Resistance of *Staphylococcus* aureus isolated from nasal of hospital staff and patients against antibiotics

Shaker G. Jerjees AL-Mola
University of Mosul
College of Science
Department of Biology

Mahmood Zaki AL-Hasso
University of Mosul
College of Science
Department of Biophysics

Ahmed Yousif Al- Badrani
Ninava Health Directorate
Ibn sena teaching hospita, Ninava

Queasy Younis Ibrahim
Ninava Health Directorate
Ibn sena teaching hospita, Ninava

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Abstract: The aim of this investigation was to determine the incidence of *Staphylococcus aureus* in the nasal cavity and theirs antibiotic sensitivity profiles in health care workers and fallowed patients in Mosul Hospitals, Iraq. Nasal samples were inoculated on primary isolation medium and isolated *S. aureus* strains were identified using specific conventional bacteriological tests. Antimicrobial susceptibility profiles against some antibiotics were determined .The results explained that 34(34%) represented nasal bearing of *S. aureus*, and among them, 15 (44.11%) were MRSA holders. 42 (42%) were nasal carriers of Staphylococcus and among them 12 (28.28%) were MRSA carriers. Highest rate of MRSA nasal carriage 33.3 % (5/15) was found among nurses and at lower percentage among laboratory personal 4 (26.6%) , doctors and cleanness workers accounted for 20 % (2/15) of MRSA carriers for each. The results showed that *S. aureus* strains from nasal cavity of HCW were sensitive to Co-trimoxazole, Amikacin ,Gentamycin, Clindamycin at 97%,88.23%,85.29,79.4% and toward ciprofloxacin and cefoxitin at 82.35 for each one.

مقاومة المكورات العنقودية الذهبية المعزولة من التجويف الانفي للعاملين والراقدين في المستشفيات تجاه المضادات الحيوية

الملخص: هدفت الدراسة الى تحديد نسبة تواجد جرثومة المكوات العنقودية الذهبية في التجويف الانفي للاشخاص العاملين في مستشفيات الموصل وكذلك نسب تواجدها في التجويف الانفي للاشخاص المرضى الراقدين في هذه المستشفيات عام 2011 . تم تلقيح عينات مسحات التجويف الانفي على وسط العزل الاولي الخاص بالجرثومة وشخصت السلالات المعزولة باستخدام الاختبارات البكتيريولوجية التقليدية الخاصة للجرثومة . حددت مدى مقاومتها تجاه بعض المضادات الحيوية. اظهرت النتائج بان (34%)34 شخصا من الكادر الطبي كان حاملا لجرثومة المكورات العنقودية الذهبية وان كانت مقاومة (44%) 15 عزلة من لمضاد الميثيسلين, في حين اظهرت النتائج بان 42 شخصا من المرضى الراقدين كانوا حاملين لجرثومة المكورات العنقودية الذهبية وكانت نسبة العزلات المقاومة للميثيسلين(28.5%).بلغت اعلى نسبة تواجد للعزلات المقاومة للميثيسلين في التجويف الانفي لفئة الممرضين(33.3%) وبنسة اقل في العاملين بالمختبر(26.6%), اما في فئتي الاطباء وعاملي النظافة فقد بلغت اقل نسبة (20%). اظهرت النتائج بان العزلات المعزولة من التجويف الانفي للكادر الطبي كانت حساسة لمضادات Co–trimoxazole, Amikacin Gentamycin, Clindamycin بنسب 97%,88.23%, 85.29%, 79.4%على التوالي وتجاه مضادي ciprofloxacin and cefoxitin بنسبة 82.35%.

Introduction

The Asymptomatic carriage of *S. aureus* in the anterior nasal cavity of general population is an important dangerous element for several kinds of purulence internal infections in addition bacterial communication in confidential and opportunistic clinical habitats (Wertheim *et al*.,2005; Zia Sheikholeslami *et al*.,2015).

Nearly 20 to 30% of the human Individuals noses is abruptly or continuously colonized by *S aureus* (Klevens *etal*.,2007). Clinical reports showed that nearly 10% of the inhabiting S. *aureus* isolates were resistive to ß-lactams which considered the primary option of treatment with antibiotics. like these isolates are mostly identified as Methicillin-Resistant *Staphylococcus aureus* (MRSA). Recently, these strains considered the predominant common induction for inextricabled nosocomial contagious infections. (Klevens *etal*.,2007; Zia Sheikholeslami *et al*.,2015). Therefore, identification the asymptomatic carriage of MRSA by investigation procedures considered the essential medical protocols to eliminate the risk of nosocomial contagious transportation of MRSA-infections in clinical centers (Sheikholeslami *et al*.,2015).

