Prevalence and in vitro Susceptibility Pattern of MRSA, VISA and VRSA Isolated from Surgical Site Infection in Tertiary Care Hospital

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ABSTRACT

Introduction: Bacterial infections at surgical sites and surgical wounds are fairly common despite aseptic measures. Surgical site infections are responsible for delayed wound healing, prolonged stay in hospital and put financial burden on the family. Study aimed to determine the prevalence and in vitro susceptibility of MRSA, VRSA, VISA isolated from surgical site infections in tertiary care hospital.

Material and methods: This study was conducted for 1year (January2019 to December 2019) in the Department of Microbiology in Government Medical College, Amritsar. Specimens from a total of 984 patients undergoing either emergency or elective surgery were collected from infected sites or stitch lines and inoculated onto appropriate media. The bacterial cultures were identified utilizing standard microbiological and biochemical methods. Isolates were tested for susceptibility to antimicrobials using the Kirby Bauer disk diffusion method.

Results: Out of 984, 842 i.e 85.57% were culture positive samples, 494 (58.67%) were Gram negative, 348 (41.33%) were Gram positive. Most common isolate was *Staphylococcus aureus* 340 (40.31%) among which 168 were MRSA (20.3%) This was followed by *Klebsiella* species 180 (21.3*%), Escherichia coli* 134 (15.9%), *Pseudomonas* species 100 (11.9%), *Proteus* species (4.03%), *Acinetobacter* species 30 (3.5%) and *Citrobacter* species 16 (1.9%) among Gram negative organisms.In Gram positive organisms resistance pattern was, Ciprofloxacin (61%), clindamycin (43.5%), Gentamicin (42.8), erythromycin (40.5%). However all gram positive isolates were susceptible to vancomycin,linezolid and teicoplanin.In Gram negative isolates resistance pattern was, Ciprofloxacin (60%) followed by Ceftazidime (39%) and Gentamicin (26%) in Gram negative organisms.

Conclusion: It was observed that there was a high incidence of SSI's by MDR organisms. Increased bacterial resistance was probably due to irrational and inappropriate use of antimicrobial agents, not following the culture susceptibility pattern while administering antimicrobial agents. So there is a need for implementation of contact prevention and hand hygiene practices in healthcare facilities.The choice of antimicrobial agents should be evidence based (i.e based on in vitro susceptibility pattern)

Keywords: Antibiotic Resistance, Surgical Site Infection, Prevalence

INTRODUCTION

Instead of aseptic precautions, bacterial infections at Surgical Sites and wounds are very common. Surgical site infections are also responsible for -

1. Delayed wound healing
2. Prolonged hospital stay
3. Increased cost of therapy and drugs used for treatment
4. Increased morbidity and mortality of the patient.[1]

There is relationship of many factors for the development of Surgical Site Infections. Degree of microbial contamination of the wound during surgical procedure, the duration of the procedure, many factors related to host like diabetes, malnutrition, obesity, immune suppression, and a number of underlying disease states.[2]

Instead of the development of many antimicrobial agents, there is development of resistance to number of these agents because of irrational use of antimicrobials, which promote resistance and toxicity to various antimicrobials.

So treatment should be started according to the Antimicrobial Susceptibility pattern of the antimicrobial agents.[3]

Staphylococcus aureus remain the most common cause of SSI, despite the universal practices and potent use of antistaphylococcal drug preoperatively.[4] Methicillin Resistant *Staphylococcus* strains established itself as most common nosocomial pathogen worldwide.[5] According to a report from Centres for Disease Control (CDC), data from United States reported for an overall SSI rate of 1.9% between 2006 to 2008.A 17%decrease in SSI related to 10 selected procedures was reported between 2008 and 2014.In India, several multicentric studies reported SSI rate ranging from 4.1 to 11 per 100 surgeries.The true data is expected to be much higher as post discharge follow up is a big challenge in SSI surveillance. The prevalence varies from region to region and among hospitals to hospitals in the same city.[6]

Study aimed to determine the prevalence and in vitro susceptibility of MRSA, VISA, VRSA isolated from surgical site infections in tertiary care hospital.

MATERIAL AND METHODS

This study was conducted for 1year (January2019 to December 2019) in the Department of Microbiology in

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Government Medical College, Amritsar. Specimens from a total of 984 patients undergoing either emergency or elective surgery were collected from infected sites or stitch lines and were processed as per the standard protocol by inoculating into Blood and Mac Conkey agar and identification of the bacteria will be done by standard techniques.[7]

All the confirmed *Staphylococcus aureus* strains will be tested for Methicillin resistance by Kirby Bauer Disk diffusion method performed on Muller Hinton Agar as per CLSI guidelines using commercially available Cefoxitin disc (30µg) (Hi media, Mumbai).

