Staphylococcus aureus nasal carriage: effect on peritonitis and exit site infection in continuous ambulatory peritoneal dialysis patients

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***Staphylococcus aureus* is an important cause of exit site infections and peritonitis in patients receiving continuous ambulatory peritoneal dialysis. To determine the role of *Staphylococcus aureus* nasal carriage in determining the rate of *Staphylococcus aureus* exit site infection and peritonitis, we studied 177 continuous ambulatory peritoneal dialysis patients who were followed up at Queen Mary Hospital from January 1990 through June 1995. The cumulative rate of exit site infection was one episode per 11.5 patient months. The cumulative rate of peritonitis was one per 19.2 patient months. The total number of patients with one or more positive cultures of *Staphylococcus aureus* from the anterior nares was 30 (16.9%). There is a significant association of the *Staphylococcus aureus* nasal carriage status with *Staphylococcus aureus* exit site infection and peritonitis. Moreover, there seems to be a trend for the *Staphylococcus aureus* nasal carrier to run a higher risk of multiple episodes of *Staphylococcus aureus*-related infections. Thus for this group of patients, decolonisation of *Staphylococcus aureus* from the anterior nares with local or systemic antibiotics may be useful.**

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Introduction

Staphylococcus aureus is an important cause of exit site infection and peritonitis in patients receiving continuous ambulatory peritoneal dialysis (CAPD). It causes considerable morbidity and a significant financial burden on the health care system. Several studies have shown an association between *S. aureus* nasal carriage and exit site infection and peritonitis,[1-5] while others have not.[6] There is also growing interest in investigating whether nasal decolonisation of *S. aureus* with local or systemic antibiotics can decrease the incidence of *S. aureus*-associated infections and whether or not these measures are cost-effective.

The aim of this study was to investigate the incidence of *S. aureus* exit site infection and *S. aureus* peritonitis in Chinese patients and to determine whether *S. aureus* nasal carriage is associated with a higher risk of *S. aureus* infection.

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Subjects and methods

All patients who had been admitted to the CAPD programme at the Queen Mary Hospital from January 1990 through June 1995 were recruited. Cultures were taken from the anterior nares at the begining of the study and repeated four weeks later. *S. aureus* nasal carriage was defined as someone having one or more positive *S. aureus* cultures. *Staphylococcus aureus* exit site infection was defined as erythema of the exit site of greater than 2 mm and exudate from which *S. aureus* was grown. *Staphylococcus aureus* peritonitis was diagnosed if cloudy dialysate with more than 100 white blood cells/mL and more than 50% polymorphonuclear leucocytes occurred and from which *S. aureus* was grown. All episodes of exit site infection and peritonitis were recorded. Exit site infection and peritonitis-free survival curves (ie. time to first episode of infection) were constructed using actuarial life table analysis and the difference between the groups was compared using the Generalized Wilcoxon test. Contingency tables were analysed using the Fisher's exact test or Chi-square test where appropriate. Continuous variables were compared using the two-tailed Student's *t* test; a P value ≤ 0.05 was considered significant.

Table. Demographic and clinical data of patients with and without *Staphylococcus aureus* nasal carriage

No.	Carrier (n=30)	Non-carrier (n=147)	P value
Sex (F:M)	14:16	74:73	ns†
Age (y)	51.2±13.5*	53.9±14.4	ns
Duration of follow up (m)	28.5±22.6	26.7±21.6	ns
Diabetes mellitus: non-diabetes mellitus	4:26	29:118	ns
S. aureus exit site infection (patient months)	19	33.6	
Non-*S. aureus* exit site infection (patient months)	20	18.3	
S. aureus peritonitis (patient months)	74.1	210	
Non-*S. aureus* peritonitis (patient months)	20	22	

* Mean value ± SD
† ns not significant

Results

One hundred and seventy-seven CAPD patients were studied. All patients were dialysed using double cuffed Tenckhoff catheters. Thirty patients (16.9%) were *S. aureus* nasal carriers and of these, four were methicillin-resistant *S. aureus* (MRSA) nasal carriers, the remainder being methicillin-sensitive *S. aureus* (MSSA) nasal carriers. The demographic and clinical data of the *S. aureus* nasal carriers and the non-carriers are shown in the Table.

Altogether, there were 633 episodes of exit site infection and 379 episodes of peritonitis. The cumulative rate of exit site infection of the whole group was one episode per 11.5 patient months and the cumulative rate of peritonitis was one episode per 19.2 patient months.

Staphylococcus aureus *exit site infection*

There were 241 episodes of *S. aureus* exit site infection, which accounted for 38% of all exit site infections. The cumulative rate of *S. aureus* exit site infection among *S. aureus* nasal carriers was one episode per 19 patient months, compared with one episode per 33.6 patient months in the non-carriers. For exit site infection not due to *S. aureus*, the cumulative rate was one episode per 20 patient months and one episode per 18.3 patient months among nasal carriers and non-carriers, respectively. There was no difference in the rate of exit site infection between MRSA and MSSA nasal carriers. When comparing the infection-free survival times, there was a significant difference between the percentage of *S. aureus* nasal carriers free from *S. aureus* exit site infection at one year (56.7%) compared with the non-carrier group (74.8%) [P<0.05] (Fig 1). For non-*S. aureus* exit site infection, there was no significant difference in the percentage of patients free of infection at one year, as carriers (72.4%) and non-carriers (68.8%) had similar infection rates.

