



Original Article

Risk factors of aspiration pneumonia related to improper oral hygiene behavior in community dysphagia persons with nasogastric tube feeding



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KEYWORDS

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Abstract *Background/purpose:* Aspiration pneumonia (AsP) was reported to be closely related to poor oral hygiene. This study aimed to investigate the association between caregivers' oral hygiene behavior with AsP in the community dysphagia persons with nasogastric tube feeding (DPNgTF).

Materials and methods: A cross-sectional study was conducted on 128 DPNgTF and their corresponding caregivers. A self-reported structuralized questionnaire was used to measure the oral care behavior of caregivers. All data analyses were performed using the SPSS. The Chi-square was used for comparison of nonparametric data. Fisher's exact test was used when the expected frequency of any cell in the table was less than five. A *p* value <0.05 was considered statistically significant.

Results: Fifty-five DPNgTF had developed AsP (43.0%) and they had statistically significantly halitosis (adjusted OR = 4.46; 95%CI = 2.01–9.93), deposition of oropharyngeal secretion (OR = 4.39; 95%CI = 1.99–9.66), dry mouth (OR = 4.23; 95%CI = 1.81–9.85) and closing mouth and not allow to brush (adjusted OR = 2.83; 95%CI = 1.28–6.27). The poor oral hygiene status of DPNgTF was significantly correlated with the occurrence of AsP. The caregivers' oral care to DPNgTF after getting up (OR = 14.09; 95%CI = 2.92–68.08) and using sponge stick to care (OR = 3.29; 95%CI = 1.26–8.55) were the risk factors of AsP.

Conclusion: The implemented oral care after getting up only, using sponge stick has a higher risk compared to the implemented oral care prior to sleeping, using toothbrush. The

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importance of implementing oral care prior to sleeping by using toothbrush should be reinforced in DPNgTF. Guidelines of oral care and education courses for caregivers during the process in their career training are needed.

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Introduction

Aspiration pneumonia (AsP) is defined as a misdirection of oropharyngeal or gastric contents caused by dysphagia, accompanied with massive oral bacteria flora and secretion to invade into the larynx and lower respiratory tract, and then to produce an infectious response in the lungs.¹ AsP is one of the most critical complications and a major cause of death in patients with dysphagia.² The risk factors of AsP are dysphagia, compromised consciousness, insufficient oral care and decrease in salivary clearance.³

Dysphagia is a complication of cranio-neurological injuries and diseases, also often seen in fragile elderly due to the degenerative process of aging. Nearly 50% of all individuals residing in nursing homes suffer from a swallowing disorder.⁴ Dysphagia persons always have problems in loss of sensation and mobility, paralysis or weakness of affected side of mouth and limbs, which makes them unable to feel whether food is pocketed in the mouth or not, cannot take care of their daily life activities including tooth brushing by themselves, or cannot get proper oral care from caregivers. Moreover, dry mouth often acts as an exaggeration factor to produce multiple caries or severe periodontitis. A massive bacteria reservoir in the oro-pharyngeal area and oral cavity may invade the trachea and lung tissues accompanied with dysphagia, finally leads to AsP.^{5–8}

Dysphagia elderly always suffer from chronic malnutrition and dehydration caused by the difficulty of taking meals and drinking orally.^{9,10} Nasogastric tube feeding is an option, yet it has not been shown to reduce the risk of aspiration or pneumonia.¹¹ Furthermore, gastric bacteria can migrate upward along the tube and colonize the pharynx.¹² Prolonged nasogastric tube feeding is associated with pathologic colonization of bacteria in the oropharynx, reduces the ratio of stimulated saliva flow to basal level and alters the content of saliva that is related to the risk of AsP.¹³ Stroke patients have poor oral health status in tooth loss, dental caries experience, and periodontal status, and less dental attendance. This is caused by lack of oral health knowledge by nurses and poor patient attitude.¹⁴

A study of 115 nurses and healthcare professionals working regularly on care of the elderly in wards found that respondents think that oral and dental health of older persons is 'extremely important', and approximately half of the respondents regularly give advice to their patients about dental care. Unfortunately, their knowledge of and reasons for providing oral care and advice is often incorrect. They are even potentially giving inappropriate advice regarding oral care to the patients.¹⁵ Talbot surveyed oral care training courses for nurses in the wards of stroke units

showed that only a third of units received oral care training in one year, the use of oral care assessment tools and protocols was limited, and not all units had access to toothbrushes, toothpaste or chlorhexidine.¹⁶

