ORIGINAL ARTICLE

NASAL CARRIAGE AND DRUG SENSITIVITY OF STAPHYLOCOCCUS AUREUS AMONG HEALTH WORKERS OF JIMMA UNIVERSITY SPECIALIZED HOSPITAL, SOUTHWESTERN ETHIOPIA

Rosina Gabriel, BSc, Estifanos Kebede, BSc, MSc

ABSTRACT

BACKGROUND: ***Staphylococcus aureus is a common cause of community and hospital acquired infections. Additionally emergence of drug resistant strains especially metacillin resistant staphylococcus aureus is a serious problem in hospital environments. The objective of the study was to determine the nasal carriage and antimicrobial sensitivity patterns of S. aureus isolates among Jimma University Specialized Hospital health workers.***

METHOD: ***A cross sectional study was conducted from February 20 - March 27, 2005. Nasal swabs were collected from 82 subjects using sterile cotton swabs and cultured on mannitol salt agar. Sensitivity pattern of isolates were done using eleven antibiotics.***

RESULT: ***Staphylococcus aureus nasal carriage was observed in 76 (92.7%) of subjects from which 35 (42.5%) of the isolates were S. aureus. The drug sensitivity test against penicillin 35 (100%), tetracycline 25 (71.4%), erythromycin 25 (71.4%), gentamycin 24 (68.6%) and chloramphenicol 20 (57.1%). Resistance to oxacillin/methicillin was observed in 15 (42.8%) of S. aureus isolates. All the 35 isolates were resistant to at least four of the antibiotics used.***

CONCLUSION: ***Though the nasal carriage of S. aureus in the health professionals was in the reported range by other studies, increased methicllin resistance Staphylococcus aureus isolates was observed in the study. Furthermore, most of the methicllin resistance Staphylococcus aurous strains were resistant to other beta-lactamse, and were detected from health workers working in the wards indicating the need for instituting strong infection control measures.***

KEY TERMS: - ***Drug sensitivity, Health workers, Nasal carriage, S .aureus,***

INTRODUCTION

Staphylococcus aureus (S. aureus) is carried by 30-50% of total population forming normal flora of nose and skin (1, 2, 3). Generally S. aureus lives quite harmlessly and becomes dangerous only when it inters blood streams causing bacteriamea (1, 4, 5). It is associated with illnesses ranging from impetigo to severe systemic diseases such as endocarditis and toxic shock syndrome (1, 6,7). The bacterium also causes nosocomial infections in surgical wounds and in debilitated patients who may have chronic wound, prolonged hospitalization, and exposure to multiple antibiotics and in newborn nursery (4,7,8,9-11).

Drug resistant S. aureus are the major causes of infection especially in hospital settings. The penicillinase producing strain makes penicillin and ampicillin useless (1,8,12). Frequent administration of systemic antibiotics modified nasal S. aureus from metacillin sensitive *staphylococcus aureus* (MSSA) to metacillin resistant *Staphylococcus aureus* (MRSA) (13). This renders almost all antibiotics useless against S. aureus including the most potent and penicillinase stable β- lactams (oxacillin, methicillin, nafcillin and cephalosporins) (7, 10, 14-17). Strains resistant to vancomycin and ciprofloxacin are also emerging (10, 18, 19).

The prevalence of drug resistant strains of S. aureus varies between different countries ranging from 7.5%-25% (14,15). The first report of methicillin resistant *Staphylococcus aureus (*MRSA) from Ethiopia was made from 1987 – 1988 from clinical specimens and the overall MRSA isolation rate was 31% while 71% out of the MRSA strains were multiple drug resistant (20). A retrospective study conducted by Jimma regional laboratory from 1990 – 1991 indicated that S. aureus is the most commonly isolated bacteria among the subjects and it also is resistant to the commonly used antibiotics (21). In another study in Addis Ababa, 40% of the S. aureus isolates were found to be MRSA, which were also resistant to vancomycin (25%), chloroamphenicol (38%) erythromycin (50%) (22).

