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A study of nasal carriage of methicillin-resistant *staphylococcus aureus* in patients undergoing hemodialysis in a tertiary care hospital of Punjab

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ABSTRACT

Background: Infection is one of the major problems encountered in hemodialysis patients. The mortality rate among the patients undergoing hemodialysis remains unsatisfactorily high. Hemodialysis patients have higher nasal carriage rate of *Staphylococcus aureus* than the healthy population. In long-term hemodialysis patients, colonization is a significant problem and is associated with an increased risk of the bloodstream infections. The antimicrobial resistance to this pathogen is increasing rapidly, and the consequences of methicillin resistance for the outcomes of *Staphylococcus aureus* infections are drastic.

Methods: Two swabs were collected from anterior nares of patients undergoing hemodialysis, and then these swabs were transferred to microbiology laboratory for processing. Isolated strains were subjected to antimicrobial susceptibility testing using Kirby-Bauer disc diffusion. Methicillin resistance was detected by using cefoxitin disc. Inhibition zone diameters were measured as per CLSI criteria. Vancomycin screen agar test was done. Brain heart infusion agar plates containing 6 μg/ml of vancomycin were used. *S. aureus* ATCC 29213 was used as reference strain.

Results: It was observed that 38% (38/100) of the hemodialysis patients were carriers of *S. aureus* followed by CoNS, followed by aerobic spore bearers. All the *S. aureus* isolates (100%, 38/38) were methicillin-resistant (MRSA).

Conclusions: Staphylococcal nasal carrier status in hemodialysis patients along with antibiotic susceptibility testing should be done in routine and infection control practices should be followed to prevent the transmission of MRSA among chronic hemodialysis patients.

Keywords: Hemodialysis patients, Kirby-Bauer disc diffusion, MRSA, Nasal carriage, Staphylococcus aureus

INTRODUCTION

Infection is a major cause of morbidity and mortality among patients undergoing hemodialysis for chronic renal failure. 1-4 Dialysis therapy including hemodialysis results in frequent contact with the hospital environment. The major pathogen in this group is *Staphylococcus aureus* and colonization of *S. aureus* is associated with a fourfold higher risk of bloodstream infection. 5-10 The predominance of this pathogen is because of the virulence factors permitting rapid tissue invasion, dissemination

throughout the body, genetic plasticity permitting constant adaptation. ¹¹

Carriage of nasal *S. aureus* has been reported as a significant risk factor for septicemia and infections due to *S. aureus* in hemodialysis patients. ^{4,12,13} Patients on hemodialysis are at more risk to Staphylococcal infections because of their low immunity, increased skin colonization by *Staphylococci*, multiple needle punctures required for dialysis, and also, because they are repeatedly exposed to the healthcare environment and

often due to receiving prolonged courses of antibiotics, even besides being immunocompromised. 14,15

There are various reports of rapidly increasing resistance to multiple antibiotics, and the consequences of methicillin resistance for the outcomes of *S. aureus* infections are drastic. ¹⁶⁻²⁶ Studies have found that nasal colonization with methicillin-resistant *Staphylococcus aureus* poses an increased risk of infection. ²⁷

The present study was therefore conducted to evaluate the nasal carriage of MRSA in patients undergoing hemodialysis and the pattern of their antimicrobial resistance.

METHODS

The study was conducted on 100 patients undergoing hemodialysis in our institute.

Collection of specimens²⁸

Two sterile pre-moistened cotton-tipped swabs were used to collect specimens from anterior nares of patients at the hemodialysis unit after taking informed consent. Two swabs were rotated five times over the inner wall of the ala and septum of nose and were immediately transferred to microbiology laboratory for processing as per the standard microbiological protocol. Isolated strains were subjected to antimicrobial susceptibility testing using Kirby-Bauer disc diffusion.

The antibiotics used were, ampicillin (10 μ g/disc), erythromycin (15 μ g/disc), clindamycin (2 μ g/disc), ciprofloxacin (5 μ g/disc), amikacin (30 μ g/disc), cotrimoxazole (25 μ g/disc) and linezolid (30 μ g/disc).

Methicillin resistance was detected by disc diffusion test using cefoxitin disc (30 μ g) which is a surrogate marker for methicillin. Zone diameters were then measured as per CLSI criteria.

Vancomycin screen agar test^{29,30}

In-house prepared brain heart infusion agar plates containing $6\mu g/ml$ of vancomycin were used for vancomycin screen agar. The plates were inoculated with the test strain from the standard inoculum and incubated at 35°C for 24 hours. Any visible growth indicated reduced susceptibility to vancomycin. *S. aureus* ATCC 29213 was used as a reference strain.

Results have been shown in Tables 1, 2, and 3.

RESULTS

In our study, males (78%) outnumbered females (22%).

