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Prevalence of Methicillin Resistant *Staphylococcus aureus* (MRSA) Nasal Carrier State among Pediatric Patients and Para-Medical Staff in Tertiary Care Hospital

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ABSTRACT

Staphylococcus aureus, especially Methicillin resistant *Staphylococcus aureus* (MRSA), is a significant pathogen in hospital-acquired infections. The nasal carrier state of MRSA is concerning, particularly in pediatric patients and para-medical staff in tertiary care hospitals. This study aimed to assess the prevalence of MRSA nasal colonization among pediatric patients and para-medical staff in a tertiary care hospital and to understand its implications on hospital infections. A two-month study, from September to October 2023, was conducted in the department of Microbiology. 100 nasal swab samples were collected, 76 from pediatric patients and 24 from para-medical staff. Samples were inoculated onto HiCrome Rapid MRSA Agar plates and incubated for MRSA detection. The study also involved collecting urine samples from patients with a catheter for >45 hrs for culture and sensitivity testing. Of the 100 samples, 21 (21%) showed MRSA nasal colonization. Among these, 18 (85.7%) were pediatric patients and 3 (14.28%) were para-medical staff. Children aged 0-5 years represented 83.3% of the pediatric MRSA carriers. MRSA nasal colonization distribution was balanced among NICU, PICU and pediatric wards. Among para-medical staff, females showed a higher prevalence of MRSA (3 out of 20) compared to males (0 out of 4). The MSSA and MRSA distribution indicated 76.3% MSSA and 23.68% MRSA among pediatric patients and 87.5% MSSA and 12.5% MRSA among para-medical staff. The study evaluates the importance of regular MRSA screening among hospitalized patients and healthcare workers to reduce MRSA infections. A proactive approach, including screening, treatment and awareness campaigns, is crucial to curbing MRSA spread in hospital settings.

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Key Words
MRSA, nasal colonization, pediatric patients, para-medical staff, tertiary care hospital

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INTRODUCTION

Staphylococcus aureus is the second most common pathogen responsible for hospital-acquired infections. It is ubiquitous in nature and colonizes skin and mucous membrane of human beings. Nose, skin, perineum, pharynx, GIT, vagina and axilla are the commonest sites colonized by *S. aureus*[1]. *Staphylococcus aureus* is responsible for various human infections ranging from mild skin infections like pimples, impetigo, boils, folliculitis, Scalded skin syndrome, abscesses to severe life-threatening diseases[2,3]. It causes many nosocomial and community related infections resulting in high morbidity and mortality[4].

Staphylococcus aureus is resistant to various groups of antibiotics including methicillin which is challenging for the management of infections. *S. aureus* and MRSA account for 40-60% of nosocomial infections causing high morbidity, mortality and increasing the duration of hospital stay and cost[5]. MRSA emergence has increased, posing a serious problem worldwide. It is now endemic in India with variable antibiograms in different geographical regions[6]. Community acquired-Methicillin resistant *S. aureus* (CA-MRSA) causes severe skin and soft tissue infections while Hospital acquired- Methicillin resistant *S. aureus* (HA-MRSA) causes severe bloodstream infections, pneumonia. 3/10 are colonized with *S. aureus* in nose and 2% are colonized with MRSA[7]. On average 6/10 *S. aureus* isolates from ICU are MRSA[8].

Although, all age groups are at risk of colonization by MRSA, the threat of infection with MRSA has increased in the paediatric age groups recently. The risk factors for colonisation in the children are the same as adults like severe underlying illness, prolonged hospital stay, exposure to broad spectrum antibiotics, presence of invasive devices and frequent contact with the health care personnel[9], with the addition of other diseases like cystic fibrosis, congenital immuno-deficiency diseases[10-12]. Colonization is an important risk factor for subsequent infections to themselves and others. Nasal colonization of MRSA in children showed variable prevalence rates, ranging from 0-20% in various studies[13]. These carriers are at greater risk of developing MRSA infection, especially in ICU settings[14,15]. Therefore, screening high-risk patients for MRSA carrier state is important for preventing MRSA infections as well as nosocomial transmission of MRSA. This has formed the basis of our study and it is necessary to screen the hospitalized paediatric population, to reduce HA-MRSA infections which are responsible for increased morbidity, mortality and duration of hospital stay of children. Hence the present study is taken to assess the incidence of CAUTI and CAASB in a tertiary care hospital and associated uropathogens with their antibiotic sensitivity pattern.

