Methicillin-Resistant \textit{. aureus} (MRSA) and Vancomycin-Resistant \textit{Staphylococcus aureus} (VRSA) Nasal Carriage in Health Care Personnel and Medical Students of Tertiary Healthcare Units.

*Final Year MBBS Rawalpindi Medical College
* Department of Pathology, Rawalpindi Medical College

Abstract

**Background:** Various drug resistant strains of \textit{Staphylococcus aureus} have emerged during the past few years; among which the most noted are the Methicillin and the Vancomycin-resistant \textit{Staphylococcus aureus} (MRSA and VRSA respectively). This study aimed at assessing the magnitude of MRSA and VRSA, along with nasal carriage of MRSA and VRSA amongst the health care personnel and medical students of a public medical college of Rawalpindi and its three Allied hospitals.

**Methods:** This cross-sectional study was conducted in 2014-15 and included 170 health care workers and medical students of the Tertiary healthcare units of Rawalpindi, Pakistan (Holy Family Hospital (HFH), Benazir Bhutto Hospital (BBH) and District Headquarters Hospital (DHQ)). Nasal swabs were collected and inoculated on blood agar. After gram staining, Catalase test was performed followed by DNAase test to ensure that the colonies formed were those of \textit{Staphylococcus aureus}. The colonies were isolated and their sensitivity to Methicillin and Vancomycin was checked on a sensitivity plate using Cefoxitin disk screen test. Proportions of study participants with positive MRSA and VRSA were determined.

**Results:** Amongst 170 healthcare workers, 16(9.41\%) isolates tested positive for nasal carriage of MRSA whereas no VRSA carrier was found. The highest carriage rate was found amongst house officers (14.5\%). The department of ophthalmology had the highest carriage rate i.e. 37.5\% followed by surgery department where 19.5\% tested positive for nasal carriage of MRSA. Benazir Bhutto hospital showed 17.4\% MRSA nasal carriage rate.

**Conclusion:** Nasal carriage of MRSA was found in 9.41\% of Health care providers, house officers being the most effected, while VRSA was not observed in anyone.

**Key words:** MRSA, VRSA, healthcare providers, medical students, nasal carriage, tertiary healthcare units.

Introduction

Methicillin resistant \textit{Staphylococcus aureus} infection refers to infection caused by a strain of \textit{Staphylococcus aureus} resistant to Methicillin, but sensitive to some other broad spectrum antibiotics, like Vancomycin. On the other hand Vancomycin resistant \textit{Staphylococcus aureus} refers to a strain of \textit{staphylococcus aureus} that is resistant to most of the antibiotics available including Vancomycin. The focus of this research was on MRSA and VRSA, Methicillin and Vancomycin resistant \textit{Staphylococcus aureus}. These are two types of drug resistant bacteria that are difficult to diagnose and treat. The drug resistance is brought about by excessive use of antibiotics. MRSA is pandemic worldwide, and Methicillin has largely been replaced as a prescription drug by the physicians, resulting in its resistance. Some individuals can be carriers of MRSA or VRSA without showing any symptoms of MRSA/VRSA infection. These people carry the drug resistant forms of bacteria on their bodies usually in the nose, axilla or perineum. Although these individuals do not themselves suffer from the infection, they can however transfer the drug resistant form of bacteria to other people who may be prone to infection. It is now generally accepted that the healthcare providers serve as possible vectors for transmission of MRSA. Thus, they can prove to be a potential cause of hospital or community acquired outbreak of MRSA infection. The ideal procedure to prevent the spread of these infections is to screen and isolate all patients who come to the hospital. A good pre-emptive measure is
The red and analyzed using statistical aily 9 13 akout of either of lied hospitals on a d 8 8 8n as well, it was classified as th ent officers, 5 , eing. Once the Rawalpindi Medical College Rawalpindi, Pakistan study was initiated after the health care providers at reference value of 12.7%. Keeping the anticipated percentage of MRSA affected medical students belonging to the clinical years (third to final academic years of Medical Education).

The objective of our study was to determine the prevalence of MRSA and VRSA carriers amongst the health care workers and medical students of the Tertiary healthcare facilities of Rawalpindi, Pakistan that were Holy Family Hospital (HFH), Benazir Bhutto Hospital (BBH) and District Headquarters Hospital (DHQ) in the year 2014-15.

Patients And Materials
This descriptive cross sectional study was conducted at the tertiary healthcare facilities of Rawalpindi, Pakistan and included departments of Medicine, Surgery, Pediatrics, Obstetrics, Gynecology, Ophthalmology, Otorhinolaryngology and Anesthesiology of all the three hospitals of Rawalpindi Medical College. The study was carried out from June 2014 till June 2015 and the study population comprised of health care providers of all three facilities including House officers (HO’s) or resident officers, post graduate trainees (PGT’s), nurses, ward boys and medical students belonging to the clinical years (third to final academic years of Medical Education). The study was initiated after the permission of the Institutional Research Forum (IRF), Rawalpindi Medical College Rawalpindi, Pakistan.