Staphylococcus aureus represent the significant pathogen and common cause induction of opportunistic and population gained infections related with high decease and morbidity worldwide (Bode *etal*.,2010). *S. aureus* have a intimacy to colonize the several different systems of precisely human like skin and the upper respiratory tract (Kuehnert *et al*.,2006). Reports of several evaluations have explained that the anterior area of noses is the most common region in which present these bacterial strains. It is a virtuous and complicated dangerous element for subsequent staphylococcal infections in medical centers and general societies (Pérez-Vázquez *et al*., 2009). Colonization the nasal cavity with MRSA isolates has been suggested the augmentation seriousness of MRSA infections in straightway and extended holders (Fard-Mousavi *et al*., 2015).The nasal bearing average of *S. aureus* of universal individuals represent 30%, this average is higher in HCWs than the universal individuals which represent approximately 45% (Saadatian-Elahi *et al*.,2013). The recognition of nasal bearing average among HCWs and their antimicrobial sensitivity patterns is essential for infections eliminating and provide suitable treatment.

An essential factor during staphylococci therapy was the emergence of MRSA isolates as prevalent pathogens in nosocomial infectious diseases. Compatibly to reported evaluates, greater

than 50% of staphylococcal contagions are a gained in health service centers and clinical institutes (Nikfar *et al*. 2015, Moreira *et al*. 2013 , Finch 2006).

MRSA isolates are proofing to all beta-lactams resulting from the genetic production of weak tendency receptors for these antibiotics. MRSA are able to production several types of PBP2, like PBP2a, which persists the primary standard function, but with limit tendency to these antibiotics (Ratti and Sousa 2009, McCulloch *et al*. 2015).

The detection of HCWs inhabited with *S. aureus* accompanied with different sanitary procedures considered the chief clinical preventive protocol adding in decreasing the transmission and eliminating the incidence of staphylococcal infections. So, our research was conducted to determine the nasal inhabiting average of *S. aureus* and MRSA among HCWs in Mosul hospitals and to evaluate the antibiotic sensitivity patterns for these isolates.

Material and Methods

Case Study:

Our study performed in Mosul Hospitals Iraq, in 2012. 100 persons of the HCWs were comprised; we excluded the several cases like, nasal allergy, antibiotic therapy, upper respiratory tract disorder, and recent nasal medical operation from our investigation. Also a total, 100 hospitalized patients aching from several different infections were encompassed in our study in order to estimate the incidence percentages of *S. aureus* and MRAS in the naris cavities of case study individuals.

Sample collection:

we collect nasal samples by using clean sterile cotton swabs moistened with sterile normal saline, by entering the swab in the anterior part of noses and rotated it several times then directly placed in the vials of transport medium then transferred immediately to laboratory(Khanal *et al*.,2015)

Isolation and Identification:

Nasal samples were inoculated onto Mannitol salt agar (MSA) then incubated at 37 °C for 24hours. Suspected colonies were elected, after that, key conventional identification tests were done. . *S. aureus* isolates were identified coincident to distinct colony morphology and biochemical tests (Cheesbrough.,2006; Khanal *et al*.,2015).

Antibiotic sensitivity test:

This test was performed by modified Kirby Bauer method as described by CLSI criteria. The antibiotics used were cloxacillin (30 µg), ciprofloxacin (5 µg), cefoxitin (30 µg) , amikacin (30 µg), ceftriaxone (30 µg) , Amoxiclav(30 µg), clindamycin (2 µg),

cotrimoxazole (1.25/23.75 µg), erythromycin (15µg), vancomycin (30µg), gentamycin (10µg),trimethoprim-sulfamethoxazole (1.25/23.75 u), (CLSI., 2007)

Oxacillin disk diffusion test:

Muller-Hinton agar plates inoculated with a suspension of the *S. aureus* studied strains then incubated at 35 ºC for 24 hours, the zones of inhibition were measured . depending on Interpretive standards we estimated the results: 13 mm considered susceptible, 11-12 mm intermediate, and 10 mm resistant (Mimica *et al*., 2007).

Results and Discussion

A total of 100 HCWs, participated in this study. Among the all cases examined, 34 34%) persons were accounted as *S. aureus* holders and among them 15(44.1%) were MRSA carriers as shown in Table 1. Whereas, 56 samples (56%) showed negative culture for *S. aureus* and classified as non carriers. Of 100 hospitalized patients 42 (42%) were *S. aureus* carriers and among them 12 (28.28%) were MRSA carriers. On the other hand, 58 cases (58%) of hospitalized patients give negative culture for *S. aureus* and we identified as non carriers.