Strains having the diameter of zone of inhibition of ≤21mm will be considered as MRSA.[8]

The susceptibility to vancomycin will be tested by performing broth dilution method as per CLSI guidelines.

The in vitro antibiotic susceptibility pattern of isolated strains will be tested by using commercially available antibiotic disc (Hi Media Mumbai) like-

Amikacin (30µg), Gentamycin (10µg), Ciprofloxacin (15µg), cefoxitin (30µg), Clindamycin (2µg), Erythromycin (5µg), Doxycycline (30µg) linezolid(30µg), vancomycin (30µg), Teicoplanin (30µg), Rifampicin (5µg).[9]

Data obtained will be statistically analyzed.

MIC ranges from 4 to 8 µg ml−1 of vancomycin, the isolates were considered as Vancomycin-intermediate *Staphylococcus aureus* (VISA), MIC >16 µg ml−1 of vancomycin, isolates were considered as Vancomycin-Resistant *Staphylococcus aureus* (VRSA).[10]

Department	MRSA (SSI)	Total samples taken	Percentage
Surgery	86	384	22.4%
Orthopedics	38	320	11.9%
Obstetrics & gynae	22	224	9.82%
ENT	20	38	52.6%
Plastic Surgery	2	18	11.1%
Total	168	984	

Table-1: Department wise distribution of MRSA in SSI

RESULTS

- A total of 842 samples out of 984 i.e 85.5% were culture positive, 494(58.67%)were Gram negative, 348(41.33%) were Gram positive.
- Most common isolate *was Staphylococcus aureus* 340 (40.31%) among which 168 were MRSA(20.3%) among Gram positive organisms.
- This was followed by *Klebsiella* species 180(21.3%), *Escherichia coli* 134 (15.9%), *Pseudomonas species* 100 (11.9%), *Proteus* species(4.03%), *Acinetobacter* species 30 (3.5%) and *Citrobacter species* 16 (1.9%) *among Gram negative organisms.*

Among the 340 *Staphylococcus aureus*, 168 were Methicillin resistant *Staphylococcus aureus* (MRSA) strains were observed. Prevalence of MRSA was (168 /984 x 100)17.07%. MRSA were isolated from 68 (62.54%) male patients and 100 (37.45%) female patients having surgical site infection. In distribution, Surgery and Orthopaedics departments accounted for most of the MRSA case.

8 clinical isolates were found to be resistant to vancomycin by 30 µg disc by the disc diffusion method and out of 8, 3 strains were confirmed as VISA by broth dilution method having an MIC range between 4-6 µg ml−1.[10] For the other strains, MIC of vancomycin was ≤ 2 µg ml indicating Vancomycin sensitive strains.[11] Not even a single isolates were resistant to Vancomycin by broth dilution (MIC in the range of 16-64 µg ml−1).[12]

All MRSA strains were found to be 100% sensitive to linezolid[13] and Teicoplanin and 86.91% sensitive to Rifampicin and 80.96% sensitive to Doxycycline

Antimicrobial agent	Strains total number	Resistance	Sensitive
Amikacin	MRSA 168 MSSA 172	55 (32.7%) 40 (23.3%)	113(67.3%) 132(76.7%)
Gentamicin	MRSA 168 MSSA 172	72(42.8%) 62(36%)	96(57.2%) 110(64%)
Ciprofloxacin	MRSA 168 MSSA 172	106(63%) 61(35.5%)	62(40%) 111(64.5%)
Erythromycin	MRSA 168 MSSA 172	68(40.5%) 55(32%)	100(59.5%) 117(68%)
Clindamycin	MRSA 168 MSSA 172	73(43.5%) 58(33.7%)	95(56.5%) 114(66.3%)
Rifampin	MRSA 168 MSSA 172	22(13%) 18(10.5%)	146(87%) 154(89.5%)
Doxycycline	MRSA 168 MSSA 172	32(19%) 28(16%)	136(81%) 144(84%)
Linezolid	MRSA 168 MSSA 172	0(0%)	168(100%) 172(100%)
Vancomycin	MRSA 168 MSSA 172	- -	168(100%) 172(100%)
Teicoplanin	MRSA 168 MSSA 172	- -	168(100%) 172(100%)

Table-2: Antibiotic resistance pattern of *Staphylococcus aureus* (MRSA and MSSA) isolated from SSI

