Journal of Oral Science, Vol. 56, No. 1, 85-89, 2014

Original

Oral opportunistic infections in institutionalized patients with motor and intellectual disabilities

Norio Horie[1)], Daisuke Nasu[1)], Miki Endo[1)], Atsushi Uchida[2)], Takahiro Kaneko[1)], Tetsuo Shirakawa[3)], and Tetsuo Shimoyama[1)]

[1)]Department of Oral and Maxillofacial Surgery, Saitama Medical Center, Saitama Medical University, Kawagoe, Japan
[2)]Department of Dentistry, Ranzan-go, Saitama Social Welfare Corporation, Ranzan, Japan
[3)]Department of Pediatric Dentistry, Nihon University School of Dentistry, Tokyo, Japan

(Received November 22, 2013; Accepted February 19, 2014)

Abstract: To establish a basic strategy for prevention of aspiration pneumonia in patients with motor and intellectual disabilities, we investigated oral opportunistic pathogen (OOP) infections in 31 such patients who were resident at a welfare home. Patients received special oral care from a dental hygienist once a week. OOP samples were collected by scraping the dorsal surface of the tongue, and then cultured. For each patient, the basic reasons for admission and the degree of intellectual disability and mobility were recorded. OOPs were found in 61.3% of the patients, of which methicillin-sensitive *Staphylococcus aureus* (MSSA) was the most commonly detected (38.7%). A significantly high proportion of male patients were OOP-positive, and a significantly high proportion of patients with mental retardation were *Candida* sp.-positive. However, multivariate logistic regression revealed that disability was not associated with OOP positivity. No correlation was found between OOP positivity and disability. Nevertheless, special oral care may be beneficial for maintenance of oral health in patients with disabilities.
(J Oral Sci 56, 85-89, 2014)

Correspondence to Dr. Norio Horie, Department of Oral and Maxillofacial Surgery, Saitama Medical Center, Saitama Medical University, 1981 Kamoda, Kawagoe, Saitama 350-8550, Japan
Fax: +81-49-228-3687 E-mail: horien@saitama-med.ac.jp

doi.org/10.2334/josnusd.56.85
DN/JST.JSTAGE/josnusd/56.85

Keywords: oral opportunistic infections; motor disability; intellectual disability.

Introduction

Recently, several reports have indicated that infection with oral opportunistic pathogens (OOPs) in the oropharyngeal space is associated with systemic diseases such as aspiration pneumonia, heart disease, and influenza (1-3). Daily oral health care has been evaluated as an effective prophylactic method for such diseases (4-6). The prevalence of OOPs has been primarily investigated in patients at geriatric hospitals and residents of geriatric nursing homes, and the rate of OOP infections has been reported to be higher in institutionalized elderly than in community-dwelling elderly (7-10). In institutionalized elderly, the rates of infection with *Pseudomonas aeruginosa* and methicillin-resistant *Staphylococcus aureus* (MRSA), the most commonly detected bacteria, were 20-40% and 15-35%, respectively (11,12). Generally, welfare homes and hospitals accommodate a number of patients with various motor and intellectual disabilities; however, OOP infection is rarely reported in these patients, despite the fact that the most common cause of death in patients with severe motor and intellectual disabilities is aspiration pneumonia (13,14). In this study, to establish a basic strategy for the prevention of aspiration pneumonia in patients with severe motor and intellectual disabilities, we investigated OOP infection in residents of a welfare home.

Materials and Methods

The present study was conducted at Ranzan-go, a welfare home for patients with motor and intellectual disabilities managed by Saitama Social Welfare Corporation. Thirty-one inpatients with various congenital disabilities who attended the dental clinic of the home between December 1, 2011 and March 31, 2012 were included in the study. The patients ranged in age from 6 to 68 years, with a mean age of 40.5 years. There were 21 males and 10 females (male:female ratio, 2.1:1). The major reasons for admission were mental retardation (MR) (n = 27), epilepsy (EPI) (n = 9), limb inconvenience (LI) (n = 6), cerebral palsy (CP) (n = 3), and Down syndrome (n = 3) (some patients had multiple reasons). The degree of intellectual disability was assessed according to the criteria of Saitama Prefecture: circle A, patients with an intelligence quotient (IQ) lower than 20 (n = 18); A, IQ 21-35 (n = 9); B, IQ 36-50 (n = 1); C, IQ 51-70 (n = 0); and other (n = 3). Patients were grouped into two categories according to the degree of intellectual disability: a circle A group, and a group comprising A, B, C, and other. With regard to mobility, 22 patients were able to walk on their own and nine used a wheelchair. All patients were in good health and were able to consume food orally with or without the help of caregivers. No patients required a nasogastric tube, a percutaneous enterogastric tube, or intravenous hyperalimentation, and none had been treated with antibiotics within 4 weeks prior to the study. At the welfare home, all patients received regular oral care after meals three times a day with the cooperation of caregivers, as well as special oral care provided by a dental hygienist once a week.

