (47.22%)
10.	Gentamicin	21 (58.33%)	15(41.66%)
11.	Ciprofloxacin	23 (63.88%)	13 (36.11%)
12.	Neomycin	19 (52.77%)	17 (47.22%)
13.	Penicillin	4 (11.11%)	32 (88.88%)

Table 8: Showing The Antibiotic Susceptibility Pattern Of Gram Negative Organisms To Various Antibiotics. (n=76).

S.no		Sensitive	Resistant
1.	Piperacillin-tazobactam	31 (40.78%)	45 (59.21%)
2.	Cefaperazone-sulbactam	48 (63.15%)	28 (36.84%)
3.	Polymyxin B	65 (85.52%)	11(14.47%)
4.	Amikacin	45 (59.21%)	31 (40.78%)
5.	Gentamicin	48 (63.15%)	28 (36.84%)
6.	Co-Amoxyclav	29 (38.15%)	47 (61.84%)
7.	Ceftriaxone	46 (84.21%)	30 (39.47%)
8.	Cephalothin	34 (44.73%)	42 (55.26%)
9.	Ceftazidime	39 (51.31%)	37 (48.68%)
10.	Neomycin	66 (86.84%)	10 (13.15%)
11.	Cotrimoxazole	20 (26.31%)	56 (73.68%)
12.	Meropenem	50 (65.78%)	26 (34.21%)
13.	Imipenem	53 (69.73%)	23 (30.26%)

Discussion

Healthcare-associated infections (HAIs) are acquired by patients when receiving care, in both primary and secondary environments and are the most frequent adverse event affecting patient safety worldwide. Although the global burden remains unknown because of the difficulty to gather reliable data, it is estimated that hundreds of millions of patients are affected by HAIs each year, leading to significant mortality and huge financial strain on health systems .[(6)]

In present study a total number of 3149(100%) surgical procedures were done during the study period out of which 198 (6.28%) samples were collected from symptomatic SSI cases (table 1) and out of the samples collected from post operative cases, 89 (44.94%) samples showed growth of the single isolates whereas 44 (22.22%) samples showed multiple isolates and 65 (32.82%) did not show any bacterial growth after 48 hrs of aerobic incubation (table 2).HAI case is 112 (3.55%).

In the present study out of 112 (100%) isolates 36 (32.14%) isolates were gram positive organisms and 76 (67.85%) isolates were gram negative organisms (table 3). Gram negative organisms were more frequently isolated than gram positive organisms.

In a study done by Kanwalpreet Kaur et al (2017) [(7)] majority of bacteria were gram negative bacteria (60.74%) as compared to gram positive bacteria (39.25%), but most common isolate was Staphylococcus aureus (29.90%).

Similar findings were observed in the study done by M. Saiful Islam et al (2025) [(8),] It was observed that E. coli (54.1%) was the most common organism isolated from SSI followed by S. aureus (26.23%), Pseudomonas (8.2%), Klebsiella (4.92%).

Out of 36(32.14%) gram positive isolates, 13(36.11%) Staphylococcus aureus (MSSA) is the predominant pathogen followed by Coagulase Negative Staphylococci 10(27.77%). Staphylococcus aureus (MRSA) 6(16.66%), Enterococcus species 4(11.11%), Streptococcus pyogenes 3(8.33%) respectively (table 4).

Out of 76 (67.85%) Gram negative organisms isolates, 45 (59.21%) Escherichia coli followed by Klebsiella species 25 (32.89%), Pseudomonas aeruginosa 12 (15.78%), Acinetobacter baumanii 6 (7.89%) respectively (table 5).

Similar observation was also observed by the study done by Abdurrahman Ali et al (2020)[(9)]. The most frequent isolate was Staphylococcus aureus, 14 (66.67%), followed by Escherichia coli, 9 (33.33%). The most frequent isolate in study done by Kiran Kumar et al (2025)[(10)] The most common pathogenic bacteria found at the surgical site infection was Klebsiella pneumoniae reported in 22.5% cases, followed by GPC in 15% cases, Escherichia coli in 13.8% cases.

In the present study out of 112 isolates, 76 (67.85%) were isolated from superficial SSI and 36 (32.14%) from Deep or organ/space SSI and in superficial SSI among gram positive MSSA 11 (14.47%) is the predominant pathogen and among gram negatives Escherichia coli 34 (44.73%)is the predominant pathogen and from deep or organ/space SSI also MSSA 2 (5.55%) is the predominant pathogen among gram positives and Escherichia coli 11(30.55%) is the predominant pathogen among gram negatives (table 6).

In a study done by Nivitha Mohan et al (2023) [(11)] superficial and deep SSIs were 69 (59.4%) and 47 (40.5%), respectively.