It is evident that dysphagia and long-term placement of nasogastric tube feeding are risk factors for AsP, and improper oral care will act as a bacteria reservoir to cause AsP in dysphagia patients. Since long-term care elderly always have poor oral hygiene and unmet needs in oral care, we investigated to find out what is incorrect about caregivers' skills in daily oral care and how poor oral hygiene status has been involved in developing AsP for dysphagia persons with nasogastric tube feeding (DPNgTF).

Material and methods

This is a cross-sectional, descriptive study conducted from June to December 2015 on 128 DPNgTF receiving home care and their corresponding main caregivers in the Tainan area, Taiwan. The Research Ethics Committee of Chi Mei Hospital (No. SMA-NHR10311) approved the protocol. All study subjects signed an Informed Consent Form.

DPNgTF had similar severity caused by cranio-neurological disorder or injuries such as stroke, dementia and Parkinson's disease. Subjects receiving placement of nasogastric tube for more than 6 weeks and home care for more than 3 years, have clear consciousness, with communicable skills and full past medical history records were included in the study. Consciousness assessed by observing a patient's arousal and responsiveness based on the physician's judgment while he/she left hospital and went home.

The caregivers had been fully trained and certified by the Taiwan Ministry of Social Welfare, had more than 3 months experience in long-term care residents and are currently employed in caring for DPNgTF at least 6 h a day.

The demography and physiological status of DPNgTF were evaluated as follows: the physiological data diagnosed and recorded by physicians including consciousness status, cardiopulmonary function, symptoms and signs of pneumonia; hospitalization history due to pneumonia in the last year. The evaluation of oral hygiene and health status of DPNgTF was conducted at bedside with a head light torch and obtained the data by a dentist. The oral hygiene status included halitosis (bad oral odor can be detected when the dentist standing at bed side); deposition or oropharyngeal secretion (plaque deposition more than 25% over teeth of fixed prosthesis or removable denture, or oropharyngeal secretion more than 25% attached to soft tissue of hard palate and buccal mucosa); dry mouth (saliva over tongue surface and oral mucosa shows less moisture, sticky or cleft

of tongue base); gum bleeding spontaneously; closing mouth and not allow to brush by a caregiver (close mouth and not allow to brush); dentate (edentulous or dentate); brushing ability by caregivers (partially or completely); gum bleeding due to brushing.

The caregivers' oral care behavior was evaluated by a home care nurse. Oral care behavior included assist oral cleaning, times, timing (brush teeth before sleeping, after getting up or both) and brushing tool (toothbrush or sponge stick).

This study explored the relationship among the variables using SPSS (Version 18.0) (SPSS Inc. Chicago, IL. USA). The chi-square test was used to compare the AsP regarding the demographic distribution, oral hygiene and health status of the subject and oral care behavior of the caregivers. Fisher's exact test was used when the expected frequency of any cell in the table was less than five. A p value <0.05 was considered a statistically significant. In order to assess the unadjusted and adjusted association, both univariate and multivariate regression models were estimated. Only the oral hygiene and health of the subject and oral care behaviors that were found to be significant associated with AsP in the univariate regression were put into the multiple regression models. Adjusted odds ratios and 95% confidence intervals were reported for the multivariate analysis.

Results

There were 486 persons who were disabled in daily self-caring skills and received home care by caregivers in this study. Among them, 282 persons (58%) are diagnosed as DPNgTF. One hundred and fifty-four patients were excluded from this study due to conscious status was confused, combined with multiple medically compromised physical status or refused to attend. Finally, 128 DPNgTF (attending rate: 45.4%) were included in this study (Table 1) in daily care.

AsP developed in 55 DPNgTF (42.97%). The oral hygiene parameters of halitosis, oropharyngeal secretion, dry mouth and closing mouth and not allow to brush appeared in the DPNgTF had significantly higher prevalence of AsP than non-AsP patients (Table 2). Table 3 revealed the risk factors related AsP were halitosis, oropharyngeal secretion, dry mouth and closing mouth and not allow to brush.

