Original Article

Nasal carriage rate of community- and hospital-acquired methicillin-resistant *staphylococcus aureus* in children, Kermanshah, Iran

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Abstract

Background: *Staphylococcus aureus* (*S.aureus*) is an importantpathogen in human infections.Some strains of *S. aureus*are methicillin-resistant (MRSA) andcause hospital- and community-acquired infections in children. The aims of this study were to determine nasalcarriage rate of *S. aureus* and susceptibility pattern of this organism to some antibioticsamong children in Kermanshah province, Iran.

Methods: This was a cross-sectional study conducted in Kermanshah province, Iranfrom 2007 to 2008.Nasal swabs were obtained from 274 children who were hospitalized in our university hospital at the time of admission and 219 children upon dischargetime.If result of nasal culture was positive at admission time they considered community acquired and if result at admission time was negative but positive at discharge time they considered hospital acquired. Antibiotic susceptibility patterns of *S.aureus*were done by disk diffusion method and results were compared between them.

Results: In 55 patients out of 274 cases (20.07%), *S. aureus* was demonstrated upon admission (community-acquired). In the remaining 219 cases, *S. aureus* was detected in 46 cases (21%) at discharge time (hospital-acquired). The rate of methicillin-resistant S. aureus (MRSA) in community- and hospital-acquired infections were 96.4% and 95.7%, respectively.We observed no statistical significance different in antibiotic resistance pattern between community acquired and hospital – acquired S.aureus except for co-triomoxcazol (P=0.034).

Conclusion: A high rate of MRSA in both community- and hospital-acquired infections were observed.

Keywords: Methicillin-resistant S. aureus; Child; MRSA; Nasal carier.

Introduction

Staphylococcus aureus, *a*Gram-positive coccus, is ubiquitous in nature and can be pathogen for humans and animals. *S.aureus* is part of normal human flora and 20-30% of normal individuals carry at least one strain of this organism in anterior nares at any given time. The organism can cause local as well as systemic infections like skin infection, osteomylitis, pneumonia, sepsis and endocarditis (1-3).

Methicillin-resitant *S. aureus* (MRSA) has become a major problem in children and adults over the last decades. For the first time, this entity wasreported in England in 1961 (4). MRSA can be acquired from community known as community acquired MRSA (CA-MRSA) or from hospital known as hospital acquired MRSA (HA-MRSA). Recent findings suggest that the proportion of *S.aureus* isolates which are MRSA has increased (1,2,5-9). A new multicenter study in the US showed that MRSA is the most common cause of skin and soft tissueinfections among adults (10). MRSA can cause wide range of infections from skin infection to life-threatening ones.CA-MRSA unlike HA-MRSA usually are susceptible to most non-Beta lactam antibiotics.For severe infections caused by MRSA, vancomycin alone or in combination with an aminoglycoside or rifampin is the drug of choice. However, for mild to moderate soft tissue infections caused by CA-MRSA, empirical antibiotic therapy depends on the rate of resistant of these organisms to clindamycin.When resistance to clindamycin is less than 10 percent, this antibiotic can be used for empirical treatment. But if resistance is more than 10%, vancomycine or linazolid would be used (1,2,11).

Nasal carriage of *S.aureus* including MRSA is a significant risk factor for serious infections (3,7,12-14). Some data suggest that source of more than 80 percent of *S.aureus* infections is from nasal colonization. Therefore this study was done to identify nasal carriage rate of *S. aureus* including MRSA in children in Kermanshahprovince, Iran and tocompare antibiotic susceptibilitypatterns of CA-MRSA and HA-MRSA.

Methods

From January 2007 to April 2008, 274 patients were enrolled in our study.Inclusion criteria included any pediatric (>2 mo <18 years old)patientof both genderwho was admitted non-emergetically to pediatric ward of Imamreza Hospital,a major referral hospital in western

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Iran which is affiliated to Kermanshah University of Medical Sciences. Patients with history of any of the following items were not included: hospitalization during the preceeding month, immune deficiency, systemic disease like diabetic mellitus or chronic renal failure, chronic ulcer, antibiotic therapy during the preceeding week, systemic corticosteroid therapy andprevious staphylococcus infections.

Specimens were taken from nasal nostrils. Hence, sampling was performed using a cotton-tipped swab which was inserted about 1 cm into each nostril. Then, thesamples by transitional browth were sent to laboratory immediately. After of culturing and using morphology of colony, catalase, coagulase, DNase, mannitol fermentation and telluritereduction tests S. *aureus* were identified and antimicrobial susceptibility patterns wered determined according to the Clinicaland Laboratory Standards Institute guidelinesby Disk Diffusion Method (HI-MEDIA India)(1).Based on detecting *S. aureus* at admission to or discharge from hospital, the patients were divided into two groups. The first group consisted of patients who had positive cultures at the time of admission (community-acquired *S. aureus*) and were excluded from further nasalsampling upon discharge from hospital. The second group were those who had negative cultures at the time of admission and had positive cultures at discharge (hospital-acquired *S. aureus*).