Opportunistic pathogens on the tongue surface were previously demonstrated to be similar to those of the saliva, dental plaque and oropharynx, and therefore reflect opportunistic pathogens in the oral cavity as a whole (7,15). In the present study, aerobic bacterial species were collected from each patient, cultured, and identified. The dorsal surface of the tongue was scraped with a sterile cotton swab, which was then immersed in transport fluid (0.4% agar, 0.15% thioglycollate/phosphate-buffered saline). The sample was brought to BIO MEDICAL LABORATORIES (Kawagoe, Japan) for culture purposes. The following bacteria were identified from the samples using the corresponding tests: methicillin-sensitive *Staphylococcus aureus* (MSSA) and MRSA using PS latex, rabbit plasma (Eiken Chemical Co., Ltd., Tokyo, Japan), and MRSA screening plates (Nippon Becton Dickinson Co., Tokyo, Japan); *Pseudomonas* sp. using VITEK (bioMérieux, Tokyo, Japan); *ß-Streptococcus* using a Seroidenstrepto kit (Eiken Chemical Co., Ltd.), API STREP, and VITEK (bioMérieux); *Streptococcus pneumoniae* using a *Streptococcus* identification disk (Nippon Becton Dickinson Co. and bioMérieux); *Haemophilus influenzae* using a *Haemophilus* ID4 plate (Nippon Becton Dickinson Co.); *Klebsiella pneumoniae* by VITEK (bioMérieux); *Serratia marcescens* by VITEK (bioMérieux); *Moraxella (Branhamella) catarrhalis* by an ID test·HN-20 (NISSUI, Tokyo, Japan); and *Candida* sp. by Candida Check (Mitsubishi Chemical Medience Corporation, Tokyo, Japan). The detection levels for each organism were determined in accordance with the manufacturer's instructions. Patients who tested positive for one or more of the above OOP infections were defined as OOP-positive, and those who tested positive for none of them were defined as OOP-negative.

Table 1 Detection of oral opportunistic pathogens (OOPs)

	n (%)
OOP-positive (overall)	19 (61.3%)
Staphylococcus aureus (MSSA)	12 (38.7%)
Candida sp.	4 (12.9%)
Klebsiella pneumoniae	4 (12.9%)
Haemophilus influenzae	2 (6.5%)
ß-Streptococcus	0
Staphylococcus aureus (MRSA)	0
Serratia marcescens	0
Streptococcus pneumoniae	0
Pseudomonas aeruginosa	0
Moraxella (Branhamella) catarrhalis	0

*$P < 0.05$. There were no significant differences among the prevalences of the four pathogens.

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 10.0 software program. Fisher's exact test was used for categorical variables. Those with probability values of < 0.10 were eligible for inclusion as predictor variables in the logistic regression analysis for the factors associated with OOP-positive and *Candida* sp.-positive status. Differences at $P < 0.05$ were considered to be statistically significant.

This study was approved by the Clinical Research Ethics Board of Ranzan-go (2011). All study participants, next of kin, or nursing personnel gave their signed, informed consent before inclusion in the project.

Results

OOPs were found in 19 patients (61.3%) (Table 1), including 12 cases of MSSA (38.7%), four cases of *Candida* sp. (12.9%), four cases of *Klebsiella pneumoniae* (12.9%), and two cases of *Haemophilus influenzae* (6.5%); no cases of *ß-Streptococcus*, *Pseudomonas*

Table 2 Characteristics of patients and details of oral opportunistic pathogens (OOPs)

