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Nasal hygiene in patients with end-stage renal disease

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Abstract

Staphylococcus aureus is the most common endogenous infection in patients with end-stage renal disease (ESRD), and the anterior nares are the most common endogenous *S. aureus* carrier sites. Eliminating nasal *S. aureus* will greatly benefit ESRD patients. However, prophylactic topical nasal usage of mupirocin or any kind of antibiotic is against the principles of antibiotic usage. Nasal irrigation has been demonstrated to significantly increase ciliary clearance and decrease mucous inflammation, and has been proven to be an inexpensive, effective, simple, and safe treatment method in nasal health care. We propose that nasal irrigation might be the appropriate nasal hygiene intervention for ESRD patients and should be routinely applied in ESRD patients, especially those with risk factors.

Introduction

Infection is one of the most common causes of hospitalization, morbidity, and mortality among patients with End-Stage Renal Disease (ESRD) who are undergoing hemodialysis (HD), Peritoneal Dialysis (PD), Continuous Ambulatory Peritoneal Dialysis (CAPD), or kidney transplantations [1-3]. Endogenous gram-positive cocci, especially *Staphylococcus aureus* (S. *aureus*), are the most frequently associated microorganism in long-term dialysis patients, and anterior nares are the most common endogenous SA carrier sites [4].

Nasal *S. aureus* is the most common endogenous infective resource of ESRD patients

Based on sensitivity to methicillin, *S. aureus* is usually divided into two subclasses, namely methicillin-resistant *S. aureus* (MRSA) and methicillin-sensitive *S. aureus* (MSSA). 15.1%-73.9% ESRD patients carried nasal MSSA while 1.1%-27.4% ESRD patients carried MRSA in their noses (Table 1).

Nasal *S. aureus* will spread to the skin and catheter exits via touching, or to the bronchus and lung via airflow. Hence, the nose is the main original source of endogenous *S. aureus*. Besides, most *S. aureus* nasal carriers are asymptomatic but have greater potential risk of bacteremia than non-carriers. In particular, dialysis patients who are *S. aureus* nasal carriers usually have poor clinical outcomes, especially elderly patients [1,2]. Thus, eliminating nasal *S. aureus* will benefit ESRD patients and reduce the economic burden of both the patients and the government [1,2].

Prophylactic antibiotic is no longer the first choice to eliminate nasal *S. aureus*

Topical mupirocin application has been proven to be effective in eradicating *S. aureus* in the nose and catheter exits [5], and has been applied for years [6]. Topical application of mupirocin near catheter exits is rational and necessary because catheterization is an invasive treatment. However, there is no adequate reason for prophylactic nasal application of mupirocin because most *S. aureus* carriers are asymptomatic. Prophylactic antibiotic usage will induce antibiotic resistance and break the balance of nasal flora between *S. aureus* and other microorganisms such as *Staphylococcus epidermidis*. Therefore, prophylactic topical usage of mupirocin or any kind of antibiotic in ESRD patients is against the principles of antibiotic usage. Meanwhile, screening for nasal *S. aureus* is a time-consuming and economically inefficient process.

Nasal irrigation in patients with end-stage renal disease

Nasal hygiene of ESRD patients is essential but long-ignored. From otolaryngologists' perspective, we propose that topical nasal irrigation might be the appropriate nasal hygiene intervention for ESRD patients.

Nasal irrigation, also called nasal wash, rinse, douche, and lavage, is a series of adjunctive treatments for patients with chronic sinusitis and a postoperative treatment of other nasal diseases. Abundant data provide evidence that nasal irrigation is an inexpensive, effective, simple, and safe treatment [7-10]. Treatment guidelines in many countries, including China, Europe, and North America, now advocate the use of nasal irrigation for all causes of rhinosinusitis and for postoperative cleaning of the nasal cavities [11].

