

Research Article

Surgical site infections with special reference to methicillin resistant *Staphylococcus aureus*: experience from a tertiary care referral hospital in North India

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ABSTRACT

Objective: Surgical site infections are an important cause of health care associated infections among surgical patients.

Aim: To determine the prevalence of *Staphylococcus aureus* and Methicillin resistant *Staphylococcus aureus* (MRSA) in surgical site infections with relation to age and sex and its antimicrobial susceptibility pattern.

Methods: During a period of three years, 5,259 specimens received from surgical site infections were processed for isolation and identification of bacterial pathogens according to the standard microbiological techniques.

Results: Abscess drainage was the most common type of surgical site infection (26.62%) and *Staphylococcus aureus* (34%) was the most common isolate. The most frequent isolation of the *S. aureus* in relation to age was noted in the age group of 21–40 years and the prevalence rate was higher in male patients. Out of the total *S. aureus* isolates, 27.96% were found to be methicillin resistant.

Conclusions: There is a need for continuous surveillance and monitoring for the frequency of MRSA with its antimicrobial resistance patterns which may help in decreasing the prevalence of MRSA and antibiotic resistance.

Keywords: Surgical site infection, Methicillin resistant *Staphylococcus aureus* (MRSA), Prevalence, Antibiotics, Age, Sex

INTRODUCTION

Surgical site infections (SSI) are an important cause of health care associated infections among surgical patients. Patients who develop surgical site infections have longer hospital stays, more expensive hospitalizations, and increased mortality.¹ These infections are usually caused by the exogenous and endogenous microorganisms that enter the operative wound during the course of the surgery.² The development of SSI depends on the integrity and

protective function of the skin.³ The incidence of the infected surgical wounds may be influenced by factor such as pre-operative care, the theatre environment, post operative care and the type of surgery. *Staphylococcus aureus* is now the leading causative pathogen in SSIs as well as in the skin and soft tissue infections. Methicillin resistant *Staphylococcus aureus* (MRSA) was the most common pathogen of SSIs in the patients who underwent vascular, cardiac and orthopaedic surgery.⁴ A considerable increase in the prevalence of MRSA has been observed globally during the last decade.⁵

Infections due to MRSA are difficult to treat because of the restricted spectrum of antimicrobials of proven efficacy. Out of these, there are multiple reasons for SSIs, which have been validated and documented as risk factors. A risk factor is any recognised contribution to an increase in SSI.⁶ The clinical significance of MRSA is highlighted because these isolates are not only resistant to multiple antibiotics, but also act as a reservoir for drug-resistant genes.⁷ The incidence of MRSA in SSI is increasing more in developing countries because of lack of general hygienic measures, mass production of low quality antiseptic, improper and inadequate treatment and difficulties in proper definition of the responsibilities among the hospital staffs. So, the objective of our study was to determine the prevalence of *Staphylococcus aureus* and MRSA in surgical site infections with relation to age and sex and its antimicrobial susceptibility pattern.

METHODS

The present retrospective study was conducted in the Department of Microbiology, Gajra Raja Medical College, Gwalior. All the specimens received from patients hospitalized from April 2010 to March 2013 were processed for isolation and identification of bacterial pathogens according to the standard microbiological techniques.⁸ A total of 5,259 cases of SSI were included in the study and two pus samples were collected from each patient with sterile swabs. One swab was for Gram stain and other one was inoculated for culture. The samples were inoculated on blood agar, MacConkey agar, and glucose broth which were aerobically incubated for 24 hours at 35°C. Subcultures from the liquid media on to solid media were carried out after incubating for 18-24 hours. The plates were read the following day but extended to 48 hours if there was no bacterial growth within 24 hours. Isolated colonies were subjected to identification by colony morphology, gram staining and standard biochemical tests.⁸ MRSA detection was done using oxacillin disc (1 µg) and Mueller Hinton agar with 2% NaCl. The plates were incubated for 24 hours at 35°C and zone diameter was measured. If zone diameter was ≥ 13 mm, it was considered as Methicillin sensitive *Staphylococcus aureus* (MSSA) and if it was ≤ 10 mm then it was considered as MRSA.⁹ All MRSA and MSSA strains were tested for their susceptibility to all antibiotics including ciprofloxacin, co-trimoxazole, gentamicin, amikacin, clindamycin, erythromycin, chloramphenicol, cephalixin, vancomycin, linezolid, penicillin, amoxicillin, amoxyclov, cefuroxime, and cefotaxime by Kirby-Bauer disc diffusion technique.⁹ All tests were performed on Mueller-Hinton agar and were interpreted after 24 hours of incubation at 35°C. The inhibition zone diameters were measured around each disc and were interpreted according to the Clinical Laboratory Standards Institute guidelines.⁹ *S. aureus* ATCC 25923

was used as a control strain for the standardization of antimicrobial susceptibility testing.

RESULTS

A total of 4,312 bacterial isolates were isolated from surgical site infections. The abscess drainage was the most common type of surgical site infection (1,148 isolates, 26.62%) [Table 1] and most common isolated organism was *Staphylococcus aureus* (1,466 isolates, 34%) [Table 2]. The most frequent isolation of the *S. aureus* in relation to age was noted in the age group of 21-40 years (52.3%) [Table 3]. We also found the relationship between surgical site infections and sex. The prevalence rate was higher in male (58%) patients compared with females (42%). A total number of 410 isolates (27.96%) were identified as MRSA. Table 4 shows the antimicrobial resistance patterns of MRSA and MSSA strains. Glycopeptides and linezolid exhibited excellent activity against both MRSA and MSSA. The other antibiotic which was found to be effective against MRSA was amikacin (90.2%). Overall the drug resistance was more in MRSA isolates as compared to MSSA. As many as 24% MRSA strains were resistant to multiple drugs in comparison to 9% of MSSA.