Table 1: percentage of *S.aureus* and MRSA nasal carriers among health care workers and hospitialized pateints.

Type of study case	No of samples	*S. aureus* nasal carriers (%)	MRSA nasal carriers (%)
Healthcare workers	100	34(34%)	15 (44.11%)
hospitalized patients	100	42(42)	12 (28.28%)

HCWs considered an essential origin of *S. aureus* which inhabit the upper respiratory tract. Patients and hospital workers inhabited with *S. aureus* may be transmitting it to patients or other general persons through immediate or intimate contact. Also, they considered important dangerous factor in the transmission of staphylococcal contagions (Kakhandki &Peerapur., 2012, Sharma *et al*., 2012). *S. aureus* Nasal bearing averages differs among different individual groups, ethnicities, and geographic regions (Ruimy *et al*., 2010).

Considering to absence of studies about the incidence of *S. aureus* nasal carriage among HCWs at Mosul Hospitals to date. Our results showed that 34% of studied cases were *S. aureus*

nasal carriers. Among them, 44.1% were MRSA .the Carriage rate of *S. aureus* in the nasal cavity has been determined in several estimations carried out in different nations including, Saudi Arabia (25.4%), China (21.6%) Northeast Ethiopia (28.8%), , and Nepal (15.7%) (24-28), and France (35.52%). Iran (33.6%) (Zia Sheikholeslami *et al.*, 2016).

Our results explained that *S. aureus* carries was (34%) which covenant with reports performed by (Askarin *et al*., 2009 and Rahbar *et al*., 2010) who isolated these strains at 31% and 31.1%, respectively.

The evaluated percentage of S .*auras* carriers is higher than that estimated by, Ghafouri et al. (11%), and Sharifi-mood *et al*. (10%) and khanal *et al*.,2015. However, our research showed lower percentage of *S. aureus* nasal carrying than the reports of Rashidian *et al*.,2001 (43%) and Citak *et al*.,2011 and Shrestha *et al.*, 2009.

Our study stated Highest rate of MRSA nasal carriage 33.3 %(5/15) was found among nurses and at lower percentage among laboratory personnel 4 (26.6%) , doctors and cleanness workers accounted for 20 % (2/15) of MRSA carriers for each as shown in Table 2.

Table 2: incidence of *S.aureus* and MRSA among health care laborers

Healthcare workers	No of samples	*S. aureus* (%)	MRSA (%)
Nurse	40	11 (32.35%)	5 (33.3%)
Doctor	30	8 (23.52%)	3 (20%)
Laboratory personnel	15	8(23.52%)	4(26.6%)
Cleanness workers	15	7 (20.58%)	3 (20%)

Our reports showed higher percentage of MRSA carriage (44.11 %) than some researches (10 %) (Shakya *etal*., 2010) and (2.32 %) (shrestha *et al*.,2009) Reported range (5.8 to 17.8 %) (Na'was & Fakhoury., 1991 Akoua *etal*., 2004; Mulqueenetal.,2007). These diverges may be due to the fluctuating in laboratory procedures (transporting , technique, inculcating and method of correct identification), regional contagion prevention , criterion and the vicinal incidence of MRSA and geographic regions . Vonberg *et al*. explained that searching of HCWs must be effectuated before starting work duties to preclude the determination of transient, short-term MRSA carriage which occur during a clinical task period (Vonberg *et al*.,2006).

Our study explained that carriage rate of .*S. aureus* and MRSA was highest

among nurses (32.35 %) , (33.3%) which agreed with studies performed by (Khanal *et al*.,2015; Shibabaw *et al*., 2013). High perilous of MRSA inhabitation including nurses may be attributed to irrational patient connection.

Study of Khanal *et al*.,2015 showed that 28.6 % of the MRSA carriers were HCWs from surgical and operation centers . This might be attributed to the traumatic and immunological repression of the sick individuals after surgery operations. The study of Rongpharpi *et al*.,2013 explained that percentage of nasal *S.aureus* among doctors were 25%and at 22.86% among Nurses

The HCWs whose noses bearing MRSA represent the chief factor for transition of the pathogenic microbes to ill individuals during clinical treatment. Because the common strains arrive to HCWs from operative unit and operation chambers, the intimacy of operative wound contagion with MRSA among the patients, following communication from the HCWs, requiring additional protocols to success and provide effective treatment and recuperation. (Khanal *et al*., 2015)

Because the HCWs considered essential factor for disseminate the staphylococcal contagions in central care unit habitats, uniform searching and cure of MRSA holders among hospital staff is described for effective decrease of staphylococcal contagion transportation in the central care units. Therefore, estimation of drug sensitivity of staphylococcal strains is important before starting the treatment with antibiotic in order to supply effective reliable treatment.