Keeping the anticipated percentage of MRSA affected Health care providers at reference value of 12.7%8, level of confidence as 5% and anticipated absolute precision as 5.5%, the minimally required sample size was calculated to be 141 using WHO sample size calculator. However 170 participants were included in our study.

Using the stratified random sampling technique, a random number list was generated using the registration list of all three hospitals and equal number of health care providers were selected from each department of all three health care facilities. The sample size taken from each ward was identical. We took the nasal swabs from three post graduate trainees, three House officers, three nurses and one ward boy from each ward after informed consent. Ten students were randomly taken from each clinical year i.e. third, fourth and final year MBBS.

Anyone among the selected population, who was in contact with the patients of Allied hospitals on a daily basis and was included. After obtaining nasal swabs, samples were immediately transported to the Pathology laboratory of Holy Family Hospital. The lab testing was done in a step wise manner. First the bacteria Staphylococcus aureus was inoculated at 35-37 degree centigrade and then isolated. The sensitivity of this bacteria was then checked to establish whether it was a drug resistant strain or not. The isolation of Staphylococcus aureus was done by gram staining since all Staphylococcus bacteria are gram positive organisms. The next two tests were the catalase and the coagulase test. The catalase test is positive for Staphylococcus bacteria and differentiates it from Streptococcus bacteria. The coagulase test is positive for Staphylococcus aureus in particular and differentiates it from Staphylococcus epidermidis. Coagulase test was then followed by DNAase test which confirmed the presence of Staphylococcus aureus. Once the Staphylococcus aureus was isolated, the next step was to test the sensitivity of the isolated organism to Methicillin, Vancomycin and other common antibiotics. If the strain was resistant to Methicillin, then it was classified as MRSA (Methicillin Resistant Staphylococcus aureus). And if a strain was found to be resistant to Vancomycin as well, it was classified as VRSA (Vancomycin Resistant Staphylococcus aureus). All the samples were subsequently recorded as either negative, MRSA positive or VRSA positive in a structured check list designed for this study. All the data was then entered and analyzed using statistical package of social sciences (SPSS version 22). Descriptive statistics were calculated for categorical variables like gender, designation, department, hospital and frequency of nasal carriage of MRSA and VRSA along with percentages were calculated.
Results

Among the total 170 participants, 65 (38.32%) were males and 105 (61.76%) were females. Amongst all 170 study participants, 48 (28.2%) were House Officers, 43 (25.3%) were nurses, 24 (14.1%) were Post Graduate Trainees, 10 (5.9%) were ward boys and 45 (25.5%) were the medical students. Apart from these 45 (28.5%) medical students. The distribution of the remaining 125 health care providers according to the specialty of department in which they were currently working were Medicine 45 (26.5%), Surgery 41 (24.1%), Obstetrics & Gynecology 10 (5.9%), Anesthesia 10 (5.9%), Ophthalmology 8 (4.7%), Pediatrics 6 (3.5%) and Otorhinolaryngology 5 (2.9%).

None of 170 study participants was found to be nasal carriers of VRSA. However 16 isolates (9.4%) tested positive for nasal carriage of MRSA while 154 (90.6%) were negative. The gender wise distribution showed more females 12 (11.4%) to be MRSA positive compared to 4 (6.15%) male health care providers and this comparison (figure 1).

Figure 1. Gender distribution of MRSA positive study participants

When the carriage rate was observed based on the designations of the study participants it was highest amongst the House Officers with 14.5% carriers. Whereas 10% of the ward boys; 0% of the students; 8.3% of the post graduate trainees; and 13.9% of the nurses tested positive for nasal carriage of MRSA. Department of Ophthalmology had the highest MRSA nasal carriage i.e. 37.5% where 3 out of 8 health care providers tested positive. The carriage rate according to departments is displayed in table 1.

