Pattern Of Bacterial Pathogens And Their Susceptibility Isolated From Surgical Site In Tertiary Care Hospital Of Western India

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Abstract: Background: The emergence of multidrug resistant Bacterial pathogens in hospitals and associated risk factors are strenuous task for surgeons to treat SSIs.Isolation of MRSA and MDROstrains are an existing problem with a rising trend in Indian hospitals. To study the microbial profile and their susceptibility pattern & the risk factors of SSIs and revising antibiotic prophylaxis policy to reduce injudicious use of antimicrobial agents. Material And Methods: This studyincluded 465 post of patients of general surgeries held at Tertiary care teachingcenter, western side of India from July 2017 to August 2018.Samples were collected using sterile cotton swab and processed as per standard operative procedures in appropriate culture media and susceptibility testing was done using Kirby-Bauer disc diffusion technique. After incubation plates were examined and interpreted according to CLSI guidelines. Result: Among465patients SSIs were identified in 32 (6.88%) patients. In this study, predominant organism isolated was E. coli (40.6%), followed by Klebsiella spp. (31.2%), Pseudomonas aeruginosa (25.0%), Staphylococcus aureus (3.13%). Pan-antibiotic resistance was noted among 9(29.03%) gram negative rods. Conclusion: Overall, resistance to cephalosporin group of antibiotics (including latest 3rd generation) & penicillin group is increased, so rather than moving on to costlier antibiotics, aminoglycosides (amikacin/gentamycin) and fluoroquinolones (levofloxacin) are the better preferred drugs. [Sathwara N Natl J Integr Res Med, 2020; 11(5):41-49]

Key Words: Surgical site infections,Injudicious use of Antibiotics, Antibiotic prophylaxis policy.

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Introduction: Surgical site infection (SSI) is defined as an infection occurring within 30 or 90 days after a surgical operation except stitch abscess (or within 12 months if an implant is left in place after procedure) and affecting either superficial or deep incisional infection or infections involving organ or body space.[1]

Hospital acquired surgical site infections (HAIs) are one of the serious health problems affecting hospitalized patients[1.] Healthcare associated infections also called as Nosocomial infection are defined as infections developing in hospitalized patients, not present nor in incubation at the time of their admission. Pathogens that are able to survive long and resist disinfection are particularly important for HAIs. SSIs account for a high proportion of the total number of HAIs and have a great impact on patient's health care cost, morbidity, and mortality worldwide. Globally SSIs rates have been reported to range from 2.5% to 41.9%[1]. The risk of acquiring hospital infection on hospitalized patients in relation to surgery is high, since about 77% of death of patients with HAI was reported to be related with post-operative infections The number of cases increased in developing countries.In recent years there has been shift noted toward infection with antibiotic resistant strains of both - gram positive and gram negative organisms, in SSI.[1]

While in today's era infection control practices, including improved operating room ventilation, sterilization methods, barriers, surgical technique, and availability of antimicrobial prophylaxis, SSIs remain a substantial cause of morbidity and an associated mortality rate of 3% has been attributed to them. Of this, 75% of the mortality rate has been directly related to the SSI[2].

The battle between bacteria and their susceptibility to drugs is yet difficult tasks. Monitoring the rate of surgical site infection, revising antibiotic prophylaxis policy & reducing the risk factors wherever possible will leads to reduction in rate of SSI. The microbiologist plays important role in monitoring and warns clinicians about infections and resistant strains.

So this study was carried out to Study of Microbiological Profile of SSIs in Tertiary Care Teaching center, western side of India. Common microorganisms and their antimicrobial susceptibility pattern and various factors contributing to SSI rates in surgical patients using National Nosocomial Infections Surveillance system(NNIS) are also studied. The antimicrobial spectrum of these isolates would be helpful to clinician in the treatment and restrict the injudicious use of antimicrobial agents.

Material & Methods: Source Of Data: This study was carried out in post of patients (465) undergone different surgeries held at Tertiary care teaching center, western side of India from July 2017 to August 2018as a part of infection control program of Hospital.