MATERIAL AND METHODS

The study was conducted in department of Microbiology for the duration of 2 months, from September to October 2023. Total 100 samples were collected from patients and para-medical staff. The patients admitted in ICUs and wards who are on urinary catheter insertion for >48 hrs from September to October 2023 are included in the study.

Inclusion criteria: Patients admitted in wards and ICUs with Foley's catheter for >48 hrs with or without clinical symptoms.

Exclusion criteria:

- Outpatients with urinary catheter
- Patients with history of sexually transmitted diseases
- Immunocompromised patients

Institutional ethical committee clearance was obtained before beginning of the study. Patients on Foley's catheter in the hospital, who accepted to be part of the study were approached and their consent was obtained.

The following data was collected from the patient in CAUTI is suspected and satisfying the inclusion criteria by means of the specially controlled case report form, including the following:

Demographic data: Name, age, sex, occupation, address, phone number.

History included, data of admission to hospital, data of indwelling catheter, number of days with the catheter, diseases data, treatment data and personal history.

Collection of samples: Urine samples were collected from patient with catheter >45 hrs in a sterile wide mouthed universal container taking aseptic precautions with a sterile disposable syringe after cleaning and clamping the catheter tube. The samples were sent immediately to Microbiology department for culture and sensitivity testing.

Study procedure: The urine samples were subjected to wet mount for evaluation of puss cells, epithelial cells, RBCs and microorganisms. Sem-quantitative culture of urine samples was done by calibrating loop method on 5% sheep blood agar and MaconKey agar and incubated in aerobic conditions at 37°C for 24-48 hrs. The urine culture off colony count >10^5 colony forming units CFU mL^{-1} with more than two species of microorganisms was considered contaminated.

Positive culture were identified by various biochemical reactions like nitrate test, catalase test, catalase test, oxidase test, methyl red test, urease test, sugar (glucose, lactose, sucrose, mannitol, fructose) fermentation test, arginine dihydroxylation of lycine and ornithine[16]. Antibiotic susceptibility testing will be performed by Kirby-Bauer s disc diffusion method on Mueller-Hinton agar as per the CLSI guidelines[17].

The antibiotic tested was ampicillin, imipenem, ceftraxazone, cefotaxime, cefaxitine, ceftazidime, ciprofloxacin and gentamycin. The CAUTI rate per 1000 urinary catheter days in calculated by dividing the number of CAUTIs by the number of catheter days and multiplying the results by 1000.

Methods: Two Pre-moistened nasal swabs (one from each nostril) were collected and immediately transported to the microbiology laboratory for processing.

Swabs were inoculated on to HiCrome Rapid MRSA Agar plate (HI-Media labs, Mumbai) and incubated at 35°C for 48 hrs. Greenish yellow colonies with luxuriant growth were considered as MRSA and further confirmed by conventional methods (Gram's staining, catalase test, tube coagulase test) according to CLSI 2022 guidelines.

Methicillin resistance was confirmed by using cefoxitin 30 µg disc (Hi-Media labs, Mumbai). For internal quality control, a known clinical isolate of MRSA and *Staphylococcus aurues* ATCC 25923 were used as positive control and negative control, respectively. Mupirocin local application is advised for MRSA nasal colonization personnel for 5 days. Post treatment swabs could not be collected as the patients got discharged and paramedical staff were not willing to give samples.