In a study done by Abdurrahman Ali(2023)[(12),] Out of 48 bacterial isolates, more than half (56.25%) of them were Gram negative. The most frequent isolate was Staphylococcus aureus, 14 (66.67%), followed by Escherichia coli, 9 (33.33%).

In a study done by AnkitaBanik et al (2024)[(13)] also reported Gram-positive cocci 74.69% Staphylococcus aureus, 18.41% coagulase-negative Staphylococcus spp. (CONS), 5.23% Enterococcus spp. and 1.67% Streptococcus pyogenes. were identified and Gram-negative bacilli 26.34% Klebsiella pneumoniae, 25.59% Escherichia coli, 14.76% Pseudomonas aeruginosa, 11.93% Acinetobacterbaumannii complex, 8.2%Enterobacterspp.were reported.

In the present study, gram positive organisms showed high suspectibility to Vancomycin and Linezolid 36(100%) followed by Ciprofloxacin 23(63.88%), Gentamicin21 (58.33%), Oxacillin22 (61.11%), Cephalothin 19 (52.77%),(table 7) whereas Gram negative organisms showed high suspectibility to Neomycin66 (86.84%), Polymyxin B 65 (85.52%), Meropenem50 (65.78%), Imipenem53 (69.73%), Cefaperazone-sulbactam48 (63.15%), Gentamicin 48 (63.15%) respectively (table 7).

In a study done by Misbah Najam et al (2015)[(14)]found most of the gram negative isolates to be sensitive to Polymyxin B (86.66%), Imipenem (80%), and Amikacin (73.33%).

In the present study, Gram negative organisms showed high susceptibility to polymyxin B (85.52%)followed by imipenem (69.73%), amikacin (59.21%), meropenem (65.78%), gentamicin (63.15%), piperacillin-tazobactam (40.78%), neomycin (86.84%), cefaperazone-sulbactam(63.15%), co-amoxyclav (38.15%), cotrimoxazole(26.31%), ceftriaxone (84.21%), ceftazidime (51.31%), cephalothin (44.73%)respectively (Table 8)

According to Nandita pal et al (2012)(15),[18] 100% susceptibility was showed for imipenem, meropenem, piperacillin -tazobactam, cefaperazonesulbactam, amikacin followed by ciprofloxacin (85.7%), gentamicin (71.4%), ceftriaxone (30%), ceftazidime and cotrimoxazole (28.6%), co-amoxyclav (14.3%) respectively.

In a study done by PratibhaShamanna et al (2017)[(16)] showed gram negatives 94.7% susceptibility to polymyxin –B followed by imipenem (75.4%), meropenem (71.9%), amikacin (73.7%), piperacillin-tazobactam (52.6%), gentamicin (64.9%), ciprofloxacin (40.3%), cefaperazone-sulbactam (43.8%), co amoxyclav (33.3%), cotrimoxazole (26.3%) whereas ceftriaxone and ceftazidime (10.5%).

CONCLUSION

A plethora of risk factors contribute to post operative SSI's. It is evident that SSI increases with an increase in degree of contamination of wounds operated upon. Prevention, in the form of adequate infection surveillance, ensuring standard aseptic techniques as well as proper preparation and maintenance of operating room are very important in addition to pre operative antibiotics, in decreasing the incidence of SSI's. This aligns with global observations emphasizing the need for updated antibiotic stewardship programs and the judicious use of prophylactic antibiotics. Implementing more precise infection control protocols could help to mitigate the spread of these resistant organisms in clinical settings. Additionally, the role of hospital hygiene practices and patient education in reducing SSIs cannot be underestimated, as the transmission of resistant pathogens often involves lapses in infection control measures.The prevention of surgical site infections encompasses meticulous operative technique, timely administration of appropriate preoperative antibiotics, and a variety of preventive measures aimed at neutralizing the threat of bacterial, viral, and fungal contamination posed by operative staff, the operating room environment, and the patient's endogenous skin flora.

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10. (POSTOPERATIVE SURGICAL SITE INFECTIONS AND ANTIMICROBIAL RESISTANCE PATTERN IN SURGICAL PATIENTS Kiran Kumar1 , Deepthi Vadakattu2 , Anish Kumar Jain3 , Devasani Srinivasa4 , Deva SumanSujith Kumar5 1Assistant Professor, Navodaya Medical College Hospital & Research Center, Raichur, Karnataka, India 2Laproscopic Surgeon, KIMS Hospitals Kondapur, Telangana, India 3Orthopedic Surgeon, ShantilalNavodayaMultispeciality Hospital, Hyderabad, Telangana, India 4Consultant, ShantilalNavodayaMultispeciality Hospital, Hyderabad, Telangana, India 5Assistant Professor, Department of Anaesthesiology, Chettinad Hospital and Research Institute, Chennai, Tamil Nadu, India,DOI: 10.47009/jamp. 2025.7.1.20
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