Characteristics	Any opportunistic pathogen	*Staphylococcus aureus* (MSSA)	*Candida* sp.	*Klebsiella pneumoniae*	*Haemophilus influenzae*
Sex					
Male (n = 22)	16 (72.7)**	10 (45.5)	4 (18.2)	3 (13.6)	2 (9.1)
Female (n = 9)	3 (33.3)	2 (22.2)	0 (0)	1 (11.1)	0 (0)
Age					
≥40 (n = 17)	10 (58.8)	7 (41.2)	1 (5.9)	2 (11.8)	1 (5.9)
<40 (n = 14)	9 (64.3)	5 (35.7)	3 (21.4)	2 (14.3)	1 (7.1)
Degree of intellectual disability					
Circle A (n =18)	12 (66.7)	8 (44.4)	1 (5.6)	3 (16.7)	1 (5.6)
A (n = 9), B (n = 1), C (n = 0), other (n = 3)	7 (53.8)	4 (30.8)	3 (23.1)	1 (7.7)	1 (7.7)
Basic reasons for admission					
Mental retardation (MR)					
Yes (n = 27)	16 (59.3)	11 (40.7)	2 (7.4)**	4 (14.8)	1 (3.7)
No (n = 4)	3 (75.0)	1 (25.0)	2 (50.0)	0 (0)	1 (25.0)
Epilepsy (EPI)					
Yes (n = 9)	6 (66.7)	4 (44.4)	1 (11.1)	2 (22.2)	0 (0)
No (n = 22)	13 (59.1)	8 (36.4)	3 (13.6)	2 (9.1)	2 (9.1)
Limb inconvenience (LI)					
Yes (n = 6)	3 (50.0)	2 (33.3)	2 (33.3)*	1 (16.7)	0 (0)
No (n =25)	16 (64.0)	10 (62.5)	2 (8.0)	3 (12.0)	2 (8.0)
Cerebral palsy (CP)					
Yes (n = 3)	0 (0)**	0 (0)	0 (0)	0 (0)	0 (0)
No (n = 28)	19 (67.9)	12 (42.9)	4 (14.3)	4 (14.3)	2 (7.1)
Down syndrome					
Yes (n = 3)	1 (33.3)	1 (33.3)	0 (0)	0 (0)	0 (0)
No (n =28)	18 (64.3)	11 (39.3)	4 (14.3)	4 (14.3)	2 (7.1)
Mobility					
Able to walk on one's own (n = 22)	14 (63.6)	9 (40.9)	2 (9.1)	2 (9.1)	2 (9.1)
Uses a wheelchair (n = 9)	5 (55.6)	3 (33.3)	2 (22.2)	2 (22.2)	0 (0)

Circle A, intelligence quotient (IQ) < 20; A, IQ 21-35; B, IQ 36-50; C, IQ 51-70.
*P < 0.1, **P < 0.05

Table 3 Results of logistic regression analysis of factors associated with oral opportunistic pathogens (OOPs) and *Candida* sp.

Associated factors	OR	95% CI	P value
OOPs (overall)			
Sex	77.211	2.379 – 2506.021	0.014
Cerebral palsy (CP)	0.0	0.0 – 8.04E+79	0.896
Candida sp.			
Mental retardation (MR)	0.0	*	0.987
Limb inconvenience (LI)	0.637	*	1.0

E+79, $\times 10^{79}$; *, Calculation is impossible.

aeruginosa, MRSA, *Serratia marcescens*, *Streptococcus pneumoniae*, or *Moraxella (Branhamella) catarrhalis* were found (overlapping infections were included). There were no significant differences among the prevalences of the four pathogens. However, there was a significantly higher number of OOP-positive patients among males than among females, and a significantly lower number of OOP-positive patients among patients with CP, than among patients who had been admitted for other reasons (P < 0.05) (Table 2). *Candida* sp. was significantly more frequent in patients with MR than in patients admitted for other reasons (P < 0.05) (Table 2).

A logistic regression model for predicting OOP-positive and *Candida* sp.-positive status was constructed

using factors with a significance level of $P < 0.10$. Thus, CP and sex were adopted as factors associated with overall OOP positivity, and MR and LI as factors associated with *Candida* sp. positivity. However, the results revealed that *Candida* sp. positivity was not associated with either of the above factors, and that only male sex showed a significant association with overall OOP positivity (OR, 77.221; 95% CI, 2.379 to 2506.021; $P = 0.014$) (Table 3).