Among the *S. aureus* carrier group, 8 of 11 patients (72.7%) had three or more episodes of *S. aureus* exit site infection, compared with 27 of 61 patients (44.3%) in the non-carrier group (P=0.1).

Staphylococcus aureus *peritonitis*

For CAPD-related peritonitis, 44 episodes of *S. aureus* peritonitis accounted for 11.6% of all peritonitis episodes. The cumulative rate of *S. aureus* peritonitis among *S. aureus* nasal carriers was one episode per 74.1 patient months compared with one per 210 patient months among the non-carriers. The cumulative rate of non-*S. aureus* peritonitis was one episode per 20 patient months and one per 22 patient months among *S. aureus* carriers and non-carriers, respectively. There was no difference in the rate of peritonitis between MRSA and MSSA carriers. A comparison of infection-

free survival showed that there was a significant difference between the percentage of *S. aureus* nasal carriers who were free from *S. aureus* peritonitis at one year (90.0%), compared with the non-carriers (98.0%) [P<0.05] (Fig 2). For non-*S. aureus* peritonitis, there was no significant difference in the percentage of patients who were infection-free at one year—carriers (79.3%) and non-carriers (70.8%).

Among the carrier group, three of four patients (75%) had multiple episodes of *S. aureus* peritonitis compared with five of 13 patients (38.5%) in the non-carrier group (P=0.2).

Discussion

Staphylococcus aureus is the single most important organism, causing 38% of exit site infections and 11.6% of peritonitis in our CAPD population. Both MSSA and MRSA nasal carrier rates in our population are low compared with others who have reported MSSA nasal carrier rates of 23% to 65%[1-5] and a MRSA carrier rate of 16.9%.[7]

Luzar et al report a higher incidence of diabetes among the *S. aureus* nasal carriers.[4] However, the association could not be demonstrated in our population. There was also no association between the nasal carrier status and the age, sex, or duration of peritoneal dialysis.

A significant association between *S. aureus* nasal carrier status and *S. aureus* exit site infection and peritonitis was shown in this study. This is in agreement with the results of other studies. Lye et al report a higher rate of catheter losses and CAPD patient drop out among MRSA carriers compared with MSSA carriers.[7] Unfortunately, the number of MRSA nasal carriers among our dialysis population was too small for a meaningful analysis. The results of this study also show a trend for increased risk of multiple episodes of *S. aureus* exit site infection and peritonitis among nasal carriers compared with non-carriers, although the difference did not reach statistical significance.

There is growing interest in studying whether eradication of nasal carriage can decrease *S. aureus*-associated infections. Previous studies have shown systemic antibiotics such as trimethoprim-sulfamethoxazole[8] or cyclical oral rifampicin are effective in decreasing *S. aureus* infections in haemodialysis[9] and peritoneal dialysis patients.[10,11] Side effects, however, are common. Recent studies have concentrated on the use of topical mupirocin to the anterior nares, which has been shown to decrease the incidence of *S. aureus* exit site infections and peritonitis.[12] A multicentre prospective study on the use of nasal mupirocin in the prevention of *S. aureus* infection is being conducted in Europe. Whether nasal mupirocin can decrease the incidence of *S. aureus* infections awaits the results of this study.

