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Prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) among healthcare workers in Yafran general hospital

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انتشار المكورات العنقودية الذهبية المقاومة للميثيسيلين (MRSA) بين العاملين في مجال الرعاية الصحية في مستشفى يفرن العام

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Abstract:
Nasal carriage of MRSA among hospital personnel is a big problem in hospital environment. Accordingly, the main objective of current study was to determine the prevalence of MRSA among Health Care Workers (HCWs) in Yafran hospital. 108 HCWs samples of nasal swabs were collected, and cultured on Mannitol Salt Agar. The isolates were identified as *S. aureus* based on morphology. Besides, confirmatory tests were performed, including coagulase and catalase test. Finally, cefoxitin disc resistance was used to identify the MRSA strain. Antibiotic susceptibility testing of MRSA was performed according to the guidelines of the Clinical and Laboratory Standards Institute.
The results showed that, out of the 108 HCWs, 37 (34%) carried MRSA. MRSA carriage rate was highest among Administration Department workers 30 % compared to other professions, followed by Emergency Department workers 21% , Obstetrics and Gynecology workers 19 %, Radiology, Laboratory and Internal Medicine Department workers was 8% ,5% and 5% respectively. Tetracycline showed the highest rate of resistance among MRSA isolates 27%, followed by Vancomycin 22%. While the Ciprofloxacin showed less resistance 11%. In conclusions, the high rate of nasal MRSA carriage among healthcare workers found in this study is alarming and highlights the need for adjusted infection control measures to prevent MRSA transmission from HCWs to the vulnerable patient.

Keywords: Yafran hospital, MRSA, nasal carriage, antibiotic susceptibility, healthcare workers.

الملخص
إن نقل المكورات العنقودية الذهبية المقاومة للميثيسيلين عن طريق الأنف بين العاملين في المستشفيات يمثل مشكلة خطيرة في بيئة المستشفيات وخاصة على المرضى. لذلك، كان الهدف من هذه الدراسة هو تحديد معدل انتشار المكورات العنقودية الذهبية المقاومة للميثيسيلين بين العاملين في مستشفى يفرن. وقد أجريت هذه الدراسة على 108 من العاملين في مستشفى يفرن العام. تم جمع مسحات الأنف وزرعها على وسط المانيتول MSA. تم التعرف على البكتيريا المعزولة على أنها المكورات العنقودية الذهبية *S. aurues* بناءً على الشكل الظاهري للمستعمرات واختبار التخثر واختبار الكتاليز. وتم التعرف على المكورات العنقودية الذهبية المقاومة MRSA عن طريق مقاومة قرص سيفوكسيتين. ومن ثم اجريت اختبارات حساسية المضادات الحيوية بالانتشار القرصي وفقًا للإرشادات السريرية والمخبرية. حيث أظهرت النتائج أنه من بين 108 من العاملين كان 37 (34٪) يحملون المكورات العنقودية الذهبية المقاومة للميثيسيلين. وكان معدل نقل المكورات العنقودية الذهبية المقاومة للميثيسيلين (MRSA) الأعلى بين العاملين في قسم الإدارة بنسبة

30٪ مقارنة بالمهن الأخرى، يليه العاملون في قسم الطوارئ بنسبة 21٪، والعاملون في أمراض النساء والولادة بنسبة 19٪، والعاملون في أقسام الأشعة والمختبر والطب الباطني بنسبة 8٪ و5٪ و5٪ على التوالي. وقد أظهر التتراسيكلين أعلى معدل مقاومة بين عزلات المكورات العنقودية الذهبية المقاومة للميثيسيلين (MRSA) بنسبة 27٪، يليه الفانكومايسين بنسبة 22٪. بينما أظهر السيبروفلوكساسين مقاومة أقل بنسبة 11٪. يستنتج من هذه الدراسة إن المعدل المرتفع لانتشار المكورات العنقودية الذهبية المقاومة للميثيسيلين بين العاملين في مجال الرعاية الصحية أمر مثير للقلق ويسلط الضوء على الحاجة إلى تدابير مكافحة العدوى المعدلة لمنع انتقال المكورات العنقودية الذهبية المقاومة للميثيسيلين من العاملين في مجال الرعاية الصحية إلى المريض المعرض للخطر.

الكلمات المفتاحية: مستشفى يفرن، المكورات العنقودية الذهبية المقاومة للميثيسيلين، الحمل الأنفي للبكتيريا، حساسية المضادات الحيوية، العاملون في مجال الرعاية الصحية.