Discussion

Few studies have investigated OOP infection in patients with motor and intellectual disabilities. In a polymerase chain reaction study, Binkley et al. (14) reported that *Prevotella melaninogenica* was found in 100% of patients, *Streptococcus pneumoniae* in 42.9%, *Candida albicans* in 25.4%, and MRSA in 12.7%. In the present study, the overall OOP infection rate was 61.3%, which is not low compared to the report of Binkley et al. (14), although the species detected and the rates of detection differed between the two studies. In our study, MSSA, the most frequently detected bacterium, was found in 38.7% of patients, *Candida* sp. in 12.9%, *Klebsiella pneumoniae* in 12.9%, and *Haemophilus influenzae* in 6.5%, whereas more serious pathogens such as MRSA and *Pseudomonas aeruginosa* were not detected. Detection of these bacteria strongly reflected the patients' recent status and medical history, including antibiotic use (12,16-18). Although patients who had used antibiotics during the preceding 3 months were strictly excluded from the study by Binkley et al. (14), the precise nature of their condition at the time of the study was unclear, and the patients included those who were receiving tube feeding and had swallowing difficulty: factors associated with high rates of MRSA and *Pseudomonas aeruginosa* infection (19,20). In contrast, the patients in the present study were in good health, were able to take food orally without a tube, and had no marked swallowing difficulty.

Initially, we considered that the severity of motor and intellectual disabilities might be a risk factor for OOP infection. However, in the present study, although *Candida* sp. was detected significantly more frequently in MR patients than in patients with other reasons for admission to the welfare home, logistic regression revealed that there was no correlation between the rate of OOP infection and the reason for admission, degree of intellectual disability, or mobility. After 6 months of observation, Binkley et al. (14) reported that participants with OOPs in baseline samples were significantly more likely to develop respiratory infection and that those with poor oral health were significantly more likely to develop pneumonia, although there were no significant differences in oral health or the rate of respiratory infection between participants with moderate, severe, or profound intellectual or developmental disabilities, or between those who were chair-bound, partially mobile, or fully mobile. The patients' present status was thus suggested to have a greater influence on OOP infection than disability.

Logistic regression revealed that only male sex was significantly associated with OOP infection. Older age has been considered to be a risk factor for OOP infection; however, the reason for this male predominance is unclear (10,21). No previous reports have identified a male predominance in OOP infection among patients with disabilities, except for one report that described a male predominance in pediatric patients with head and neck MRSA infections (14,22-24). Further investigations with larger sample sizes will be necessary to clarify this issue.

Binkley et al. (14) suggested that colonization of the oral cavity with OOPs may persist despite routine tooth brushing, and that meticulous, comprehensive oral hygiene may be needed to reduce OOPs. Studies have confirmed that the number of oropharyngeal bacteria decreases significantly with professional care by oral care specialists (6,25,26). In the present study patients, history of infection with serious pathogenic OOPs was not known. Nevertheless, the special oral care provided once a week by a dental hygienist in addition to daily oral care might have contributed to the maintenance of a good oral environment in these patients.

In conclusion, the present findings suggest that, although there is no direct correlation between OOP positivity and disability, special oral care might be effective for the maintenance of oral health in patients with disabilities. However, in this study, it was not possible to examine in detail the association between OOP positivity and factors associated with disability in the daily life of the patients (i.e., activities of daily living, ADL). In a future study, therefore, it will be necessary to include additional data on ADL in order to obtain a more complete picture of the association between OOP positivity and disabilities.

References

1. Yoneyama T, Yoshida M, Ohrui T, Mukaiyama H, Okamoto H, Hoshiba K et al. (2002) Oral care reduces pneumonia in older patients in nursing homes. J Am Geriatr Soc 50, 430-433.
2. Ohrui T (2005) Preventive strategies for aspiration pneumonia in elderly disabled persons. Tohoku J Exp Med 207, 3-12.
3. Soh KL, Shariff Ghazali S, Soh KG, Abdul Raman R, Sharif Abdullah SS, Ong SL (2012) Oral care practice for the ventilated patients in intensive care units: a pilot survey. J Infect

