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PREVALENCE OF METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* (MECA GENE) AMONG THE PATIENTS ADMITTED IN INTENSIVE CARE UNIT

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Abstract: The present study was aimed to evaluate the prevalence of among the patients admitted in intensive care unit. The blood samples were processed which were already sent to microbiology department. Blood samples were collected in blood culture bottles containing the medium for the bacterial growth. After incubating the blood culture bottles containing medium and blood samples were plated on the solid medium and incubated for the bacterial growth. All the samples were subjected to grams staining and for identification of *Staphylococcus aureus* catalase test, coagulase test, oxidation/fermentation test, sugar fermentation test, Amino acid tests and urease test. *CONS* (27.34%) were the predominating species in all blood culture followed by Acinetobactor, *E. coli* and *Staphylococcus aureus* which are 24.10%, 13.67% and 13.31% respectively. Thirty one, 83.8%, MRSA strains were detected in the 37 *S. aureus* isolates obtained during the study period. Over all *S. aureus* isolation was obtained 37 (13.31%) of all 278 isolates from blood culture. More than 80% resistance was shown by gentamicin, oxacillin, amoxicillin and cefoxitin. All 31 strains were resistant to cifoxitin. More than 90% resistance was shown by gentamicin, ciprofloxacin and amoxicillin. More than 50% isolates were resistant to erythromycin. Vancomycin and Linezolide were 100% sensitive drugs against the MRSA isolates. More than 50% isolates were sensitive to clindamycin. Due to the ever increasing MRSA infection in hospitals, related cost and ailments and its spread in other patients and as well as in the community via the health care workers, every hospital or health care settings should survey the MRSA prevalence and follow the universal precautions, the most important one being washing hand with alcohol based soap after each patient care.

Keywords: MRSA, blood sample, prevalence, ICU

INTRODUCTION

Methicillin-resistant *Staphylococcus aureus* (MRSA) is an increasing problem in health care facilities[1,2]. The burden of MRSA continues to rise, with a rate of 14% of all *Staphylococcus aureus* strains in 2004 documented from clinically significant samples in New South Wales, Australia[3]. Rising colonization rates lead to increased infection rates in the community and in hospitals. The consequence to the health care system is longer hospital stays and greater costs, which approximately double the expenditure per patient[4]. Patient risks include significantly higher mortality and morbidity rates with invasive MRSA infection[5].

MRSA infections are traditionally associated with exposure to a health care environment, especially the inpatient hospital setting. However, MRSA has newly evolved to include bacterial strains affecting persons without previous exposure to health care environments. These community-associated MRSA (CA-MRSA) infections have been identified in a variety of populations, including: athletes participating in close contact sports, military recruits in barracks settings, intravenous drug users, men who have sex with men, tattoo recipients, religious community members, and inmate populations. Moreover, many healthy adults and children without any obvious risks for exposure are also developing MRSA infections.

Phenotypically susceptible strains, known as pre-methicillin-resistant *S. aureus* (pre-MRSA) and pre-methicillin-resistant coagulase-negative staphylococci (pre-MRCNS), have been discovered, which do not express methicillin resistance, as *mecA* is fully repressed by *mecI*[6]. The induction of *mecA* transcription is very slow and might be due to mutations of *mecI*[7]. The present study was aimed to evaluate the prevalence of among the patients admitted in intensive care unit.

MATERIAL AND METHODS

The study was carried out in the Department of Microbiology, SN Medical College, Agra in collaboration with KD Dental College, Mathura, UP. Neonates and children up to age of 12 years attending the Department of Paediatrics, from April 2011 to March 2012 were included in this study.