Introduction

Nowadays, nosocomial infections constitute a public health, but these infections still affect hospitalized patients in often-worrying proportions, which given the multi-resistance of many types of bacteria involved and their socio-economic cost. [1].

Healthcare-associated infection leads to serious illnesses and high mortality rates. These infections that are caused by some common bacteria are characterized by their ability to resist antibiotics multiply and simultaneously, this means one type of bacteria can resist many types of antibiotics [2]. In some isolates of bacteria, it is found to be resistant of many known antibiotics. This makes the treatment of infections complicated or sometimes impossible. It is worth noting the nature of patients in hospitals are often of the vulnerable class of immunity, due to age or because they have other diseases, which makes it easy for them to become infected [2]. In healthcare units, the infection could be transmitted in a variety of ways and from different sources including air, water, food, medical staff, patients themselves, tools, devices and others [2].

Out of many types of bacteria, *S. aureus* is one of the most important pathogens, which cause nosocomial infections and wide range of diseases [3]. It is commonly found on the surface of human skin and it is found in the nasal passages. Unfortunately, many strains of *S. aureus* have developed resistance to antibiotics, making it difficult to treat infections caused by these bacteria [4].

Currently, there has been an increase in the prevalence of methicillin-resistant strains of *S. aureus* (MRSA). These resistant strains can now be found in both hospital and community settings [5]. Moreover, it has also been found that the rate of MRSA has increased in Libyan hospitals during the last decades in patients with burns and infected surgical wounds. Despite all these studies that have been undertaken in Libya, very little is known about the prevalence of MRSA. Thus, the present study focused on the prevalence of *S. aureus* MRSA bacteria among healthcare workers in Yafran Hospital (western Tripoli, Libya).

Material and methods

Sample Collection

This study was carried out from 11th February to 30th of June 2024, at Yafran Hospital western of Tripoli, Libya. This study was conducted in all staff members who were working in the different hospital units including pediatrics unit, intensive care unit, obstetrics and gynecology, ambulance services, the surgical operations, and others. 108 consenting participants were included in the study. They were apprised of the details of the study. Personal information of the participants in the study, such as age, gender, and job title were collected.

Isolation and Identification of Bacteria

Nasal swabs were taken by using sterile cotton swabs from both nostrils of the health care workers (HCWs), which were moistened with sterile physiological saline and then inserted 2–3 cm into the nostrils [6], and were cultured in 1mL Nutrient Broth (NB) in plastic tubes. Then, samples were incubated at 37C for 24 h. Then, the samples were cultured on Mannitol Salt Agar (MSA) plates and incubated at 37°C for 24 h. Only samples that appeared as *S. aureus* on the MSA agar (colonies with yellow color) were selected. Following Gram staining, subsequently, confirmatory tests were performed, including: the coagulase and catalase tests [7]. Finally, it was used of Cefoxitin (30 µg) in the disc diffusion test for detecting methicillin resistance in *S. aureus* [7].

Antibiotic Sensitivity

Antibiotic susceptibility testing for all isolates of MRSA was performed, Tetracycline (30 µg), Gentamicin (120 µg), Rifampicin (5 µg), Ciprofloxacin (5 µg), and Vancomycin (30 µg) by the modified Kirby-Bauer method. Antibiotic sensitivity testing and interpretation of results were done according to CLSI guidelines [8].

Data Analysis

Following data collection from the samples, statistical analysis was performed using Windows Excel 2010 to compute frequencies, percentages, means, and standard deviations.

Results and discussion

Results

108 samples were collected from HCWs, whose ages ranged from 21- 60 years and were screened for MRSA (Table 1 and figure 1). Forty-nine (45%) were males and fifty-nine (54%) were females. It was found that 37 samples (34.25%) were MRSA. MRSA carriage rate was highest among Administration Department workers 30 % (11/108) compared to other professions, followed by Emergency Department workers 21% (8/108). Then Obstetrics and Gynecology workers 19 % (7/108), whereas carriage among Radiology, Laboratory and Internal Medicine Department workers was 8%, 5% and 5% respectively (Table 2).

Table 1 The age of the sample.