The susceptibilities of the isolates to oxacillin, erythromycin, clindamycin, cefazolin, co-trimoxazole, chloramphenicol and vancomycin were determined.

For data entry and statistical analyses, SPSS software of Windows (ver. 13.0) was applied. To summarize the data, we used freqency (percent) distribution and two dimentional tables. To compare categorical variables between the two study groups, the chi-square test was used. Ethics approval for the study protocol was obtained from the Ethics Committee of Kermanshah University of Medical Sciences.

Results

Among 274 hospitalized children at admission, 55(20%) were colonized with*S.aureus*and 96.4% were MRSA.Of 219 patients whose samples were taken at discharge time, 46 patients(21%)were colonized with*S. aureus*that95.7% were MRSA(p=0.057)see Table 1.Nasal screening identified that the rate of colonization for CA-MRSA was 19.3% and for HA-MRSA was about 20% (p=0.32). Resistance of CA-*S.aureas* isolates to erythromycin, clindamycin, cefazolin,co-trimoxazole, and choloramphenicol were 10.9%, 14.5%, 9.1%,18.2% and 7.3%, respectively.Resistance of HA-*S.aureus* isolates to these antibiotic were 23.9%, 21.7%,13%, 37% and 4.3%, respectively. 3.6% of CA-*S. aureus* isolates were resistant to vancomycin but none of HA-*S.aureus* isolates were resistant to this agent. 65.5% of CA-*S. aureus* and 67.4% of HA-*S. aureus* had semisenstive pattern of antibiotic susceptibly to vancomycin (Table 2). Patterns of drug susceptibility of CA-MRSA and HA-MRS are shown in Table 3. Inspite of overal higher drug resistance rate in HA-*S.aurues* than CA-*S.aures*, statically thisdifference was not statistically significant and P.values of drug resistant to all antibiotics in CA-S.aureus and HA.S.aureus were above0/0.5 except for co-trimoxazole (p=0.034).

Table 1. Susceptibility state of community- and hospital-acquired S. aureus isolates to oxacillin(p = 0.855)

	NUMBER/ PERCENT	CASA	HASA	TOTAL
Sensitive	Number	2	1	3
	Percent	3.6	2.2	3
Intermediate	Number	0	1	1
	Percent	0	2.2	1
Resistant	Number	53	44	97
	Percent	96.4	95.7	96
Total	Number	55	46	101
	Percent	100	100	100

CASA: community-acquired *S. aureus*

HASA: hospital-acquired *S. aureus*

Table 2. Antibiatic susceptibility pattern of community and hospital acquired methicillin-resitant *S. aureus*

ANTIBIOTIC SUSCEPTIBILITY PATTERN	ANTIBIOTICES						
	Number/ Percent	C	E	Cef	SXT	Va	CL
Sensitive	Number	85	67	34	53	32	64
	Percent	87	69.1	33.7	54.6	33	66
Intermediate	Number	8	13	56	17	63	15
	Percent	8.2	13.4	55.4	17.5	46.9	15.5
Resistant	Number	4	17	11	27	2	18
	Percent	4.1	17.5	10.9	27.8	2.1	18.6
Total	Number	97	97	97	97	97	97
	Percent	100	100	100	100	100	100

C=chloramphenicol; E=erythromycin; Cef=cefazolin; SXT=co-trimoxazole, Va=vancomycin; CL=clindamycin

Table 3- Antibiatic susceptibility pattrn of community and hospital acquired *S.aureus*

TYPES OF S.AUREUS	PATTERN OF ANTIBIOTIC SUSEPTIBILITY	ANTIBIOTICS						
CASA		OX(p=0.85)	E(p=0.081)	CL(P=049)	Cef(p=0.52)	SXT(0.034)	Va(p=0.19)	C(p=0.53)
	Resistant	96.4%	10.9%	14.5%	9.1%	18.2%	3.6%	7.3%
	Intermediate	0%	16.4%	6.4%	58.2%	20%	65.5%	9.1%
HASA	Resistant	95.7%	23.9%	21.7%	13%	37%	0%	4.3%
	Intermediate	1%	13%	15.2%	52.5%	13%	67.4%	06.5%

