

The efficacy of mupirocin ointment and chlorhexidine body scrubs in the eradication of nasal carriage of *Staphylococcus aureus* among patients undergoing long-term hemodialysis

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Background: Patients undergoing long-term hemodialysis have a high prevalence of *Staphylococcus aureus* nasal carriage, which may lead to serious infections. Mupirocin ointment has been used intranasally to eradicate *S. aureus* carriage in health human volunteers and health care workers. Chlorhexidine, an antiseptic with excellent antistaphylococcal activity, is widely used for handwashing and skin cleansing.

Methods: Anterior nares cultures were obtained from patients older than 18 years who were undergoing long-term hemodialysis. Patients with *S. aureus* nasal carriage were enrolled in the study. Axillae and groins were cultured. Patients were given mupirocin ointment intranasally twice per day for 7 days and chlorhexidine body scrubs daily for the first 3 days. Follow-up cultures were obtained from anterior nares, axillae, and groins at 1 day, and 1, 4, 8 and 12 weeks after treatment.

Results: One day after completion of treatment nasal carriage was eradicated in 83% of patients (15/18). After 12 weeks, 69% of patients (11/16) were free of nasal carriage.

Conclusions: Success rates of eradication were excellent compared with those in other published reports. This simple and effective regimen had no major side effects. (AJIC AM J INFECT CONTROL 1992;20:138-41)

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Staphylococcus aureus is the most common cause of infection in patients undergoing long-term hemodialysis.^{1,2} *S. aureus* may cause serious infections in these patients, including bacteremia, endocarditis, infected arteriovenous fistulas and shunts, and vascular access site infections.³⁻⁵ Most patients undergoing long-term hemodialysis are nasal carriers of *S. aureus*.^{6,7} Although one study reported that *S. aureus* on the vascular access site appeared to be acquired

from the anterior nares,⁸ another study reported that *S. aureus* on the skin of vascular access site was associated with poor personal hygiene.⁹ It seems certain, however, that there is a close relationship between skin colonization and nasal carriage of *S. aureus*.

Over the years, eradication of *S. aureus* nasal carriage has been attempted with systemic and topical antimicrobial agents, with varying degrees of success.¹⁰ However, nasal recolonization of *S. aureus* is not uncommonly detected on follow-up. Mupirocin, a recently available topical antimicrobial agent, is effective against *S. aureus*.¹¹ Mupirocin has been used to eradicate *S. aureus* nasal carriage in healthy human volunteers, among the staff of a hospital during an outbreak of staphylococcal infections, and among residents of a long-term care institution.¹²⁻¹⁴ Chlorhexidine is an antiseptic with excellent antistaphylococcal activity. It is widely used for handwashing and skin cleansing.

The purpose of this study was to ascertain the efficacy of the application of mupirocin ointment to the anterior nares, in combination with body-scubs with chlorhexidine, in the eradication of *S. aureus* nasal carriage among patients undergoing long-term dialysis.

METHODS

Patient population

All patients more than 18 years of age in the long-term hemodialysis unit in our hospital were asked to participate in this study. Patients who had a history of allergy to either mupirocin or chlorhexidine were excluded. Written, informed consent was obtained after oral explanation. The research protocol was approved by the medical research committee and the institutional review board of the hospital. The nephrologists gave permission for their patients to participate in this study.

Study design

Screening of patients. After written, informed consent had been obtained, swabs from both anterior nares were obtained for culture. Patients whose anterior nares culture grew *S. aureus* were enrolled in this study. For patients whose anterior nares culture did not grow *S. aureus* at this time, an anterior nares culture was obtained 1 month later. If this repeated anterior nares culture grew *S. aureus*, the patient was then asked to enroll in the study.

Study protocol. Cultures of the axillae and groins were obtained from all patients whose anterior nares culture grew *S. aureus*. Demographic data were collected. Patients were given 14 packets of mupirocin 2% ointment in polyethylene glycol base and 14 swab applicators and taught how to apply mupirocin to the anterior nares twice daily for 7 days. One packet of mupirocin ointment and one swab applicator were to be used each time and discarded after use. Patients were also given three bottles of chlorhexidine solution (4 fluid ounces each) and instructed to apply the solution to the whole body from the neck down, especially to the axillae and groins, during daily baths for 3 days. One bottle was to be used each time.

Posttreatment cultures of the anterior nares, axillae, and groins were taken 1 day, 1 week, 4 weeks, 8 weeks, and 12 weeks after completion of treatment.

Microbiology. Swabs were streaked on mannitol salt agar and incubated at 37° C for 48 hours. Mannitol-positive colonies were tested for coagulase. Coagulase-positive colonies were designated as *S. aureus*. All *S. aureus* isolates were tested for susceptibility to penicillin and oxacillin by the standard disk diffusion test.¹⁵

RESULTS

Sixteen of the 52 patients originally cultured were *S. aureus* nasal carriers. The remaining 36 patients were cultured again 1 month later; six were then found to be *S. aureus* nasal carriers. Twenty-two patients were therefore enrolled in the study.

Diabetes mellitus

Eight (35%) of the 23 patients with diabetes mellitus and 14 (48%) of the 29 patients who did not have diabetes mellitus were *S. aureus* nasal carriers. Five (38%) of the 13 patients who were receiving insulin therapy and three (30%) of the 10 patients with diabetes mellitus but not receiving insulin therapy were *S. aureus* nasal carriers.

