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Investigation of *Staphylococcus aureus* nasal carriage rates in hemodialysis patients *Staphylococcus aureus* nasal carriage in hemodialysis patients

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ABSTRACT

Aims: This study aimed to assess the prevalence of nasal carriage of *Staphylococcus aureus (S. aureus)* in patients receiving hemodialysis and to evaluate the susceptibilities to mupirocin and fusidic acid in those with nasal carriage of *S. aureus*.

Methods: A total of 165 hemodialysis patients, 55 (33.3%) females and 109 (66.03%) males, were included in the study. Nasal swab samples obtained from the patients were inoculated on mannitol-salt agar (Beslab, Turkey) medium. The media were incubated in an oven at 37°C for 72 hours. Methicillin resistance was determined on Mueller-Hinton agar medium with cefoxitin disk (Bioanalyse, Turkey), and mupirocin and fusidic acid susceptibilities were determined by disk diffusion method with the discs of these antibiotics (Bioanalyse, Turkey).

Results: A total of 14 patients (8.48%) exhibited nasal carriage of *S. aureus*, comprising 9 patients (5.45%) with methicillin-sensitive *S. aureus* (MSSA) and 5 patients (3.03%) with methicillin-resistant *S. aureus* (MRSA). Of a total of 5 MRSA strains, 1 was resistant to mupirocin, and 1 was resistant to fusidic acid. Of a total of 9 MSSA strains, 2 were resistant to mupirocin and 2 were resistant to fusidic acid. It was determined that mupirocin and fusidic acid resistance was higher in MSSA strains.

Conclusion: In our study, the rate of *S. aureus* nasal carriage in hemodialysis patients was found to be low. In addition, the resistance rates of MSSA strains to mupirocin and fusidic acid, which are topical antibiotics that can be used in the eradication of *S. aureus* nasal carriage, were higher than the resistance rates of MRSA strains to mupirocin and fusidic acid. We think that planning the eradication of nasal carriage in dialysis patients according to mupirocin and fusidic acid susceptibility results will increase the eradication success.

Keywords: Hemodialysis patients, nasal carriage, *Staphylococcus aureus*, mupirocin, fusidic acid

INTRODUCTION

Infections in hemodialysis patients and end-stage renal failure patients are an important cause of mortality and morbidity. Hemodialysis patients are in the risk group in terms of methicillin-resistant *Staphylococcus aureus* (MRSA) infection and colonization.[1] MRSA and coagulase-negative staphylococci are commonly identified as etiological agents of catheter-associated bacteremia in hemodialysis patients, as well as peritoneal dialysis catheter infections and peritonitis in peritoneal dialysis patients. The elevated resistance rate to mupirocin, a topical antibiotic employed in the elimination of *Staphylococcus aureus (S. aureus)* nasal carriage in these patients, constitutes a significant issue.[2] The most frequently colonized body site of *S. aureus* is the nose. It has been reported that nasal carriage of *S. aureus* plays an important role in the pathogenesis of infections due to this agent.[4-6]

Studies have reported that the rates of *S. aureus* nasal carriage in diabetic patients, hemodialysis patients, intravenous drug addicts, and patients with HIV infection are higher than the population.[4-10] The relationship between *S. aureus* nasal carriage in hemodialysis patients and infections developing due to this agent has been shown in many studies. It has been reported that the rates of bacteremia and catheter-related infections are higher in *S. aureus* nasal carriers than in non-carriers.[3,5,7,8] MRSA have an important place in staphylococcal infections. Many studies have reported the relationship between nasal MRSA carriage and MRSA infections. The main risk factors for MRSA nasal carriage are hospitalization, broad-spectrum antibiotic use, surgical intervention, residence in a nursing home, presence of hospital personnel in the family, etc.[1,3-5]

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This study aimed to ascertain the prevalence of nasal carriage of *S. aureus* in hemodialysis patients, identify the related risk factors, and evaluate susceptibilities to mupirocin and fusidic acid in patients with nasal carriage of *S. aureus*.

METHODS

A total of 165 hemodialysis patients, including 55 (33.3%) females and 109 (66.03%) males, who were dialyzed at the Private Ankara Balgat Dialysis Center, were included in the study. Nasal swab samples obtained from the patients were sown on Mannitol-salt agar (Beslab, Turkey) medium. The media were incubated in an oven at 37°C for 72 hours. Colonies that grew on Mannitol salt agar medium with yellow color reflex were evaluated as *S. aureus*, and the strains with positive catalase and coagulase tests were evaluated as *S. aureus*. MRSA1 strains was determined on Mueller Hinton agar medium with cefoxitin disk (Bioanalyse, Turkey), and mupirocin and fusidic acid susceptibilities were determined by disk diffusion method with the discs of these antibiotics (Bioanalyse, Turkey).