Nasal irrigation is performed by injecting saline in one nostril and allowing it to drain out of the other nostril, bathing the nasal cavity. In the past century, many trials have been conducted about the irrigating solution components and devices [10]. Currently, a consensus seemed to have been reached that the combination of high-volume and low-pressure devices with hypertonic solutions show optimal outcomes [11,12] . Nasal irrigation has no longer been considered as merely an adjunctive treatment and is now becoming increasingly popular in nasal healthcare [12].

The beneficial mechanisms of nasal irrigation is to increase

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Table 1. Nasal carriage of *S. aureus* and MRSA in ESRD patients.

Sample Size	Total *S. aureus*		MRSA		Dialysis types	Experiment Year	Country	Reference
	n	%	n	%				
87	20	23.0	-	-	CAPD	1984	UK	[18]
140	63	45.0	-	-	CAPD	1987	Belgium	[19]
146	41	28.1	-	-	CAPD	1989	Singapore	[20]
167	-	-	28	16.8	CAPD	1989	Singapore.	[21]
129	66	51.2	-	-	CAPD	1992	Denmark	[22]
129	60	46.5	-	-	CAPD	1992	Denmark	[22]
168	100	59.5	-	-	HD	1992	Denmark	[22]
168	96	57.1	-	-	HD	1992	Denmark	[22]
172	67	39.0	-	-	HD	1992	Netherland	[6]
54	31	57.4	-	-	CAPD	1993	Netherland	[23]
138	69	50.0	-	-	PD	1993	USA	[24]
32	12	37.5	-	-	CAPD	1995	Denmark	[25]
24	9	37.5	-	-	CAPD	1996	USA	[26]
205	78	38.0	22	10.7	HD	1997	Saudi Arabia	[15]
28	16	57.1	-	-	HD	1998	Poland	[27]
52	30	57.7	-	-	PD	1998	Netherland	[28]
144	50	34.7	-	-	HD,CAPD	1999	UK	[29]
71	39	54.9	-	-	HD	2000	Spain	[30]
83	-	-	2	2.4	PD	2002	TAIWAN	[31]
198	-	-	11	5.6	HD	2002	USA	[32]
509	-	-	12	2.4	HD	2002	TAIWAN	[31]
69	28	40.6	-	-	HD	2003	Iran	[33]
43	12	27.9	-	-	HD	2004	Poland	[34]
43	12	27.9	1	2.3	HD	2004	Poland	[35]
136	72	52.9	16	11.8	HD	2004	GERMAN	[4]
261	148	56.7	-	-	HD	2004	Turkey	[36]
289	-	-	34	11.8	HD	2004	Germany	[5]
84	31	36.9	23	27.4	HD	2006	Iran	[37]
157	26	16.6	10	6.4	HD	2006	USA	[38]
103	-	-	12	11.7	HD	2007	USA	[39]
120	40	33.3	26	21.7	DIALYSIS	2007	USA	[17]
130	32	24.6	-	-	HD	2007	Iran	[40]
306	-	-	29	9.5	HD	2007	TAIWAN	[1]
541	121	22.4	32	5.9	HD	2007	TAIWAN	[16]
54	24	44.4	3	5.6	HD,CAPD	2008	Maroc	[41]
54	24	44.4	3	5.6	HD	2008	Morocco	[41]
46	34	73.9	-	-	TRANSP.	2009	Brazil	[42]
48	36	75.0	-	-	TRANSP.	2009	Brazil	[42]
70	37	52.9	-	-	DIALY.	2009	Brazil	[43]
111	55	49.0	-	-	DIALY.	2009	Brazil	[43]
112	-	-	10	8.9	HD	2009	JAPAN	[44]
264	48	18.2	14	5.3	DIALYSIS	2009	TAIWAN	[2]
70	30	42.9	1	1.4	HD	2010	Morocco.	[45]
103	-	-	4	3.9	HD	2010	JAPAN	[44]
184	52	28.3	-	-	HD	2011	Turkey	[46]
296	48	16.2	20	6.8	HD	2011	TAIWAN	[47]
185	28	15.1	2	1.1	HD	2012	Turkey	[48]
28	16	57.1	-	-	HD	-	Poland	[27]
91	34	37.4	-	-	HD	-	Netherland	[23]
114	34	29.8	-	-	HD	-	Marseille	[50]

