

Prevalence of *Staphylococcus aureus* carriage in patients on hemodialysis and the pattern of antibacterial resistance

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ABSTRACT

Background: *Staphylococcus aureus* is a virulent pathogen that is currently the most common cause of infection in hospitalized patients. These days, increment in antimicrobial resistance coupled with increasing prevalence of the agent as a nosocomial infection makes the situation even more complex. Patients on hemodialysis are at increased risk due to their immunocompromised state. The present study was designed to determine the prevalence of *Staphylococcus aureus* nasal carriage in a group of Iranian patients on hemodialysis.

Materials and methods: For this descriptive study, sterile-cotton-tripped swabs were rotated into anterior nares of 96 patients on hemodialysis, and then cultured on blood-agar medium. Having grown the colony, gram stain, catalase, manitol, DNAase and coagulase tests were all performed and the pattern of antibacterial sensitivity was determined.

Results: Of 96 patients on hemodialysis, 44 (45.8%) were nasal carrier of *S. aureus*. All isolated *S. aureus* were resistant to methicillin (MRSA), while 95% were resistant to cloxacillin, 6.81% to clindamycin, 6.81% to ciprofloxacin and 4.5% to rifampin; however, all microorganisms were sensitive to vancomycin.

Conclusion: Patients on hemodialysis are at increased risk of *S. aureus* contamination, thus, screening these susceptible patients should be served as a health priority. Meanwhile, antibiogram should be ordered for all cases to optimize treatment options.

Keywords: *Hemodialysis, Staphylococcus aureus, antimicrobial resistance.*

(Iranian Journal of Clinical Infectious Diseases 2006;1(2):55-58).

INTRODUCTION

Staphylococcus aureus is gram-positive, non-spore forming coccus that has a unique ability to develop resistance to virtually any new antibacterial agent despite recent advances. It is one of the most virulent species of *Staphylococcus* genus (1,2). Ogston had first described this

pathogen in wound infection in 1880 (1), while, Skinner and Keefer denoted its virulence when they reported a mortality rate of 82% (3). In humans, staphylococci are ubiquitous colonizers of the skin and they are more commonly found at groin, anterior nares and perianal region of relatively all age groups (1). They could be transmitted in both community and hospital environment; however, the carriage state of the pathogen, i.e. nasal carriage, is the most frequent

Received: 3 August 2005 Accepted: 19 December 2005

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form of infection transmission (1,2). Approximately 20% of healthy people are persistent carriers while 60% are intermittent carriers. Most infants (6-24%) become colonized on days 3rd-4th of hospitalization. Cross-sectional studies reported carriage rate of 50% for physicians, 70% for nursing staff, and up to 91% for other health-care workers (1).

Certain populations of patients entail a significantly greater risk of invasive *S. aureus* infection and carriage state than the normal population. They are represented by hemodialysis and peritoneal dialysis patients, as well as patients with HIV or intravenous drug users (1,3,4).

The problem of antibiotic resistant *S. aureus* is extremely challenging. In 1991, the prevalence of penicillin resistant *S. aureus* was 91% while methicillin resistant *S. aureus* (MRSA) was 29% (3). *S. aureus* species are becoming increasingly resistant to methicillin and multiple other drugs. In 1990s, nearly all studies reflected the MRSA species (5). The prevalence of MRSA progressively increased thereafter; however, great geographic variations exist. The prevalence varied as follow: Denmark, 0.1%; Italy, 34.4%; United States, 34.2%; Canada, 5.7% (1,5,6). Following conditions are associated with increased risk of MRSA development: frequent contact in hospitals, venous catheter or tracheostomy tubes, long hospitalization, surgical approach, and receiving antibiotic during the recent 2-month period prior to hospitalization (6,7).

Certainly, determining the prevalence of nasal carriage, especially among hemodialysis patients and recognizing the appropriate pattern of antibacterial resistance could pave the way for optimized antibiotic prescription in order to prevent resistance to newly developed antibiotics.

In the present study, we evaluate the *S. aureus* carriage state of all chronic renal failure (CRF) patients subjected to hemodialysis in a 3-month period. The pattern of antibacterial resistance was determined according to the latest guidelines of

National Committee for Clinical Laboratory Standard (NCCLS) (8).