OX=oxacillin,C=chloramphenicol,E=erythromycin,Cef=cefazolin, SXT=cotrimoxazole, Va=vancomycin,CL=clindamycin

CASA: community-acquired *S. aureus*

HASA: hospital-acquired *S. aureus*

Discussion

Nasal colonization with CA-MRSA and HA-MRSAhas become serious problem in children.In this study the rate of nasal colonization with MRSA was more than that of other studies worldwide (1,2,3). Among the children included in our study, nasal colonization rate with CA-*S.aureus* and HA-*S.aureus* was about 20% which is similar to most other studies (1,2,3,15,16)but about 96% of both CA-*S.aureus* and HA-*S.aureus* isolates were MRSA which is a very high rate of resistance.According to SENTRYAntimicrobial Surveillance Program during 1977-1999, the frequency of MRSA in the US, England, Italy and Australia were 30-50%, 45%, 40% and 23.6%, respectively (17). Japoni and colleaguesreported that MRSA had risen up from 33% to 43% in Shiraz, Iran (5).According to the current results, 21% of non-colonized patients at the time of admission were colonized following hospitalization but in Sedighi study (12) this rate was 13.7% and in Srilanka thisrate has been reported to be 6% (18). In contrast to Sedighi study (12) that 9.8 of HA-*S.aureus* isolates were MRSA, about 96% of our isolateswere MRSA.

For severe infections due to MRSA, the drug of choice is vancomycin but for mild to moderate skin and soft tissue infections caused by CA-MRSA clindamycin or co-trimoxazole can be used.If resistance of CA-MRSA to clindamycin is lower than 10%, this antibiotic can be used for empiric treatment of moderately invasive infections such as pnenumonia(1.2). In our study resistance rate to clinidamycin in CA-MRSA was 14.5% and in HA-MRSA was 21.7%. So this agent can not be used in such infections. Allen and colleagues recently showed that resistance of CA-MRSA to clindamycin and other drugsin the US is high(11).

About 27% of our *S. aureus* isolates were resistant to co-trimoxazole.Resistancerate to this agent in the US,Latin America and Canada have beenreported to be 26%, 65.4 and 16%,respectively (17).Resistance to this drugs in our study was more than Canada, less than Latin America and similar to the US.

Results of our study also indicate that only 11.3% of isolates were resistant to cefazolin inspiteof 96% resistant rate to oxacillin. Therefore, cefazolin may be a betterchoice in the treatment of *S. aureus*infection than oxacillin, although this agent is not recommended for the treatment of MRSAand also because the mothod of our study was disk diffusion the results about cefazolin has this limitation.

17.5% of staph isolates in our study were resistant to erythromcin but resistance rate to erythromycin in the US is more than 90% (9,17) and in Canada, Europe,Latin America and Hamadan (Iran)have been reported as 75.3%, 82.6%, 93% and (33-66%), respectively (9,12,17). These findings indicate that resistance to this agent is lower according to the obtained results.

Chloramphenicol, due to infrequent adverse effect (e. g., agranulocytosis),is not routinly administeredin children but according to the current results of this and former studiesfrom Iran (19,20) and low resistance rate in Canada and Europe (17), it seems that this antibiotic is an effectivemedication for the treatment of MRSA infection. With increasing prevalence of MRSA, the application of vancomycin hasbeen increased in a way that infections with vancomycin-resistant*S.aureus* (VRSA) have been reported world wide after the first report from Japan in 1996 (21-23). Vancomycin-intermedate *S.aureus* (VISA)also has been reported worldwide (22,24,25). In our study, 3.6% of CA-*S.aureus* and none of HA-*S.aureus*cases were resistant to vancomycin but more than 65% of these isolates were VISA which is a significantfigurealthough disk diffusion is not a optimal method for resistant ti vancomycin.According to some other studies, VRSA and VISA are present in Iranas well (20,26). Among the drugs that we used for susceptibility pattern, chlormaphenicol is the most effective probably due to infrequent use of this agent.

We observed no statistical significance different in antibiotic resistance pattern between community acquired and hospital – acquired S.aureus except for co-trimoxcazol (P=0.034).

The limitation of our study was that method of antibiogram was disk diffusion but in spite of this limitation the results were different from most previos studies.We recomed further studies by using the more accurate methods.

Conclusion

There was a high rate of MRSA in both community- and hospital-acquired *S. aureus*and resistance to clinidamycin and vancomycin is present and chloramphenicol is aneffective drug for the tratment of MRSA.

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The authors declare that there is no conflict of interest regarding this study and that informed written consent was received for publication of the manscript. We thank all the staff of MicrobiologyDepartment of Imamreza Hospital for their great assistance.

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