Limited studies done in Italy in 2000 and United States of America (USA) in 2004 on the carrier status of staff members indicated that isolates from staff members are found to be similar with the isolates from patient (23,24). A study conducted on surgical staff members and environmental contamination of Tikur Anbessa Hospital revealed that the isolation rate of MRSA was 27.6% (25). Studies in Brazil and Australia indicated that MRSA is transmitted from patient to patient largely by the hands of health professionals (26,27).

Employees colonized with MRSA often act as a reservoir for the spread of the strain within the hospital and the strain causes hospital-acquired sepsis & wound infections. Even though there have been report of community acquired MRSA from other parts of the world, it is not always clear whether these strains have come from the community or are hospital strains that have spread to the community (28).

The objective of the study was to determine the nasal carriage and drug sensitivity pattern of S. aureus among health workers of Jimma University Specialized Hospital (JUSH).

MATERIALS AND METHODS

A cross sectional study was conducted in Jimma University Specialized Hospital's health workers, Southwest Ethiopia from *February 20 – March 27 2005*.

Swabs from both anterior nares were collected from volunteer subjects after getting verbal consent. A questionnaire that assesses profession, ward (department), year of service in the hospital and other places was also provided for the study subjects to see the risk factors for MRSA acquisition.

The sample collection, culturing, staining and sensitivity tests were performed according to the WHO standard for diagnosis of S. aureus (1). Sterile cotton swabs were used for sample collection. The samples were obtained by rotating the swab on both nares of the subjects and it was transported to the laboratory using nutrient broth. The swabs then were inoculated on to mannitol salt agar (MSA) within three hours of sampling and were incubated at 37°c for 24-48 hrs. A control S.aureus strain was also inoculated in another MSA with every batch of samples. After the plate had been left at room temperature for pigment formation, colonies were selected for coagulase test in slide method. Gram stain was also performed on colonies taken from the media. Those colonies that were mannitol fermenter (golden or cream colonies) and coagulase positive were taken as S.aureus while those with a white colony (mannitol non fermenters) and coagulase negative were considered as other staphylococci.

Colonies confirmed to be S. aureus were taken and inoculated in Muller Hinton agar for sensitivity testing according to modified Kirby- Bauer disk-diffusion technique using eleven selected drugs, penicillin (10 units), amoxicillin (25μg), erythromycin (15 μg), oxacillin (1μg), chloroamphenicol (30 μg), compound sulphonamides (300 μg), clindamycin (2 μg), co-trimoxazol (25 μg) and vancomycin (30 μg) all from oxoid and tetracycline (30μg) & gentamycin (10μg) from BBL microbiology systems. The final data then were analyzed using simple calculator. Oxacillin was used in the place of methicillin and those strains of S. aureus which are referred to as MRSA are usually oxacillin resistant S. aureus (ORSA). Though methicillin and oxacillin are similar antibiotics, MRSA is the usually accepted designation and this approach was preferred in this study (1, 17, 27).

RESULTS

A total of 82 subjects from different wards & departments were participated in the study. Among the study subjects 52 (63.5%) were male and the rest were females with male to female ratio of 1:0.6. The age of the subjects' ranges from 20-50 with a mean age of 29.4 years and their average year of service is 8.2 with a range of 1 to 30 years.

Among the subjects whose nasal swab was collected; 76 (92.7%) showed growth of staphylococci in MSA. S. aureus was the sole isolate from 13 (17.1%) of the total isolates it grew together with other staphylococci in 22 (28.9 %) while the rest 41 (54.0%) were other staphylococci species only (Table 1). No statistically significant difference was observed in staphylococcal carriage by sex, age and year of service of study subjects.

Table 1. Distribution of S. aureus (CPS) and other staphylococci (CNS) among the total nasal cultures of health professionals of JUSH from Feb. 20-Mar. 272005.