Type Of Study: Study was conducted with active surveillance as a part of infection control program of Hospital. All patients were visited in post-operative ward and monitored for sign of infection. Wound infection was suspected if there was a serious, purulent discharge with or without signs of inflammation (edema, redness, raised local temperature, tenderness, induration, fever >38°C) at the wound site, pus discharge or visible wound dehiscence. Dressing was generally opened on 5^{th} and 7^{th} day when no sign of infection was seen. If such signs were observed, dressing was opened. Diagnosis of SSI was made by surgeon and samples for culture & sensitivity were collected from these patients. All patients were followed up in wards till discharge. All the patients were discharged on $7^{th}/8^{th}$ post-operative day after stitch removal, if no signs of infection were present. At time of discharge all patients were explained about symptoms and signs of surgical site infection.

Inclusion Criteria: All the patients who developing symptoms of SSIs after operation in the hospital of any age & gender.

Exclusion Criteria: Patients with known preoperative infection, all the wound infections other than postoperative wound were excluded from the study. The proforma includes age, sex, date of surgery, type of surgery – emergency or elective, American Society of anesthesiology-ASA score, type of anesthesia, type of wound, associated risk factors, investigations, duration of surgery.

Entire Study Is Divided Into Three Parts:
Sample Collection: Bacteriological processing and identification.

Antibiogram
1] Sample Collection: Samples of post-operative infections were collected from patients by residents or nursing staff with complaints of discharge, pain, swelling, foul smelling, delayed and non-healing wound. Wound aspirates, exudates and discharge from the depth of wound were collected with the help of two sterile swabs (one for gram stain and one for culture), before antiseptic dressing was applied, taking care to avoid contamination of the specimen with commensals from the skin. The sample labelled with all details of patient and immediately delivered to the Bacteriology section under sterile conditions where these samples will be processed and analyzed for SSIs [12,17]

Receiving Of Sample: Samples with completely filled LRF were received in Laboratory, ID-was generated by using LIS.

2] Processing Of Samples Done In The Following Ways: Direct Microscopy: Smears were prepared on clean glass slide by rotating one swab and were heat fixed. Gram staining was done by standard technique [17] and examined under oil immersion objective of the light microscope.

Processing Of Sample For Culture: All the samples were inoculated on MacConkey agar and blood agar. The inoculated plates were incubated overnight aerobically at 37°C in an incubator and results were read after 24 hours & 48 hours. Organisms isolated in pure culture were tested for the biochemical reactions. All positive cultures were identified by their characteristic colony morphology, gram staining and by the pattern of biochemical profile. [12,17]

By Gram Staining The Organisms Isolated Were Broadly Classified Into:

Gram Positive Cocci: Staphylococcus aureus (in groups or cluster)

Gram Negative Bacilli: Escherichia coli (straight, 1-3 *0.4-0.7 µm arranged singly),Klebsiella spp. (Gram-negative rods, short plump, straight, about 1-2 *0.5-0.8 µm), Pseudomonas (slender gram-negative bacilli (1.5-3*0.5µm, occasionally capsulated, no spores.)

Biochemical Profile For Isolates: The isolates were identified by colonial morphology, the gram staining from the direct smears and culture smears were compared for presence of similar organisms and conventional biochemical tests such as catalase, coagulase (Tube & Slide), and mannitol fermentation for Gram positive bacteria and Oxidase test,Triple Sugar Iron (TSI) test, Citrate utilization test, Phenylalanine Deaminase test, Urease test (Christensen's method), Indole test, Methyl Red test,VogesProskauertest,Sugar

fermentation test,Nitrate Reduction test, Acetamide test, Amino Acid Decarboxylase test, Oxidation/Fermentation test for Gram negative bacteria.

3]Antibiotic Susceptibility Testing Of Isolated Pathogens [12,17] : Kirby bauer disk diffusion test for antimicrobial susceptibility: Antimicrobial susceptibility testing (AST) was performed after bacterial growth on above mentioned agar plates. MHA plates were dried well in incubator for 15-20 minutes. Lab ID was written on the plates.

