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Staphylococcus aureus Carriage Rate of Patients Receiving Long-Term Hemodialysis

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• **We studied the carriage rate of *Staphylococcus aureus* in patients receiving long-term hemodialysis and also noted the incidence of shunt infections, bacteremia, and septicemia in colonized patients. Thirty-one of 50 patients (62%) carried *S aureus* in the nose, throat, or on the skin, of whom 20 patients developed shunt infections; nine infections resulted in episodes of bacteremia. Patients with chronic renal failure not undergoing hemodialysis had a 21% carriage rate. Thus, there is a high carriage rate of *S aureus* in asymptomatic patients receiving hemodialysis that is probably related to an increased incidence of shunt infections and bacteremia.**

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Staphylococcus aureus is the most common organism causing serious infections in patients undergoing long-term hemodialysis.[1-4] Evidence has been presented that the infecting organism first colonizes the patient.[2-4] Previously, we reported that regular needle use somehow increases the carriage rate of *S aureus*.[4,5]

See also p 1609.

The present study examines the carriage rate of *S aureus* in another population of patients in whom needles are regularly used, namely noninfected patients receiving long-term hemodialysis. We also determined the incidence of shunt infections and bacteremia that occurred in colonized patients.

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MATERIALS AND METHODS

From April 1976 through June 1977, cultures of the skin, nose, and throat were obtained from patients in the George Washington University Hospital Dialysis Unit, the Outpatient Hemodialysis Center, and the Renal Clinic using methods previously described.[4] Phage typing was performed by the Bacteriology Laboratory of the National Institutes of Health.

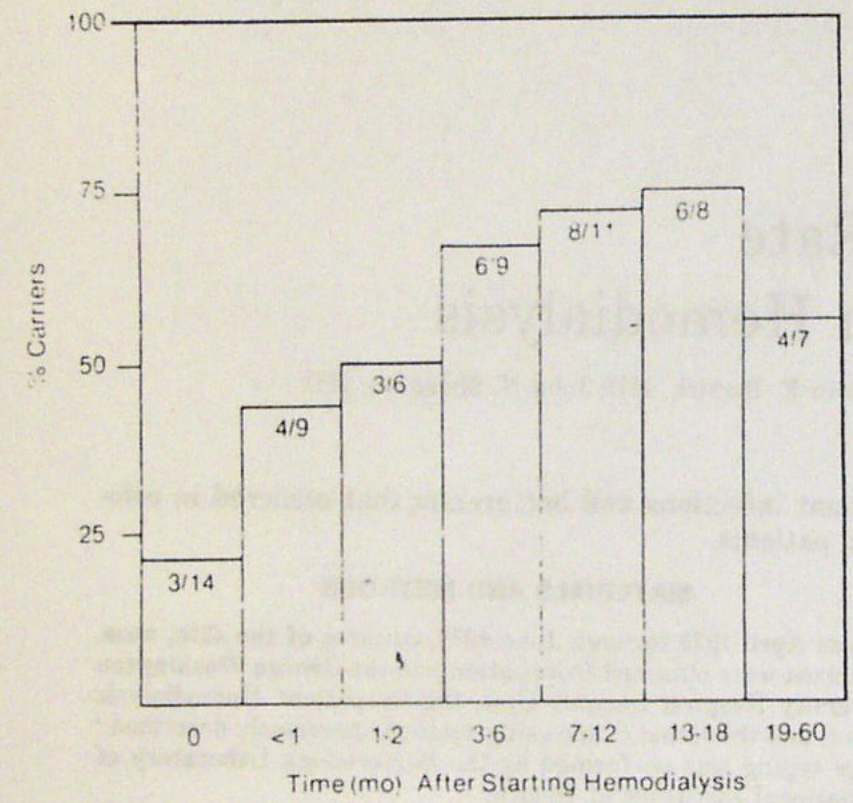
During the above period, cultures were obtained from 50 patients undergoing long-term hemodialysis. Patients studied were evenly divided throughout the study period, and no changes in the rate of carriage were noted on a month to month basis. Cultures were obtained from no patient more than once. There were 20 men and 30 women. Ages ranged from 21 to 79 years with a mean age of 51 years. Underlying causes for chronic renal failure included chronic glomerulonephritis, hypertension, multiple myeloma, lupus nephritis, diabetic glomerulosclerosis, and chronic pyelonephritis. None of the diabetic patients was taking insulin at the time of the study. Duration of dialysis varied from one week to 48 months, the mean duration being 10.6 months. No patient had clinical evidence of infection at the time cultures were obtained. For comparison, cultures were obtained from 14 ambulatory patients with chronic renal failure not requiring hemodialysis; age, sex, and causes of renal failure were similar to those of the dialysis patients. One of these 14 patients was receiving corticosteroids for multiple myeloma as compared with three of 50 in the dialysis group. Also, cultures were taken from ten members of the dialysis staff. In addition, settle plate studies were done in both dialysis centers looking for air-borne organisms.