RESULTS

Total 100 samples were collected from patients and para-medical staff. 21(21%) showed MRSA nasal colonization. Among 21, 18(85.7%) were pediatric patients and 3(14.28%) were para-medical staff. 15(83.3%) were 0-5 years of age. MRSA nasal colonization was equally distributed among NICU, PICU and pediatric ward (Table 1).

Table 2 presents data on MRSA nasal carriage among para-medical staff, categorized by gender. Among 20 samples collected from females, 3 were positive for MRSA, while none of the 4 samples from males tested positive. This table highlights gender-related differences in MRSA nasal carriage rates among para-medical staff.

Table 3 presents the distribution of Methicillin-Sensitive *Staphylococcus aureus* (MSSA) and Methicillin-Resistant *Staphylococcus aureus* (MRSA) among two groups: Pediatric patients and para-medical staff. Among 76 pediatric patients, 58 (76.3%) had MSSA and 18 (23.68%) had MRSA. Among 24 para-medical staff, 21 (87.5%) had MSSA and 3 (12.5%) had MRSA. It provides a quick overview of the MSSA and MRSA prevalence in these two groups.

Table 1: Distribution of MRSA nasal carriage among pediatric patients

Factors/groups	No. of samples collected	No. of samples positive for MRSA
Sex		
Female	31	7
Male	45	11
Age (years)		
0-5	49	15
6-10	9	1
11-14	18	2
Admitted unit		
NICU	21	6
PICU	29	6
WARD	26	6

Table 2: Distribution of MRSA nasal carriage among para medical staff

Factors/groups	No. of samples collected	No. of samples positive for MRSA
Sex		
Female	20	3
Male	4	0

Table 3: Distribution of MSSA and MRSA among pediatric patients and para-medical staff

Factors	No. of MSSA	No. of MRSA	Total
Pediatric patients	58 (76.3%)	18 (23.68%)	76
Para medical staff	21 (87.5%)	3 (12.5%)	24

DISCUSSIONS

The emergence of MRSA in the community is of great importance and is the subject of multiple studies in a variety of clinical settings and from many parts of the world. MRSA colonized adults are at increased risk of developing a MRSA infection but data are limited in children. Milstone *et al*.[15] found that critically ill children colonized with MRSA were at significantly higher risk of subsequent MRSA infection. Patients who acquired MRSA in the hospital were at greater risk of developing a MRSA infection. Davis and colleagues reported a 9.5 fold increased risk of subsequent infection in critically ill patients colonized with MRSA compared with those not colonized[16].

This increased risk of infection in those who acquire MRSA colonization in the ICU provides a strong basis for the importance of strategies to prevent nosocomial MRSA transmission in children. In our study, total samples collected were 100 including the pediatric patients and paramedical staff posted in pediatric units. Out of 100, 76 samples were collected from pediatric patients and 24 from paramedical staff. Out of 76, 18 (23.68%) were positive for MRSA nasal colonization (Fig. 1-3).

Similarly, 21% MRSA nasal colonization was reported by Schlesinger *et al*.[17]. Out of 18, 11 were female children and 7 were male children. There were no studies showing sex wise distribution of MRSA nasal colonization. Mean age group of MRSA nasal colonization was 0-5 years of age which was correlating

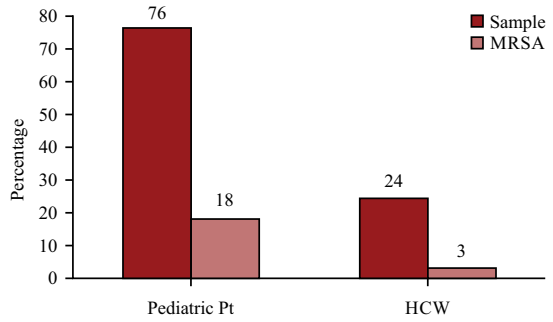

Fig. 1: Distribution of samples among pediatric and HCW (n = 100)