Suspension: At least 3-5 well isolated colonies were selected using sterile cotton swab and were transferred into normal saline tube and mixed well. Turbidity of the suspension was adjusted according to 0.5 % mcfarlandturbidity standard. A lawn culture was done on MHA using suspension dipped sterile cotton swab. Antibiotic disc circle was applied on the inoculated MHA plates. The plates are inverted and placed in an incubator at 35-37°C for overnight incubation.

After incubation plates were examined by naked eye under reflected light with the help of antibiotic zone scale and the zone diameters including the diameter of the discs were noted referring to CLSI guidelines. The results were interpreted and reported as follows: Susceptible(S), Susceptible dose dependent (SDD), Intermediate (I), Resistant (R), Non susceptible. After taking the results, special tests were done for detecting MRSA, MBL, ESBL and AmpC[15].

Quality Control: The reliability of the study findings was guaranteed by implementing quality control (QC) measures throughout the whole laboratory works. All materials, equipment, and procedures were adequately controlled, and each procedure were aseptically performed. Culture media were tested for sterility during the lot validation or changes in lot. International Control bacteria strains, Staphylococcus aureus ATCC 25923, Staphylococcus aureus ATCC 43300,Klebsiellapneumoniae ATCC 700603, Escherichia coli ATCC 25922, Enterococcus faecalis ATCC 29212**,** Pseudomonas aeruginosa ATCC 27853were used according to the CLSI.

Detection Of Methicillin Resistance: A lawn culture was done on MHA using suspension of S.aureus isolate tested for methicillin resistance by using 30µg cefoxitin disk [10]. The S. Aureus strains ATCC 25923 and ATCC 43300 were used as negative and positive controls respectively. After incubation read zone of inhibition was ≤ 21 mm indicates MRSA.

Detection Of Esbl: Screening Test: After lawn culture of isolates disks of Ceftazidime (30µg) and Cefotaxime (30µg) were placed on inoculated MHA plate which incubated at 35± 2°C for 16 to 18 hours. Cetazidime ≤ 22mm or Cefotaxime ≤ 27mm were taken as indicator of ESBL production confirmed by phenotypic method.

Phenotypic Confirmation By Combination Disk Test: After lawn culture of isolates disks of Ceftazidime (30 µg), Cetazidime plus clavulanic acid (30 µg/10 µg) were placed on MHA plate. After incubationan increase of ≥5 mm in zone diameter with any of the antibiotic tested in combination with acid versus tested alone was taken as ESBL producer isolates[4] .

Detection Of Amplified Cephalosporinase (Ampc): Screening Test: An isolate was screened for ampcβ- Lactamases by Kirby-Bauer's disk diffusion method demonstrating reduced susceptibility to cefoxitin (30 µg) as ≤18mm zone of inhibition.

Confirmatory Test For ampc β-lactamase: Modified Three-Dimensional Test (MTDT): Lawn culture of E. Coli ATCC 25922 was done on MHA plates, and a cefoxitin (30 µg) disc was placed on the surface of the medium. Linear slits (3 cm long) were cut using sterile blade up to a point 3 mm away from the edge of the cefoxitin disc. Wells of 8 mm diameter were made on the slits at a distance 0.5 cm inside from the outer end of the slit using a sterile Pasteur pipette. The wells were loaded with oraganism inoculam in 10 µl increments until the well was full. (30-40 µl of extract was loaded) After incubation results showed clear distortion of zone of inhibition of cefoxitin were taken as ampcproducers. Isolates with no distortion were taken as ampcnon-producers[18].

Detection Of Carbapenemases:
Modified Hodge Technique: Streak a lawn of the 1:10 dilution of E. coli ATCC 25922 to a MHA plate put ertapenem (10μg) disk in the center of the test area. In a straight line, streak test isolate from the edge of the disk to the edge of the plate. Positive strain shows Clover leaf

appearance at the end of streaking line towards the disk.