Ward / Department	No of nasal cultures	Total staphylococci isolates				Negative cultures	
		CPS		CNS			
		No	%	No	%	No	%
Surgical	18	11	61.1	7	39.9	0	0
Medical	18	9	50.0	9	50.0	0	0
Pediatrics	12	4	33.3	6	50.0	2	16.7
Maternity	10	1	10.0	8	80.0	1	10.0
Gynecology	12	4	33.3	8	66.7	0	0
Laboratory	5	3	60.0	1	20.0	1	20.0
Ophthalmology	3	1	33.3	1	33.3	1	33.4
Pharmacy	2	1	50.0	1	50.0	0	0
X-ray	2	1	50.0	0	0	1	50.0
Total	82	35	42.7	41	50.0	6	7.3

Abbreviations: - CPS - coagulase positive staphylococci, CNS - coagulase negative staphylococci

The drug sensitivity pattern of the 35 isolates of S. aureus that was done by Kirby-Bauer disk diffusion technique indicated that the highest resistance rate was seen to penicillin (100%) followed by amoxicillin and tetracycline (71.0% each), erythromycin (68.6%), gentamycin and chloramphenicol (57.1% each), compound sulphonamide (48.0%), oxacillin (42.8%), clindamycin and co-trimoxazol (40.0% each). The least resistances were seen to vancomycin (31.4%). All the isolates were grouped under sensitive & resistance and those isolates that were in intermediate phase were considered as resistant (Table 2).

Table 2. Drug Sensitivity Patterns of the 35 S. aureus isolates from Nasal swab cultures of JUSH staff members between Feb. 28 & Mar. 27,2005.

Antimicrobials	Staphylococcus aureus			
	Resistant		Sensitive	
	No	%	No	%
Penicillin	35	100.0	-	-
Amoxicillin	25	71.4	10	28.6
Tetracycline	25	71.4	10	28.6
Erythromycin	24	68.6	11	31.4
Gentamycin	20	57.1	15	42.9
Chloroamphenicol	20	57.1	15	42.9
Cpd. sulphonamide	17	48.6	18	51.4
Oxacillin	15	42.8	20	57.4
Clindamycin	14	40.0	21	60.0
Co-trimoxazol	14	40.0	21	60.0
Vancomycin	11	31.4	24	68.6

All the isolate were resistant to penicillin and for at least three other antimicrobials used and 1 (2.9%) was resistant for all the drugs used in the sensitivity testing (table 4).

A separate analysis done for oxacillin resistance indicated that 15 (42.8%) of them were resistant (MRSA) while the rest 20 (57.2%) were sensitive (MSSA). Surgical ward contributes the highest proportion of MRSA isolates 6 (40.0%) followed by medical 5 (33.3%) and gynaecology with 2 (13.3%). Isolates from maternity, ophthalmology, pharmacy and radiology (one from each) were sensitive for oxacillin (table 3).

Table 4: - Antibiograms of total S. aureus isolates from staff members of different wards & departments of JUSH from Feb 28 to Mar 27, 2005.

Antibiotics	Resistant Strains	
	No	*%*
1,2,3,6	1	2.9
1,2,4,5	1	2.9
1,4,6,8	1	2.9
1,2,3,4,6	2	5.7
1,2,5,7,10	2	5.7
1,3,4,9,10	1	2.9
1,4,5,6,10	2	5.7
1,4,6,7,10	1	2.9
1,2,3,4,6,7	1	2.9
1,2,3,4,6,8	3	8.6
1,2,3,4,7,10	2	5.7
1,2,3,6,9,10	1	2.9
1,2,5,7,8,9	2	5.7
1,3,4,5,8,10	3	8.6
1,3,4,7,8,9	1	2.9
1,2,3,4,5,7,11	1	2.9
1,2,4,6,7,9,11	1	2.9
1,3,4,6,7,10,11	1	2.9
1,2,3,4,5,6,7,11	1	2.9
1,2,3,4,5,6,8,9	1	2.9
1,2,3,4,5,6,8,11	1	2.9
1,2,3,4,5,7,8,10	1	2.9
1,2,3,4,5,7,9,11	1	2.9
1,2,3,4,5,6,7,8,10	1	2.9
1,2,3,5, 7,8,9,10,11	1	2.9
1,2,3,4,5,6,7,8,9,10,11	1	2.9
Total	35	100.0

Key 1,Penicillin, 2,Amoxicillin, 3,Tetracycline, 4,Erythromycin, 5,Gentamycin, 6,Chloroamphenicol, 7,Compound sulphonamide, 8, Oxacillin, 9, Clindamycin, 10,Co-trimoxazol, 11,Vancomycin

Table 3. Distribution of MRSA & MSSA strains among the total S. aureus isolates from Nasal Cultures of JUSH Staff members from Feb.28 to Mar.27, 2005.