mucociliary clearance and decrease mucous inflammations, which might include the following aspects: 1) activation of the cilia motility and decreasing the bacterial adhesion, and therefore reducing nasal bacterial attachment; 2) physically flushing away inflammatory mediators, the crust, and other nasal discharges that act as the culture media of bacteria, hence inhibiting bacterial growth [7].

Only low-level evidence support the efficacy of nasal irrigation with antibiotics, suggesting that irrigation itself plays a more important role than the additive antibiotics. Nasal irrigation has been proven to decrease antibiotic usage and thereafter reduce antibiotic resistance [9]. Unfortunately, direct data are lacking that show the elimination effect of nasal irrigation on *S. aureus*.

Given that it is an inexpensive and convenient procedure, nasal irrigation is recommended to all dialysis patients and health-care staff. Moreover, it should be routinely used among patients with risk factors, which at least include the following: 1) antibiotic usage within 3 months before admission[13]; 2) hospitalization during the past 12 months [13]; 3) diagnosis of skin or soft tissue infection at admission [13,14]; 4) human immunodeficiency virus infection [13]; 5) elderly patient (≥75 years) [1,15]; 6) prolonged hospitalization[1,2]; 7) congestive heart failure [1,2]; and 8) nursing home admission and nasogastric tube feeding in the last 3 months [16,17].

Conflict of interest

No conflict of interest relevant to this paper is declared.

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None

References

1. Lai CF, Liao CH, Pai MF, Chu FY, Hsu SP, et al. (2011) Nasal carriage of methicillin-resistant *Staphylococcus aureus* is associated with higher all-cause mortality in hemodialysis patients. *Clin J Am Soc Nephrol* 6: 167-174. [Crossref]

2. Wang CY, Wu VC, Chen YM, Su CT, Wu KD, et al. (2010) Risk factors for methicillin-resistant *Staphylococcus aureus* colonization among elderly patients with end-stage renal disease in Taiwan. *Am J Infect Control* 386: 499-500. [Crossref]

3. Hoen B, Paul-Dauphin A, Hestin D, Kessler M (1998) EPIBACDIAL: a multicenter prospective study of risk factors for bacteremia in chronic hemodialysis patients. *J Am Soc Nephrol* 9: 869-876. [Crossref]

4. Lederer SR, Riedelsdorf G, Schiffl H (2007) Nasal carriage of meticillin resistant *Staphylococcus aureus*: the prevalence, patients at risk and the effect of elimination on outcomes among outclinic haemodialysis patients. *Eur J Med Res* 127: 284-288. [Crossref]

5. Schmid H, Romanos A, Schiffl H, Lederer SR (2013) Persistent nasal methicillin-resistant *Staphylococcus aureus* carriage in hemodialysis outpatients: a predictor of worse outcome. *BMC Nephrol* 14: 93.

6. Kluytmans JA, Manders MJ, van Bommel E, Verbrugh H (1996) Elimination of nasal carriage of *Staphylococcus aureus* in hemodialysis patients. *Infect Control Hosp Epidemiol* 17: 793-797. [Crossref]

7. Papsin B, McTavish A (2003) Saline nasal irrigation: Its role as an adjunct treatment. *Can Fam Physician* 49: 168-173. [Crossref]

8. Rabago D, Zgierska A (2009) Saline nasal irrigation for upper respiratory conditions. *Am Fam Physician* 80: 1117-1119. [Crossref]