More than 92% of caregivers provided oral care for DPNgTF. For the oral care behavior of caregivers, AsP had a statistically significant difference with the items of "oral care after getting up", "using sponge stick as a tool of oral care" (Table 4). The tool of brushing teeth by using sponge stick and the timing of oral care after getting up had 3.29 times and 14.09 times risk respectively to have AsP than using toothbrush as a tool and oral care before sleep or both (Table 5).

Table 1 Demographic characteristics of dysphagia subjects with nasogastric tube feeding and caregivers.

Variables	Terms	N	p		p
			Yes (n = 55) n (%)	No (n = 73) n (%)	
Participants					
Gender	Male	65	32 (58.18)	33 (45.21)	0.146
	Female	63	23 (41.82)	40 (54.79)	
Age	≤ 64 years old	26	11 (20.00)	15 (20.55)	0.939
	≥ 65 years old	102	44 (80.00)	58 (79.45)	
Marital status	Single	7	1 (1.82)	6 (8.22)	0.115
	Married	121	54 (98.18)	67 (91.78)	
Education level	Less than senior high school	107	45 (81.82)	62 (84.93)	0.638
	Senior high school or higher	21	10 (18.18)	11 (15.07)	
Disease	≤ 2	40	17 (30.91)	23 (31.51)	0.942
	≥ 3	88	38 (69.09)	50 (68.49)	
Dependence in activities	Completely	114	49 (89.09)	65 (89.04)	0.993
	Partially	14	6 (10.91)	8 (10.96)	
Weight status	Underweight	25	13 (23.64)	12 (16.44)	0.534
	Healthy weight	81	34 (61.82)	47 (64.38)	
	Overweight	22	8 (14.55)	14 (19.18)	
Consciousness	Clear	43	21 (38.18)	22 (30.14)	0.340
	Unclear	85	34 (61.82)	51 (69.86)	
Caregivers					
Gender	Male	20	7 (12.73)	13 (17.81)	0.433
	Female	108	48 (87.27)	60 (82.19)	
Age	≤ 64 years old	114	48 (87.27)	66 (90.41)	0.582
	≥ 65 years old	14	7 (12.73)	7 (9.59)	
Education level	Less than senior high school	77	36 (65.45)	41 (56.16)	0.288
	Senior high school or higher	51	19 (34.55)	32 (43.84)	
Relationship with participant	Relative	49	16 (29.09)	33 (45.21)	0.063
	Non-relative	79	39 (70.91)	40 (54.79)	
Experiences of oral health education	Yes	85	37 (67.27)	48 (65.75)	0.857
	None	43	18 (32.73)	25 (34.25)	

Table 2 Relationship between oral health for subjects of dysphagia persons with nasogastric tube feeding and the hospitalization due to aspiration pneumonia.

Variables	Terms	N	Yes (n = 55)	No (n = 73)	p
			n (%)	n (%)	
Halitosis	None	67	19 (34.55)	48 (65.75)	0.001
	Yes	61	36 (65.45)	25 (34.25)	
Deposition of oropharyngeal secretion	None	70	20 (36.36)	50 (68.49)	0.001
	Yes	58	35 (63.64)	23 (31.51)	
Dry mouth	None	94	32 (58.18)	62 (84.93)	0.001
	Yes	34	23 (41.82)	11 (15.07)	
Gum bleeding spontaneously	None	117	51 (92.73)	66 (90.41)	0.064
	Yes	11	4 (7.27)	7 (9.59)	
Closing mouth and not allow to brush	None	84	30 (54.55)	54 (73.97)	0.022
	Yes	44	25 (45.45)	19 (26.03)	
Dentate	Edentulous	99	19 (34.55)	15 (20.55)	0.076
	Dentate	29	36 (65.45)	58 (79.45)	
Brushing ability by caregivers	Completely	110	47 (85.45)	63 (86.30)	0.891
	Partially	18	8 (14.55)	10 (13.70)	
Gum bleeding due to brushing	None	74	31 (56.36)	43 (58.90)	0.773
	Yes	54	24 (43.64)	30 (41.10)	

Table 3 Aspiration pneumonia predict factors among dysphagia subjects with nasogastric tube feeding.