Ward /Department	No of Isolates tested	S. aureus isolates (total 35)			
		MRSA		MSSA	
		No	%	No	%
Medical	9	5	55.6	4	44.4
Surgical	11	6	54.5	5	45.5
Gynaecology	4	2	50.0	2	50.0
Laboratory	3	1	33.3	2	66.7
Paediatrics	4	1	25.0	3	75.0
Maternity	1	0	0	1	100.0
Ophthalmology	1	0	0	1	100.0
Pharmacy	1	0	0	1	100.0
X-ray	1	0	0	1	100.0
Total	35	15	42.9	20	57.1

DISCUSSION

Staphylococcus aureus is reported to be the most versatile cause of hospital acquired (nosocomial) as well as community acquired infections. Results of the nasal cultures of this study indicated that significant number of health workers carried Staphylococcal species in general and S. aureus in particular in the anterior nares. This figure is in the range of expected adult population nasal carriage (30-50%). It also in line with the result of other similar study which showed a prevalence of MRSA colonization 44.0% on health care workers and healthy

residents of India (28). But is lower when compared with the carrier rate of (76%) Burns unit staff of Indian tertiary care hospital (29). This difference could be due to the fact that the Indian subjects were from special unit. The highest proportion of carriers was from surgical ward (31.0%) followed by medical ward (25.7%), and to a lesser extent by paediatrics, gynaecology and laboratory. This might be due to the long hospital stay of patients in surgical and medical wards as compared to other wards may contribute for increasing the chance of colonization of the staff from patients due to prolonged contact.

Antimicrobial susceptibility studies of the isolates by disc-diffusion methods indicated that all of the isolates (100%) were resistant to penicillin similar with the report from India (29). Most of the isolates in this study were also resistant to other commonly used antimicrobial agents. This result is in line with other similar studies from our country as well as other countries (20, 21, 30). Nevertheless, the resistance rate of our study is higher than reports of different studies in our country that showed all the isolates were resistant to at least four antimicrobials used (25, 31). It is also higher than the results from studies done on staff members and inpatients of Sudanese University hospital and India in which most of the isolates were found to be sensitive for the antibiotics used (29,30). The increased resistance in this study could be due to indiscriminate use of antibiotics leading to emergence of antibiotic resistant strains (17). Continuous genetic variation of the strains and over crowdedness of wards (higher exposure of staff member with patients) could also have contributed to the increase in resistance (32).

Resistance was demonstrated by all isolates to penicillin (100%), followed by to amoxicillin and tetracycline (71.4% each), erythromycin (68.6%), gentamycin and chloroamphenicol (57.1% each) and the least resistance was for vancomycin (31.4%). Though vancomycin was not in use before and during the study in our country for treatment, resistant strains to it were observed which might be due to importing of drug resistant strains from other countries or due to presence of natural resistance strains of S. aureus to the drug as occurred with methicillin (33).

Increased resistance to erythromycin (68.6%), gentamycin (57.1%) and clindamycin (40.0%) was observed in this study when compared with corresponding reports of 42.4%, 15.3% & 12.9% respectively while chloroamphenicol (57.1%) and co-trimoxazol (40.0%) showed a lesser result when compared with a (70.6%) and (68.2%) resistance found on the inpatients of Jimma Hospital (17). This might be due to the increased contact between the health workers and patients and survival of the most resistant strains of the bacteria in health professionals than the less resistant strains, it also might be due to the replacement of the sensitive strains by more virulent or resistant strains in hospital settings.

S.aureus is one of those organisms that can readily develop resistance to any antibiotic (32). Development of methicillin resistance among this organism is very important clinically. Since the first discovery of MRSA isolates in 1961, a large number of studies around the world have brought forth the increasing percentage of these isolates (33). Our study showed a 42.5% resistance for methicillin which is similar to the report from Jimma (40.0%) and Addis Ababa (44.0%) (22, 30). However, is higher when compared with a report from the general population of Pakistan (19.5%) and Sudanese University hospital, (30,32) and less than the report from Burn Unit staff of India (50.0%) and the carriage of inpatients of Jimma Hospital (52.0%) (17, 29).