Detection Of Class B Carbapenemase By CDST:
For detection of carbapenemases, we use phenotypic method combine disc Synergy test(CDST). Streak a lawn of the test strain to a Muller Hinton agar plate. This method involves use of two discs one with a carbapenem antibiotic (Imipenem 10mcg) and the other with carbapenem with an inhibitor (Imepenem with EDTA) an increase in the Zone diameter around the disc with inhibitor by ≥5 mm over the carbapenem disc indicate metallo-betalactamase production.

Colistin Mic Testing[17]: In this test, colistin powder 2µg/ml is incorporated into MHA plate. The inoculum of test organisms (32 to 36 inoculum) can be applied simultaneously to the agar surfaces using an inoculum loop wire. After incubation, if the colonies are present indicates organism is resistant to Colistin and no growth indicates test organism is sensitive to Colistin. Resistant strains sent to NCDC New Delhi under National Program for containment Antimicrobial Resistance for confirmation.

The following antibiotics were used with their respective concentration. Gentamicin (10 μg), amikacin (30μg) ciprofloxacin & levofloxacin ((5 μg) each), and tetracycline & doxycycline ((30 μg) each) ampicillin (10 μg), ampicillin-sulbactam (20μg), co-trimoxazole (25 μg), cefuroxime (30 μg) and chloramphenicol (30 μg) were used for both Gram positive and Gram negative bacteria.

Penicillin G (10 units), erythromycin (15 μg), clindamycin (2 μg) cefoxitin (30 μg), vancomycin, teicoplanin& linezolid (30 μg) each)) were used for Gram positive bacteria while piperacillin-tazobactam (110 μg), ceftazidime (30 μg), cefepime (30 μg) and imipenem (10μg) were used for all enterobacteriaceae and non-fermenter organisms. While cefotaxime (30μg) & cefoperazone (75 μg) used in group and piperacillin (100 μg), ticarcillin (75μg), mezlocillin (25μg), netilmicin (30 μg) & cefepime-tazobactam (40 μg) used as an anti-Pseudomonas drugs.

Results: Among 465 patients SSIs were noted in 32(6.88%). Among the cases of SSIs number of E. coli -13(40.63%), Klebsiellapnemoniae -9(28%), Klebsiellaoxytoca 1(3.31%), S.aureus 1(3.31%) and P.aeruginosa-8(25%) were isolated.

Table-1: Associated Factors

Characteristics	Cases	Infected	(%)
Age			
0-20	30	1	3.33
21-40	146	8	5.48
41-60	194	15	7.73
≥61	95	8	8.42
Preoperative hospital stay (days)			
0 TO 5	417	4	0.95
6 TO 10	45	25	55.55
>10	3	3	100
ASA score			
1	1	0	0.00
2	268	3	1.12
≥3	153	29	18.95
Risk Index			
0	382	15	3.93
1	60	9	15.00
2	21	7	33.33
3	1	1	100.00
Type of OT			
Elective	412	11	2.67
Emergency	53	21	39.62
Type of anesthesia			
Spinal	288	9	3.13
General	177	23	12.99
Wound Type			
Clean	103	0	0.00
Clean contaminated	282	9	3.19
Contaminated	64	15	23.44
Dirty	15	7	46.67
Duration			
0-1 hour	265	10	3.77
1-2 hour	177	17	9.60
>2 hour	23	5	21.74
Risk factor			
Anemia	31	7	22.58
Diabetes mellitus	57	12	21.05

Distribution Of SSI According To Surgery: Among 131 Laparotomy 19 cases infected (14.5%), 21 Colo-rectal 2 cases infected (9.52%), 34 Small Intestinal 2 cases infected (5.88%), 42 Cholecystectomy 2 cases infected (4.76%), 43 Mastectomy 2 cases infected (4.65%), 56 Appendectomy 2 cases infected (3.57%), 96 Hernia 3 cases infected (3.13%), 37 Thyroidectomy and 5 Hydrocele 0 cases infected (0.0% each).