Table 1: Distribution of surgical site infection in relation to type of surgery.

Type of surgery	Number of specimen (percentage)
Abscess drainage	1,400 (26.62)
Diabetic foot	705 (13.40)
Caesarean section	641 (12.20)
Open knee wound	620 (11.78)
Liver abscess	520 (9.87)
Herniorrhaphy	426 (8.11)
Abdominal abscess	327 (6.22)
Perianal fistula	242 (4.60)
Neck abscess	168 (3.20)
Lipoma excision	90 (1.72)
Amputation	83 (1.58)
Thyroidectomy	37 (0.70)
Total	5,259 (100)

Table 2: Distribution of bacteria isolated from surgical site infections.

Organisms		No. of isolates (Percentage)
Gram Positive Cocci	<i>Staphylococcus aureus</i>	1466 (34)
	<i>Staphylococcus epidermis</i>	561 (13)
	<i>Enterococcus</i> spp.	129 (3)
	β -hemolytic <i>Streptococcus</i>	86 (2)
	Total	2242 (52)
Gram Negative Bacilli	<i>Pseudomonas aeruginosa</i>	905 (21)
	<i>Klebsiella</i> spp.	388 (9)
	<i>Escherichia coli</i>	345 (8)
	<i>Acinetobacter</i> spp.	216 (5)
	<i>Citrobacter</i> spp.	87 (2)
	<i>Proteus</i> spp.	86 (2)
	<i>Enterobacter</i> spp	43 (1)
Total	2070 (48)	

Table 3: Frequency of *Staphylococcus aureus* isolation in relation to the age group.

Age group (years)	Number of isolation (Percentage)
0–20	768 (52.39)
21–40	568 (38.75)
41–60	77 (5.25)
>60	53 (3.61)
Total	1,466 (100)

Table 4: Antimicrobial sensitivity patterns methicillin-resistant *S. aureus* (MRSA) and methicillin-susceptible *S. aureus* (MSSA) strains.

Antimicrobials	MRSA percentage	MSSA percentage
Ciprofloxacin	36.2	81.6
Co-trimoxazole	30.3	60.2
Gentamicin	42.4	64.2
Amikacin	90.2	92.6
Clindamycin	56.0	72.0
Erythromycin	32.0	63.0
Chloramphenicol	44.0	75.0
Cephalexin	74	80
Linezolid	100	100
Vancomycin	100	100
Penicillin	NA	25.2
Amoxicillin	NA	32.4
Amoxyclav	NA	80.1
Cefuroxime	NA	96.6
Cefotaxime	NA	97.2

DISCUSSION

A surgical site infection is a post operative complication that brings about embarrassment to the surgeon, discomfort alongwith prolonged hospitalization and sometimes death for the patients and considerable financial burden on the society. The rate of SSI varies greatly worldwide and from hospital to hospital. In our study, *S. aureus* was the most prevalent organism (34%) among all the pathogens isolated from SSI. The results were consistent with similar studies carried out by elsewhere in India.^{10,11} The prevalence of surgical site infection in relation to the type of surgery was maximum in patients involving drainage of abscess and diabetic foot operations, followed by caesarean section. When factors such as age and sex of the patients were considered, we found the occurrence of *S. aureus* to be higher in males and in patients in the age group 21-40 years. Naik and colleagues¹⁰ also reported that *S. aureus* was more commonly isolated from patients in age group 21-30 years and isolation rate was maximum in males.

Surgical site infections are a major cause of morbidity of post operative surgical patients and in spite of using broad spectrum antibiotics including potent anti staphylococcal drugs for perioperative prophylaxis, *S. aureus* remains most common cause of SSI. MRSA comprises a significant percentage among these isolates. Infection with MRSA is becoming endemic in hospitals worldwide. It enters healthcare facilities through infected or colonized patients and health care workers. Several studies all over the world have well established that the early detection of methicillin resistance is very essential in the prognosis of infections which are caused by *S. aureus* as many of these infections are life threatening.^{11,12} MRSA has become prevalent even in the community with the indiscriminate overuse and easy availability of many antibiotics. MRSA is of great concern not only because of its resistance to methicillin, but also because it is generally resistant to many other

commonly used antimicrobials. In our study, out of the total *S. aureus* isolates 27.96% were MRSA, which is in consistence with average Indian data.¹³ Mehta and colleagues also reported 33% prevalence of MRSA in their study.¹⁴ However Hussain and colleagues¹⁵ reported a 65% prevalence of MRSA. Another observation that was made in our study was that MSSA strains were generally sensitive to most of the antibiotics tested as compared to MRSA isolates. Mulla and colleagues¹⁶ also observed in their study that multidrug resistance was more common in MRSA than MSSA. In our study, amikacin sensitivity among the *S. aureus* strains was still high in comparison to the findings from other parts of the countries.¹⁶ The sensitivity to amikacin was noted in 90.2% and 92.6% of MRSA and MSSA strains respectively. However all the isolates in our study were sensitive to vancomycin and linezolid.

Therefore there is a need for frequent monitoring of susceptibility patterns of MRSA and formulation of a definite antibiotic policy to control this deadly superbug. In addition, infection control measures such as proper hand hygiene should be enforced in a stringent manner to restrict the spread of MRSA in hospitals.

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