The majority (38%) of the patients were in the age group 41-60 years followed by 61-80 years (28%). A minimum number of patients were of age more than 80 years.

A significant correlation was found regarding the nasal carriage of *S. aureus* and hemodialysis duration.

Table 1: Various organisms isolated from anterior nares of hemodialysis patients (n=100).

Organisms	No. of patients	Percentage of patients
S. aureus	38	38
CoNS	34	34
Aerobic spore bearer	28	28

Table 2: Duration of hemodialysis among nasal carriers of MRSA.

Duration of	No. of	MRSA
hemodialysis	patients	carriers
Less than 6 months	52	12
More than 6 months	48	26

Statistically analytic (Pearson's Chi square test). $\chi^2 = 3.885$, df = 1, p value =0.048 (statistically significant)

It was observed that 38% of the patients were carriers of *S. aureus* followed by CoNS, followed by aerobic spore bearers (Table 1).

Of the total 100 patients in a study, *S. aureus* was isolated in 38 (38%) patients and all the *S. aureus* isolates (100%, 38/38) were resistant to cefoxitin i.e., methicillin-resistant *Staphylococcus aureus* (MRSA).

All these MRSA isolates (38) in our study were found to be susceptible to vancomycin.

Table 3: Antibiotic resistance pattern of MRSA.

Antibiotics	Resistance	Percentage
Ampicillin	38	100
Erythromycin	32	84.21
Clindamycin	24	63.15
Ciprofloxacin	38	100
Amikacin	30	78.94
Cotrimoxazole	26	68.42
Vancomycin	0	0
Linezolid	0	0
T10 4 1 1		

VSA = no colonies seen

Antimicrobial susceptibility testing of all the MRSA isolates showed that they had high resistance to multiple classes of antibiotics. The maximum resistance was observed against ampicillin (100%), followed by ciprofloxacin (100%), erythromycin (84.21%), amikacin (78.94%), and cotrimoxazole (68.42%), and clindamycin (63.15%) (Table 3).

24 isolates were D-test positive out of the 38 MRSA (Figure 1).

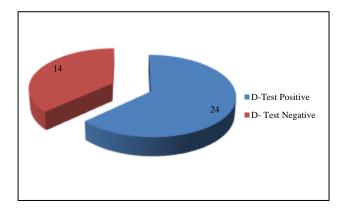


Figure 1: D-test positive isolates.

Of these 38 MRSA isolates, 26 were isolated from patients on hemodialysis for more than 6 months duration while 12 from the patients on hemodialysis were of less than 6 months and the difference in the distribution of MRSA isolates between less than 6 months and more than 6 months was statistically significant (Table 2).

DISCUSSION

The nasal carriage of *S. aureus* plays a major role in the epidemiology and pathogenesis of staphylococcal infections. *S. aureus* nasal carriage has shown to be more common in long-term hemodialysis patients than in the general population. ¹⁰ Several studies reported an increased risk for colonization and infection with MRSA in patients with end-stage renal disease. ^{9,14,23,27,31}

In our study, males (78%) outnumbered females (22%) which are in accordance with the many other studies. A study conducted by Sathish et al, had 37 males (74%) and 13 females (26%) out of 50 patients enrolled. A study by Ghasemian et al, enrolled patients having most of the males (53.5%) than females (46.4%). However, in the studies conducted by Anil et al, Celik et al, and Chun Fu Lai et al, females were more in number as compared to males. 19,20,22

In the present study, the majority (38%) of the patients were in the age group 41-60 years followed by 61-80 years (28%). A minimum number of patients were of age more than 80 years.

A significant correlation was found regarding the nasal carriage of *S. aureus* and hemodialysis duration. Publications differ on this issue; some authors had not found hemodialysis duration as a risk factor while others have found it as a risk factor. 16,18

It was observed that 38% of the patients were carriers of *S. aureus* followed by CoNS, followed by aerobic spore bearers (Table 1). Montewka et al, have also reported the

isolation of *S. aureus* and CoNS from nasal swabs obtained from the hemodialysis patients. ¹⁷

Of the total 100 patients in a study, *S. aureus* was isolated in 38 (38%) patients. Many authors have reported similar isolation rates in their studies. However, a study conducted by Sathish et al, had reported *an S. aureus* nasal carriage rate of 62% among their study population. On contrary, a study conducted by Celik et al, reported 28.3% of their patients undergoing hemodialysis were nasal carriers of *S. aureus*. 20

All the *S. aureus* isolates (100%, 38/38) in our study were resistant to cefoxitin i.e., methicillin-resistant *Staphylococcus aureus* (MRSA). A study conducted by Deepika et al., has also reported similar findings.²¹ This poses a significant risk of transmitting MRSA from person to person directly or indirectly among hemodialysis patients and to other healthcare workers. Different studies had reported different rates of nasal carriage of MRSA among hemodialysis patients.¹⁶⁻²¹

Of these 38 MRSA isolates, 26 were isolated from patients on hemodialysis for more than 6 months duration while 12 from the patients on hemodialysis were of less than 6 months and the difference in the distribution of MRSA isolates between less than 6 months and more than 6 months was statistically significant (Table 2).