The mean age of the patients was 52±12.08 years. For the study, a patient consent form was obtained from hemodialysis patients, and ethics committee approval was obtained from Ankara Bilkent City Hospital Medical Research Scientific and Ethical Evaluation Board (Date: 04.12.2024, Decision No: TABED 1-24-384). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Statistical Analysis

SPSS (Statistical Package for the Social Sciences) is a software program used by researchers in various disciplines for quantitative analysis of complex data. A Chi-square test was used in the statistical analysis; p≤ 0.05 was considered statistically significant.

RESULTS

Among the 165 hemodialysis patients, nasal carriage of *S. aureus* was identified in 14 (8.48%) individuals, with 9 (5.45%) exhibiting methicillin-sensitive *Staphylococcus aureus* (MSSA) nasal carriage and 5 (3.03%) displaying methicillin-resistant *Staphylococcus aureus* (MRSA) nasal carriage.

Of a total of 5 MRSA strains, 1 was resistant to mupirocin, and 1 was resistant to fusidic acid. Of a total of 9 MSSA strains, 2 were resistant to mupirocin and 2 were resistant to fusidic acid. It was determined that mupirocin and fusidic acid resistance was higher in MSSA strains (Table 1).

Table 1. Mupirocin and fusidic acid resistance was identified in MSSA and MRSA strains

Agent	Mupirocin resistant (n)	Fusidic acid resistant (n)
MSSA (n:9)	7	7
MRSA (n:5)	1	1
Total (n:14)	8	8

MSSA: Methicillin-sensitive *Staphylococcus aureus*, MRSA: Methicillin-resistant *Staphylococcus aureus*

All patients who grew MRSA and MSSA in nasal cultures had a history of antibiotic use in the last 6 months and hospital or outpatient clinic admission in the last year as risk factors. Congestive heart failure was present in 3 patients with MRSA and 7 patients with MSSA nasal cultures. Diabetes mellitus was present in one patient with MRSA growth and in two patients with MSSA growth. Two patients who grew MSSA in nasal culture had a history of surgical intervention, and one patient had a family history of healthcare personnel. None of the patients who grew MRSA and MSSA in nasal cultures had a history of nursing home stay, hospitalization in the last 1-year, immunosuppressive treatment, or malignancy. The risk factors in patients with MRSA and MSSA growth in nasal cultures are shown in Table 2.

DISCUSSION

S. aureus nasal carriage plays a key role in the pathogenesis and epidemiology of *S. aureus* infections.[3,4,7] *S. aureus* nasal carriage rates in hemodialysis patients and patients receiving continuous outpatient peritoneal dialysis treatment have been reported to be higher than those in the general population.[4-8] *S. aureus* infections are common in hemodialysis patients due to hospitalization, immunosuppression, invasive interventions (hemodialysis catheter, subclavian catheter, etc.), frequent antibiotic use and high staphylococcal colonization on the skin and nose.[4,5]

Nasal carriage of S. aureus is one of the most important risk factors in the pathogenesis of catheter infections, bacteremia, and sepsis in hemodialysis patients.[4-13]

Compared to the general population, hemodialysis patients have been reported to be more colonized with *S. aureus*. Scheuch et al.[14] found *S. aureus* carriage in an average of 40% of hemodialysis patients in their cross-sectional study, while the carriage rate in the general population was reported as 27%.

Dialysis patients are often exposed to *S. aureus* due to their regular stay in dialysis centers, hospitals, and nursing homes. In studies, the rate of *S. aureus* carriage was reported as 51% in hemodialysis patients, 43% in patients receiving continuous outpatient peritoneal dialysis treatment, and 37% in the normal population.[3,4,14]

S. aureus is one of the most common causative agents of catheter-related bacteremia and sepsis in hemodialysis patients.[15] The eradication of *S. aureus* nasal carriage with topical antibiotics in patients undergoing hemodialysis and peritoneal dialysis has been shown to significantly reduce infection rates associated with this pathogen.[1,4,5]