Length of treatment by hemodialysis

For the 22 patients who were *S. aureus* nasal carriers, the duration of hemodialysis treatment ranged from 2 to 82 months, with a mean of 35 months and median of 37 months. For the 30 patients who were not *S. aureus* nasal carriers, the duration of hemodialysis treatment ranged

Table 1. Results of mupirocin ointment and chlorhexidine in the treatment of *S. aureus* carriage

Source of specimens	Pretreatment	Posttreatment				
		1 d*	1 wk	4 wk†	8 wk	12 wk†
Anterior nares	22/22	3/18	3/18	5/17	4/17	5/16
Axillae	4/22	0/18	0/18	0/17	0/17	0/16
Groins	8/22	2/18	1/18	2/17	2/17	1/16

Values are expressed as number of positive cultures/number of patients cultured.

*Four patients did not complete treatment.

†One patient died.

from 1 to 58 months, with a mean of 23 months and median of 22 months. The difference between the two groups is almost statistically significant ($p = 0.063$, $t = 1.95$, two-tailed t test).

S. aureus carriage

Results of cultures for *S. aureus* are detailed in Table 1. Four patients did not complete treatment; three of these four patients were enrolled during the second month. Two patients died during follow-up. One day after completion of treatment, nasal carriage had been eradicated in 15 of 18 patients (83%). Twelve weeks after treatment, 69% (11/16) of the surviving patients were free of *S. aureus* nasal carriage. Four of the five patients had transient loss of nasal carriage but reacquired carrier status at the end of follow-up period. All five patients who were nasal carriers at the end of follow-up did not have diabetes mellitus. Only one patient had persistent positive groin culture but negative nasal culture.

Antibiotic susceptibility

All *S. aureus* isolates from pretreatment nasal cultures were susceptible to oxacillin and all except five isolates were resistant to penicillin. These five isolates were also tested for β -lactamase production; all were negative. One patient was also colonized before treatment with an oxacillin-resistant *S. aureus* in the axillae and groins. All posttreatment cultures from all sites of this patient had no *S. aureus*.

In two (50%) of the four isolates from pretreatment axillary cultures and four (50%) of the eight isolates from posttreatment groin cultures, antimicrobial susceptibility was different from that of the corresponding isolates from the nasal cultures of the same patient. In four patients, pretreatment cultures from all three sites were positive for *S. aureus*, but in two of these four pa-

tients the antimicrobial susceptibility of isolates from the axillae and groins was different from that of the isolate from the anterior nares.

DISCUSSION

It has been shown that *S. aureus* nasal carriage in patients who are undergoing long-term hemodialysis is associated with more frequent *S. aureus* infections and that infections occur less frequently in *S. aureus* nasal carriers given periodic rifampin to eliminate the carrier state.⁷ However, resistance to rifampin develops fairly rapidly.⁷ In a recent study of oral ciprofloxacin plus rifampin in the treatment of patients with nasally carried methicillin-resistant *S. aureus*, resistance to ciprofloxacin also developed rapidly, necessitating the termination of the study.¹⁶

Mupirocin ointment has been used for 9 months nasally in patients undergoing long-term hemodialysis, resulting in the reduction of carriage and infection.¹⁷ With the long-term usage of mupirocin, however, development of resistance is a real concern.¹⁸ We decided to use short-term therapy with mupirocin ointment applied intranasally, in conjunction with chlorhexidine body scrubs, in an attempt to eradicate *S. aureus* nasal carriage and prevent recolonization of the anterior nares from other body sites.

In this study, we found that the prevalence of *S. aureus* nasal carriage was not higher among patients with diabetes mellitus, either insulin-dependent diabetes or non-insulin-dependent diabetes, than among patients with no history of diabetes mellitus. This is in accordance with findings from a large, geographically based study.¹⁹ Instead, the prevalence of *S. aureus* nasal carriage was related to the length of time the patient had been undergoing long-term hemodialysis. The patients who were *S. aureus* nasal carriers had been undergoing hemodialysis

much longer than the ones who were not *S. aureus* carriers. This difference almost attained statistical significance ($p = 0.063$).

Our success rates of eradication (83% immediately after treatment and 69% after follow-up for 12 weeks) are excellent, in comparison with other studies of patients undergoing hemodialysis that used topical and oral treatment regimens.¹⁰ In a study using oral and topical antimicrobial agents with a 12-week follow-up period, the rates of eradication of *S. aureus* nasal carriage at 12 weeks were 44% and 25%, for rifampin/bacitracin and bacitracin alone, respectively.⁷ With the chlorhexidine body-scrub treatment, axillae and groins were eliminated as sources of nasal recolonization. We used mupirocin 2% ointment in a polyethylene glycol base, which is approved by the Food and Drug Administration for topical use on skin surfaces. Mupirocin ointment in a soft paraffin base is currently under clinical investigation for intranasal use.²⁰ If the efficacy of this short regimen of mupirocin ointment and chlorhexidine body scrub is confirmed in large clinical trials, this treatment can be used on a periodic basis, perhaps every 3 months, for those patients who are *S. aureus* nasal carriers by repeated cultures.

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