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The blood samples were processed which were already sent to microbiology department. Blood samples were collected in blood culture bottles containing the medium for the bacterial growth. After incubating the blood culture bottles containing medium and blood samples were plated on the solid medium and incubated for the bacterial growth. All the samples were subjected to grams staining and for identification of *Staphylococcus aureus* catalase test, coagulase test, oxidation/fermentation test, sugar fermentation test (Glucose, Lactose, Sucrose, Mannitol, Maltose), Amino acid tests (Arginine, Lysine, Ornithine) and urease test. For positive samples of *S. aureus* antimicrobial susceptibility test was done by disk diffusion method. Degree of resistance for methicillin resistant *S. aureus* was studied by minimum inhibitory concentration (oxacillin and cefoxitin), Kirby Bauer disk diffusion method (oxacillin and cefoxitin) and oxacillin agar screening test. PCR was done for all *S. aureus* species to see the methicillin resistance.

RESULTS

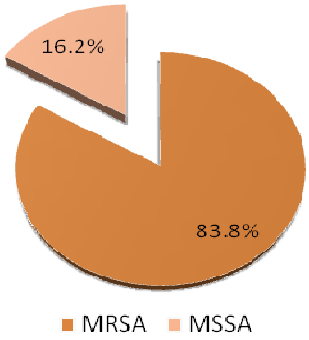
The study comprised of 2529 samples from the patients admitted in the Neonatal Intensive Care Unit (NICU). In 2103 (83.2) samples, no growth was observed, growth was observed among 278 (11%) samples and 148 (5.9%) of the samples were contaminated.

Table 1 shows that *CONS* (27.34%) are the predominating species in all blood culture followed by *Acinetobactor*, *E. coli* and *Staphylococcus aureus* which are 24.10%, 13.67% and 13.31% respectively.

Table.1: Distribution of total isolates (n=278)

Organisms	Number (%)
CONS	76 (27.34)
Acinetobacter	67 (24.10)
E.coli	38 (13.67)
Staphylococcus aureus	37 (13.31)
Enterococcus	24 (8.63)
Klebsiella spp.	11 (3.96)
Pseudomonas spp.	9 (3.24)
Citrobacter	6 (2.15)
Enterobacter	5 (1.80)
Candida	5 (1.80)

Figure 2 shows percentage of MRSA in total *S. aureus*. Methicillin resistance is shown as determined by the gold standard test in the study i.e. Oxacillin MIC by agar dilution method. Thirty one, 83.8%, MRSA strains were detected in the 37 *S. aureus* isolates obtained during the study period. Over all *S. aureus* isolation was obtained 37 (13.31%) of all 278 isolates from blood culture.



Figures in parentheses represent percentage

Figure.2: Percentage of MRSA in total *S. aureus*.

Table 2 presents the antibiotic sensitivity pattern of *S. aureus* strains (n=37) for different groups of antibiotics. *S. aureus* isolates show high percentage of resistance to β-lactam antibiotics. More than 80% resistance was shown by gentamicin, oxacillin, amoxicillin and cefoxitin. Ciprofloxacin resistance was also ~80%. Vancomycin and Linezolide were 100% sensitive drugs against the *S. aureus* isolates.

Table.2: Antibiotic sensitivity pattern of *S. aureus* isolates (n=37)

Antibiotics	Sensitive (S)	Intermediate (I)	Resistant (R)
Gentamicin	7 (18.92)	--	30 (81.08)
Ciprofloxacin	6 (16.22)	2 (5.40)	29 (78.38)
Vancomycin	37 (100)	--	--
Erythromycin	19 (51.35)	1 (2.70)	17 (45.95)
Linezolide	37 (100)	--	--
Oxacillin	6 (16.22)	--	31 (83.78)
Clindamycin	23 (62.16)	--	14 (37.84)
Amoxicillin	5 (13.51)	2 (5.40)	30 (81.08)
Cefoxitin	6 (16.22)	--	31 (83.78)

Figures in parentheses represents percentage

All 31 strains were resistant to cifoxitin. More than 90% resistance was shown by gentamicin, ciprofloxacin and amoxicillin. More than 50% isolates were resistant to erythromycin. Vancomycin and Linezolide were 100% sensitive drugs against the MRSA isolates. More than 50% isolates were sensitive to clindamycin (Table-3).

