

Nasal and Skin Colonization of *Staphylococcus Aureus* in Hemodialysis Patients in Northeast of Iran

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Introduction. Staphylococcal infections are a major cause of morbidity and mortality in patients on hemodialysis. We conducted a study of nasal and skin colonization in patients receiving maintenance hemodialysis.

Materials and Methods. From September 2003 through June 2004, we evaluated 69 patients who were receiving maintenance hemodialysis via an internal fistula or graft. Four samples were obtained for culture from both nares and needle insertion sites on the skin by standard methods. The growth of *Staphylococcus aureus* was recorded during the study.

Results. Of the 69 patients, 28 (40.5%) had *S aureus* present in the nose and 9 (13.0%) had it present on the skin around the access site at some times during the study period. The presence of *S aureus* on the skin of the access site was significantly related to the simultaneous presence of this organism in the nose ($P = .03$).

Conclusions. From our observations, it can be concluded that the nose provides an environment in which *S aureus* can propagate and maintain itself for prolonged periods. As skin colonization with *S aureus* is a risk factor for the development of staphylococcal infection, it could be recommended that effective removal of *S aureus* from the nose would be critical for prevention of vascular access site infection.

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INTRODUCTION

Infections are a major cause of morbidity and the second most common cause of death in patients on hemodialysis.¹ *Staphylococcus aureus* is the most frequently isolated pathogen, causing infection at the vascular access site, often associated with bacteremia.²⁻⁵ Staphylococcal infections can lead to severe consequences despite antibiotic therapy.^{6,7} Therefore, prevention of staphylococcal infections is of utmost importance in end-stage renal disease patients. Although *S aureus* can be cultured from multiple sites of the carriers, some studies have shown that the anterior nares are the most consistent area from which this organism can be isolated.^{8,9}

The prevalence and incidence of nasal carriage of *S aureus* vary according to the population studied. In the general population, a mean carriage rate

of 37.2% is reported.³ Some studies, however, demonstrated increased carriage rates in patients receiving maintenance hemodialysis than in the general population.^{3,10-12} We planned this study to evaluate the nasal and skin colonization of *S aureus* in patients receiving maintenance hemodialysis. The first objective of the present study was to determine the flora of the nose and the access site. The second objective was to evaluate the relationship of the flora in the nose with the flora on the skin of the access site.

MATERIALS AND METHODS

Patients

In a study performed from September 2003 through June 2004, we evaluated 69 patients who were receiving hemodialysis via an internal

fistula or graft. The patients were on long-term hemodialysis at 3 educational hospitals of Mashhad University of Medical Sciences in Mashhad, Iran (Ghaem, Imam Reza, and Hasheminejad). Informed consent was obtained and the study was approved by the ethics committee of Mashhad University of medical Sciences. Patients with temporary access devices such as indwelling catheters were excluded from the study. The demographic and clinical characteristics of the enrolled patients were recorded. Surveillance samples from the anterior nares and the skin overlying the access site were obtained every 3 months (4 samplings during the study period).

Microbiologic Techniques

Cultures were obtained from both nares by using sterile premoistened cotton swabs and were transported to the microbiology laboratory, where they were immediately streaked onto plates containing tryptic soy agar with 5% sheep blood, MacConkey agar, and mannitol-salt agar.

To examine the needle insertion sites, before skin preparation, cultures were obtained from a 3 × 3-cm area around each insertion site with a sterile cotton swab.¹³ All cultures were incubated at 36°C for 48 hours and examined daily for evidence of growth. All organisms isolated were identified by standard methods as outlined in the *Manual of Clinical Microbiology*.¹⁴ Gram-positive cocci that produced catalase and coagulase were identified as *S aureus*. A semiquantitative technique was used to quantitate the colonies per swab. This consisted of counting the number of colonies per plate after incubation and assigning the following scale: light growth, 1 to 15 colonies; moderate growth, 16 to 30 colonies; and heavy growth, greater than 30 colonies.

Data were analyzed by the SPSS software (Statistical Package for the Social Sciences, version 10.0, SPSS Inc, Chicago, Ill, USA) and categorical variables were evaluated by the 2-tailed Fisher exact test. A *P* value less than .05 was considered significant.

RESULTS

Sixty-nine patients participated in the study. Epidemiologic data for the patients are outlined in Table 1. Data on cultures were analyzed by combining culture results from each site during the study period. Of the 69 patients, 28 (40.6%) had *S aureus* present in the nose and 9 (13.0%) had it present on the skin over the access site at some time during the study. Seventeen patients (24.6%) and 11 (15.9%) had gram-negative bacilli in the nose and on the skin over the access site before skin preparation, respectively.

The relationship between the floras present in the nose and on the skin prior to skin preparation is shown in Table 2. The presence of *S aureus* on the skin of the access site was significantly related to the simultaneous presence of this organism in the nose (*P* = .03). The presence of gram-negative bacilli in the nose was weakly related to the simultaneous presence of gram-negative bacilli on the skin of the access site (*P* = .12). The odds ratio for risk estimate of the presence of *S aureus* in the nose for the simultaneous presence of this organism on the skin was 2.22 (95% confidence interval [CI], 1.36 to 3.63). The odds ratio for gram-negative bacilli was 2.197 (95%CI, 0.97 to 4.99).