Age group	Frequency	Percentage
21-30	42	39%
31-40	34	32%
41-50	9	8%
51-60	23	21%

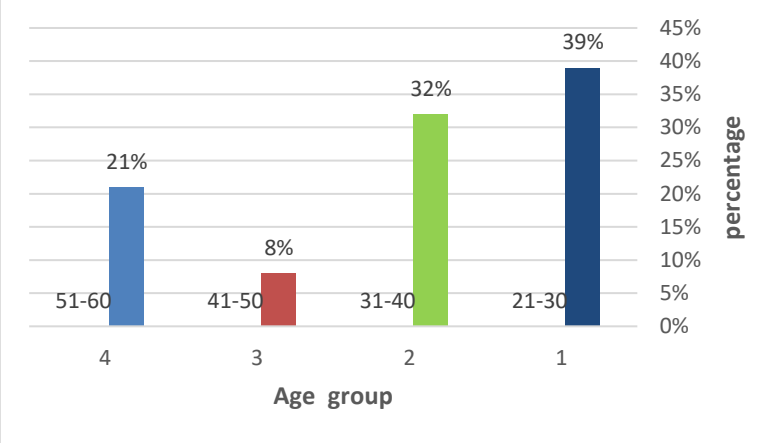

Figure 1 The age of the samples.

Table 2 MRSA carriage rate among different unit's workers.

Department name	Numbers of MRSA Infections	Percentage %
Obstetrics and gynecology	7	19%
Operating Room (OR)	0	0%
Emergency Department	8	21%
Physical therapy	1	3%
Administration Department	11	30%
Laboratory Department	2	5%
Pediatrics	0	0%
Anesthesiology	0	0%
Pharmacy Department	1	3%
Internal Medicine	2	5%
Orthopedics	0	0%
Radiology	3	8%
Sterilization Department	0	0%
Ophthalmology Department	0	0%
General Surgery	1	3%
Others	1	3%

The results of the current study showed varying rates of sensitivity and resistance to the antibiotics used against MRSA. The disk diffusion susceptibility test result showed that out of 37 isolates strains, 27% and 22% were resistant to Tetracycline and Vancomycin respectively. Followed by Gentamicin 16% and Rifampicin 14%. While the Ciprofloxacin showed less resistance 11% (Table 3 and Figure 2).

Table 3 The resistance and sensitivity of MRSA to antibiotics.

Antibiotics	Sensitive		Resistance	
	MRSA(n=37)	%	MRSA	%
Vancomycin	29	78%	8	22%
Ciprofloxacin	33	89%	4	11%
Rifampicin	32	86%	5	14%
Gentamicin	31	84%	6	16%
Tetracycline	27	73%	10	27%

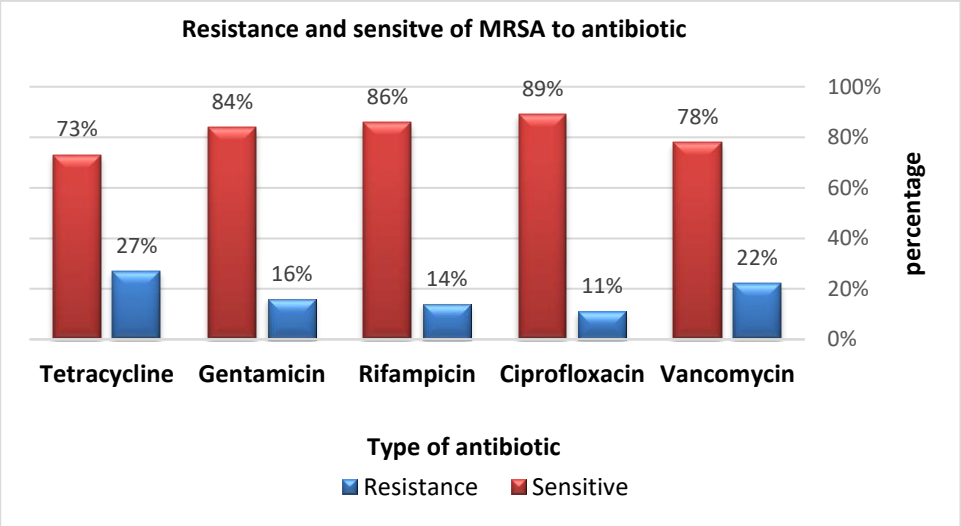

Figure 2 The resistance and sensitivity of MRSA to antibiotics.

Overall, the data indicates that the isolated MRSA strains exhibited varying degrees of sensitivity and resistance to the antibiotics tested. On the other hand, it was found that Ciprofloxacin was the most effective antibiotic, demonstrating 89% effectiveness, followed by Rifampicin (86%) and Gentamicin (84%), and then Vancomycin (78%) and the last was Tetracycline (73%).