RESULTS

Thirty-one of the 50 hemodialysis patients (62%) carried *S aureus* in the nose, throat, or on the skin (Table). Twelve of the 50 (24%) carried the organism at two sites, whereas four (8%) were carriers at all three sites. Nasal carriage was found in 20 patients (40%), throat carriage in 18 (36%), and skin carriage in 15 (30%). Phage typing was done on 14 of the 31 patients. There appeared to be no predominating

Rates and Sites of Carriage of *Staphylococcus aureus* Among Various Groups of Needle-Using Patients and Controls

Group	Source	Mean Age, yr	No.	No. (%) of Carriers	No. of Sites Showing *S aureus* Growth			
					Nose	Throat	Skin	Total
Chronic renal failure on hemodialysis regimen	Present study	50.8	50	31 (62)	20	18	15	53
Parenteral drug abusers, recently injecting	Tuazon and Sheagren*	25.7	65	22 (35)	16	13	4	33
Diabetics taking insulin	Tuazon et al†	48.0	35	12 (34)	8	3	4	15
Chronic renal failure, no hemodialysis	Present study	44.7	14	3 (21)	2	1	0	3
Diabetics taking oral hypoglycemic agents	Tuazon et al†	56.6	36	4 (11)	3	1	0	4
College students	Tuazon and Sheagren*	27.2	55	6 (11)	2	4	1	7
Parenteral drug abusers, no longer taking drugs	Tuazon and Sheagren*	26.3	31	3 (10)	1	2	0	3



Rate of *S aureus* carriage vs time before (0 months) and after initiating hemodialysis in patients with chronic renal failure. Numbers inside boxes are carriers/number of patients cultured.

...here type among these patients; however, organisms ... one group of three patients were typable by phages 7 ...42E and from another group of three by phages 86 and ...1. These six patients were all cultured at different times ...uring the study. Of the group of 14 patients with chronic ...enal failure *not* on hemodialysis, three (21%) were carrying *S aureus*. Among the staff of the dialysis unit, two ...echnicians and a physician were carriers of *S aureus* of ...ifferent phage types. All settle plates showed no *S aureus* ...rowth.

The Figure shows the carriage rates of *S aureus*‡ for ...roups of patients cultured before and then at various ...mes after the initiation of hemodialysis. Group comparisons were made, for serial studies on individual patients ...ere not able to be carried out. The carriage rate steadily ...ncreased through the first 12 to 18 months of hemodialysis ...eaching a peak of 75% in the group cultured from 13 to 18 ...onths. The rates in the groups of patients cultured at 3 to ..., 7 to 12, and 13 to 18 months were all significantly ($P < .025$) greater than the rate for patients not on ...emodialysis (Figure).

The Table presents the overall carriage rates and sites ...olonized in these groups of patients with chronic renal ...ailure compared with various groups of needle-using ...atients and control subjects from the Washington, DC ...rea, which we have reported previously. Patients on ...emodialysis had the highest carriage rate (62%), followed by recently injecting hard drug abusers (35%), insulin-using diabetics (34%), and chronic renal failure patients not on hemodialysis (21%). Diabetic patients using oral hypoglycemic agents, healthy college students, and rehabilitated drug users all had rates of carriage of approximately 10%.