Dev Ctries 6, 333-339.
4. Adachi M, Ishihara K, Abe S, Okuda K, Ishikawa T (2002) Effect of professional oral health care on the elderly living in nursing homes. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 94, 191-195.
5. Adachi M, Ishihara K, Abe S, Okuda K (2007) Professional oral health care by dental hygienists reduced respiratory infections in elderly persons requiring nursing care. Int J Dent Hyg 5, 69-74.
6. Ishikawa A, Yoneyama T, Hirota K, Miyake Y, Miyatake K (2008) Professional oral health care reduces the number of oropharyngeal bacteria. J Dent Res 87, 594-598.
7. Russell SL, Boylan RJ, Kaslick RS, Scannapieco FA, Katz RV (1999) Respiratory pathogen colonization of the dental plaque of institutionalized elders. Spec Care Dentist 19, 128-134.
8. Honda E (2001) Oral microbial flora and oral malodour of the institutionalised elderly in Japan. Gerodontology 18, 65-72.
9. Smith AJ, Robertson D, Tang MK, Jackson MS, MacKenzie D, Bagg J (2003) Staphylococcus aureus in the oral cavity: a three-year retrospective analysis of clinical laboratory data. Br Dent J 195, 701-703.
10. Sumi Y, Miura H, Nagaya M, Michiwaki Y, Uematsu H (2006) Colonisation on the tongue surface by respiratory pathogens in residents of a nursing home--a pilot study. Gerodontology 23, 55-59.
11. Hall DL (2003) Methicillin-resistant Staphylococcus aureus and infection control for restorative dental treatment in nursing homes. Spec Care Dentist 23, 100-107.
12. Ewan V, Perry JD, Mawson T, McCracken G, Brown AN, Newton J et al. (2010) Detecting potential respiratory pathogens in the mouths of older people in hospital. Age Ageing 39, 122-125.
13. Kanda T, Murayama K, Kondo I, Kitazumi E, Takahashi K, Nakatani K et al. (2005) An estimation chart for the possibility of aspiration in patients with severe motor and intellectual disabilities: its reliability and accuracy. No To Hattatsu 37, 307-316.
14. Binkley CJ, Haugh GS, Kitchens DH, Wallace DL, Sessler DI (2009) Oral microbial and respiratory status of persons with mental retardation/intellectual and developmental disability: an observational cohort study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 108, 722-731.
15. Abe S, Ishihara K, Adachi M, Okuda K (2006) Oral hygiene evaluation for effective oral care in preventing pneumonia in dentate elderly. Arch Gerontol Geriatr 43, 53-64.
16. Scannapieco FA, Stewart EM, Mylotte JM (1992) Colonization of dental plaque by respiratory pathogens in medical intensive care patients. Crit Care Med 20, 740-745.
17. Tada A, Senpuku H, Motozawa Y, Yoshihara A, Hanada N, Tanzawa H (2006) Association between commensal bacteria and opportunistic pathogens in the dental plaque of elderly individuals. Clin Microbiol Infect 12, 776-781.
18. Moore G, Dunnill CW, Wilson AP (2013) The effect of glove material upon the transfer of methicillin-resistant Staphylococcus aureus to and from a gloved hand. Am J Infect Control 41, 19-23.
19. Segal R, Dan M, Pogoreliuk I, Leibovitz A (2006) Pathogenic colonization of the stomach in enterally fed elderly patients: comparing percutaneous endoscopic gastrostomy with nasogastric tube. J Am Geriatr Soc 54, 1905-1908.
20. Al-Talib H, Yean CY, Hasan H, Nik Zuraina NM, Ravichandran M (2013) Methicillin-resistant Staphylococcus aureus nasal carriage among patients and healthcare workers in a hospital in Kelantan, Malaysia. Pol J Microbiol 62, 109-112.
21. Ogawa T, Ikebe K, Enoki K, Murai S, Maeda Y (2012) Investigation of oral opportunistic pathogens in independent living elderly Japanese. Gerodontology 29, e229-233.
22. Naseri I, Jerris RC, Sobol SE (2009) Nationwide trends in pediatric Staphylococcus aureus head and neck infections. Arch Otolaryngol Head Neck Surg 135, 14-16.
23. Gaszyńska E, Tyndorf M, Manowska B, Arkuszewski P (2011) Methicillin resistant Staphylococcus aureus infections of soft issues of the oral cavity, face and neck in patients hospitalized at the Cranio-Maxillofacial Surgery Department. Pol Przegl Chir 83, 212-215.
24. Schaumburg F, Köck R, Mellmann A, Richter L, Hasenberg F, Kriegeskorte A et al. (2012) Population dynamics among methicillin-resistant Staphylococcus aureus isolates in Germany during a 6-year period. J Clin Microbiol 50, 3186-3192.
25. Ueda K, Toyosato A, Nomura S (2003) A study on the effects of short-, medium- and long-term professional oral care in elderly persons requiring long-term nursing care at a chronic or maintenance stage of illness. Gerodontology 20, 50-56.
26. Kokubu K, Senpuku H, Tada A, Saotome Y, Uematsu H (2008) Impact of routine oral care on opportunistic pathogens in the institutionalized elderly. J Med Dent Sci 55, 7-13.