In respect to the MRSA nasal carriage among patients we found that the Highest MRSA nasal carriage rate of (5/12) 41.6 %was found among surgical operation patients and at lower percentage among upper respiratory tract patients 1/ 12(8.3%), While the kidney patients and wound and burn patients have MRSA in Nasal cavities at (33.3%), (16.6%) percentages respectively.

Table 3: incidence of *S.aureus* and MRSA among hospitalized patients.

Type of disease	No of samples	*S. aureus* (%)	MRSA (%)
Surgical patients	20	15 (35.71%)	5 (41.6 %)
kidney patients	50	15 (35.71%)	4 (33.3%)
Wound and burn patients	15	8 (19%)	2 (16.6%)
Upper respiratory patients	15	4 (9.52%)	1(8.3%)

S. aureus considered the prevalent cause of contagions in hospitals and society. Studies have shown that hospital acquired strains of *Staphylococcus aureus* are often resistant to many different drugs.

Our study showed isolation of *S. aureus* at 42% percentage from nasal cavities of different hospitalized patients include the skin(wound and burn) infections, renal infection and surgical operation patients and this result due to occurrence transmission of *S. aureus* from the hands and nasal cavity of HCW by the direct contacting with hospitalized patients .

Also the implication is the occurrence of different ailments due to *S.aureus* which include skin infections and infection to some organs such as nose and throat, these organisms are commonly spread from one lesion such as furuncle to other areas of body by fingers.

These findings corroborate the observation of previous workers which showed that the Nasal carriage of *S.aureus* increase among patients who underlying illnesses such as severe dermatitis, poorly controlled diabetes, kidney failure and blood disorders. (Adekunle &Olatunji ,2011).

Study of (Zriouil *et al.*,2012) demonstrated that percentage of nasal *S.aureus* among skin department patients was 41.8%and at 32.9% among burn patients, but the study of Ouidri, 2018 demonstrated that the percentage of nasal carriage according to service were 17.78%,21.94%,19.15%,25%,27.27%, and 41.18% in trauma, cardiology, neurosurgery ,ENT, Pediatrics and Infant surgery respectively.

There are a number of strategies should be performed in order to decrease the incidence of hospital acquired *S.aureus* infections, which comprise the drugs employment to deprivation surgical operative local contagions, persistence of using hygiene protocols .There are also protocols to decrease the incidence of *S.aureus* infections that occurred in hospitals like making a nasal swab to investigate for *S. aureus* and efforting for removing. Second essential clinical intermediation used to render sure patients with concrete contagions comprise applying of clinical privacy.(Adekunle &Olatunji ,2011).

Resistance to oxacillin and cephoxitin were observed in 44.11%and 28.57% (represent the percentages of Methicillin Resistant *S.aureus* isolatesof HCW and hospitalized patients isolates respectively, which dissimilar with reports showed by Kobayashi et al. (2009), whose assessed the drug sensitivity profile of *S.aureus* pathogenic strains in a public hospital in

Goiânia. The mechanism of resistance to methicillin in *S.aureus* isolates is mainly due to production of modified proteinPBP2a encoded by mec A gene which is carried in the mobile genetic elements (Zriouil *et al*., 2013).

Implicating the examined antibiotics, Trimethoprime-sulfamethoxazol, Gentamycin, co-trimoxazole, Amikacin, Cefoxitin and Ciprofloxacin were subsist to be the most effective toward *S.aureus* HCW strains as showen in the table 4. While the Ceftriaxone and Erythromycin were less effective antibiotics, so the sensitivity percentage of our isolates toward them were 68.8% and 52.94% respectively.

From our results we conclude that the *S. aureus* isolates of HCW nasal cavities have moderate resistance toward Vancomycin Amoxiclav and Clindamycin. our study was no agreement with the study of (Rongpharpi *etal*.,2013) which demonstrated that *S. aureus* isolates from HCW were Sensitive to most antibiotic tested ,thus the resistance percentages were 18.6%,27.14%,17.14% to Amoxiclav, Amikacin and Ciprofloxacin. But our results concluded that Health Care Workers Nasal carriage *S. aureus* isolates were more resistant against the several classes of antibiotics as shown in Table 4.