9. Adappa ND, Wei CC, Palmer JN (2012) Nasal irrigation with or without drugs: the evidence. *Curr Opin Otolaryngol Head Neck Surg* 20: 53-57. [Crossref]

10. Rudmik L, Soler ZM, Orlandi RR, Stewart MG, Bhattacharyya N, et al. (2011) Early postoperative care following endoscopic sinus surgery: an evidence-based review with recommendations. *Int Forum Allergy Rhinol* 1: 417-430. [Crossref]

11. Dunn JD, Dion GR, McMains KC (2013) Efficacy of nasal irrigations and nebulizations for nasal symptom relief. *Curr Opin Otolaryngol Head Neck Surg* 21: 248-251. [Crossref]

12. Brown CL, Graham SM (2004) Nasal irrigations: good or bad? *Curr Opin Otolaryngol Head Neck Surg* 12: 9-13. [Crossref]

13. Hidron AI, Kourbatova EV, Halvosa JS, Terrell BJ, McDougal LK, et al. (2005) Risk factors for colonization with methicillin-resistant *Staphylococcus aureus* MRSA) in patients admitted to an urban hospital: emergence of community-associated MRSA nasal carriage. *Clin Infect Dis* 412: 159-66. [Crossref]

14. Hoen B, Kessler M, Hestin D, Mayeux D (1995) Risk factors for bacterial infections in chronic haemodialysis adult patients: a multicentre prospective survey. *Nephrol Dial Transplant* 10: 377-381. [Crossref]

15. Saxena AK, Panhotra BR, Chopra R (2004) Advancing age and the risk of nasal carriage of *Staphylococcus aureus* among patients on long-term hospital-based hemodialysis. *Ann Saudi Med* 24: 337-342. [Crossref]

16. Wang CY, Wu VC, Wang WJ, Chen YM, Su CT, et al. (2009) Nasal carriage of methicillin-resistant *Staphylococcus aureus* among patients with end-stage renal disease. *Infect Control Hosp Epidemiol* 301: 93-4. [Crossref]

17. Wang CY, Wu VC, Wang WJ, Lin YF, Lin YH, et al. (2012) Risk factors for nasal carriage of methicillin-resistant *Staphylococcus aureus* among patients with end-stage renal disease in Taiwan. *J Formos Med Assoc* 111: 14-18. [Crossref]

18. Davies SJ, Ogg CS, Cameron JS, Poston S, Noble WC (1989) *Staphylococcus aureus* nasal carriage, exit-site infection and catheter loss in patients treated with continuous ambulatory peritoneal dialysis CAPD). *Perit Dial Int* 9: 61-64. [Crossref]

19. Luzar MA, Coles GA, Faller B, Slingeneyer A, Dah GD, et al. (1990) *Staphylococcus aureus* nasal carriage and infection in patients on continuous ambulatory peritoneal dialysis. *N Engl J Med* 322: 505-509. [Crossref]

20. Lye WC, Leong SO, van der Straaten J, Lee EJ (1994) *Staphylococcus aureus* CAPD-related infections are associated with nasal carriage. *Adv Perit Dial* 10: 163-165. [Crossref]

21. Lye WC, Leong SO, Lee EJ (1993) Methicillin-resistant *Staphylococcus aureus* nasal carriage and infections in CAPD. *Kidney Int* 43: 1357-1362. [Crossref]

22. Zimakoff J, Bangsgaard Pedersen F, Bergen L, Baagø-Nielsen J, Daldorph B, et al. (1996) *Staphylococcus aureus* carriage and infections among patients in four haemo- and peritoneal-dialysis centres in Denmark. The Danish Study Group of Peritonitis in Dialysis DASPID). *J Hosp Infect* 334: 289-300. [Crossref]

23. Wanten GJ, van Oost P, Schneeberger PM, Koolen MI (1996) Nasal carriage and peritonitis by *Staphylococcus aureus* in patients on continuous ambulatory peritoneal dialysis: a prospective study. *Perit Dial Int* 16: 352-356. [Crossref]

