Nasal Carriage of *Staphylococcus* in Health Care Workers in Benghazi Hospitals

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Received May 07, 2014; Revised June 21, 2014; Accepted July 08, 2014

Abstract

This study was aimed to determine the frequency of staphylococcal nasal carriage of health care workers (HCWs) and antimicrobial susceptibility profile of the isolates in hospitals of Benghazi, Libya. The study was conducted in the period between April 2013 and August 2013 on HCWs from ten hospitals in Benghazi-Libya. Nasal swabs from anterior nares of HCWs were cultured and identified as *Staphylococcus aureus* (*S. aureus*), coagulase - negative staphylococci (CoNS) and methicillin-resistant *S. aureus* (MRSA) by using standard methods. Antimicrobial susceptibility testing was performed on Muller Hinton Agar using disc diffusion method. Of the 472 HCWs, (47.5%) were nasal carriers of *S. aureus*, (21.4%) for MRSA and (26.1%) for MSSA, (36.4%) of CoNS. The highest carriage rate for *S. aureus* was in Physician (30.6%) followed by nurses (20.4%), helpers (22.9%) and technicians (10.9%). Almost all of the isolates showed high resistance against penicillin (97.5%) and ampicillin (98.2%). The lowest resistance recorded was for augmentin (14.2%), gentamycin (7.1%), clindamycin (7.5%), ciprofloxacin (3.2%) and vancomycin (2.1%). Most of isolated strains were susceptible to rifampicin (98.9%). The emergence of resistant strains of *S. aureus* should be prevented by controlling the amount of antibiotics used in and out of hospitals. Also, better control measures of nosocomial infection must be established.

Keywords: Nasal carriage, health care workers, *Staphylococcus aureus*, Staphylococcus

Cite This Article: Nadia. E. Al-Abdli, and Saleh.H. Baiu, “Nasal Carriage of Staphylococcus in Health Care Workers in Benghazi Hospitals.” *American Journal of Microbiological Research*, vol. 2, no. 4 (2014): 110-112. doi: 10.12691/ajmr-2-4-1.

1. Introduction

*Staphylococcus* is a major nosocomial pathogen, both methicillin-sensitive *Staphylococcus aureus* (MSSA) and methicillin-resistant *S. aureus* are important causes of healthcare-associated infections. Healthcare workers (HCWs) may carry pathogenic hospital strains in their nose and skin, where (HCWs) are vectors of transmission [1]. Accordingly colonized healthcare workers (HCWs) may constitute a reservoir for transmission of resistant organisms like MRSA to patients and other HCWs [2], and may spread these pathogens to the community leading to more dreadful condition [3]. HCWs, who have direct contact with persistently colonized patients, or contaminated objects in the immediate environment around them can contaminate their hands and subsequently transmit the organism to other patients. A subset of these will remain as nasal carrier for a prolonged period of time and may spread the organism to patients by direct contact transmission [4].

The fact that huge portions of healthy population carry *S. aureus* in their nose and body surfaces is responsible for the fast spread of the staphylococcal infections and the situation seems worse in hospitals [5]. So, study of *S. aureus* as nasal carrier is of importance, especially in health care workers to explore the clear picture regarding its existence. Other staphylococci such as coagulase - negative *Staphylococcus* (CoNS) are also pathogenic. Methicillin - resistant CoNS (MRCoNS) have also been found worldwide. Moreover, CoNS may transfer its resistance to MRSA [6,7]. Almost 25% of the health care workers are stable nasal carriers, and 30% to 50% of them also possess the bacteria on their hands [8,9]. Occasionally, health care workers who carry *S. aureus* in their nares are at high risk of infection and can be a potential source of nosocomial pathogens. The aim of this study was to describe the pattern of colonization with *Staphylococcus* among HCWs of Benghazi Hospitals in Libya as well as the antibiotic susceptibility pattern of these isolates.

2. Material and Methods

2.1. Collection of Samples and Isolation of Bacteria

This study was performed from April to August 2013 in ten hospitals of Benghazi, Libya. (Psychiatric hospital and Al-Erada sanatorium, Benghazi Medical Center, 7th of October hospital, Benghazi Childrens hospital, Al-Joumhouria hospital, Cardiac Center, Nephrology Center, Al-Jala Hospital, Urology and ENT Centers and Eye...
hospital. This study was done on a total of 472 HCWs. The ages of all study population were from 20 year to 65 year.

2.2. Cultivation and Identification

Specimens were collected from the anterior nares with sterile dry cotton swabs (SPA Cultiplast, Melano-Italy), dipped in normal saline (0.9%). All swabs were inoculated on blood agar (BA-HiMedia, India) and subsequently on Mannitol salt agar plates (MSA-HiMedia, India) and were incubated at 37°C for 24-48 hours. Well isolated colonies were initially Gram-stained and then biochemical tests such as catalase, DNase and coagulase tests [10] and API Staph (BioMérieux, France). Characterized according to Bergey’s.

2.3. Methicillin-Resistance Test

Methicillin resistance was tested using Mueller- Hinton agar with Cefoxitin disc (30 µg) by Kirby-Bauer disc diffusion method [11]. Zone diameters were measured and recorded after a 24h incubation at 37°C. A zone size of >22 mm was considered sensitive and < 21 was considered resistant [12].

2.4. Antibiotic Susceptibility Testing

Standardized Kirby-Bauer disc diffusion method, was performed on Mueller-Hinton agar. Single isolated colonies were selected and inoculated in Mueller-Hinton broth and placed in incubator for 24 hours at 37°C. When its turbidity is comparable to 0.5 McFarland turbidity standards, the plates were inoculated with each broth culture and left to dry before the application of antibiotic discs. The plates were inverted and incubated at 35-37°C for 18-24 hours. Results were interpreted according to the criteria of CLSI (2012) [12].