Table.3: Antibiotic sensitivity pattern of MRSA isolates (n=31)

Antibiotics	Sensitive (S)	Intermediate (I)	Resistant (R)
Gentamicin	1 (3.23)	--	30 (96.77)
Ciprofloxacin	2 (6.45)	1 (3.23)	28 (90.32)
Vancomycin	31 (100)	--	--
Erythromycin	13 (41.93)	1 (3.23)	17 (54.84)
Linezolide	31 (100)	--	--
Clindamycin	17 (54.84)	--	14 (45.16)
Amoxicillin	--	1 (3.23)	30 (96.77)
Cefoxitin	--	--	31 (100)

DISCUSSION

Methicillin resistant *Staphylococcus aureus* (MRSA) strains were initially described in 1961 and emerged in the last decade as one of the most important nosocomial pathogens[8]. Infected and colonized patients provide the primary reservoir and transmission is mainly through hospital staff[9]. The risk factors which contribute to MRSA are excessive antibiotic usage, prolonged hospitalization, intravascular catheterization and hospitalisation in intensive care unit[10]. *Staphylococcus aureus* (*S. aureus*) is a Gram-positive coccus bacterium that belongs to the family Micrococcaceae. Isolated colonies of *S. aureus* are usually large (6 to 8 mm indiameter), smooth, entire, slightly raised, and translucent. The colonies of most strains are pigmented with colors ranging from cream-yellow to orange. Rare strains have relatively large capsules, which gives them a wet appearance[11].

The aim of this study was to determine whether molecular methods offer any other benefit in addition to rapid turnaround times to offset the additional expense of molecular testing. In this study, neonates (of age less than or equal to 28 days) and children up to 12 years of age were included. A total of 2529 samples were investigated, out of which 278 (10.9%) samples had bacterial growth. Out of the bacterial growth, 37 (13.3%) had the confirm etiology of *Staphylococcus aureus*. Out of 37 *Staphylococcus aureus* samples, 31(83.8%) were methicillin resistant *Staphylococcus aureus* (MRSA).

The prevalence of MRSA (13.3%) in the present study is lower than the other studies. The prevalence of MRSA in a study from Chennai[12] was reported as 40-50%. *S. aureus* constituted 17% of catheter related blood stream infections (CRBSIs) in that centre. A high prevalence of MRSA (35% in ward and 43% in ICU) was observed from blood culture specimens in a study in Delhi[13]. Patel *et al.*[14] reported a change in the blood stream infections with *S. aureus* emerging as the predominant pathogen. The incidence of MRSA varies from 25% in western part of India to 50% in South India. Community acquired MRSA (CA-MRSA) has been increasingly reported from India[15]. In a multicentric study, the incidence of MRSA in ICU from blood specimen was reported to be 51%. The difference in the incidence of MRSA between present study and other studies might be the geographical differences and type of hospitals. The present study was carried out among the neonates and children upto 12 years as well as in ICU of the Pediatric department. Other studies included all the patients as well as in the different wards and outpatients.

One of the more alarming recent trends in infectious diseases has been the increasing frequency of antimicrobial resistance among microbial pathogens causing nosocomial infection[16]. In the present study, *S. aureus* isolates show high percentage of resistance to β-lactam antibiotics. More than 80% resistance was shown by gentamicin, oxacillin, amoxicillin and cefoxitin. Ciprofloxacin resistance was also ~80%. Vancomycin and Linezolide were 100% sensitive drugs against the S. aureus isolates. However, 83.8% strains were resistant to cifoxitin. Majority (83.8%) resistance was shown by gentamicin, ciprofloxacin and amoxicillin. More than 50% isolates were resistant to erythromycin. Vancomycin and Linezolide were 100% sensitive drugs against the MRSA isolates. More than 50% isolates were sensitive to clindamycin. Tsering *et al.*[17] reported antibiotic susceptibility pattern of MRSA infection in a referral tertiary care teaching hospital of Sikkim, India. Methicillin resistance was seen in 152 isolates of *S. aureus*, 111 from clinical specimens and 41 from carrier screening samples. MRSA positivity among males was significantly higher than females.