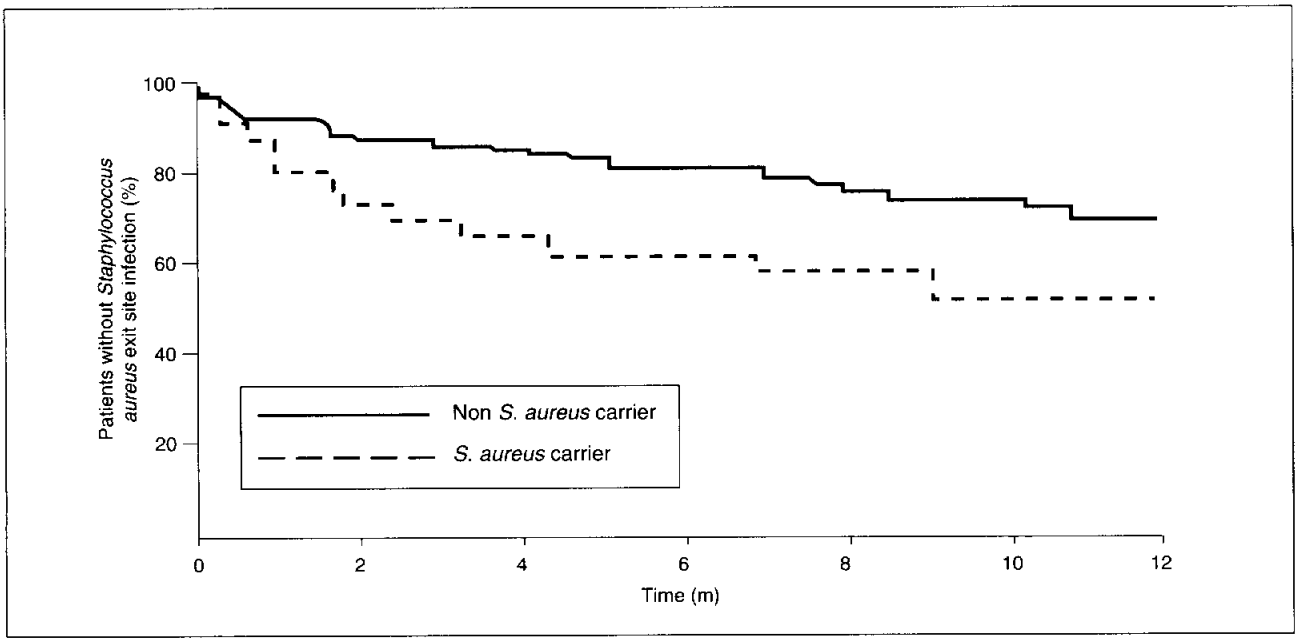

Fig 1. Life table analysis of the time to first episode of *Staphylococcus aureus* exit site infection. Patients who were *S. aureus* nasal carriers were significantly at risk of *S. aureus* exit site infection at one year (P<0.05).

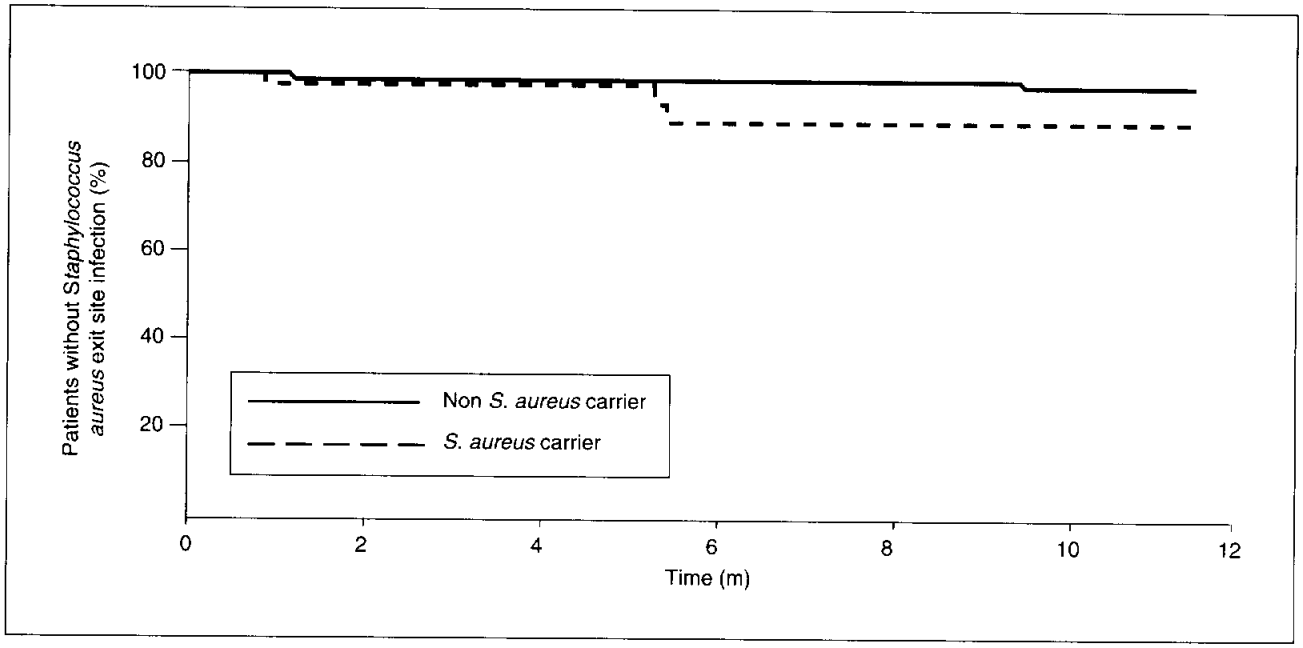

Fig 2. Life table analysis of the time to first episode of *Staphylococcus aureus* peritonitis. Patients who were *S. aureus* nasal carriers were significantly at risk of *S. aureus* peritonitis at one year ($P<0.05$).

In conclusion, we have shown that in this CAPD population, there is a significant association of *S.aureus* nasal carriage status with *S. aureus* exit site infection and peritonitis and that the carriers also tend to have multiple episodes of *S. aureus* infection. Thus, for this group of patients, nasal decolonisation using topical mupirocin may be useful.

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