24. Piraino B, Perlmutter JA, Holley JL, Bernardini J (1993) *Staphylococcus aureus* peritonitis is associated with *Staphylococcus aureus* nasal carriage in peritoneal dialysis patients. *Perit Dial Int* 13: S332-334. [Crossref]

25. Bistrup C, Jensen KT, Kabel B, Pedersen RS (1997) *Staphylococcus aureus* carriage in adult peritoneal dialysis patients and their spouses. *Perit Dial Int* 17: 480-485. [Crossref]

26. Mylotte JM, Kahler L, Jackson E (2011) "Pulse" nasal mupirocin maintenance regimen in patients undergoing continuous ambulatory peritoneal dialysis. *Infect Control Hosp Epidemiol*: 741-745. [Crossref]

27. Koziol-Montewka M, Chudnicka A, Ksiazek A, Majdan M (2001) Rate of *Staphylococcus aureus* nasal carriage in immunocompromised patients receiving haemodialysis treatment. *Int J Antimicrob Agents* 182: 193-6. [Crossref]

28. Nouwen JL, Fieren MW, Snijders S, Verbrugh HA, van Belkum A 2005) Persistent not intermittent) nasal carriage of *Staphylococcus aureus* is the determinant of CPD-related infections. *Kidney Int* 67: 1084-1092. [Crossref]

29. Peacock SJ, de Silva GD, Justice A, Cowland A, Moore CE, et al. (2002) Comparison of multilocus sequence typing and pulsed-field gel electrophoresis as tools for typing *Staphylococcus aureus* isolates in a microepidemiological setting. *J Clin Microbiol* 4010: 3764-70. [Crossref]

30. Peña C, Fernández-Sabe N, Domínguez MA, Pujol M, Martinez-Castelao A, et al. (2004) *Staphylococcus aureus* nasal carriage in patients on haemodialysis: role of cutaneous colonization. *J Hosp Infect* 58: 20-27. [Crossref]

31. Lu PL, Tsai JC, Chiu YW, Chang FY, Chen YW, et al. (2008) Methicillin-resistant *Staphylococcus aureus* carriage, infection and transmission in dialysis patients, healthcare workers and their family members. *Nephrol Dial Transplant* 235: 1659-1665. [Crossref]

32. Hadley AC, Karchmer TB, Russell GB, McBride DG, Freedman BI (2007) The prevalence of resistant bacterial colonization in chronic hemodialysis patients. *Am J Nephrol* 27: 352-359. [Crossref]

33. Ghazvini K, Hekmat R (2007) Nasal and skin colonization of *Staphylococcus aureus* in hemodialysis patients in Northeast of Iran. *Iran J Kidney Dis* 1: 21-24. [Crossref]

34. Koziol-Montewka M, Szczepanik A, Baranowicz I, Jozwiak L, Ksiazek A. et al. (2006) The investigation of *Staphylococcus aureus* and coagulase-negative staphylococci

nasal carriage among patients undergoing haemodialysis. *Microbiol Res* 1614: 281-7. [Crossref]

35. Bogut A, Kozioł-Montewka M, Baranowicz I, Jóźwiak L, Ksiazek A, et al. (2007) Characterisation of *Staphylococcus aureus* nasal and skin carriage among patients undergoing haemodialysis treatment. *New Microbiol* 302: 149-54. [Crossref]

36. Duran N, Ocak S, Eskiocak AF (2006) *Staphylococcus aureus* nasal carriage among the diabetic and non-diabetic haemodialysis patients. *Int J Clin Pract* 60: 1204-1209. [Crossref]

37. Ghasemian R, Najafi N, Makhlough A, Khademloo M (2010) Frequency of nasal carriage of *Staphylococcus aureus* and its antimicrobial resistance pattern in patients on hemodialysis. *Iran J Kidney Dis* 4: 218-222. [Crossref]