Antimicrobial Susceptibility Pattern: In this study in gram positive organismS. aureus was the single

strain isolated which was resistant to Penicillin G, ampicillin, cefuroxime, ampicillin-sulbactam, Co-trimoxazole, Ciprofolxacin, Levofloxacin, Chloramphenicol, amikacin, erythromycin (0 (100%)each) and also resistant to cefoxitin (0(100%))(MRSA) while sensitive to clindamycin, gentamycin, tetracycline, doxycycline, vancomycin, lenozolid. (1(0.0%))**.**

Gram negative organisms were considered to be highly resistant to most of the antibiotics tested. Of the isolates, 0 (92.31%), 2 (91.31%), 3 (86.96%) each, 5(78.27%) , (6 (73.92%)each) were found to be resistant to ampicillin, 2nd to 3rd generation cephalosporins, (includes cefuroxime, ceftazidime,cefotaxime, cefoperazone, cefepime) ciprofloxacin & levofloxacin, Co-trimoxazole, Ampicillin-sulbactam & Piperacillin- Tazobactam in their respective order, while aminoglycosides (include gentamicin &amikacin(10 (56.53%)each), tobramycin 11 (52.18%)) and tetracyclin 9 (60.87%), minocycline 10 (56.53%) were relatively less resistant against Gram negative bacterial isolates. Chloramphenicol 13 (43.48%), imipenem 14 (39.14%) were relatively effective against gram negative rods.P.aeruginosa demonstrated high level of resistance to ciprofloxacin 0 (100%), piperacillin, ticarcillin, mezlocilli, ceftazidime, aztreonam, Gentamycin, Tobramycin,Amikacin, Netilmicin (1 (87.5%)each), Piperacillin-Tazobactam 2 (75%) and relatively less resistance against cefepime& levofloxacin (3 (62.5%)each) while imipenem 6 (25%) was relatively effective against P.aeruginosa.

ESBL & Ampc Producing Isolates In Entero bacteriaceae: Among 13 E. coli and 10 Klebsiella spp. isolated 3(23%) & 1(10%) respectively produce ESBL and 5(38%) & 3(30%) respectively produce AmpC.

Carbapenemases/MBL Producing Isolates: Among 23 Enterobacteriaceae 9(39%) isolates produce Carbapenamases and among 8 non fermenters 2(25%) isolates produce Metallo-betalactamases. Detection of carbapenemases in Enterobacteria - ceae by Modified Hodge test and Metallo-betalactamases test by CDST representing of class A, B and class D beta-lactamases. Detection of carbapenemases in nonfermenters by Metallo-betalactamasestest by CDST representing class B beta-lactamases.

Multidrug Resistance Pattern of Bacterial Isolates: More than 75% of the Gram negative organisms showed evidences of multiple antibiotics resistance (resistance ≥ 5 drugs). Pan-antibiotic resistance was noted among 9(29.03%) gram negative rods. Klebsiella spp. were most pan-antibiotic resistant isolate among all gram negative rods. While S.aureus was resistant to cefoxitin (MRSA) strain. Pan-antibiotic resistance was not observed in S.aureus.

MDRO Gram Negative Rods: Among 13 E. coli 2 MDRO, 9 Klebsiellapnemoniae 4 MDRO, 1 Klebsiellaoxytoca 1 MDRO, 8 Pseudomonas aeruginosa 2 MDRO.

Discussion: Surgical sites were classified using CDC's criteria. In this study, it was evident that SSI increases with an increase in the degree of contamination of the wounds operated upon.The rate of SSI is almost doubled with dirty/infected surgical sites than contaminated surgical sites. The difference in the rates of SSIs between the clean and the clean contaminated wounds showed the effect of endogenous contamination and the difference in the rates of SSIs between the clean contaminated and the dirty wounds showed the effect of exogenous contamination. The endogenous or the exogenous contamination of the wounds by the organisms had a profound influence on the SSIs [14].

