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A prospective study of Methicillin Resistant Staphylococcus aureus (MRSA) infections in patients with cardiac surgeries and its antimicrobial sensitivity pattern

Medical Science

KEYWORDS : *Antimicrobial susceptibility pattern, Cardiac surgeries, MRSA Prevalence, Staphylococcus aureus*

Dr. K.SAGAR BABU	Assistant Professor, Department of Cardio Thoracic Surgery, Andhra Medical College/King George Hospital,Maharanipeta,Visakhapatnam – 530002
Prof.Dr.PERALA BALA MURALI KRISHNA	Professor of Microbiology, Gayatri Vidya Parishad Institute of Health Care & Medical Technology, Marikavalasa, Madhurawada, Visakhapatnam-530048
Dr.D.VIJAYA BHARATHI	Assistant Professor, Department of Microbiology, Gayatri Vidya Parishad Institute of Health Care & Medical Technology, Marikavalasa, Madhurawada, Visakhapatnam – 530048, * Corresponding author
Prof.Dr.BANDARU NARASINGA RAO	Professor & Head Department of Microbiology, Gayatri Vidya Parishad Institute of Health Care & Medical Technology, Marikavalasa, Madhurawada, Visakhapatnam – 530048

ABSTRACT

Aim: To determine the prevalence of Staphylococcus aureus and Methicillin resistant Staphylococcus aureus (MRSA) in patients following cardiac surgeries and its antimicrobial susceptibility pattern.Patients and Methods: Consecutive patients undergoing cardiac surgeries between June2014 and December 2015 have been included for study. Suspected sites of infection were cultured, processed and MRSA identification was done by using cefoxitin (30µg) disc.The antimicrobial susceptibility testing was done by modified Kirby- Bauer disc diffusion technique.Results: The prevalence of MRSA in our study was 16.67% .Isolation rate of MRSA was more in males (80%) than females(20%) with a male female ratio of 4:1.The least resistant antibiotics were vancomycin(0%),linezolid(0%),cefoperazone sulbactam(20%) and piperacillin tazobactam(20%) and the most resistant antibiotics were penicillin(100%),amoxycillin clavulanic acid(80%), cefotaxime(80%), gentamicin(60%) and ceftriaxone (60%). Conclusions: There is a need for continuous surveillance and monitoring for the frequency of MRSA, a super bug with its antimicrobial resistance patterns which may help in decreasing the prevalence of MRSA and antibiotic resistance.

Introduction:

Infection due to *Staphylococcus aureus* is a common complication of cardiac surgical procedures and has been associated with significant morbidity, prolonged hospitalization, higher medical costs and increased likelihood of readmission within 90 days post procedure and death.[1–4].Multi drug resistant organisms have become a global problem and it has become very difficult to manage these infections. The introduction of beta lactamase resistant semi synthetic penicillins in the early 1960's provided temporary relief which ended with emergence of Methicillin resistant *Staphylococcus aureus* (MRSA),discovered shortly after methicillin became available for clinical use.[5] Methicillin Resistant *Staphylococcus aureus* (MRSA) is an important cause of nosocomial as well as community acquired infections [6].Methicillin resistant *Staphylococcus aureus* (MRSA) was the most common pathogen of surgical site infections in patients who underwent vascular and cardiac surgery.[7] A considerable increase in the prevalence of MRSA has been observed globally during the last decade.[8] MRSA infections have become a global problem and infections with these organisms are difficult to treat because of the restricted spectrum of antimicrobials of proven efficacy. 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.[9] The incidence of MRSA in surgical site infections is increasing more in developing countries because of lack of general hygienic measures, mass production of low quality antiseptics, improper and inadequate treatment and difficulties in proper definition of the responsibilities among the hospital staff. So, the objective of our study was to determine the prevalence of MRSA in surgical site infections during cardiac surgeries and its antimicrobial susceptibility pattern.