DISCUSSION

The nose is regarded as the major site of *S aureus* carriage from where the organism can spread to

Table 1. Epidemiologic Data for Patients on Long-term Hemodialysis*

Characteristic	Value
Mean age (range), y	43.3 (19 to 78)
Sex	
Man	37 (53.6)
Woman	32 (46.4)
Mean hemodialysis duration (range) , mo	83.0 (1 to 156)
Patients with diabetes mellitus	8 (11.6)
Vascular access	
Arteriovenous fistula	60 (87.0)
Arteriovenous graft	8 (11.6)
Catheter	1 (1.4)

*Values are percents unless otherwise indicated.

Table 2. Patients With Positive and Negative Culture Results for *Staphylococcus Aureus* and Gram-negative bacilli in Their Noses and on Their Skins around Vascular Access Site

Organism	Patients With Positive/Negative Cultures			
	Nose-/skin-	Nose-/skin+	Nose+/skin-	Nose+/skin+
<i>Staphylococcus aureus</i>	39	2	21	7
Gram-negative bacilli	46	6	12	5

other parts of the body.^{9,15} Reagan and colleagues have shown that the elimination of nasal carriage by using topical mupirocin also eliminates hand carriage.¹⁶ From these observations, it can be concluded that the nose provides an environment in which *S aureus* can propagate and maintain for prolonged periods. The proposed pathogenesis for a number of endogenous infections would be that the skin becomes colonized originating from the nose, causing subsequent infection in patients with impaired skin sites, eg, in patients on hemodialysis and in those with intravascular catheters.¹⁷ The relationship between nasal and skin colonization with *S aureus* and subsequent infection in patients on hemodialysis has been well established by Yu and colleagues.¹⁸ They found that patients on hemodialysis were colonized persistently by the same phage type of *S aureus* and that the colonizing strain was also implicated in the infection. Our study showed a colonization rate as high as that reported by Yu and associates¹⁸ for patients on hemodialysis, but considerably higher than that observed by Sewell and coworkers.¹⁹ Furthermore, the majority of patients (95%) with both nasal and pericatheter skin colonization were colonized with isolates of the same subtypes at both sites. These investigators concluded that culture of the anterior nares was the more sensitive indicator of *S aureus* carriage. Although with more frequent culturing, we were able to culture *S aureus* from the nose of 40.5% of the study patients, our data and those of Goldblum and coworkers¹¹ showed that the presence of the organism in the nose is not highly predictive for the simultaneous presence of the organism on the skin. It would appear that the status of skin colonization can be accurately assessed only by culture of the skin.

Few studies of the microbial flora in the nose and on the skin of patients on hemodialysis have examined the presence or absence of gram-negative bacilli. Noble and associates recovered multiple species of gram-negative bacilli from the nose and skin of patients on hemodialysis and kidney transplant recipients, but they did not study the relationship between nose and skin colonization.²⁰ Our study showed a nonsignificant relation between the presence or absence of gram-negative bacilli on these sites.

It is documented that skin colonization with *S aureus* is a risk factor for the development of staphylococcal infection on the access site. Therefore, it seems that effective removal of *S aureus* from the

skin of the access site would be critical for prevention of vascular access site infection. The significant relationship between the presence and density of *S aureus* colonization after skin preparation and the status of patient's hygiene support infection control measures based on improvement in the hygienic practices of our patients. In our patients, this approach would appear to be preferable to periodic nasal cultures and antibiotic prophylaxis as proposed by Yu and associates.¹⁸ These researchers were able to significantly reduce the rate of dialysis access site, skin, and soft tissue infections in hemodialysis patients by prophylaxis with rifampin every 3 months when nasal cultures were positive for *S aureus*. However, there are several potential difficulties with routine antibiotic prophylaxis, including the need for repeated cultures, untoward reactions to antibiotics, development of antibiotic resistance, problems ensuring patient compliance, and costs.

Several oral and topical antibiotics for the eradication of *S aureus* nasal carriage in patients on hemodialysis have been studied. These studies were summarized by Chow and Yu.²¹ Rifampin has been the most effective oral agent used for this purpose. Yu and colleagues¹⁸ used rifampin in conjunction with nasal bacitracin and obtained a significant reduction in the *S aureus* infection rate in their population of patients receiving hemodialysis. Mupirocin has been evaluated in 6 studies reviewed by Boelaert.¹⁷ By using a short-term course of therapy for 5 to 10 days, a high elimination rate was observed (mean, 87%; range, 76% to 100%). However, in some studies, the nares were sampled at 3 months posttherapy and a relapse rate of 20% to 77% was found. Therefore, a schedule of continuous mupirocin was proposed by Boelaert and colleagues.²²

CONCLUSIONS

Our study showed a high colonization rate of *S aureus* in the nose of patients on hemodialysis. Although there was a significant relation between the colonization rates in the nose and on the skin of the vascular access site, it seems that the status of skin colonization can be accurately assessed only by culture of the skin. The significant relationship between the presence and density of *S aureus* colonization after skin preparation and the status of patient's hygiene support infection control measures based on improvement in the hygienic

practices of our patients. Prophylactic antibiotics based on routine culturing of the nose has been recommended; however, there are several potential difficulties with routine antibiotic prophylaxis, including the need for repeated cultures, untoward reactions to antibiotics, development of antibiotic resistance, problems ensuring patient compliance, and costs.

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CONFLICT OF INTEREST

None declared.

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