Incidence of SSIs: Comparative studies for rate of SSI in General surgical procedure: 2008-Umesh et al[12] SSI Rate 30.70%, 2010-Mahesh c b et al[14] SSI Rate 20.90%, 2013-Barnali kakati al[4] SSI Rate 7.44%, 2018- This study SSI Rate 6.88%

Risk Factor & SSIs Rate: Various factors affecting rate of SSI in present study are patient age, H/O diabetes mellitus & Anemia, preoperative hospital stay, ASA score, urgency of surgery, duration of surgery, Anesthesia type, Class of surgical wound. In this study patients were divided in four age groups. The rate of SSI was highest (8.04%) in age group ≥61 years. This is due to poor immune response, existing co morbidities in old patients and reduced compliance with treatment. In this study out of 57 patients with diabetes mellitus, 12 patients had SSI. The rate of SSI was 21.05 % in patients with diabetes mellitus.

Prolonged preoperative hospital stay was found to be associated with higher rate of infection as this leads to colonization with antimicrobial resistant microorganisms. In this study we

divided patients in 3 groups. The rate of SSI (100%) is higher in patients with preoperative hospital stay of **>**10 days.

Comparative Studies For Rate Of SSI According To Preoperative Hospital Stay: Patel Sachin[21] 0-5 Day (5.5%), 6-10 Days (12.8%), >10 Days (33.3%), Mahesh C B[14] 0-5 Day (13.93%), 6-10 Days (28.57%), >10 Days (33.3%) and this study: 0-5 Day (0.95%), 6-10 Days (55.55%), >10 Days (100%). In present study the infection rate was found to be almost 2-times higher following emergency surgery (39.62%) than planned elective surgery (2.97%)**,** due to inadequacy of time for appropriate preoperative aseptic preparation, sub-optimal preoperative antibiotic prophylaxis, and emergency operations were more likely to be dirty.Exploratory laparotomy was associated with the highest incidence (14.50%) of SSI amongst all surgery.

Comparative Studies For Rate Of SSI According To Type Of Surgery: Mahesh C B[14] Elective -7.61% & Emergency - 21.05%, Satyanarayana V[23] Elective - 7.6% & Emergency - 25.2%, Barnali Kakati[4] Elective - 4.86% & Emergency - 15.2%, Hariom Sharan[8] Elective -10.53% & Emergency - 19.44%, Agrawal Amit[3] Elective - 5.7% & Emergency - 28.6%, This study Elective - 2.67% & Emergency - 39.62%. So in this rate of SSI in Emergency type is high.

Table 2: Comparative Studies For Rate Of SSI According To Wound Type

Study	Clean	Clean Contaminated	Contaminated	Dirty	Total
David h. Culver (1987-1999)[6]	2%	3%	6%	70%	--
Lilanispjangale n.(2003)ijmm[13]	3%	22%	--	--	8%
Barnalikakati(2013)[4]	3%	4%	11%	16%	7%
Mahesh c b(2010)[14]	11%	23%	38%	57%	20%
N nreddy (2013-2014)[20]	4%	8%	34%	52%	6%
This study(2018)	0%	3.19%	23.4%	46.6%	6.88%

Above table shows rate of SSIs in various surgical sites according to surgical site classification. All studies reported increasing SSI rate in clean contaminated (3.3%-23.33%), contaminated (5.7%-38.10%) & dirty wounds (7.1% -57.14%). ASA score is highly predictive for development of SSI. In this study risk of SSI was increased with ASA score more than 2 (14.80%).

Table 3: Comparatives Studies For Rate Of SSI According To ASA Score

Study	ASA score		
	1	**2**	**≥ 3**
Culver[(6)]	1.5 %	2.1 %	5.5 %
Patel Sachin[(21)]	0.0	4.2 %	29.8 %
This study	0.0	1.12 %	18.95 %

SSI rates were compared with NNIS riskindex in this study. The rate of SSI increased with increase in the risk index from 0 to 3 with highest rate reported in risk index 3 shown in table 42. NNIS risk index is highly predictive for development of SSI. The study of risk indices helps in Surveillance programs and infection prevention and control efforts.[21]

Table 4: Comparatives Studies For Rate Of SSI According To Risk Index(RI)

Author/RI	Anderson[11]	NNIS Report[19]	This study
0	0.47%	2.70%	3.93%
1	0.71%	4.10%	15.0%
2	2.15%	7.50%	33.33%
3	NA	NA	100.0%

This study showed higher rate (12.99%) of infection in patients given general anesthesia than patients given spinal anesthesia (3.13%). This may be due to artificial respiration given in general anesthesia and so chances of tissue hypoxia are more during surgery in patients given general anesthesia.

