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Prevalence and antimicrobial susceptibility pattern of methicillin-resistant *Staphylococcus aureus* (MRSA) in AL-Yarmook teaching hospital-Baghdad

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Abstract

Nosocomial infection is a major problem in the world today. Methicillin- resistant Staphylococcus aureus (MRSA) strains, usually resistant to several antibiotics and also intrinsic resistance to ß- lactam antibiotics, shows a particular ability to spread in hospitals and now present in most of the countries. The present study was carried out to investigate the prevalence of MRSA and their rate of resistance to different antistaphylococcal antibiotics.

Between Decembers 2009and April 2011, the clinical specimens submitted at the microbiology laboratory were processed and all Staphylococcus aureus (S. aureus) isolates were included in this study.

All isolates were identified morphologically and biochemically by standard laboratory procedures and antibiotic susceptibility pattern including oxacillin was determined by modified Kirby Bauer disc diffusion method.

Out of a total of 337 Staphylococcus aureus strains isolated from various clinical samples, 140(41.54%) were found to be Methicillin- resistant. Among MRSA isolates, 86(46.99%) were from different inpatient departments, whereas, 54 (35.06%) of the isolates were from outpatients. All MRSA were resistant to penicillin. About 70% of the MRSA strains were resistant to cephalexin, ciprofloxacin and cloxacillin ,while less than 10% of them were resistant to amikacin and tetracycline. Many MRSA strains were multidrug resistant. However, no strains were resistant to vancomycin.

This report showed a high prevalence of MRSA in Al-Yarmook hospital. To reduce the prevalence of MRSA, regular surveillance of hospital acquired infection and isolation is the need of the hour.

Key words: Nosocomial infection, methicillin-resistant Staphylococcus aureus (MRSA), multidrug resistant.

الخلاصة:

تعتبر عدوى المستشفيات من اكبر المشاكل الموجودة في العالم في هذه الايام. أظهرت عزلات المكورات العنقودية الذهبية المقاومة للمثيسيلين (*MRSA*) المقاومة لبعض المضادات الحيوية بالاضافة الى مقاومتها الداخلية لمضادات (*ß-lactam*)، قابلية خاصة للانتشار في المستشفيات والان موجودة في أغلب البلدان.

هدفت الدراسة الحالية التقصي عن انتشار عزلات المكورات العنقودية الذهبية المقاومة للمثيسيلين (*MRSA*) ونسبة مقاومتها لمختلف المضادات الحيوية التي تستعمل ضد المكورات العنقودية الذهبية، وقد شملت الدراسة كل العينات السريرية المقدمة الى مختبر الاحياء المجهرية للفترة من كانون الثاني 2009 الى نيسان 2011 والتي شملت كل عزلات المكورات العنقودية الذهبية.

تم التعرف على الصفات الشكلية والكيمو حيوية للمكورات بالاعتماد على الطرق المختبرية القياسية وحساسيتها للمضادات الحيوية متضمنة (الاوكساسيلين) بالاعتماد على طريقة (*Kirby Bauer*) المحورة للانتشار بالاقراص.

من مجموع 337 عزلة من المكورات العنقودية الذهبية المأخوذة من مختلف النماذج السريرية وجدت 140 عزلة مقاومة للمثيسيلين (41.54%)، ومن ضمن هذه العزلات المقاومة للمثيسيلين 86 عزلة (46.99%) مأخوذة من المرضى الراقدين في مختلف اقسام المستشفى، بينما 54 عزلة (35.06%) عزلة من المرضى الخارجيين. كل عزلات (*MRSA*) هي مقاومة للبنسلين (*penicillin*)، بما يقارب 70%من عزلات المكورات العنقودية الذهبية المقاومة للمثيسيلين (*MRSA*) هي

مقاومة للسيفالكسين (*cephalexin*)، والسبروفلوكساسين (*ciprofloxaci*) والكلوكساسيلين(*cloxacillin*) بينما بنسبة اقل من 10% من العزلات كانت لديها مقاومة للاميكاسين (*amikacin*) والتتراسايكلين (*tetracycline*) .

وجد ان اكثر عزلات المكورات العنقودية الذهبية المقاومة للمثيسيلين (*MRSA*) كانت لها قابلية مقاومة متعددة للمضادات، وعلى الرغم من ذلك لم تعزل منها اي عزلة مقاومة للفانكومايسين (*vancomycin*). ونستدل من هذه الدراسة وجود قابلية انتشار عالية لبكتريا (*MRSA*) في مستشفى اليرموك، وللتقليل من انتشار هذه البكتريا نحتاج الى تفتيش دائم وعزل مستمر للعدوى المكتسبة من المستشفيات و على مدار الساعة.

Introduction:

Staphylococcus aureus is a leading cause of hospital acquired infection (HAI) and over the past 50 years it has acquired resistance to previously effective antimicrobials including the penicillinase resistant ones like methicillin [1]. Today, methicillin resistant *Staphylococcus aureus* (MRSA) has emerged as one of the most important nosocomial pathogens[2].