PATIENTS and METHODS

For this descriptive study, hemodialysis patients who did not consume antibiotic during the past 2 weeks and were not hospitalized for reasons other than hemodialysis during the past 2 months were included. Patients were referred to Labbafinejad hospital affiliated to Shaheed Beheshti University of Medical Sciences.

Sterile-cotton-tripped swabs were rotated into anterior nares of 96 patients, then immediately cultured on blood-agar medium. In the laboratory, samples were distributed on the medium with a sterile loop, then, incubated for 24 hours (30-32°C). Having grown the colonies, gram stain, catalase, manitol, DNAase and coagulase tests were achieved to confirm the diagnosis. Then, single colonies cultured on Muller-Hinton medium and antibiotics with different concentrations were applied; oxacillin 10mcg/disc, methicillin 10mcg/disc, erythromycin 15mcg/disc, clindamycin 2mcg/disc, vancomycin 30mcg/disc, chloramphenicol 30mcg/disc, cephalosporin 30mcg/disc, ciprofloxacin 5mcg/disc, tetracycline 30mcg/disc and rifampin 30mcg/disc. Finally, they were inoculated for another 24 hours at 30-32°C. Results were evaluated using Kirby-Bauer technique.

All patients were requested to complete an informed consent. Data were analyzed by SPSS for Windows (version 10.5, USA).

RESULTS

The study population included 47 males and 49 females with the mean age of 52 years (a range, 24-79 years). Totally, 44 (45.8%) patients including 19 males and 25 females revealed to be nasal carrier of *S. aureus*. None of these carriers had positive HIV serology; however, 5 had predisposing factors

other than hemodialysis (4 were diabetic receiving insulin and one IV drug user).

Antibiogram studies showed that all species were methicillin resistant (MRSA: 100%), 95% were oxacillin resistant while all were sensitive to vancomycin. Table 1 presents the pattern of antibacterial sensitivity of *S. aureus*.

Table 1. Pattern of antibacterial sensitivity of *Staphylococcus aureus* in hemodialysis patients

| Antibiotic | Resistant | Sensitive | Intermediate |
|------------------------|-----------|-----------|--------------|
| Methicillin | 44(100) | - | - |
| Oxacillin | 42(95.5) | 2(4.5) | - |
| Erythromycin | 9(20.3) | 33(75) | 2(4.5) |
| Gentamicin | 7(15.9) | 34(77.3) | 3(6.8) |
| Tetracycline | 6(13.6) | 38(86.4) | - |
| Co-trimoxazole | 5(11.4) | 39(88.6) | - |
| Chloramphenicol | 4(9.1) | 40(90.9) | - |
| Clindamycin | 3(6.8) | 41(93.2) | - |
| ciprofloxacin | 3(6.8) | 41(93.2) | - |
| Rifampin | 2(4.5) | 42(95.5) | - |
| Vancomycin | - | 44(100) | - |

DISCUSSION

Totally, 44 (45.8%) patients were *S. aureus* carrier that is comparable with Yuv study which has reported a 52% carrier rate (9). Like Gachkar *et al* we did not find any difference between genders (2).

Pattern of antibacterial sensitivity showed significant discrepancies with prior studies. We reported the prevalence of MRSA 100% that was significantly higher than Nishijima (40.8%) and Archer (38%) reports (4,10). This could be explained by our technique. Unlike the aforementioned studies, we employed disk diffusion instead of MIC. Disk diffusion technique entails lesser accuracy than MIC in evaluation of antibacterial resistance and sensitivity.

In Nishijima study, MRSA were isolated from hospital environment in 3-5% of cases, thus, they

have concluded that patients who are carrying MRSA, spread MRSA throughout the hospital environment (4).

With respect to the increasing frequency of MRSA and transmission of infection from carriers to others, especially immunocompromised subjects, MRSA carriers should be isolated and medical staff should be obliged to wash their hands routinely prior to deal with their patients (11). Meanwhile, we strictly suggest effective antibiotic for experimental therapy of *S. aureus* and prescribe vancomycin only if the microorganism was revealed to be oxacillin and methicillin resistant.

In summary, patients subjected to hemodialysis are more susceptible to be infected with *S. aureus* and become *S. aureus* carrier, hence, transmitting infection to others. Screening these patients is a cost-effective strategy. Furthermore, antibiotics must be prescribed according to the antibiogram.

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