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Prevalence of Methicillin-resistant *Staphylococcus aureus* among Health Care Workers in Tripoli Hospital, Libya

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Authors' contributions

This work was carried out in collaboration between all authors. Authors BD and WMZ designed the study, carried the experiments. Authors MSAH and AMZ managed the literature. Author BD did the analysis and wrote the first draft of the manuscript. Authors BD and FMG contributed to the study design, the analysis of the results and writing the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: *Staphylococcus aureus* is a common cause of community and a hospital infection, methicillin-resistant *Staphylococcus aureus* (MRSA), is a common nosocomial infection pathogen,

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its resistance to multiple antibiotics has made it difficult to control. Healthcare workers are the most important source of MRSA nosocomial transmission in hospital. The main aim of our study is to determine the prevalence of MRSA, which was isolated from healthcare workers nasal carriage from different department of Tripoli center Hospital in Libya, as well as to determine the resistance of the MRSA isolates to commonly used antibiotics.

Study Design: This cross sectional study was carried out at central medical center of Tripoli. Informed healthcare workers from different department of Tripoli center Hospital in Libya participated in this study. The Nasal swabs samples of Health care workers were collected for microbiology screening for MRSA.

Place and Duration of Study: Samples were collected from Health care workers present in the different departments of Tripoli Centre hospitals from January– July 2013.

Methodology: A total of 408 nasal swabs of health care works in center Tripoli hospital were collected and microbiology laboratory investigation for positive results, which were identified as *S. aureus* that were mannitol fermenting colonies, gram-positive cocci, catalase positive and coagulase positive. The disc diffusion methods were used for antibiotic susceptibility test and methicillin resistance.

Results: The 408 nasal swabs samples were collected from healthcare workers out of which 64 (15.7%) isolated *S. aureus* and 14 (21.9%) MRSA. The highest MRSA rate was in samples collected from nurses (7.8%). About the department, the surgical wards and operating room had the highest rate of MRSA (28.6%) than other hospital department that participated in this study. The MRSA isolated from Health care workers were tested for antibiotic resistance, the result was erythromycin (75%), ciprofloxacin (70%), clindamycin (30%), trimethoprim/sulfamethoxazole (50%), quinuprisin/dalfopristin (20%), vancomycin (15%) and mupirocin (4%). The disk diffusion result indicated that 20% of those isolates had inducible resistance to clindamycin (MLSBi) and about 11% were characterized as having an MLSBc (constitutive) phenotype.

Conclusion: The results provide evidence that Libyan health care workers could serve as MRSA carriers and play a role in the dissemination of MRSA to the public and other workers.

Keywords: MRSA; Tripoli hospital; nasal carriage; antibiotic susceptibility; MIC; healthcare workers.

ABBREVIATIONS

MRSA : Methicillin resistant Staphylococcus aurues
NICU : Neonatal intensive care unit.
MLSBi : Macrolide-lincosamide-streptogramin B inducible resistance;
MLSBc : Macrolide-lincosamide-streptogramin B constitutive resistance.
NICU : Neonatal intensive care unit.
ICU : Intensive care unit.
CCU : Coronary Care Unit.
ENT : Ear, Nose and Throat

1. INTRODUCTION

Staphylococcus aureus is a common cause of community and hospital infections. The main source of hospital-acquired infection is Methicillin resistant *S. aureus* (MRSA), which considered as an significant factor contributing to failure of infection control and management [1]. MRSA isolates are resistant to all available penicillin and other beta-lactam antimicrobial drugs [2]. It is commonly isolated from skin and soft-tissue infections, pneumonia, septic arthritis, endocarditis, osteomyelitis, foreign-body infections, and sepsis [2,3]. Though MRSA infections were limited mostly to hospitals, other health care environments, and patients frequently visiting these facilities [2]. On the conflicting, there has been an outbreak of MRSA infections related for those populations who have lacking the risk factors for exposure to the health care system [4]. These are considered as the most important cause of hospital acquired infections and community-acquired infections, resulting in increased morbidity and mortality in the hospital settings [5,6]. In 1960s, Methicillin antibiotic was started as the treatment of infections caused by penicillin's resistant *S. aureus,* methicillin resistant *S. aureus* appeared in 1961 in England [7].

Methicillin-resistant *S. aureus* is not restricted to any geographic area; it is a worldwide problem [8]. Europe has a strong presence of MRSA, accounting for approximately 44% of nosocomial infections in the year 2008 [9]. Fortunately, this is improving because of surveillance programs and stringent outbreak control criteria [10]. Hospital-acquired MRSA has a high prevalence in New Zealand and The Netherlands [10], Australia [11], North Africa, the Middle East, and East Asia [12] and has been reported in 25% or more of *S. aureus* isolates in Bulgaria, Croatia, Cyprus, Greece, Israel, Italy, Malta, Portugal, Ireland, Romania, Spain, Turkey, and the UK [9]. Community-acquired MRSA has a higher prevalence in the US [8], Canada [8], and Australia [9,11]. Standard precautions are recommended when treating those patients with infection or those who are susceptible to infection. Accordingly, health care providers should wear gloves when examining or treating body areas with a suspected cutaneous lesion; and proper hand washing following examination or treatment is required [12], including proper hand hygiene; gloving; wearing eye, mouth, and nose protection; gowning; cleaning equipment with disinfectant; and the appropriate cleaning of laundry [8].