The percentage of hospitals isolating MRSA in the developed countries has increased from 2% in the 70's to 30% in the 90's.[3]) Moreover, half of *S. aureus* in many centres are methicillin resistant (multidrug resistant) posing major therap-eutic challenge [4]. MRSA causes more than 50% of HAI and are more virulent than the methicillin sensitive strains [5,6]. Prompt diagnosis of MRSA infection is, therefore, important for patients, health care givers and for epidemiological purposes. Hospital acquired infection (HAI) gives an enormous burden to the health care system signify-cantly affecting the patient's morbidity and mortality. It results in prolongation of hospital stay and hence higher bed occupancy rate with an attendant increase in the cost of hospitalisation [7, 8]. Surveillance of MRSA related infections especially in the hospital set up is required and has been doing in the developed countries. Not only that, the magnitude of the problem is yet to be quantified. This study is an attempt to assess the prevalence of methicillin resistant S. *aureus* (MRSA) infection and its antibiotic susceptibility pattern in this hospital.

Materials and methods:

This study was based on collection of samples sent from different wards and Out Patients Departments of AL-Yarmook teaching hospital, Baghdad. Total strains of 337 *S. aureus* were isolated from pus, urine, sputum, wound swab, aural swab, blood, throat swab and urethral swab during December 2009and April 2011. *S. aureus* was identified by conventional method [9].

All confirmed *S. aureus* isolates were subsequently tested for methicillin resistance by screening for susceptibility to oxacillin using oxacillin disks (1µg) (HI Media Laboratories, Pvt. Ltd. Mumbai). The isolates were labeled as MRSA if it was observed to be resistant to oxacillin disc after incubation at 37°C for 24 hours (Oxacillin-resistance on laboratory susceptibility testing also indicates methicillin-resistance).

The antimicrobial susceptibility test was carried out using Kirby-Bauer's disc diffusion method modified and updated by Clinical and Laboratory Standards Institute guidelines (CLSI) [10].

Oxacillin disc (1µg), was applied along with other antimicrobials for testing sensitivity and the plates were examined after an overnight incubation at 37 º C.

Zone of inhibition diameter (in mm) were measured and results were interpreted as sensitive, resistant as per recommendation of Clinical and Laboratory Standards Institute guidelines (CLSI).

Other antimicrobials tested were Penicillin (30µg), chloramphenicol (30µg), tetracycline (30 µg), gentamicin (10µg), erythromycin (15µg), cotrimoxazole (25µg),

cephalexin (30µg), ciprofloxacin (5µg), amikacin (30µg), cefotaxime (30µg) and vancomycin (10µg).

Results:

Isolation of *Staphylococcus* was maximum in pus samples. Out of the 337 strains of *S. aureus* examined 140 (41.54%) were found to be Methicillin- resistant and of which 86(46.99%) were from inpatient departments. Amongst them only 7 (8.14%) of the isolates were from intensive care units (ICU).

A total of 154 *S. aureus* isolated from different outpatient specimens,only (35.06%) were found to be MRSA strains. Maximum isolation of MRSA was from pus (48.21%), followed by wound swabs (41.66%), ear swab (40%), sputum (33.33%), etc. (Table- 1) shows detection of MRSA in different samples.

All the strains of MRSA were found to be resistant to Penicillin. (Table -2) depicts the antibiotic susceptibility data for all the *S. aureus* isolates.

Among MRSA, resistance to cephalexin was 68%, ciprofloxacin-75.64 %, cloxacillin -72%, erythromycin -48%, gentamicin -32.14%, cefotaxim -24.53%, cotrimoxazole -18.92%, Amoxyclav-20%, while amikacin and tetracycline were resistant to less than 10% of the MRSA strains. Many MRSA strains were multidrug resistant.

No strain was resistant to vancomycin. However, 44.12 % of Methicillin sensitive *S. aureus* (MSSA) were resistant to penicillin, 30.77% resistance to cephalexin, 15.32% resistance to cipro-floxacin, 20 % resistance to cloxacillin, 8.51% resistance to erythromycin, 30.26 % resistance to gentamicin as compared with MRSA. MSSA isolates also revealed higher susceptibility to cefotaxime, Amikacin and cotrimoxazole with a resistance rate of 3.77%, 5.55% and 7.5% of the strains respectively.

Table- 1: Isolation of MRSA from Specimens of outdoor and indoor patients in Al- Yarmook teaching hospital, Baghdad.

S.No	Specimens	OPD		Ward & ICU		Total	
		S. aureus	MRSA (%)	S. aureus	MRSA (%)	S. aureus	MRSA (%)
1	Pus	56	27 48.21	64	42 65.63	120	69 57.5
2	Urine	18	4 22.22	25	12 48	43	16 37.21
3	Wound swab	12	5 41.66	14	9 64.29	26	14 53.85
4	Sputum	15	5 33.33	20	9 45	35	14 40
5	Ear swab	10	4 40	14	6 42.86	24	10 41.66
6	Blood	10	1 10	16	2 12.5	26	3 11.54
7	Throat swab	15	3 20	16	4 25	31	7 22.58
8	Semen	3	1 33.33	1	0 0	4	1 25
9	Vaginal swab	15	3 20	13	2 15.38	28	5 17.86
Total		154	54 35.06	183	86 46.99	337	140 41.54

Table- 2: Resistance to individual antimicrobials in MRSA and MSSA isolated in Al- Yarmook teaching hospital, Baghdad.