Antimicrobial susceptibility testing of all the MRSA isolates showed that they had high resistance to multiple classes of antibiotics. The maximum resistance was observed against ampicillin (100%), followed by ciprofloxacin (100%), erythromycin (84.21%), amikacin (78.94%), and cotrimoxazole (68.42%), and clindamycin (63.15%) (Table 3).

24 isolates were D-test positive out of the 38 MRSA (Figure 1).

Other studies have also reported high resistance to various classes of antibiotics amongst MRSA isolates. All these MRSA isolates (38) in our study were found to be susceptible to vancomycin which correlates with the findings of other authors. ¹⁶⁻²¹ A hundred percent susceptibility to vancomycin in our study may be because this 6 lycopeptides is not being regularly used to treat staphylococcal infections in our setup. This reduces the selective pressure for the development of resistance to vancomycin.

CONCLUSION

Adequate establishment of Staphylococcal nasal carrier status in hemodialysis patients accompanied by antibiotic susceptibility testing should be done in routine as it is crucial to reduce associated morbidity and mortality. Robust infection control practices should be followed to

prevent the transmission of MRSA among chronic hemodialysis patients.

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Ethical approval: The study was approved by the Institutional Ethics Committee BFUHS/2K19P-TH/8907

REFERENCES

- Churchill DN, Taylor DW, Cook RJ, LaPlante P, Barre P, Cartier P, et al. Canadian hemodialysis morbidity study. Am J Kidney Dis. 1992;19:214-34.
- 2. Luzar MA, Coles GA, Faller B, Slingeneyer A, Dah GD, Briat C, et al. *Staphylococcus aureus* nasal carriage and infection in patients on continuous ambulatory peritoneal dialysis. N Engl J Med. 1990;322:505-9.
- 3. Monsen T, Olofsson C, Ronnmark M, Wistrom J. Clonal spread of Staphylococci among patients with peritonitis associated with continuous ambulatory peritoneal dialysis. Kidney Int. 2000;57:613-8.
- 4. Nouwen JL, Fieren MW, Snijders S, Verbrugh HA, van Belkum A. Persistent (not intermittent) nasal carriage of *Staphylococcus aureus* is the determinant of CPD-related infections. Kidney Int. 2005;67:1084-92.
- 5. Bradley JR, Evans DB, Calne RY. Long-term survival in hemodialysis patients. Lancet. 1987;1:295-6.
- 6. Neff MS, Eiser AR, Slifkin RF, Baum M, Baez A, Gupta S, et al. Patients surviving 10 years of hemodialysis. Am J Med. 1983;74:996-1004.
- 7. Shinefield H, Black S, Fattom A, Horwith G, Rasgon S, Ordonez J, et al. Use of a *Staphylococcus aureus* conjugate vaccine in patients receiving hemodialysis. N Engl J Med. 2002;346:491-6.
- 8. Zimakoff J, Bangsgaard PF, Bergen L, Baago-Nielsen J, Daldorph B, Espersen F, et al. *Staphylococcus aureus* carriage and infections among patients in four haemo- and peritoneal-dialysis centers in Denmark. The Danish study group of peritonitis in dialysis (DASPID). J Hosp Infect. 1996;33:289-300.
- Saxena AK, Panhotra BR, Venkateshappa CK, Sundaram DS, Naguib M, Uzzaman W, et al. The impact of nasal carriage of methicillin-resistant and methicillin-susceptible Staphylococcus aureus (MRSA and MSSA) on vascular access-related septicemia among patients with type-II diabetes on dialysis. Renal Failure. 2002;24:763-77.
- Yu VL, Goetz A, Wagener M, Smith PB, Rihs JD, Hanchett J, et al. *Staphylococcus aureus* nasal carriage and infection in patients on hemodialysis efficacy of antibiotic prophylaxis. N Engl J Med. 1986;315:91-6.
- 11. Vandecasteele SJ, Boelaert JR, de-Vriese AS. *Staphylococcus aureus* infections in hemodialysis: what a nephrologist should know. Clin J Am Soc Nephrol. 2009;4:1388-400.

