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Staphylococcus aureus Nasal Colonization in a Nursing Home: Eradication With Mupirocin

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ABSTRACT

Recent reports have emphasized an increase in both infection and colonization with methicillin-resistant *Staphylococcus aureus* (MRSA) in institutionalized older patients. We studied whether or not local treatment with mupirocin ointment could eliminate nasal colonization with *S aureus*. A total of 102 patients in a Veterans Administration nursing home were screened for *S aureus* nasal colonization. Thirty-nine patients (38.2%) were colonized, 18 with methicillin-sensitive *S aureus* (MSSA) and 21 with MRSA. Almost half of all colonized patients were in the most dependent functional category and there was a significant association of MRSA colonization, but not MSSA colonization, with poor functional status. Colonized patients were treated with mupirocin ointment applied to the anterior nares twice daily for seven days. After treatment, MSSA persisted in only two patients and MRSA in only one patient; thus, nasal colonization was eliminated in 91.4% of colonized patients. At one month and two months follow-up, 11 patients became transiently recolonized and three became persistently recolonized with *S*

aureus. Mupirocin was well tolerated with no side effects noted. Mupirocin ointment may be useful in controlling nasal colonization with *S aureus* in the nursing home setting. [*Infect Control Hosp Epidemiol.* 1990; 11:13-16.]

INTRODUCTION

Methicillin-resistant *Staphylococcus aureus* (MRSA) has been found with increasing frequency in hospitals and nursing homes and has emerged as a major cause of nosocomial infections over the past decade.¹⁻⁴ Attempts at controlling the spread of MRSA have involved any or all of the following measures: isolating colonized and infected patients to stop patient-to-patient transmission, stopping spread from colonized personnel to patients; and eradicating the organism from the environment.^{2,5,6}

The occurrence of MRSA in nursing homes is of special concern because chronic care facilities may serve as reservoirs for MRSA and introduce the organism into acute care hospitals when patients are admitted,^{3,7,8} as has been noted with antibiotic-resistant gram-negative bacilli.⁹

Various measures have been attempted to eradicate MRSA colonization but none have been completely successful.^{5,10-13} Mupirocin ointment is a topical antibiotic with antistaphylococcal activity that might prove useful in eradicating MRSA colonization.¹⁴ Use of mupirocin is attractive because it is a topical antibacterial agent with efficacy comparable to systemic formulations and with minimal side effects.¹⁵ The purpose of this study was to evaluate the efficacy of mupirocin ointment in eradicating *S aureus* nasal colonization in nursing home patients.

MATERIALS AND METHODS

The Ann Arbor Veterans Administration Nursing Home Care Unit is a 110-bed facility attached to the

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acute care hospital. Patients are admitted for long-term care, rehabilitation and geriatric evaluation.

All patients in the nursing home care unit were screened for MRSA and methicillin-sensitive *S aureus* (MSSA) colonization of the anterior nares. Both nares were swabbed with cotton tipped applicators that were placed in Stuart's transport media and taken immediately to the infectious diseases laboratory. Each swab was plated separately on mannitol salt agar using a semi-quantitative four-quadrant method of streaking the plate; cultures were incubated at 35°C for 24 hours. The amount of growth on the plates was quantified and yellow colonies were isolated. Gram-positive cocci in clumps that were catalase and coagulase-positive (using a tube coagulase test) were considered to be *S aureus*. Colonies from an overnight culture were suspended in 0.9% NaCl to the turbidity of a 0.5 McFarland standard and then plated on Mueller-Hinton (Difco, Detroit, Michigan) agar containing 6 µg/ml oxacillin (Remel, Inc., Lenexa, Kansas). After 24 hours incubation at 35°C, growth indicated MRSA and absence of growth indicated MSSA.¹⁶

All patients who had two consecutive anterior nares cultures positive for MSSA or MRSA taken three days apart were asked to give their consent to participate in the study. Topical mupirocin 2% ointment in a polyethylene glycol base was applied by the investigator to the anterior nares with a sterile swab twice daily for seven days. Therapy was begun five days after the second positive baseline culture was obtained. Anterior nares cultures were repeated at three days, seven days, 14 days, one month and two months after mupirocin therapy was initiated. Cultures obtained during therapy (days 3 and 7) were performed right before the application of mupirocin ointment. Patients were asked each day ointment was applied whether or not they experienced any side effects from the application.