The main studies has been widely discussed the responsibility of health care workers for nosocomial transmission of MRSA in hospital, and mentioning that they are a main source of nosocomial transmission of MRSA in developing countries [13,14] as Libya [15,16]. Also the other studies reported that health care workers play an important role for MRSA spread in hospital [17]. In the present research the prevalence and antimicrobial susceptibility of MRSA isolated from nasal carriage of healthcare workers in the Tripoli hospital was investigated.

2. MATERIALS AND METHODS

2.1 Isolation and Identification of Clinical Specimens

The study was carried out at central medical center of Tripoli during the period of January–July 2013 as cross sectional study. Informed consent was taken from all the participants. Nasal swabs from 204 Health care works were collected before commencement of duties. Health care works that was excluded from this study who with history of upper respiratory tract infection, fever, recent nasal surgery, diabetes, that with nasal medications, or use antimicrobial therapy. The samples of Nasal swabs from anterior nares of the health care workers were collected using sterile cotton swabs previously moistened with normal saline. This was introduced 2–3 cm into the nasal cavity and rotated 4–5 times both clockwise and anticlockwise. Then, in microbiology laboratory samples were inoculated onto Mannitol salt agar and incubated at 37℃ for 24 hours. The positive result for *S. aureus* colonies with yellow or golden yellow fermented mannitol colonies that were selected, and sub-cultured on Nutrient agar. Followed by Gram's staining, catalase test and coagulase test [18].

2.2 Antibiotic Susceptibility Testing

The antibiotic susceptibility pattern of all the confirmed MRSA strains isolated from collected samples in this study was determined by Kirby Bauer disc diffusion method (1966) as recommended by CLSI guidelines [19], which were tested against: oxacillin, trimethoprim/ sulfamethoxazole, erythromycin, clindamycin, ciprofloxacin, mupirocin, quinupristin/dalfopristin, vancomycin and linezolid. Minimum inhibitory concentrations (MICs) were determined by the agar dilution method [20] only for isolates that exhibited resistance to vancomycin and mupirocin in the disk diffusion susceptibility tests. Disk diffusion tests were performed on isolates exhibiting erythromycin resistance to assay for inducible clindamycin resistance [macrolide-lincosamide-streptogramin B inducible resistance (MLSBi) phenotype], as described by Fiebelkorn et al. [21].

2.3 Data Statistical Analysis

Data was analysed using Statistical Package for Social Science (SPSS) computer software (Version 19, SPSS Inc. USA). The contributing collected samples were divided into groups. Data were presented and described by using mean, mode, standard deviation, cross tabulations and graphical presentations. A chi-square test was performed to examine and compare the prevalence of MRSA infection between studied groups.

2.4 Ethical Consideration

The study protocol was reviewed and approved by the Ethical Committees of National Authority for Scientific Research (NASR) of Libya in December 2012by health ministry of Libya. All participants endorsed a written informed consent form.

3. RESULTS AND DISCUSSION

The 408 nasal swabs samples were collected from healthcare workers it was found that 15.7% were *S. aureus* and 21.9% of MRSA with the overall MRSA rate being 3.4%. Nasal carriage among male and female health care workers were 19.4% and 11.5% respectively *(P > 0.05).* The samples of doctors were the highest *S. aureus* rate about 20.8%, whereas MRSA rate was highest with nurses 7.8% (Table 1). The health care worker in hospital in surgery, operating room and emergency had the highest rate of MRSA was, about 40-50%, while the worker in ophthalmology department had the high rate (60%) of *S. aureus* (Table 2). All isolated MRSA showed complete resistance to oxacillin antibiotic, and 75% to erythromycin, and the result of disk diffusion tests indicated that 20% of those isolates had inducible resistance to clindamycin (MLSBi phenotype). Only 50% clindamycin-resistant strains exhibited an MLSB phenotype as recommended by BSAC guidelines. Furthermore about 11% were characterized as having an MLSBc (constitutive) phenotype. The disk diffusion susceptibility test result showed that 4% isolates resistance to mupirocin, 70% ciprofloxacin resistant, 50% resistance to trimethoprim/ sulfamethoxazole, 15% vancomycin resistant, the most of the MRSA resistant were recognized with hospital isolates (Table 3).

Methicillin-resistant *S aureus* is a common problem in health care facilities, sports facilities, clinics, and the community. Previously in Libya the prevalence of MRSA was reported to be around 39% [15,16]. This study identified *S. aureus* rate in nasal carriage samples of health care workers was about 15.7%, which lower compared to previous studies in Tripoli hospital (51%) [22], Also the another study in Libyan hospital in Tripoli found that MRSA among health care workers in Tripoli, Libya about 19% [23,24]. In our study, the rate of MRSA was 3.4%, that was lower than compared earlier study that found nasal carriage rate of MRSA about 10% [25,26], and about 17.8% MRSA carriage rate in reported international studies [24,27,28]. These differences may be due to using the varied microbiology screening method for isolation, cultivation and MRSA identification techniques, and could be related to the difference in standards of local management and infection control of prevalence of MRSA. That result which lead researcher to suggest that assessment of health care workers should be achieved before starting hospital work to prevent MRSA carriage transient between hospital department and workers [29].