Table 4: Antibiotic susceptibility pattern of Health Care Workers Nasal bearing *S. aureus* isolates (n = 34)

Antibiotics	Resistant (%)	Intermediate (%)	Sensitive (%)
Amikacin	4 (11.76%)	0 (0)%	30 (88.23%)
Cefoxitin	15 (44.11%)	0 (0)%	19(55.88%)
Ceftriaxone	3 (8.82%)	5 (14.7%)	26 (68.8 %)
Amoxiclav	7 (20.5%)	0 (0)%	27 (79.41%)
Cotrimoxazole	2 (5.8%)	2 (5.8%)	30 (88.23%)
Ciprofloxacin	3 (8.82%)	3 (8.82%)	28 (82.35%)
Clindamycin	7 (20.5%)	0 (0)%	27 (79.41%)
Erythromycin	14 (41.17%)	2 (5.8%)	18 (52.94%)
Gentamycin	4 (11.76%)	1 (2.9%)	29 (85.29%)
Oxacillin	15 (44.11%)	0 (0)%	19(55.88%)
Vancomycin	10 (29.41%)	2 (5.8%)	22 (64.7%)

The resistance profile of *S. aureus* isolated from Hospitalized patients (Table 5) showed that these isolates were more resistant to tested antibiotics than s. *aureus* isolated from Health Care Workers. Thus the tested antibiotics showed less inhibitory action toward these isolates , Trimethoprime-sulfamethoxazol, ceftriaxone, Amoxiclav

were found to be the most effective antibiotics toward these isolates, thus the sensitivity percentages were 88.23%,80.9%, 73.8% respectively and this indicates that the tested therapeutic drugs considered first election for monotonous treatment of MRSA contagions and should be uses them as the first option in order to eliminate the nasal bearing of *S.aurues* isolates which reduce the transmission of these strains to the HCW in our hospitals at our hospital .

Table 5: Antibiotic susceptibility pattern of *S. aureus* isolates isolated from nasal cavity of Hospitalized patients (n=42)

Antibiotics	Resistant (%)	Intermediate (%)	Sensitive (%)
Amikacin	15 (35.71%)	2 (4.76%)	25 (59.52 %)
Cefoxitin	12 (28.57%)	1 (2.38 %)	31(73.8%)
Ceftriaxone	8 (19%)	0(0%)	34 (80.9 %)
Oxacillin	12(28.57%)	0(0%)	30 (71. 42%)
Amoxiclav	10 (23.8%)	1 (2.38 %)	31(73.8%)
Ciprofloxacin	25 (59.52%)	1 (2.38 %)	16 (38%)
Clindamycin	20(47.16%)	0 (0%)	22 (52.38%)
Erythromycin	22 (52.38%)	2 (4.76%)	18 (42.85%)
Gentamycin	25 (59.52%)	0 (0%)	7(40.47%)
Co-trimoxazole	2 (4.76 %)	0 (0%)	40 (95.23%)
Cefoxitin	12 (28.57%)	0(0 %)	30(71.42%)
Vancomycin	25 (59.52%)	1 (2.38 %)	16 (38%)

The susceptibility testing of of *S. aureus* isolated from Hospitalized patients elucidated high resistance against (ciprofloxacin& gentamycin) and erythromycin (59.52 %) , (52.38%) respectively. swale resistance against ciprofloxacin (14.3 %). Clindamycin resistance (47.16 %) was moderate. the lower resistance to clindamycin offers it may be regarded the experiential treatment, investigation of faradic clindamycin resistance must be monotonously accomplished.

In the present study, the susceptibility percentages of HCW *S.aureus* and hospitalized *S.aureus* isolates to vancomycin were (64.7%),(38%) respectively. This finding was No agreement with other reports in several countries (Zia sheirkholeslami *etal*., 2016;Rongpharpi *etal*.,2013;). Which demonstrated that *S.aureus* isolates from nasal cavities of HCW were susceptible to vancomycin at100% percentage, this finding indicate to our hospital *S.aureus* isolates were different from other isolates of other countries by

acquiring resistance genes for different antibiotic classes as a result to misuse and randomly administration of different antibiotics without doctor consultation.

Speculating the resultant data, healthcare workers, may be inhabited by several drug resistant *S. aureus*. The observation and incitation of reducing the unconscionable utilization of drugs from the individuals is principal to detention the arising of new several antibiotic resistant variants. Schoolboys and occupational health services that accompany nosocomial habitats must be guided to persistent uses of sanitary instruments and employment of personal preventive instrument to deprivation of infectious agents transmission particularly several drug resistant strains essentially isolates of MRSA.

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