Patients and methods

The present prospective study was conducted in 200 patients who underwent cardiac surgeries between June 2014 and December 2015 from Department of Cardiothoracic Surgery of King George Hospital and Manipal Superspeciality Hospital, Visakhapatnam, India. From all cases who had signs of wound infection in the immediate post operative period, samples were collected under aseptic conditions with the help of two sterile disposable cotton swabs (Himedia Mumbai, India). One swab was used for Gram staining for detection of pus cells and micro-organisms. Other swab was used for culture to inoculate onto nutrient agar,blood agar ,Mac Conkey agar and a selective medium (Mannitol salt agar) obtained from Hi-Media Laboratories Pvt. Ltd, Mumbai and incubated at 37°C for 24 hours aerobically. The suspected colonies of *Staphylococci* were taken and Gram's staining was done again,all the Gram –positive cocci in clusters were further confirmed using a battery of standard biochemical reactions including the production of bound and free coagulase enzymes using slide and tube coagulase tests based on standard testing methods[10] .*Staphylococcus aureus* ATCC-25923 included as control. The recent literature showed that MRSA testing is more sensitive and specific by using cefoxitin (30µg) disc rather than oxacillin (30 µg)disc[11,12]. For further confirmation, all the isolates were subjected to disc diffusion test using a cefoxitin(30 µg) disc for detection of MRSA.. A 0.5 McFarland standard suspension of the isolate was made and lawn culture was done on Mueller-Hinton Agar plate. Plates were incubated at 35°C for 18 h and zone diameters were measured using a special scale obtained from Hi- Media Laboratories Pvt. Ltd, Mumbai. An inhibition zone diameter of ≤ 21 mm was reported as Methicillin resistant and ≥ 22 mm was considered as Methicillin sensitive[13]. MRSA ATCC **s**train No. 43300 was included as a control strain. Further, the antibiotic susceptibility pattern of Methicillin Resistant *Staphylococcus aureus* strains was determined on the day of their isolation by Modified Kirby-Bauer disc diffusion method on Mueller-Hinton agar using the criteria of standard zone sizes of inhibition to define sensitivity or resistance to dif-

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ferent antimicrobials. Antimicrobial susceptibility testing was performed for penicillin, gentamicin, amoxycillin clavulanic acid, ceftriaxone, cefotaxime, cefoperazone sulbactam,ceftazidime clavulanic acid,piperacillin tazobactam, sparfloxacin, linezolid and vancomycin. *Staphylococcus aureus* ATCC 29213 was used as control strain for the standardization of antibiotic susceptibility.

Results:

In our present study out of 200 cardiac surgeries 30 Out of 30 isolates,17 were Staphylococcus (MRSA-5;MSSA-7 and CoNS-5) and rest of the 23 were Gram negative bacilli. patients (15%) had post operative wound infections. The most common isolated organism was *Staphylococcus aureus* (40%). Among these *Staphylococcus aureus* 16.67% were identified as MRSA (Table 1). Isolation rate of MRSA was more in males (80%) than females(20%) with male female ratio of 4:1.The antimicrobial resistance patterns of MRSA was shown in Table 2. Vancomycin and linezolid exhibited excellent activity against MRSA showing 100% sensitivity. The resistance patterns of other antibiotics were penicillin (100%), amoxycillin clavulanic acid(80%),cefotaxime (80%),gentamicin (60%),ceftriaxone (60%), sparfloxacin(40%),ceftazidime clavulanic acid (40%), cefoperazone sulbactam (20%) and piperacillin tazobactam (20%).