CONCLUSION

Due to the ever increasing MRSA infection in hospitals, related cost and ailments and its spread in other patients and as well as in the community via the health care workers, every hospital or health care settings should survey the MRSA prevalence and follow the universal precautions, the most important one being washing hand with alcohol based soap after each patient care.

REFERENCES

1. Fridkin SK, Hageman JC, Morrison M, et al Methicillin-resistant Staphylococcus aureus disease in three communities N Engl J Med 2005; 352:1485–1487.

2. Salgado CD, BM Farr and DP Calfee, Community-acquired methicillin-resistant Staphylococcus aureus: a meta-analysis of prevalence and risk factors Clin Infect Dis 2003; 36:131–139.

3. Nimmo GR, GW Coombs, JC Pearson, FG O'Brien, KJ Christiansen, JD Turnidge, IB Gosbell, P Collignon and M-L McLaws Methicillin-resistant Staphylococcus aureus in the Australian community: an evolving epidemic Med J Aust2006; 184:384–388.

4. Kim T, PI Oh, and AE Simor The economic impact of methicillin resistant Staphylococcus aureus in Canadian hospitals Infect Control Hosp Epidemiol2001; 22:99–104.

5. Lodise TP and PS McKinnon Clinical and economic impact of methicillin resistance in patients with Staphylococcus aureus bacteremia Diagn Microbiol Infect Dis2005; 52:113–122.

6. Hiramatsu, K Molecular evolution of MRSA Microbiology and Immunology 1995; 39, 531–43.

7. Weller TMA, The distribution of mecA, mecR1 and mecI and sequence analysis of mecI and the mec promoter region in staphylococci

expressing resistance to methicillin Journal of Antimicrobial Chemotherapy 1999; 43, 15–22.

8. Maple PAC, Hamilton- Miller JMT, Brumfitt W Worldwide antibiotic resistance in methicillin resistant Staphylococcus aureus Lancet 1989; 1:537-540.

9. McDonald M The epidemiology of methicillin resistant Staphylococcus aureus: Surgical relevance 20 years on Aust N Z J Surg 1997; 67:682-685.

10. Doebbeling BN The epidemiology of methicillin resistant Staphylococcus aureus colonization and infection J Chemotherapeutics 1995; 7 (3):99-103.

11. Magilner D et al: The prevalence of community-acquired methicillin-resistant Staphyloccous aureus (CA- MRSA) in skin abscesses presenting to the pediatric emergency department N C Med J 2008; 69:351.

12. Gopalakrishnan R, Sureshkumar D Changing trends in antimicrobial susceptibility and hospital acquired infections over an 8 year period in a tertiary care hospital in relation to introduction of an infection control programme J Assoc Physicians India 2010; 58 (Suppl): 25-31.

13. Wattal C, Goel N, Oberoi JK, Raveendran R, Datta S, Prasad 8 KJ Surveillance of multidrug resistant organisms in tertiary care hospital in Delhi, India J Assoc Physicians India 2010; 58 (Suppl): 32-6.

14. Patel AK, Patel KK, Patel KR, Shah S, Dileep P Time trends 2 in the epidemiology of microbial infections at a tertiary care center in west India over last 5 years J Assoc Physicians India 2010; 58 (Suppl): 37-40.

15. D'Souza N, Rodrigues C, Mehta A Molecular characterization of Methicillin-resistant Staphylococcus aureus with emergence of epidemic clones of sequence type (ST)22 and ST 772 in Mumbai, India J Clin Microbiol 2010; 48 : 1806-11.

16. Diekema DJ, Pfaller MA, Jones RN, Doern GV, Kuglr KC, Beach ML, Sader HS Trends in antimicrobial susceptibility of bacterial pathogens isolated from patients with bloodstream infections in the USA, Canada and Latin America SENTRY Participants Group Int J antimicrob Agents2000; 13(4):257-71.

17. Tsering DC, Pal R, Kar S Methicillin-resistant Staphylococcus Aureus: Prevalence and current susceptibility pattern in Sikkim J Global Infect Dis 2011; 3:9-13.

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