During this period of study (14 months), 20 of the 50 dialyzed patients (40%) developed shunt infections, and nine had 12 episodes of bacteremia secondary to *S aureus* (three patients, each having two bacteremic episodes). All recovered uneventfully after from two to four weeks of therapy with nafcillin sodium. Seven of nine bacteremic patients were carriers of *S aureus*. Because, for technical reasons, none of the organisms from bacteremic patients were preserved, no phage typing was done on organisms recovered from the blood. However, it has already been clearly shown that the colonizing organism is responsible for the episode of septicemia.[2] We have shown that the same sequence occurs in parenteral drug abusers who develop endocarditis due to *S aureus*.[6]

COMMENT

Staphylococcus aureus is a frequent cause of shunt infections and septicemia in patients with chronic renal failure undergoing hemodialysis. Martin et al[2] described 25 patients who had 78 shunt infections; 75 (96%) of these were caused by *S aureus*. Eighty percent of such infections

e shown by phage typing to be caused by the organism nizing the skin and nose of these patients. Ralston et eported 41 infections in Scribner shunts and Brescia las in 63 patients and found *S aureus* to be responsi- for 37 (90%) of these; in eight patients (11%), shunt ction resulted in bacteremia. Forty-three of these 63 ents (68%) were carriers of *S aureus*. In our series, 31 of patients (62%) carried *S aureus*, 20 developed shunt ctions, and nine suffered 12 episodes of *S aureus* teremia.

lthough we do not have data indicating that *S aureus* riage is related to time spent in hospital or in the ysis unit, a correlation certainly is possible. However, dialysis patients who were carriers had not been pitalized recently at the time cultures were taken. eover, the carriage rate in the Outpatient Dialysis ter (8/15 = 53%) was similar to that in the Hospital lysis Unit (23/35 = 65%). Settle plates in the dialysis ts showed no *S aureus* growth. Antibiotic sensitivities th olated *S aureus* strains showed them to be ny sensitive to the semisynthetic penicillins. In our ious studies showing a higher *S aureus* carriage rate ng insulin-injecting diabetics and parenteral drug sers, none of the patients had been hospitalized.

f interest was the fact that the carriage rate among the ysis staff was 30%, a rate even higher than the 21% rate arriage among patients with chronic renal failure. s, it appears that staff members of the hemodialysis have a rate of staphylococcal carriage higher than that normal persons unassociated with a hospital environ- t. Further, dialysis staff members could be the source trains of *S aureus* that subsequently colonize entering ents. Phage typing studies showed little relationship veen the organisms carried by the staff members and heavily colonized patients.

hus, we suspect that colonization with *S aureus* is not ply related to exposure to the hospital environment; regular needle use may be the factor as well as underlying immune defects. Though our study shows a higher carriage rate (21%) among nondialyzed renal patients than normal controls (11%), the number of patients tested (14) is small and the difference is not significant by the chi-square test ($P > .20$).

Thus, our study shows a high carriage rate of *S aureus* among chronic renal failure patients on hemodialysis, which increased with time after starting hemodialysis. Since bacteremic infections remain a major complication of patients with chronic renal failure on hemodialysis, despite use of fistulas to replace external shunts for vascular access, and *S aureus* accounts for 70% of such episodes,[7] an antistaphylococcal antibiotic must be included in any regimen used to treat toxic, febrile hemodialysis patients. **Patients known to be nasopharyngeal carriers of *S aureus* are particularly at risk of septicemic episodes.**

David Alling, MD, PhD, National Institutes of Health, did the statistical analysis; Charles Zierdt, PhD, did the phage typing of the organisms. George Washington University Hospital Dialysis Unit Staff and Marissa Arizabal, Microbiology, gave assistance; Margaret Mattila gave secretarial assistance.

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