3. Results

Prevalence of various microorganisms in health care workers among the 472 samples, 396 (83.9%) samples were positive for at least one of the staphylococcal species. Nasal carriage of staphylococci was (83.9%), comprising of (47.5%) S. aureus and (36.4%) CoNS (Figure 1).

![Figure 1. Percentage of Staphylococcus among study population](image)

All study population was screened for MRSA colonization (Table 1). The overall MRSA colonization among (HCWs n=472) at Benghazi Hospitals was 101 (21.4%). Of hospital group colonized with MRSA 37 (30.6%) were Physician, 34 (20.4%) nurses, helpers 19 (22.9%), and technicians 11 (10.9%). This shows that the high carriage rate of MRSA was observed among Physician (30.6%) compared with other HCWs.

| Table 1. Distribution of nasal staphylococci |
|---------------------------------------------|
| **Staphylococcus Carriers**                  |
| Category | No | MRSA % | MSSA % | CoNS % |
|---------------------------------------------|
| Physician | 121 | 37 | 30.6 | 29 | 24 | 53 | 52 |
| Nurses | 167 | 34 | 20.4 | 46 | 27.5 | 60 | 35.9 |
| Helpers | 83 | 19 | 22.9 | 26 | 31.3 | 39 | 47 |
| Technicians | 101 | 11 | 10.9 | 22 | 21.8 | 20 | 20 |
| HCWs | 472 | 101 | 21.4 | 123 | 26.1 | 172 | 36.4 |

After the identification of S. aureus, susceptibility test was done by both Disk diffusion method. A total of 281 strains of S. aureus were isolated and tested for their antimicrobial sensitivity patterns. Almost all of the isolates showed high resistance against penicillin where, approximately (97.5%) of the isolates being resistant to this drug. High rates of resistance to ampicillin (98.2%), Fusidic acid (61%), amoxicillin (58.4%), cefoxitin (43.8%), oxacillin (42.7%) and erythromycin (35.9%) were observed with strains isolated from all population study. The lowest resistance recorded was for augmentin (14.2%), gentamycin (7.1%), clindamycin (7.5%) ciprofloxacin (3.2%) and vancomycin (2.1%). On the other hand, most of isolated strains were susceptible to rifampicin (98.9%). The percentages of antibiotics resistant, susceptible and intermediate in Benghazi hospitals are shown in (Table 2).

| Table 2. Antibiotic sensitivity profile of S. aureus isolates |
|-------------------------------------------------------------|
| **Antibiotics** | **Resistant** | **Susceptible** | **Intermediate** |
|---------------------------------------------|
| Category | No | % | No | % | No | % |
|---------------------------------------------|
| Penicillin | 274 | 97.5 | 7 | 2.5 | - | - |
| Augmentin | 276 | 98.2 | 5 | 1.8 | - | - |
| Cefoxitin | 123 | 43.8 | 157 | 55.9 | 1 | 0.4 |
| Gentamycin | 20 | 7.1 | 259 | 92.2 | 2 | 0.7 |
| Ciprofloxacin | 9 | 3.2 | 272 | 96.8 | - | - |
| Fusidic acid | 171 | 61 | 110 | 39.1 | - | - |
| Augmentin | 40 | 14.2 | 241 | 85.8 | - | - |
| Erythromycin | 101 | 35.9 | 172 | 61.2 | 8 | 2.8 |
| Clindamycin | 15 | 6.4 | 263 | 93.6 | - | - |
| Cotrimoxazole | 16 | 5.7 | 264 | 94 | 1 | 0.4 |
| Oxacillin | 120 | 42.7 | 151 | 53.7 | 10 | 3.6 |
| Rifampicin | 3 | 1.1 | 238 | 98.9 | - | - |
| Amoxicillin | 164 | 58.4 | 117 | 41.6 | - | - |
| Vancomycin | 6 | 2.1 | 238 | 84.7 | 37 | 13.2 |

4. Discussion

The current study explores Nasal Carriage of Staphylococcus in Health Care Workers in Benghazi Hospitals. In the present study the prevalence of S. aureus carriage was 47.3%; out of these 21.4% were MRSA and CoNS carriage rate was 36.4% among HCWs, with some differences between hospitals. These rates are higher than those reported in other areas of the world [13,14]. Also similar results were reported by [15,16]. These rates are lower than those reported in other areas of the world [17,18,19,20]. All differences between countries and hospitals may be explained by microbiological methods (from sampling technique to culture media), local infection control.

In this study MRSA carriage was particularly high among Physicians, helpers, nurses. These rates are Similar
than those reported in other areas of the world [16,19,21]. The present study disclosed MRSA isolated from HCWs samples at Benghazi Hospitals were multidrug-resistant (MDR) and highly resistant (100%) to Beta-lactam antibiotics. These findings are similar to other studies [22,23].

This study showed that MRSA were Vancomycin-resistant and Vancomycin-intermediately susceptible S. aureus. This results agreed with finding of [24,25,26,27].

5. Conclusion

The present study indicated a high incidence of nasal carriage of staphylococci among health care workers. It also demonstrated that health personnel are at high risk of infection and can be a potential source of nosocomial pathogens, like S. aureus. Therefore, further support is required, recommendations could be made to introduce routine MRSA screening of health care workers as part of a suite of infection control measures and continuous surveillance and improvement of hygiene standards in hospitals should be adopted.

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