

Staphylococcus aureus Nasal Carriage and Its Antibiotic Resistance Profiles in Tibetan School Children in Southwest China

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Abstract

Objectives: To describe the *Staphylococcus aureus* (*S. aureus*) nasal carriage as well as its antibiotic resistance patterns among Tibetan healthy school children in Songpan County in Southwest China. **Methods:** Nasal swabs of both anterior nares were collected from healthy school children. The identification of *S. aureus* was based on the colony morphology, biochemical tests and the results of Slidex Staph Plus kit. The antibiotic resistance profiles of the isolates were determined according to standard methods. Isolated strains were tested with the polymerase chain reaction assays to detect the *mecA* gene. **Results:** 673 Tibetan healthy children were included in this study, and *S. aureus* was detected in 16 of 673 nasal samples (2.4%). The resistance of isolated strains to penicillin, erythromycin, clindamycin, and gentamicin was 87.5% (14/16), 56.2% (9/16), 12.5% (2/16), and 18.8% (3/16), respectively. No strains were resistant to ceftioxin or vancomycin, and *mecA* gene was not detected within these isolates. **Conclusion:** The methicillin-sensitive *S. aureus* (MSSA) as well as methicillin-resistant *S. aureus* (MRSA) nasal carriage rate seemed to be very low among healthy school children in the Tibet Plateau.

Key words

Antibiotic resistance; Child; Nasal carriage; *Staphylococcus aureus*

Introduction

Staphylococcus aureus (*S. aureus*) is a known coloniser in humans, and the anterior nares are the most common colonisation site. *S. aureus* is also a frequent cause of clinically important infections ranging in severity from

superficial skin and soft-tissue abscesses to invasive disease and even death.¹ Colonising strains are often similar to those isolates from the infected tissue.² Furthermore, the emergence of community acquired methicillin-resistant *S. aureus* (MRSA) has become an important challenge for the treatment of staphylococcal infections due to its high virulence and emerging antibiotic resistance of this kind of *S. aureus*.³ Nasal carriage of *S. aureus* has been regarded as being associated with the infections caused by *S. aureus* in the host. A better understanding of the prevalence of nasal carriage of *S. aureus* could be helpful for devising appropriate measurements to control diseases caused by this organism. The objectives of this study were to investigate the prevalence of nasal carriage of *S. aureus* among Tibetan healthy children and to determine the antibiotic resistance profiles of these isolates.

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Materials and Methods

This study was conducted between September and October 2008 in Songpan County at altitude between 2700 and 3000

meters with a population density of about 7.8 people per square kilometer. In this region, the medical resources are rather scanty. The traditional Tibetan medicine is prevalent, and antibiotics such as penicillin are used sometimes, whereas most of other antibiotics are not commonly used in the population. In this study, we calculated the minimum sample size required to accurately assess the *S. aureus* carriage as 242 based on the expected prevalence of nasal colonisation (30%),² with a 95% confidence interval (design effect, 3%).

Six hundred and seventy-three Tibetan healthy children aged between 7 and 18 years old from three primary and secondary schools in Songpan County were recruited. Children receiving antibiotic therapy or requiring admission in the recent 4 weeks and those with current skin infections were not included.

Samples were collected by twice rotating a sterile cotton swab pre-wetted with sterile saline in the vestibule of both anterior nares of the participants after obtaining oral informed consent.

Nasal swabs were transported to the laboratory using the Sterile Amies Agar Gel Transport Swab (Copan, Italy) and inoculated on the mannitol salt agar (Oxoid Ltd, Basingstoke, United Kingdom) and Columbia blood agar (bioMérieux, France) within 6 h. Then the inoculations were incubated for 24 h at 37°C. The identification of *S. aureus* was based on the colony morphology, positivity of catalase and tube coagulase, and the results of Slidex Staph Plus kit (bioMérieux, France). MRSA identification and antibiotic susceptibility of the isolates were performed according to the Clinical Laboratory Standards Institut guidelines,⁴ with the following antibiotics: penicillin, erythromycin, clindamycin, gentamicin, ceftazidime and vancomycin. Inducible resistance to clindamycin was tested by the double disk diffusion test (D test).⁴

All the isolated *S. aureus* strains were detected for *mecA* gene by the polymerase chain reaction assays to identify a 162 bp target product. Primers used were *mecA* P4 5'-TCCAGATTACAACCTTCACCAGG-3' and *mecA* P7 5'-CCACTTCATATCTTGTAACG-3'.⁵

Chi-square tests were performed to detect the statistical significance (5%) between groups with SPSS 13.0 for windows (SPSS Inc., Chicago, IL, United States of America). The Ethics Committee of West China Second Hospital approved this study.

Results

Six hundred and seventy-three Tibetan healthy children including 390 (57.9%) boys and 283 (42.1%) girls participated in the study. There were 245 (36.4%), 277 (41.2%) and 151 (22.4%) children in the age group of 7-13, 13-15 and 15-18 years, respectively. *S. aureus* strains were isolated from 16 (2.4%) children including 9 boys and 7 girls without significant difference with regard to sex ($p=0.889$). Of the 16 *S. aureus* strains, 7 strains (43.7%) was isolated from children between 7 and 13 years of age, 5 (31.3%) from children between 13 and 15 years of age, and 4 (25.0%) from children between 15 and 18 years of age. The antibiotic resistance profiles of the isolated *S. aureus* strains are shown in Table 1. No isolated strains were resistant to vancomycin or ceftazidime, suggesting no MRSA strain was detected. Inducible clindamycin resistance (positive D test) was found in 2 out of the 9 erythromycin-resistant isolates. No *mecA* gene was detected among the isolated *S. aureus* strains.