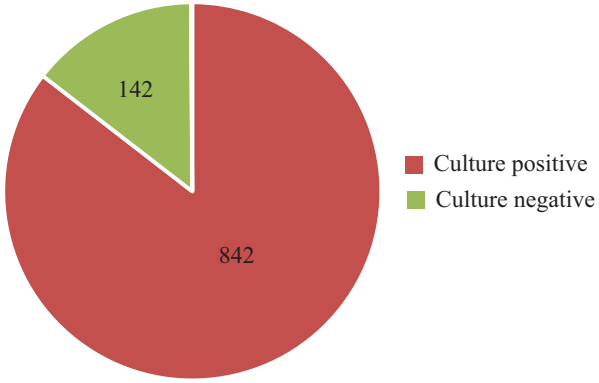

Figure-1: Prevalence of Surgical Wound Infection

DISCUSSION

SSI is an important preventable health care associated infection.[11]

More than 1/3rd of *Staphylococcus aureus* causing SSI in this study, which was comparable to studies in Gwalior (34%)[12] Karnataka (31.3%)[13] and Uttarakhand (50.4%).[14] More than 80% of healthy individuals harbour *Staphylococcus aureus* in their skin or anterior nares, and if the integrity of the skin is breached during any surgery it will lead to skin and soft tissue infections with this organism. All these factors contribute *S.aureus* as the most common pathogen causing SSIs.[11]

Among the Gram negative organism causing SSI *Klebsiella* spp. were the major offenders followed by *E.coli Pseudomonas=Proteus spp* and *Acinetobacter* spp. in this study. *Klebsiella* spp was reported as the most common Gram negative organisms causing SSI. in the studies from Uttarakhand.[14] and Karnataka[13] also, but *Pseudomonas* spp was thesecond highest Gram negative organism responsible for SSIs in both the studies.[12] So there was a great variation among Gram negative organisms causing SSIs in different geographical areas and set up.

Among the isolated *Staphylococcus aureus* strains, 17% were MRSA which was quite similar to the studies done in Gwalior (27.96%).[12] and Karnataka (28.6%).[13] Incidence of MRSA in SSI varies from 15.7% to 63.5% in different studies conducted in India and abroad.[14,15] Variation in incidence of MRSA depend on pre & postoperative antibiotic policy and surveillance program prevailing in different set up.

In this study, majority of SSIs with MRSA were from Surgery and Orthopaedics department followed by Obstetrics & Gynaecology which was comparable with study conducted in Karnataka.[13] there was a significance to assess the department wise distribution of MRSA cases.

MRSA strains were found to be more resistant than MSSA strains to all the antibiotics used and that was statistically significant except for vancomycin and linezolid, similar results were observed in studies in Uttarakhand[14], Gwalior[12] and Karnataka[13] and in a multicentric study from India.[16] where vancomycin and linezolid showed 100% sensitivity to MRSA No vancomycin resistant *Staphylococcus aureus* (VRSA) was detected in this study but 3 (1.12%) isolates were detected as VISA on the basis of MIC value in broth dilution. Six (0.76%) VISA strains and two (0.25%) VRSA strains were reported from study in Northern India.[17] 19% resistance was seen against vancomycin in a study from Congo, Africa.[15]

Slight decrease in the incidence of MRSA was observed from 2009 to 2010 (30.48% to 29.77%), followed by a significant decrease in the incidence during 2011 to 2012 (25.47% to 15.31%)[11] with an overall prevalence of 17% during the study period. Increasing incidence of MRSA is a threat to the health care system, this study reveals a paradoxical incidence. This has been possible because of effective control measures in the form of proper hand washing, barrier methods of nursing and use of appropriate disinfectants among the health care personnel attending the patients undergoing surgery

CONCLUSION

Staphylococcus aureus played a significant role in the aetiology of SSIs in this hospital, one fourth of which was due to MRSA strains. Treatment for MRSA infections still depends on glycopeptides and linezolid, whereas doxycycline and rifampin could also be used as alternative drugs as revealed in this study. A decline in the incidence of MRSA causing SSI in this study might be a ray of hope against the rising trend of this superbug.

The increase in resistance to all group of antibiotics including glycopeptides made it necessary to search for other alternative drugs for treatment of the MRSA strains.

It has been observed that there is a high incidence of SSI's by MDR organisms. So there is a need for strict implementation of contact prevention and hand hygiene practices in healthcare facilities. Increased bacterial resistance may be due to irrational and inappropriate use of antimicrobial agents, not following the culture susceptibility pattern while administering antimicrobial agents.

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