In this study each operative procedure was divided into two groups: more than 75th percentile of NNIS duration cut point & less than 75th percentile[21]. The simplest explanation for an increased infection rate with longer procedure is that a longer exposure time will increase the level of contamination of the wound, blood loss, increases the degree of damage to the tissues and greater fatigue among the members of surgical team leading to breaks in sterile technique. The spectrum of bacteria most frequently involved in surgical infections has changed over a period of time. E. coli was the commonest organism (40.63%) isolated from SSIs

in this study. Isolation of MRSA strains is an existing problem with a rising trend in Indian hospitals.

Comparatives studies for rate of SSI according to Gram Positive / Gram Negative Organisms:2003 - Hayath Kownhar[9] Gram Positive isolates 41.9% and Gram Negative isolates 58%, 2004 - Moataz abdel-Fattah[16] Gram Positive isolates 31.8% and Gram Negative isolates 66.2%, 2018 - This Study Gram Positive isolates 3.12% and Gram Negative isolates 96.87%. In this study, predominant organism isolated was E. coli (40.6%), followed by Klebsiella spp. (31.2%), Pseudomonas aeruginosa (25.0%), Staphylococcus aureus (3.13%). In this study E. colipredominates, this may be because of the fact that in majority of cases the site of surgery involved was GIT. And Gram negative organisms predominantly reported to be involved in intra-abdominal surgeries.

Table 5: Comparatives Studies For Rate Of SSI According To Various Pathogens

Year	Study(%)	Staphylococcus aureus	E. Coli	Pseudomonas aeruginosa	Klebsiella spp.
1986-1989	NNIS Report[5]	17	10	8	3
1990-1996	NNIS Report[5]	20	8	8	3
2012	Hariom Sharan[3]	31.5	10.5	15.7	26.3
2012	Sahane V[24]	22	31.2	25	-
2013	Ramesh[22]	16.1	20.8	16.1	15.4
2013	Barnali[4]	13.7	41.1	7.84	9.80
2018	This study	3.12	40.6	25.0	31.2

Antibiotic Susceptibility Of Various Organisms: S.aureus was sensitive to vancomycin, linezolid, Gram-positive isolate in our study was resistant to ampicillin (100 %) substantiating the ineffectiveness of penicillin against Gram-positive isolates also resistant to cefoxitin (MRSA).

Comparatives studies for rate of SSI according to antibiotics susceptibility pattern for Staphylococcus aureus: Hayath kownhar[9] - Ciprofloxacin (52.2%), Gentamicin (30.4%), Vancomycin (100 %), F. Khorvas[7] - Ciprofloxacin (37.5%), Gentamicin (29.6%), Clindamycin (41.5%), Vancomycin (97.1 %), This study - Ciprofloxacin (00.0 %), Gentamicin (100%), Clindamycin (100%), Vancomycin (100 %).

All Gram-negative isolates were found to be sensitive to Colistin (100%), Imipenem (60.86 %). Gram negative isolates were least sensitive to aminoglycoside drugs such as gentamicin &amikacin (43.00%). All the Gram-negative isolates showed resistance to ampicillin (92.31%) and 73.92% of isolates were resistant to combinations Ampicillin-sulbactam and ciprofloxacin (86.96 %). In this study, most of the isolates showed resistance to all generation of cephalosporins (91.31%). Extended spectrum beta-lactamases are enzymes capable of inactivation of most beta-lactam drugs, and they usually respond to carbapenem drugs. ESBL production was detected in 23.07% strains of E. coli & 10.00% of Klebsiellapneumoniae. In a study of David Agatha[29], the occurrence of ESBL producing E. coli was 47.82% and that of Klebsiellapneumoniae was 50%. [12]

All the Pseudomonas aeruginosa isolates were sensitive to Colistin (100%), while isolates were found to be sensitive to aminoglycosides (12.5%) & levofloxacin (37.5%) and were relatively resistant to antipseudomonal drugs such as piperacillin (87.5%). However, the susceptibility marginally increased when the same antibiotic was fortified with Tazobactam. Pseudomonas was resistant to most of the drugs which were used including cephalosporin.