In present study, *S. aureus* rate was highest for doctors about 20.8% while MRSA rate was highest among nurses about 7.8%, that was similar to Shibabaw group result [30]. Because nurses have high direct patient contact than other health workers, this could be the reason for the high rate of MRSA strains isolated from the nurses than other health care workers in this study. Furthermore the health care workers in surgical ward and operating room were the highest rate compare to other department was about 30% of the MRSA carriers each. This could be related to the traumatic and postoperative immunological suppression of the patients [31]. The nasal carriage of MRSA among health care workers has increased the possibilities of transmission of the bacteria infection to patients in care unit. in this study observed that the most isolates *S. aureus* and MRSA samples from health care workers in surgical department and operating room that could be due to the susceptibility of surgical wound infection with MRSA among the patients, causing transmission to the health care workers, further complicating the treatment and recovery.

Table 1. The percentage of *S. aureus* and MRSA isolated from different healthcare workers in Tripoli hospital

Healthcare workers	No of samples	*S. aureus*		MRSA (%)	
		No. of sample	%	No. of sample	%
Doctor	144	30	20.8	2	1.4
Intern	72	12	16.7	2	2.8
Nurse	102	12	11.8	8	7.8
Attender	44	8	18.2	2	4.5
Laboratory personnel	32	2	6.3	0	0
Others*	14	0	0	0	0
Total	**408**	**64**	**15.7**	**14**	**3.4**

**Other participated as pharmacists and drug supplier*

As the direct connection between in healthcare worker and patient in the emergency department high patient turnover, potentially substantial crowding, and many infected patient wounds that are being drained, explored, and dressed; perhaps it is these characteristics of the emergency department, along with the emergence of MRSA infections in this setting, that explain the colonization observed among health care work in emergency department [32].

Table 2. The frequency of *S. aureus* and MRSA isolated from healthcare works of different Tripoli hospital wards department

Wards/ Department	No of samples (n=408)	*S. aureus* (n=64)	MRSA N=14
NICU	42	6	0
Surgery	54	10	4
Operating room	52	10	4
Orthopedics	34	2	0
Medical	46	6	2
Gynecology	32	4	0
Emergency	22	4	2
ICU	8	0	0
CCU	6	2	0
Dermatology	16	4	0
Ophthalmology	10	6	0
Psychiatry	18	6	2
ENT	8	0	0
Radiology	20	2	0
Others*	40	2	0

**Others department in hospital as pharmacy unit, Laboratory and supplier rooms*

Table 3. Antimicrobial resistance rates of confirmed methicillin-resistant *Staphylococcus aureus* isolates from health care worker nasal swab in Tripoli center hospital

Antibiotics	Resistance (%) MRSA
Oxacillin	100
Ciprofloxacin	70
Erythromycin	75
Trimethoprim/ sulfamethoxazole	50
Clindamycin	30
quinupristin	20
vancomycin	15
muprocin	4
MLSBI	20
MLSBC	11

In the recent study, a high proportion of the definite MRSA isolates (77%) showed resistance to flouroquinolones. Resistance to mupirocin was only present in a small proportion of isolated MRSA. Mupirocin is the drug of choice in nasal MRSA colonization treatment and it has been reported to be effective in control MRSA infection [13]. However, new MRSA infection has been reported even after the use of mupirocin [33]. Macrolide and lincosamide resistance are significant reported among MRSA isolates. Before MRSA-MLSB phenotypes have been reported in Libya [34]. MRSA can severely compromise therapy and is associated with unsuccessful clindamycin treatment of MRSA infections [35]. The large proportion of isolates that were clindamycin susceptible in the current study (70%) suggests that the MRSA isolates from health care workers were most likely community-acquired strains. Just over half of the clindamycin-resistant strains expressed an MLSB phenotype. The existing data and others suggest that clindamycin could still be used to treat MRSA infections in our hospital, while susceptibility testing for the detection of inducible resistance to clindamycin should be regularly investigated [34].

4. CONCLUSION

The present study shown that the prevalence of MRSA for health care works from nasal carriage samples was lower than other studies in Libya and another country. In this study the highest rate of MRSA is among nurses. The surgical department and operating room in center Tripoli hospital had the highest rate among the health care workers. The results of the recent study recommended that requirement for establishing the infection control programmers and antibiotic monitoring in hospital; it also suggested that additional needed to urgent MRSA-focused studies in Libya. The data regarding antimicrobial resistance profiles of MRSA reported here provide important information for clinicians and epidemiologist the need for a national MRSA monitoring system. Future studies should focus on determining the rate of MRSA transmission between health care workers in hospital and patients.

CONSENT

All authors declare that verbal informed consent was obtained from the paraticbate for publication of this case report.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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