Table 1. Distribution of MRSA positive health care providers according to departments

<table>
<thead>
<tr>
<th>DEPARTMENTS</th>
<th>MRSA NEGATIVE f(%)</th>
<th>MRSA POSITIVE f(%)</th>
<th>TOTAL f(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesiology</td>
<td>10 (100%)</td>
<td>0 (0%)</td>
<td>10(100%)</td>
</tr>
<tr>
<td>ENT</td>
<td>5(100%)</td>
<td>0 (0%)</td>
<td>5(100%)</td>
</tr>
<tr>
<td>Gynecology</td>
<td>10 (100%)</td>
<td>0 (0%)</td>
<td>10(100%)</td>
</tr>
<tr>
<td>Medicine</td>
<td>41 (91.11%)</td>
<td>4 (8.88%)</td>
<td>45(100%)</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>5 (62.5%)</td>
<td>3 (37.5%)</td>
<td>8(100%)</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>5 (83.33%)</td>
<td>1 (16.66%)</td>
<td>6(100%)</td>
</tr>
<tr>
<td>Surgery</td>
<td>33 (80.48%)</td>
<td>8 (19.51%)</td>
<td>41(100%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>109 (87.2%)</td>
<td>16 (12.8%)</td>
<td>125 (100%)</td>
</tr>
</tbody>
</table>

*f=frequency & %=percentage

No medical student tested positive for MRSA while 17.4% of the 46 healthcare providers tested at Benazir Bhutto Hospital showed positive nasal carriage while 9.3% and 25% of participant health care providers of HFH and DHQ respectively tested positive for MRSA nasal carriage.

Discussion

In hospitals across Pakistan where empirical therapy is the rule of the day, there is a huge probability that Methicillin and Vancomycin resistant strains of Staphylococcus aureus may develop, and thus lead to a carrier state not only amongst the patients but also among the health care providers. The study was conducted to determine the carriage rate of MRSA/VRSA in the healthcare providers, as they can be a source of the spread of both the community acquired and the nosocomial infections.

A total of 170 participants were tested and the MRSA nasal carriage rate was found to be 9.4% which is comparable to the results found in the other similar studies. For instance, Bahauddin Zakaria University, Sheikh Zayed Hospitals, Baba Saheb Hospital Delhi India and Wollo university Ethiopia had the MRSA carriage rate of 14.0%, 10.7%, 11.43% and 12.7% respectively. However, no VRSA carriers were found among the tested individuals. Department of Ophthalmology had the highest MRSA nasal carriage rate i.e. 37.5%, followed by the surgery department which had the carriage rate of 19.5%. Research conducted in HFH and Ethiopia earlier clearly designate the highest percentage to the surgery department owing to the greater potential for infections. The other departments showed the nasal carriage similar to those found in the previously conducted studies. Our study also included medical students of the clinical years since they come in contact with the patients and can also be a source of community acquired or nosocomial MRSA outbreaks.
Yet, no MRSA nasal carriers were found amongst the student participants.

The Matter of concern here is that the earlier similar studies conducted at Holy Family Hospital had a MRSA carriage rate of 1.5%12 in 200812 and 1.78%11 in 198911 which when compared to our research show a marked raise to 9.3%. While the overall MRSA nasal carriage rate in the three allied hospitals has raised to 9.41%. This estimated six times increase in the carrier state of MRSA over the past seven years, clearly signifies the fact that unnecessary and extensive use of broad spectrum antibiotics has led to rapid evolution of drug resistant strains of bacteria. This is an alarming situation.

Another responsible factor, highlighted here is that there is a probability that an increase in the working hours leads to even a greater risk of acquiring the carrier state. The house officers; who spend maximum number of hours in the hospitals, have the greatest percentage of nasal carriage among all the selected health care providers i.e. 14.5% of the HOs were nasal carriers of MRSA. This contradicts the research conducted in Ethiopia6 where nurses and ward boys had the greatest carriage rate. Post graduate trainees and medical students had 8.3% and 0% carriage rate respectively which reiterate that, the time spent in a clinical setup can make the individual prone to carrier state of MRSA/VRSA. Conversely, the lack of hygiene and negligence by the young doctors, to wash hands with antiseptic soaps every time after examining the patients can also account for the spread of the bacteria17. Nonetheless, if this surplus use of antibiotics is not controlled in an optimum range. And the sterile and sanitary measures are not taken by the doctors and the authorities; we may experience a medical crisis. Whereupon the existing antibiotics will no longer be able to fight the resilient bacterial strains. Effective precautionary measures should be brought about immediately to prevent an outbreak of MRSA infection in the healthcare setup. These may include creating awareness amongst the healthcare providers, medical students and the patients to regularly wash their hands and ensuring proper sanitation as well. The use of the broad spectrum Antibiotics should be decreased to minimum, in order to prevent the evolution of such resistant strains of bacteria. Moreover, the healthcare providers and medical students should follow the necessary protocol to avoid nasal carriage by using masks, gloves and gowns17. Those having nasal carriage of MRSA and VRSA should be adequately treated using antimicrobials like Mupirocin.

Conclusion

Nasal carriage of MRSA was found in 9.41 % of Health care providers, house officers being the most effected while VRSA was not observed in anyone.

References