Carbapenems were drugs of choice for penicillin and cephalosporins resistant infections but scenario is changing with emergence of Carbapenemases producing isolates. It is an emerging threat in hospital isolates.

Carbapenemases were detected in total 18 isolates among total 31 isolated enterobacteriaceae and non-fermenters. Plasmid mediated AmpC-betalactamases belonging to Ambler class C are a new threat worldwide as they mediate resistance to a broad spectrum of antibiotics making selection of an effective antibiotic difficult. In this study, AmpC producers are 11 among all isolated 23 enterobacteriaceae. Variations in drug resistance patterns in different

studies are due to variations in the local pattern of drug prescriptions, cost and availability of drugs. Overall resistance in our study was more common for commonly prescribed drugs such as penicillin, ampicillin, co-trimoxazole, cephalosporins, etc., whereas good susceptibility pattern was seen against newer, lesser used drugs like vancomycin, linezolid, Teicoplanin, Imipenem, and fourth generation cephalosporin and also to drug combinations like Ampicillin-sulbactam, Piperacillin-Tazobactam.

It is important to know the sensitivity of different bacteria in surgical site infectionfor two reasons; firstly, to select the appropriate antibiotics to avoid the emergence or overgrowth of resistant bacteria to currently used antimicrobial agents and secondly, these resistant bacteria can cause cross infection to other patients [20].

Increasing antibiotic resistance is really major problem associated with hospital acquired infections including SSI. Avoiding inadvertent use of antibiotics can reduce this. Antibiotic policy should be revised from time to time according to changing antimicrobial susceptibility pattern of organisms causing HCAI.

Following Preventive Measures Are Suggested

Minimum preoperative hospital stay. Treating existing co morbidities whenever possible in elective surgery, Preoperative hair removal with razor should be done within 30 min. before surgery. Preoperative antiseptic bath whenever possible. Preoperative antibiotic prophylaxis within 30 min. before incision. Revising antibiotic policy from time to time & avoiding prolonged use of antibiotics &education staff.

Conclusion: This study was carried out with the aim to know the incidence (6.88%) of surgical site infections at Tertiary care teaching center, western side of India.In this study, we found predominance of Gram-negative Bacilli(E. coli (40.63%)) as the etiological agents for SSI. The spectrum of bacteria most frequently involved in surgical infections has changed over a period of time. Isolation of MRSA strains and MDRO is an existing problem with a rising trend in Indian hospitals. Overall, resistance to cephalosporin group of antibiotics (including latest 3rd generation) & penicillin group is increasing in present study. So rather than moving on to costlier antibiotics, aminoglycosides (amikacin/ gentamycin) &fluoroquinolones (levofloxacin) are the better preferred to combat with SSIs for both Gram positive and Gram negative isolates.

Abbreviation And Full Form: **AMP**=Antimicrobial Prophylaxis, **AmpC**=AmpC β-lactamases, **ASA score**=American Society of Anesthesiologists Score, **B/L**=Bilateral, **CDC**=Centre for Disease Control & Prevention, **CLSI**=Clinical and Laboratory Standards Institute, **ESBL**=Extended spectrum β-lactamases, **GA**=General Anesthesia, **HCAI**=Healthcare associated infection, **LIS**=Laboratory Information System, **LRF**=Lab Request Form, **MBL**=Metallo-β-lactamases, **MI**C=Minimum Inhibitory Concentration, **MRSA**=Methicillin resistant Staphylococci, **NAS**=National Academy of Science, **NHSN**=National Healthcare Safety Network, **NNIS**=National Nosocomial Infections Surveillance, **NRC**=National Research Council, **SSI=**Surgical site infection, **SENIC**=Study of the Efficacy of Nosocomial Infection Control

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