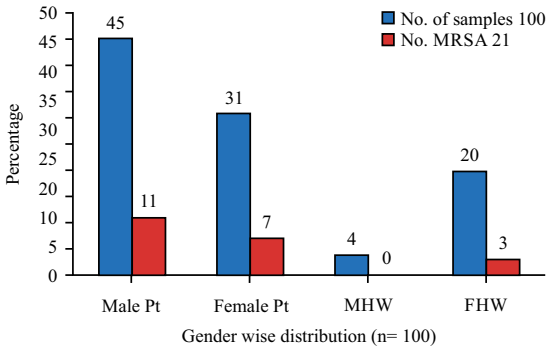

Fig. 2: Distribution of sample according to gender wise

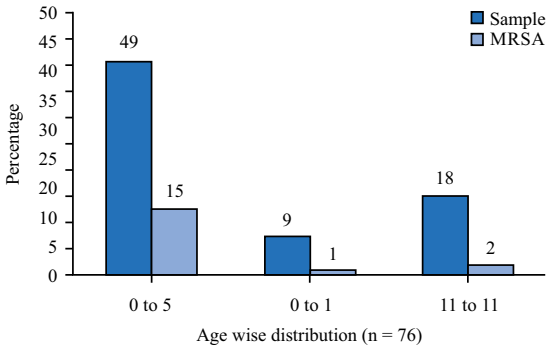

Fig. 3: Distribution of sample according to age wise

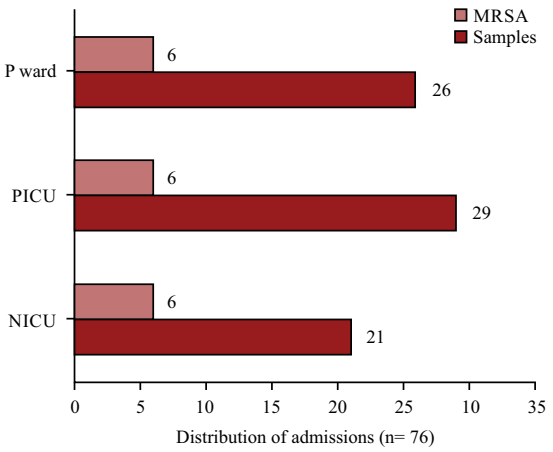

Fig. 4: Distribution of sample according to admission

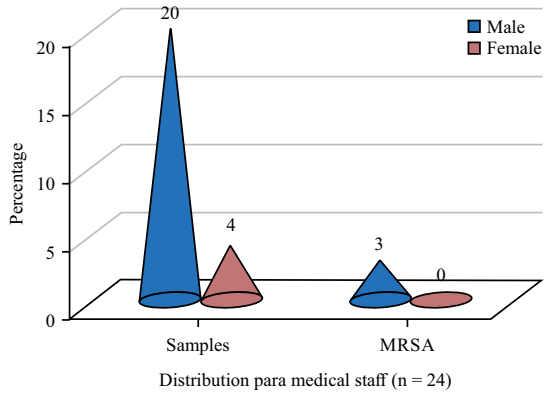

Fig. 5: Distribution of para medical staff

with a study by aaron showing 4 years of median age group[15]. There was equal distribution of MRSA nasal colonization among children admitted in NICU, PICU and pediatric wards (Fig. 4).

In our study, the paramedical staff was not interested to participate in the study hence only 24 samples were collected. Out of 24, 3 (12.5%) were positive for MRSA nasal colonization which is consistent with the study conducted in different hospital setting worldwide which has reported in the range of 5.8-17.8% (Fig. 5)[18-21].

CONCLUSION

Regular screening of MRSA carriers among hospitalized patients and awareness regarding the precautionary measures among HCW's can reduce the MRSA infections. Regular screening and treatment of MRSA of HCWs should be done in every hospital. It is also important to test for mupirocin resistance after treatment.

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