RESULTS

Of 102 patients screened for nasal colonization, 39 (38.2%) were found to be carriers of *S aureus*. Eighteen patients (17.6%) were persistently colonized with MSSA and 21 (20.6%) were persistently colonized with MRSA. Almost half of the patients sampled were in the most dependent functional status, requiring assistance with most activities (Table 1). MRSA colonization was highest in this group: 28.5% were colonized ($p=.046$, chi-square test).

Of the 39 colonized patients, 35 agreed to participate in the study; four patients were not interested in participating (three did not want to have ointment applied and one refused further cultures).

Thirty-five patients (16 with MSSA and 19 with MRSA) were treated with mupirocin ointment applied to the anterior nares twice daily for seven days. However, two patients with MRSA received mupirocin ointment for only three days and five

Table 1
Functional Status of Nursing Home Patients With *S aureus* Nasal Colonization*

Functional Level	Number of Patients	Number (%) with MRSA	Number (%) with MSSA
I†	22	2 (9)	2 (9)
II‡	31	3 (9.7)	9 (29)
III**	49	14 (28.5)	5 (10.2)

* MRSA colonization was significantly associated with poor functional status, $\chi^2=6.155$; $p=.046$.

† Independent in activities, low level nursing

‡ Requires some assistance, moderate level nursing

** Requires assistance with most activities, high level nursing

days; one refused to cooperate after day 3 and one was out of the nursing home on pass on days 6 and 7.

After three days of treatment with mupirocin, MSSA persisted in five of 16 patients (31.2%), and MRSA was still present in seven of 19 patients (36.8%) (Table 2). However, by the end of seven days of mupirocin administration, only two of 16 (12.5%) patients with MSSA and one of 19 (5.3%) patients with MRSA remained colonized. Thus, by the end of therapy, *S aureus* colonization was eradicated in 91.4% of patients, including the two patients who had only three and five days of therapy.

Of the three patients with persistent *S aureus* colonization, one remained persistently colonized with MRSA for eight weeks after mupirocin was stopped, one patient with MSSA was free of colonization on follow-up cultures and the other with MSSA died before follow-up could be accomplished.

Of those 32 patients (18 with MRSA and 14 with MSSA) in whom colonization was cleared by mupirocin, 14 (43.7%) had a recurrence of *S aureus* in the nares on at least one occasion. Six with MRSA and two with MSSA had only a single positive culture at either one week or four weeks after therapy was stopped. An additional three patients with MRSA had a positive culture at eight weeks. Because this was the last culture taken, it is not known if they were only transiently colonized or had become persistently colonized. Only three patients, all of whom had MSSA, had a recurrence of persistent colonization (two or more of the three follow-up cultures positive for *S aureus*). Mupirocin therapy was well-tolerated with no side effects noted by any of the patients.

DISCUSSION

The emergence of MRSA as a major nosocomial pathogen in US hospitals began in the 1970s and has continued unabated into the 1980s.^{1,4} Recent interest has focused on MRSA as an important nosocomial pathogen in long-term care facilities.^{3,7,8} We found that 20.6% of all patients in our nursing home care unit had MRSA nasal colonization, a rate almost twice as high as that noted by Storch, et al.

Table 2
Results of Treatment With Mupirocin in
Nasal Carriers of *S aureus*

Organ- ism	No. of Patients	Positive Cultures/Total Cultured on Each Day				
		Treatment Period		Follow-up Period		
		Day 3	Day 7	1 Week	4 Weeks	8 Weeks
MSSA	16	5/16	2/16	6/15	4/13	2/12
MRSA	19	7/19	1/19	4/18	1/17	4/15

and Thomas, et al.^{3,8} Our nursing home may well serve as a reservoir of MRSA because patients are frequently admitted to the adjacent acute care hospital. Conversely, it is likely that the high rate of colonization in our nursing home continues because of frequent transfer from the acute care facility back into the nursing home care unit.