Most proportion of the MRSA strains in this study were resistant to more than six drugs similar with other reports which showed multi-drug resistance (21, 24-28,34). The MRSA carrier state also varies with 68.0% & 32.0% for those working in inpatient and outpatients; respectively indicating those who are having maximum contact with admitted patients were at maximum risk of transmitting the organism to their patients and are in a maximum risk of acquiring nosocomial infection. Decolonizing staff using topical and oral agents like fucidic acid and employment of sufficient laboratory techniques before using any broad spectrum antibiotics was reported to help to minimize the spread of drug resistant strains of S. aureus (32, 29).

In conclusion our study indicated that S. aureus nasal carriage is in expected adult population range with a higher MRSA rate. Despite the smaller sample size we used, the findings indicated the need for an effective infection control to be employed. However, further study better be carried out on a larger sample health care workers.

ACKNOWLEDGEMENTS

We would like to convey our heartfelt gratitude to the staff of Jimma University Specialized Hospital for their willingness and all rounded support during sample collection, also Jimma University for supporting us with materials. Our special thanks goes to Pasture Institute for providing us with Erythromycin and Gentamycin discs and Ato Tamene Abdisa from Jimma Zone Public Health Laboratory for his support with materials and provision of the rest of the discs.

REFERENCES

1. Cheesbrough M. District Laboratory Practice in Tropical countries: Vol II Cambridge: Cambridge University press: England 2002: 225-248.
2. Koneman EW, Allen SD, Janda WM, etal: Color Atlas & Textbook of diagnostic Microbiology, 4th ed, J.B, Lippincott co.1986.
3. Belkum AV, Erikens W.HR, Sijmon S.M., Leeuwen W, Vander Berg M. Khuytmans J et

al. Coagulase & protein a polymorphism don't contribute to Persistence of nasal colonization by *Staphylococcus aureus*. *J Med Microbio l* 1997; 46: 222-223.

Saxena AK, Panhotra BR, Chlopra R. Advancing age & the risk of nasal carriage of staphylococcus aureus among patients on long-term hospital based haemodialysis. *Ann Saudi Med*. 2004; 24(5): 337-342.