Discussion

Colonisation by *S. aureus* is considered to be associated with the *S. aureus* infections in human body. And studies of the carriage of *S. aureus* can be of great importance. A few studies have investigated the carriage rate of *S. aureus* in the child population in the community of the low-altitude regions of mainland China,^{6,7} suggesting that the overall carriage rate of *S. aureus* was about 18% and MRSA accounted for about 6% of the isolated *S. aureus* strains. However, data about the carriage rate of *S. aureus* in the child population on the highland of China are scarce.

Table 1 Antibiotic resistance profiles of the isolated *S. aureus* strains (n=16)

Antibiotics	S (%)	I (%)	R (%)
Penicillin	2 (12.5)	0 (0.0)	14 (87.5)
Erythromycin	5 (31.3)	2 (12.5)	9 (56.2)
Clindamycin	11 (68.8)	3 (18.7)	2 (12.5)
Gentamycin	13 (81.3)	0 (0.0)	3 (18.7)
Ceftazidime	16 (100.0)	0 (0.0)	0 (0.0)
Vancomycin	16 (100.0)	0 (0.0)	0 (0.0)

S, susceptible; I, intermediate; R, resistant

This study aimed to assess the prevalence of nasal carriage of *S. aureus* within healthy children living in the Tibet Plateau and the antibiotic resistance profiles of these isolated strains. To our knowledge, this is the first study reported in this specific population in this region.

Our study showed that the nasal carriage rate of *S. aureus* among Tibetan healthy children was 2.4%. This rate was fairly low compared with previously reported rate of 30% among healthy persons.^{2,8} Two studies performed among school children aged from 5 to 15 years old reported the *S. aureus* carriage rate of 16.1% and 52.3%, respectively.^{9,10} Another study found the *S. aureus* carriage rate of 31.1% among healthy children aged between 5 and 20 years old.¹¹ Our team assessed the prevalence of *S. aureus* nasal carriage within healthy school children aged between 7 and 18 years old in Chengdu, and the results showed that the carriage rate was 18.2% between 2005 and 2007, and 18.1% between 2008 and 2010.⁷ The extremely low *S. aureus* carriage rate in this specific population seems to be related to the highland environment where these people live in. As children from areas of better economic status such as Chengdu could get better medical care and receive antibiotic therapy frequently, the low carriage rate within the Tibetan children may also be associated with the socioeconomic status and possibly the race of people. Nonetheless, this relationship needs further determination.

The resistance of the isolated *S. aureus* strains to some antibiotics often used in the empirical treatment of *S. aureus* infections was slightly higher than that reported in some other studies,^{9-10,12,13} whereas no isolates were found resistant to cefoxitin or vancomycin. It seemed that although the nasal carriage rate of *S. aureus* in this study population was low, once the *S. aureus* strains were isolated, these strains might be highly resistant to some antibiotics usually used in the clinical situation. In this situation, some other antibiotics such as cefoxitin and vancomycin may be used. However, compared with our study in Chengdu,⁷ the resistance of the isolated strains to the antibiotics assessed in this study was relatively lower, which may result from the low level of antibiotic consumption. As the number of the isolated *S. aureus* strains is very limited in this study, further studies are needed to determine the antibiotic resistance profiles of this kind of organism more precisely in this region.

No MRSA strains were detected in this study, in agreement with the results of detection of *mecA* gene which allowed the *S. aureus* strains to be resistant to antibiotics

such as oxacillin. Two studies conducted among school children aged between 5 and 15 years old reported the nasal carriage rate of MRSA of 0.5% and 3.9%, respectively.^{9,10} One study conducted among school children aged between 7 and 18 years old in Chengdu by our team found that the prevalence of MRSA was about 6%.⁷ The results of this study indicated that the prevalence of MRSA in the community of this region was still extremely low. Although there's few data about the prevalence of MRSA among paediatric patients in the hospital of this area, a few reports showed that the isolation rate of MRSA in adult patients of Tibetan highland was lower than that of other low altitude areas of mainland China.¹⁴ What's more, we found no *mecA* gene in these isolated *S. aureus* strains, which is different from the results of other studies previously reported.^{1,8,10} The low carriage rate of MRSA in this population may be related to the fact that antibiotics are not commonly used in these people and the specific environment. But as the number of participants in this study is limited, the prevalence of MRSA in this region needs to be further determined.

Conclusion

This is a preliminary study which showed that the *S. aureus* and MRSA nasal carriage rate seemed to be still low among healthy school children in the Tibet Plateau. However, as there's only a small group of participants included in this study, larger studies are needed to further determine the carriage rate of *S. aureus* among this population. Further studies can be performed to investigate why the nasal carriage of *S. aureus* is lower among this population than that from other parts of the world, which may provide new ways to reduce *S. aureus* nasal carriage in order to control the *S. aureus* infections.

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Declaration of Interest

None

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