Many therapies have attempted to eliminate MRSA colonization. Trimethoprim-sulfamethoxazole and rifampin have been given orally in combination to eradicate nasal colonization in both patients and hospital personnel.^{5,10} Although effective in the short-term, follow-up studies have often found recolonization, probably related to re-exposure in the hospital environment.^{5,10} Some studies combined trimethoprim-sulfamethoxazole and rifampin therapy with hexachlorophene baths and topical bacitracin.¹³ Others have used only topical vancomycin¹⁷ or bacitracin,^{11,12} with only modest success in eliminating nasal carriage of *S aureus*.

The present study was designed to determine the usefulness of mupirocin ointment in eradicating *S aureus* nasal colonization. Mupirocin (Bactroban, Beecham Inc., Bristol, Tennessee), a purified monocarboxylic acid isolated from *Pseudomonas fluorescens*, is a unique antibiotic that shares no structural relationships with other antibiotics.¹⁸ Mupirocin ointment has been shown to be useful in the treatment of impetigo caused by *S aureus* and beta-hemolytic streptococci,¹⁹ and it has also been used for treating secondary infection of skin lesions, such as burns or psoriasis.^{19,20}

Recently, mupirocin ointment has been used to eliminate nasal colonization with an epidemic strain of MRSA.^{21,22} In the study by Hill, et al., MRSA was eliminated after five days of topical mupirocin in all patients and staff; however, 10% of patients and 15% of staff became recolonized one to 12 weeks after therapy ended.²² Dacre, et al. also showed elimination of MRSA and MSSA in a small number of patients and staff treated for two to 23 days, but this cohort also received other local measures, including chlorhexidine gluconate and hexachlorophene powders and soaps.²¹ A preliminary study in a hemodialysis unit with a high rate of nasal colonization with *S aureus* showed not only that mupirocin ointment can eliminate colonization

in most carriers, but also that routine nasal application of mupirocin ointment may decrease staphylococcal infections.²³ In 1986, a combined working party of the Hospital Infection Society (HIS) and the British Society for Antimicrobial Chemotherapy recommended the use of mupirocin for eradicating nasal colonization with MRSA in both staff and patients.¹⁴ In the United States, the formulation of mupirocin in polyethylene glycol is not yet approved for intranasal use; currently trials are underway using a soft paraffin base rather than polyethylene glycol.

Our results are similar to the above studies in that 90% of patients showed elimination of nasal carriage of *S aureus* (both MRSA and MSSA) at the end of therapy, but recurrences were noted with increasing length of time after treatment. Patients may have been recolonized from another existing endogenous source, from other patients or from hospital personnel. The source of recurrence in our patients is not known because we did not sample multiple sites nor do phage typing of isolates to establish whether or not the same strains recurred following treatment.

An advantage of systemic therapy, such as trimethoprim-sulfamethoxazole and rifampin, is that colonization at multiple sites, such as perineum and other skin sites and not only the nares, can be eliminated. On the other hand, an advantage of using mupirocin ointment for eradicating nasal colonization is that serious side effects have not been noted.^{15,19-23} One must weigh the ease of administration and absence of side effects with the knowledge that resistance to mupirocin, although uncommon, does occur.²⁵ Chronic intermittent use in a nursing home setting might have further ramifications with regard to the development of resistance.

Nursing home patients may be predisposed toward colonization with pathogenic organisms because of several different factors, including poor functional status with high nursing care requirements, skin lesions, prior surgery, urinary catheters and frequent use of antibiotics.²⁶ One factor that played a role in *S aureus* carriage in our patients was functional status. Patients more independent in activities of daily living were less likely to have colonization than were highly dependent patients. This was especially true of colonization with MRSA.

Because nursing home patients are often *S aureus* carriers and likely to be hospitalized at some time, the transmission of this organism from one institution to another has become a major concern. The periodic treatment with mupirocin of nursing home patients who are *S aureus* carriers could perhaps reduce this significant reservoir and prevent spread back to acute care facilities. This study demonstrates that topical mupirocin can eliminate MRSA and MSSA from the anterior nares of some patients and temporarily eliminate nasal colonization from most patients in a nursing home setting. However, further studies will be required to determine the

most effective regimen to decrease recolonization and to discover if elimination of nasal carriage actually decreases the transmission of *S aureus* in either the nursing home or the acute care hospital.

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