5. Masshase A, Sachiti GC, Debia IA. Evaluation of antibiotic resistance in gram-positive pathogens. *Jchemother*. 2000: 12: 459-462.
6. Collee JG, Fraser AG, Marmion BP et al. Practical Medical Microbiology, 14th d. New York: Churchill Livingstone, 1996 .
7. Guidelines for Management of Patients with MRSA in Acute care Hospitals & long Term care facilities: The MRSA Interagency Advisory committee & Connecticut Department of Public health.1993; 4–6.
8. Murray PR, Rosenthal KS, Kobayashi GS et al. Staphylococcus & Related Organisms In. Medical Microbiology: 4th ed. St. Louis Mosby Inc. 2002:202-217.
9. Alshami I, Matthews RC, Burnie JP et al. Differential growth of epidemic MRSA in Vancomycin. *British Journal of biomedical Sciences*. 2005; 62 (3): 109-113.
10. Jod; AL, Matthew TH. Staphylococcus aureus: super bug, super genome? *Trends Microbiol.* 2004; 12(8): 379-385.
11. Rughoopuht S. The role of pseudomonas aeruginosa in nasocomial infections. Biomedical scientist. *Gazette of the institute of biomedical science*. 2001; 45(5):463-167.
12. Stewart GP, Holt RJ. Evolution of natural resistance to new penicillin's, Br. Med J. 1962;1: 309-11.
13. Nielsan S., ladetoged S., Kulmos H. Dialysis catheter related septicaemia: Focus on *Staphylococcus aureus* septicaemia. Nephrolbial transplant 1998; 13: 2847-2852.
14. Crowcroft NS, catchpole M. Mortality from MRSA in England & Wales: analysis of death certificates. *BM J* 2002: 325: 1390 –1391.
15. Edine WT, Outi L., John Ed, et al. MRSA in Europe, 1999-2002: *Emerg Infect Dis*. 2004; 10 (9):1627-1634.
16. Denis WS. Hospital Acquired Infections. *The Medical Journal of Australia*. 2002; 176(6):286-291
17. Barana B. Nasal carriage of MRSA strains among inpatients of Jimma Hospital, south Werstern Ethiopia. *Ethiop J Health Sci*. 2003; 13(2): 107-116.
18. Tenover FC, Biddle JW, Lancaster MV-Increasing Resistance to Vancomycin & Other glycopeptides in *Staphylococcus aureus*. *Emerg Infect Dis*. 2001:7:327-332.
19. Votopopulus AC, kalapothakinv: Bacterial Resistance to ciprofloxacin in Greece: Results from National Electronic Surveillance system: *Emerg Infect Dis*. 1999: 5(3):471-476.
20. Geyid A, Lemeneh Y. The Incidence of MRSA strain in clinical specimen in relation to their B .lactamase producing & multiple drug resistance properties in Addis Ababa. *Ethiop med. J*. 1991; 29 (4):149-161.
21. Beyene G. Abdisa T. common Bacterial Pathogens & their antibiotic sensitivity at Jimma Hospital: A four Year retrospective study. *Ethiop J Health Sci*. 2000; 10(2): 129-136.
22. W/Tenssay Z, Testaye H. Multiply resistant enteric Pathogens in intants feeds, feeding teats & stools of bottle fed-babies from Addis Ababa, *Bull of JIHS* 1993; 3(1) 61-71.
23. Torregrossa MV, valentionl, cucchiar P, Masellism M, SucamelI M: Prevention of Hospital Acquired Infections in the Palermo Burns Centre. *Annals of Burns & fire disaster* 2000: 13(3) 143-149.
24. Nguyen Q.V, Jaimovich D, Konop R.,Domachowske J.,Tolan RW.,Steele R.: Hospital Acquired infections: Instant access the minds of medicine: Sept 2004. [MEDLINE].
25. Tewodros W, GedebouM. S.aureus from a Surgical Department: Nasal carriage, environmental contamination, and susceptibilities to antimicrobials. *Ethiop Med J*. 1983: 21: 209-215.
26. Whitby, M., McBryde, E. S., Bradley, L. C.: An investigation of contact transmission of methicillin-resistant Staphylococcus aureus. *J Hosp Infect*. 2004 58 (. 2) 104-108.
27. Gustavo P.K, Marines D.V, Igor M.M et al. High frequency of colonization and absence of identifiable risk factors for MRSA in intensive care unit in Brazil. *Braz J. infect. Dis* 2001; 5(1):1-7.
28. Saxena S., Goyal R., Das S., et al. Prevalence of MRSA colonization among health care workers and healthy community residents. ICDDR, B Periodicals: *Journal of health population and Nutrition*; 2002; 209(3): 279-280.
29. Aravind P., Krishanan P.U., Srinivasa H. Screening of Burns unit staff of Tertiary care hospital for MRSA colonization. *Mc Gill Journal of Medicine*. MJM 2000 5(2): 80-84.
30. Ahmed AOA, Fahal A.H, Abutlnor A.E. et al. Nasal carriage of S.aureus & Epidemiology of surgical-site infections in a Sudanese university Hospital: *J of cln. Microbiolo*. 1998; 36(12): 3614-3618.
31. Asrat D., W/Amanuel Y. Prevalence and antibiotic susceptibility pattern of bacterial isolates from blood cultures in Tikur Anbessa Hospital, Addis Ababa. *Ethiop Med J* 2001; 39(2) 97-104.

32. Anwar MS., Jaffery G., Bhatti K.R., et.al: staphylococcus aureus & MRSA nasal carriage in general population: *JCPCP* 2004; 14(11): 661-664.
33. Jevons M.P., 'celbenin' resistant staphylococci. *British Medical Journal* 1961; 1: 124-125.
34. Megersa D. Drug resistance: A retrospective survey in Illubabor Region. *Bull JISH* 1993; 3:51-61.