- 12. Francioli P, Masur H. Complications of *Staphylococcus aureus* bacteremia: occurrence in patients undergoing long-term hemodialysis. Arch Intern Med. 1982;142(9):1655-8.
- 13. Johnson DW, MacGinley R, Kay TD, Hawley CM, Campbell SB, Isbel NM, et al. A randomized controlled trial of topical exit site mupirocin application in patients with tunnelled, cuffed hemodialysis catheters. Nephrol Dial Transplant. 2002;17(10):1802-7.
- Lu PL, Tsai JC, Chiu YW, Chang FY, Chen YW, Hsiao CF, et al. Methicillin-resistant *Staphylococcus* aureus carriage, infection and transmission in dialysis patients, healthcare workers and their family members. Nephrol Dial Transplant. 2007;25(5):1659-65.
- 15. Koziol-Montewka M, Chudnicka A, Ksiazek A, Majdan M. Rate of *Staphylococcus aureus* nasal carriage in immunocompromised patients receiving haemodialysis treatment. Int J Antimicrob Agents. 2001;18:193-60
- Sathish JV, Malleshappa P, Yashaswini MK, Shariff S. Influence of methicillin-resistant *Staphylococcus aureus* (MRSA) nasal carriage on MRSA bloodstream infections among patients on chronic hemodialysis. Dial Traspl. 2014;35(4):143-7.
- 17. Kozioł-Montewka M, Szczepanik A, Baranowicz I, Jozwiak L, Ksiazek A, Kaczor D. The investigation of *Staphylococcus aureus* and coagulase-negative staphylococci nasal carriage among patients undergoing haemodialysis. Microbiol Res. 2006;161(4):281-7.
- 18. Ghasemian R, Najafi N, Makhlough A, Khademloo M. Frequency of nasal carriage of *Staphylococcus aureus* and its antimicrobial resistance pattern in patients on hemodialysis. Iranian J kidney Dis. 2010;4(3):218.
- 19. Saxena AK, Panhotra BR, Chopra R. Advancing age and the risk of nasal carriage of *Staphylococcus aureus* among patients on long- term hospital-based hemodialysis. Ann Saudi Med. 2004;24(5):337-42.
- 20. Celik G, Gulcan A, Dikici N, Gulcan E. Prevalence of nasal *Staphylococcus aureus* carriage in the patients undergoing hemodialysis and evaluation of risk factors and laboratory parameters. Renal failure. 201;33(5):494-8.
- 21. Deepika G, Anaparthy U, Krishna PB. Prevalence of nasal carriage of MRSA among patients undergoing haemodialysis and in healthcare workers working in haemodialysis units. JPSI. 2015;4(1):40-3.
- 22. Lai CF, Liao CH, Pai MF, Chu FY, Hsu SP, Chen HY, et al. Nasal carriage of methicillin-resistant *Staphylococcus aureus* is associated with higher all-cause mortality in hemodialysis patients. Clin Am Soc Nephrol. 2011;6(1):167-74.
- 23. Lederer SR, Riedelsdorf G, Schiffl H. Nasal carriage of methicillin resistant *Staphylococcus aureus*: the prevalence, patients at risk and the effect of elimination on outcomes among outclinic

- haemodialysis patients. Eur J Med Res. 2007;12(7):284.
- 24. David MZ, Daum RS. Community-associated methicillin-resistant *Staphylococcus aureus*: epidemiology and clinical consequences of an emerging epidemic. Clin Microbiol Rev. 2010;23:616-87.
- 25. Nissenson AR, Dylan ML, Griffiths RI, Yu HT, Dean BB, Danese MD, et al. Clinical and economic outcomes of *Staphylococcus aureus* septicemia in ESRD patients receiving hemodialysis. Am J Kidney Dis. 2005;46(2):301-8.
- Reed SD, Friedman JY, Engemann JJ, Griffiths RI, Anstrom KJ, Kaye KS, et al. Costs and outcomes among hemodialysis- dependent patients with methicillin-resistant or methicillin- susceptible Stapylococcus aureus bacteremia. Infect Control Hosp Epidemiol. 2005;26(2):175-83.
- 27. Centers for Disease Control: invasive Methicillin-Resistant *Staphylococcus aureus* infections among dialysis patients, United States, 2005. Morb Mortal Wkly Rep. 2007;56:197-9.
- Fomda BA, Thokar MA, Khan A, Bhat JA, Zahoor D, Bashir G, et al. Nasal carriage of Methicillin-

- resistant *Staphylococcus aureus* among healthy population of Kashmir, India. Indian J Med Microbiol. 2014;32(1):39-43.
- 29. Tiwari HK, Sen MR. Emergence of vancomycin resistant *Staphylococcus aureus* (VRSA) from a tertiary care hospital from northern part of India. BMC Infect Dis. 2006;6:156.
- 30. Clinical and Laboratory standards institute (CLSI). Performance standards for antimicrobial susceptibility testing; 26th informational supplement. Wayne, PA: CLSI;2016.
- 31. Lu PL, Chin LC, Peng CF, Chiang YH, Chen TP, Ma L, et al. Risk factors and molecular analysis of community methicillin-resistant *Staphylococcus aureus* carriage. J Clin Microbiol. 2005;43:132-9.

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