Discussion:

Studies with microbiological data have shown that *Staphylococcus aureus* is the major pathological agent involved in the aetiology of surgical site infections in cardiac surgery. Infection by *S. aureus* can lead to more serious complications in cardiac procedures which use implanted biomaterials. *S. aureus* has the capacity to produce biofilms or slime layers of glycocalyx which form large microcolonies and adhere to the prosthetic material. These biofilms are less affected by antibiotics and ingestion by neutrophils.[14,15] They might consequently cause chronic infections associated with significant morbidity, pain, loss of function and death. Integration of determinants of infection in prevention programs is important for the control of surgical site infections, of which nasal carriage of *S. aureus* is one of the major risk factors. A diagnostic test to detect nasal carriage followed by elimination of nasal *S. aureus* seems therefore to be an efficient scheme to adopt. Mupirocin is the most common compound used in studies of nasal prophylaxis. Other authors have reported significantly lower incidences in subjects undergoing cardiac surgery with perioperative mupirocin nasal ointment than in controls.[16,17] The treatment of *S. aureus* surgical site infections is further complicated by the emerging problem of multidrug-resistant strains and in particular methicillin-resistant *S. aureus* (MRSA), which represent the dominant cause of *S. aureus* hospital-acquired infections. The problem of MRSA surgical site infection is of particular importance in cardiac surgery because of the potentially serious consequences of such infections. The extensive use of antibiotics is the primary cause of *S. aureus* resistance. Improvements in the timing of initial administration, the appropriate choice of antibiotic agents, and shorter duration of antibiotic administration can therefore be considered as key points in reducing such resistance. In our present study, out of 200 patients who underwent cardiac surgeries 30 patients (15%) had surgical site infections. Isolation of *Staphylococcus aureus* from surgical site infections was 40% which was in close relation to Damin[18] et al who had 42.89% isolation of *Staphylococcus aureus* and from English hospital[19] who had 40% isolation of *Staphylococcus aureus.* The prevalence rate of MRSA in our study was 16.67%,which was in close relation to the findings of Damin et al (14.6%) and Bhatia[20] et al (12.06%). In our present study ,male predominance was observed in MRSA isolates with male to female ratio of 4:1. Vancomycin and linezolid exhibited excellent activity against MRSA showing 100% sensitivity. The resistance patterns of other antibiotics were penicillin (100%), amoxycillin clavulanic acid(80%),cefotaxime (80%),gentamicin (60%),ceftriaxone (60%), sparfloxacin(40%), ceftazidime clavulanic acid (40%), cefoperazone sulbactam (20%) and piperacillin tazobactam (20%). In view of emerging resistance, antimicrobial therapy should be started after culture sensitivity report. This will prevent the development of resistance of bacteria towards important antibiotic and we will have choice of antimicrobial agents for treating complications. Resistance to different antibiotics with methicillin resistant strains was higher in comparison to methicillin sensitive strains. The marked difference between antibiogram of MRSA and MSSA isolates calls for the routine testing of methicillin resistance,which may preferably be done by using cefoxitin disc.

Conclusions

In summary, *S. aureus* is the major pathological agent of surgical site infection in patients following cardiac surgery and the prevalence of MRSA constitutes a serious threat to the current treatment therapy leading to treatment failure and escalation of costs. 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.

Table 1: *Staphylococcus aureus*, **MRSA & MSSA isolated from infected patients with** cardiac surgeries.

Pathogens isolated	Number (n=30)	%
Staphylococcus aureus	12	40
Methicillin resistant *Staphylococcus aureus*(MRSA)	5	16.67
Methicillin sensitive *Staphylococcus aureus* (MSSA)	7	23.34
Coagulase negative *Staphylococcus*	5	16.67

Table 2: Antibiotic resistance pattern of MRSA and MSSA isolates.

Antibiotics	Methicillin resistant S aureus (n =5) Resistance(%)	Methicillin sensitive S aureus(n =7) Resistance(%)
Penicillin	100	100
Cefotaxime	80	57.2
Amoxycillin clavulanic acid	80	42.9
Ceftriaxone	60	14.3
Gentamicin	60	14.3
Ceftazidime clavulanic acid	40	28.5
Sparfloxacin	40	14.3
Cefoperazone sulbactam	20	14.3
Piperacillin tazobactam	20	14.3
Linezolid	0	0
Vancomycin	0	0
Cefoxitin		

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