In studies conducted in hemodialysis patients in Turkey, MRSA nasal carriage rates ranging from 1.8% to 40.4% have been reported.[5] Çelik et al.[5] investigated the rate of *S. aureus* nasal carriage and risk factors in 127 patients on hemodialysis. In this study, *S. aureus* nasal carriage was found in 41 (32.3%) patients, while MRSA nasal carriage was found in five (3.9%) patients. When risk factors were evaluated, a statistically significant relationship was found between *S. aureus* carriage and concomitant gastrointestinal disease and history of antibiotic use in the last year. In the present study, all of the patients with *S. aureus* nasal carriage had a history of antibiotic use within 6 months and a history of admission to a hospital or outpatient clinic within the last year as risk factors. In addition, it was noteworthy that 10 (71.4%) patients with *S. aureus* nasal carriage had congestive heart failure.

Risk factors for MRSA nasal carriage in hemodialysis patients have been reported as advanced age (≥75 years), prolonged hospitalization, history of repeated antibiotic use, and proximity to another MRSA colonized area. In the present study, the rates of *S. aureus* and MRSA nasal carriage in

Table 2. Risk factors in patients with MRSA and MSSA growth in nasal cultures

Risk factors Reproductive agent	DM (n*)	Antibiotic use in the last 6 months	History of admission to hospital or outpatient clinic in the last year	CHF	History of Surgical Intervention	Presence of health personnel in the family	Staying in a care home	Hospitalization in the last 1 year	History of immunosuppressive therapy or malignancy
MRSA (n:5)	1/5	5/5	5/5	3/5	0/5	0/5	0/5	0/5	0/5
MSAA (n:9)	2/9	9/9	9/9	7/9	2/9	1/9	0/9	0/9	0/9
Total	3/14	14/14	14/14	10/14	2/14	1/14	0/14	0/14	0/14

MRSA: Methicillin-resistant *Staphylococcus aureus,* MSSA: Methicillin-sensitive *Staphylococcus aureus,* n*: Patient number, DM: Diabetes mellitus, CHF: Congestive heart failure

hemodialysis patients were lower than the rates reported in the literature. The main risk factors for MRSA and MSSA nasal carriage in hemodialysis patients were antibiotic use in the last 6 months, history of hospital or outpatient clinic admission in the last year and congestive heart failure.

MRSA nasal carriage has been reported to be associated with poor clinical outcomes in outpatients on hemodialysis. Early identification of colonized patients, isolation, and elimination of carriage with a decolonization regimen is an appropriate approach to minimize MRSA transmission rates.[4,7,13] In studies conducted in hemodialysis patients in our country, *S. aureus* nasal carriage rates were reported by Şencan et al.[6] 67%, Kurutepe et al.[11] 33%, and Çelik et al.[5] 32.3%. The rates of MRSA nasal carriage in hemodialysis patients were reported as 3.9% by Çelik et al.[5]; 40.4% by Şencan et al.[6]; 11% by Kurutepe et al.[11]; and 1.8% by Mutlu et al.[12] Cesur et al.[9] found *S. aureus* nasal carriage in 23 (22.1%) of 104 patients on hemodialysis. Of the *S. aureus* strains isolated from the patients, 22 (95.6%) were reported as MSSA, and one (4.34%) as MRSA.

Lu et al.[7] reported *S. aureus* carriage rate as 22% and MRSA carriage rate as 2.4%, and Lederer et al.[8] reported *S. aureus* carriage rate as 53% and MRSA carriage rate as 12% in hemodialysis patients.

Limitations

The limitation of our study is that we could not determine whether S. aureus carriage was permanent or transient carriage because the patients were not followed up for a long period of time. In our study, the rate of S. aureus nasal carriage was found to be low in hemodialysis patients. Possible reasons for this may be that hemodialysis patients apply to dialysis centers on a daily basis, attention is paid to infection control measures in the dialysis center, and mupirocin pomade is applied to patients with nasal carriage.

CONCLUSION

Our study found that MSSA strains were more likely to be resistant to mupirocin and fusidic acid than MRSA strains were. Mupirocin and fusidic acid are topical antibiotics that can be used to get rid of S. aureus nasal carriage. In conclusion, we think that planning the eradication of nasal carriage in hemodialysis patients according to mupirocin and fusidic acid susceptibility results will increase the eradication success.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was initiated with the approval of the Ankara Bilkent City Hospital No 1 Medical Researches Scientific and Ethics Committee (Date: 04.12.2024, Decision No: TABED 1-24-384).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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