Discussion

Prevalence of MRSA among HCWs in different hospitals units is considered a dangerous indicator particularly for those working in the critical care units. Therefore, these individuals act as a source of infection to their patients. The survey for MRSA carriage among HCWs is indispensable for those workers.

In the current study results, the nasal carriage rate of MRSA was 34.25% of HCWs at Yafran General Hospital. Several previous studies have shown the role of clinical staff as carriers of MRSA [9]. Screening for nasal carriers and colonized patients is very effective in controlling the spread of MRSA [10].

The previous studies found varying rates of *S. aureus* and methicillin-resistant *S. aureus* (MRSA) infections among patients and clinical samples. Based on studies conducted in Libya, in study in Tripoli, Libya from four main hospitals, Ahmed et al, [11] have reported that, the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) among HCWs (19%) were confirmed as MRSA. In addition, among 408 nasal samples were collected from HCWs present in the different departments of Tripoli Centre hospitals, (3.4%) were identified as MRSA [6]. In other study, 1542 HCWs in Western Australian acute care hospitals were screened for MRSA, of whom (3.4%) were colonized [12]. Moreover, out of the 200 HCWs in Al Shifa hospital in Gaza Strip, 51 (25.5%) carried MRSA [13]. These results were lower than current study results, which the rate of MRSA was (34.25%). Furthermore, Zorgani et al, [9] have reported that 36.9% of the *S. aureus* isolates collected from HCWs at six different Libyan

hospitals were MRSA, which is close to our results. These differences of these studies may be due to using the varied methods for isolation and bacteria identification with different techniques [6].
Regarding antibiotic resistance, in current study was showed different resistance to antibiotics, which were Tetracycline 27%, Vancomycin 22%, Gentamicin 16% and Rifampicin 14%, while the Ciprofloxacin showed less resistance 11%.
Several studies have investigated the susceptibility of MRSA that isolated from Health care workers to various antibiotics. Doro et al, [6] have reported in their results, MRSA was resistant to Ciprofloxacin (70%) and Vancomycin (15%). Similarly, Ahmed et al, [11] found MRSA was resistant to Ciprofloxacin (77%) and Vancomycin (12%). As well as, Waheeb et al, [14] found that 37.5% of MRSA were resistant to Ciprofloxacin. Bouzid et al, [15] have also identified resistance rates of 17.7% to Vancomycin and 33.9% to Ciprofloxacin among MRSA strains. In our results the same antibiotics that used in this study including Ciprofloxacin, which was more sensitive than these current results, while Vancomycin appeared lower sensitivity against isolated MRSA compared to our results. In addition, Abdullah et al, [16] have observed that 90.5% of *S. aureus* strains were resistant to Vancomycin and 61.9% to tetracycline. Yadav and Prakash [17] have also noted that, a Ciprofloxacin resistance rate of 55.56%, while MRSA isolates were highly sensitive to Vancomycin and Tetracycline, with sensitivity rates of 85.19%. Besides, MRSA isolated from Al Shifa Hospital in Gaza Strip were sensitive to Vancomycin (84.3%), Ciprofloxacin (88.2%), Tetracycline (86.3%), Gentamicin (92.2%) and Rifampicin (88.2%) [13].
Compared to our results, there were different effects against MRSA strains that isolated form many countries could be related to the difference in strain and its resistance to antibiotics.

Conclusion

In conclusion, this study provides valuable insights into the prevalence of *S. aureus* bacteria among healthcare workers in Yafran hospital, western Libya. The data indicates that approximately 53% of the healthcare workers tested positive for *S. aureus*, 34.25% were MRSA among *S. aureus* strains isolated, highlighting the presence of this bacteria in the hospital setting. Tetracycline showed the highest rate of resistance among MRSA isolates 27%, followed by Vancomycin 22%. While the Ciprofloxacin showed less resistance 11%. Furthermore, the findings demonstrate that the isolated MRSA strains exhibited different levels of sensitivity and resistance to specific antibiotics. Tetracycline showed the highest rate of resistance among MRSA isolates 27%, followed by Vancomycin 22%. While the Ciprofloxacin showed less resistance 11% .
The existing data suggest that Ciprofloxacin could still be used to treat MRSA infections, while susceptibility testing for the detection of inducible resistance to other antibiotics should be regularly investigated.

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