38. Alexander EL, Morgan DJ, Kesh S, Weisenberg SA, Zaleskas JM, et al. (2011) Prevalence, persistence, and microbiology of *Staphylococcus aureus* nasal carriage among hemodialysis outpatients at a major New York Hospital. *Diagn Microbiol Infect Dis* 701: 37-44. [Crossref]

39. Patel G, Jenkins SG, Mediavilla JR (2011) Clinical and molecular epidemiology of methicillin-resistant *Staphylococcus aureus* among patients in an ambulatory hemodialysis center. *Infect Control Hosp Epidemiol* 329: 881-8. [Crossref]

40. Motamedifar M, Hassanzadeh P, Ghafari N (2010) Relative frequency of Staphylococcal carriage and antibiotic sensitivity of isolated Staphylococci in hemodialysis patients in Shiraz, Iran. *Med Princ Pract* 195: 379-383. [Crossref]

41. Souly K, Ait el kadi M, Lahmadi K, Biougnach H, Boughaidi A, et al. (2011) Epidemiology and prevention of *Staphylococcus aureus* nasal carriage in hemodialyzed patients. *Med Mal Infect* 41: 469-474. [Crossref]

42. Giarola LB, Dos Santos RR, Bedendo J, da Silva Junior WV and Borelli SD (2012) HLA molecules and nasal carriage of *Staphylococcus aureus* isolated from dialysis and kidney transplant patients at a hospital in Southern Brazil. *BMC Res Notes* 5: 90. [Crossref]

43. Giarola LB, Dos Santos RR, Tognim MC, Borelli SD, Bedendo J (2012) Carriage frequency, phenotypic and genotypic characteristics of *Staphylococcus aureus* isolated from dialysis and kidney tranplant patients at a hosptial in northern parana. *Braz J Microbiol* 433: 923-30.

44. Uehara Y, Kuwahara-Arai K, Hori S, Kikuchi K, Yanai M, et al. (2013) Investigation of nasal meticillin-resistant *Staphylococcus aureus* carriage in a haemodialysis clinic in Japan. *J Hosp Infect* 84: 81-84. [Crossref]

45. Oumokhtar B, Elazhari M, Timinouni M, Bendahhou K, Bennani B, et al. (2013) *Staphylococcus aureus* nasal carriage in a Moroccan dialysis center and isolates characterization. *Hemodial Int* 17: 542-547. [Crossref]

46. Celik G, Gulcan A, Dikici N, Gulcan E (2011) Prevalence of nasal *Staphylococcus aureus* carriage in the patients undergoing hemodialysis and evaluation of risk factors and laboratory parameters. *Ren Fail* 335: 494-498. [Crossref]

47. Kang YC, Tai WC, Yu CC, Kang JH, Huang YC (2012) Methicillin-resistant *Staphylococcus aureus* nasal carriage among patients receiving hemodialysis in Taiwan: prevalence rate, molecular characterization and de-colonization. *BMC Infect Dis* 12: 284.

48. Aydogan U, Akbulut H, Gok DE, Yilmaz MI, Yuksel S, et al. (2012) To study the correlation between carrier status of nasal *Staphylococcus aureus* in patients on haemodialysis with hepatitis C, hepatitis B and their sociodemographic features. *West Indian Med J* 612: 139-44. [Crossref]

49. Wanten GJ, Schneeberger PM, Bevers A, van Ginneken E, Koolen MI (1998) Optimizing screening procedures for *Staphylococcus aureus* nasal carriage in patients on haemodialysis. *Nephrol Dial Transplant* 13: 1256-1258. [Crossref]

50. Roubicek C, Brunet P, Mallet MN, Dussol B, Gonzales A, et al. (1995) Nasal carriage of *Staphylococcus aureus*: prevalence in a hemodialysis center and effect on bacteremia. *Nephrologie* 16: 229-232. [Crossref]