.No	Antimicrobials	MRSA		MSSA		Total	
		Tested	Resistance *(%)*	Tested	Resistance *(%)*	Tested	Resistance *(%)*
1	Penicillin G	120	*120* *100*	170	75 *44.12*	290	195 *67.24*
2	Cephalexin	25	17 *68*	65	20 *30.77*	90	37 *41.11*
3	Ciprofloxacin	78	59 *75.64*	124	19 *15.32*	202	78 *38.61*
4	Cloxacillin	125	75 *72*	150	30 *20*	275	105 *38.18*
5	Erythromycin	50	24 *48*	94	8 *8.51*	144	32 *22.22*
6	Gentamicin	28	9 *32.14*	76	23 *30.26*	104	32 *30.77*
7	Cefotaxim	53	13 *24.53*	106	4 *3.77*	159	17 *10.69*
8	Co-trimoxazole	37	7 *18.92*	120	9 *7.5*	157	16 *10.19*
9	Amoxyclav	15	3 *20*	13	2 *15.38*	28	5 *17.86*
10	Amikacin	54	5 *9.26*	108	6 *5.55*	162	11 *6.79*
11	Tetracyclin	45	4 *8.88*	53	5 9.43	93	9 *9.68*
12	Vancomycin	123	0 *0*	154	0 *0*	277	0 *0*

Discussion:

Infections caused by resistant pathogens result in significant morbidity and mortality, and contribute to escalating healthcare costs worldwide [11].

Despite the availability of newer antibiotics, emerging antimicrobial resistance has become an increasing problem in many pathogens throughout the world [12].

In the last two decades prevalence of MRSA has steadily increased all over the world [13]. MRSA is a global phenomenon with a prevalence rate ranging from 2% in Netherland and Switzerland, to 70% in Japan and Hong Kong [13,14]. In this study, the prevalence of MRSA was found to be 41.54% A comparable prevalence rate of 30.24% were also reported from three teaching hospitals in Erbil city[15].

Higher prevalence rate of MRSA (68.89%) was observed in a study conducted recently to determine prevalence of antimicrobial resistance among pathogenic bacteria isolated from two main hospitals in Basrah. [16].

In another study in Iran the rate of MRSA (67.2%) was also high compared to our study[17].Prevalence of MRSA was higher among inpatients (46.99%) than outpatients (35.06%). This difference could be due to prolonged hospital stay, instrumentation and other invasive procedures.

Analysis from previous studies revealed a relationship between methicillin resistance and resistance to other antibiotics [18, 19].This study showed that all MRSA isolates were significantly less sensitive to antibiotics as compared with MSSA isolates. Many of the isolates were resistant to commonly used antistaphylococcal agents except vancomycin.

Anupurba et al. also observed that 32% of MRSA isolates are resistant to all commonly used antibiotics for *S. aureus* except vancomycin[20]. Because of the resistance of MRSA to all commonly used

antibiotics, it is necessary to test newer group of antibiotics such as vancomycin and teicoplanin routinely. Resistance to (cephalexin) was much higher (68%) in this study.

Resistance to quinolones (ciprofloxacin) was also high (71%) in this study. In the study reported by Lahari Sakia et al., the resistant rate was also high (87.5%) in Assam (India) [21].

The rapid emergence of ciprofloxacin is probably due to the indiscriminate and empirical use of these drugs. MSSA isolates shows higher susceptibility to penicillin and cloxacillin (100% vs. 44.12%) and (72% vs.30%) respectively than MRSA strains.

The epidemiology of MRSA is gradually changing since its emergence was reported. Initially there were occasional reports but now it has become one of the established hospital acquired pathogen. Moreover, the association of multidrug resistance with MRSA had added to the problem.

ß–Lactam antibiotics like penicillin and cephalexin resistance were 100% and 81% respectively. Resistance to aminoglycosides was more in gentamicin (32.14%) than amikacin (9.26%) in this study however, it cannot be recommended for empirical treatment of MRSA associated infections.

Vancomycin seems to be the only antimicrobial agent which showed 100% sensitivity and may be used as the drug of choice for treating multidrug resistant MRSA infections.

However, regular monitoring of vancomycin sensitivity and routine testing of other newer glycopeptides like teicoplanin should be carried out. Further, the regular surveillance of hospital associated infections including monitoring antibiotic sensitivity pattern of MRSA and formulation of definite antibiotic policy may be helpful for reducing the incidence of MRSA infection.

Conclusion:

This preliminary report showed a high prevalence of MRSA in our hospital.

There is a need for surveillance of MRSA and its antimicrobial profile. The hospital infection control policy and guidelines that already exists should be strictly implemented and followed so as to enable the clinicians to deliver better and proper health care to the patients.

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