Variables	Terms	COR ^a (95%CI)	p	AOR ^b (95%CI)	p
Halitosis	None	1.00		1.00	
	Yes	3.64 (1.74, 7.60)	0.001	4.46 (2.01, 9.93)	0.001
Deposition of oropharyngeal secretion	None	1.00		1.00	
	Yes	3.80 (1.82, 7.96)	0.001	4.39 (1.99, 9.66)	0.001
Dry mouth	None	1.00		1.00	
	Yes	4.05 (1.76, 9.34)	0.001	4.23 (1.81, 9.85)	0.001
Closing mouth and not allow to brush	None	1.00		1.00	
	Yes	2.37 (1.12, 4.99)	0.023	2.83 (1.28, 6.27)	0.010

^a COR = crude odds ratio. Crude odds ratios were derived from univariate logistic regression model. Dependent variable was the aspiration pneumonia.

^b AOR = adjusted odds ratio. Adjusted odds ratios were derived from a multiple logistic regression model mutually adjusted for subjects' gender, age, material status, education level, weight, and consciousness, diseases. Dependent variable was the aspiration pneumonia.

Table 4 Relationship between caregivers' oral hygiene behavior and the hospitalization due to aspiration pneumonia.

Variables	Terms	N	Yes (n = 55)	None (n = 73)	p
			n (%)	n (%)	
Assist oral care	Yes	117	51 (92.73)	66 (90.41)	0.643
	None	11	4 (7.27)	7 (9.59)	
Times of oral care	1 time	72	33 (60.00)	39 (53.42)	0.458
	≥2 times	56	22 (40.00)	34 (46.58)	
Timing of oral care	After getting up	75	46 (88.46)	29 (45.31)	0.001
	Before sleeping	21	4 (7.69)	17 (26.56)	
	After getting up and before sleeping	20	2 (3.85)	18 (28.13)	
Tools of oral care	Sponge stick	82	46 (82.14)	36 (64.29)	0.001
	Toothbrush	30	10 (17.86)	20 (35.71)	

Discussion

The incidence of dysphagia was highly reported to range from 51 to 84% in cerebrovascular accident patients,

Parkinson's disease and Alzheimer's disease.^{17–19} Martino connected the high incidence of pneumonia with dysphagia associated with aspiration in stroke patients.²⁰ Falsetti found that dysphagia occurs in more than a third of stroke

Table 5 Aspiration pneumonia risk factors for oral hygiene behavior among caregivers.

Variables	Terms	COR ^a (95%CI)	<i>p</i>	AOR ^b (95%CI)	<i>p</i>
Times of oral care	1 time	1.72 (0.82, 3.60)	0.149	1.52 (0.70, 3.32)	0.295
	≥2 times	1.00		1.00	
Timing of oral care	After getting up and before sleeping	1.00	0.420	1.00	0.436
	Before sleeping	2.12 (0.34, 13.10)		2.08 (0.33, 13.14)	
	After getting up	13.80 (2.98, 63.83)		14.09 (2.92, 68.08)	
Tools of oral care	Toothbrush	1.00	0.012	1.00	0.015
	Sponge stick	3.36 (1.31, 8.65)		3.29 (1.26, 8.55)	

^a COR = crude odds ratio. CORs were derived from univariate logistic regression model. Dependent variable was the aspiration pneumonia.

^b AOR = adjusted odds ratio. AORs ratios were derived from a multiple logistic regression model mutually adjusted for caregiver's gender, age, education level, and relationship with participant. Dependent variable was the aspiration pneumonia.

patients in rehabilitation wards, and 26.5% of dysphagia patients developed AsP.²¹ The present study found a rather high incidence of AsP (42.97%) could be associated with our subjects consisting of the most risky groups of causing AsP, since they were dysphagia patients with long-term placed nasogastric tube and with poor oral hygiene.

Rofes¹⁷ described that the oropharyngeal functional dysphagia is a complication of neurological diseases, injuries and aging. Many researchers^{5,7,8,22,23} declared that oropharyngeal dysphagia is an independent risk factor for the development of respiratory tract infections and community-acquired pneumonia in older patients. Rofes¹⁷ strengthened that oropharyngeal dysphagia, malnutrition-led impaired resistance to infections and poor oral health are the three pathophysiological factors associated with AsP.¹⁷ He further explained that since stroke patients with oropharyngeal dysphagia suffer with eating difficulty and easy choking during drinking water or liquid. Nasogastric tube feeding is a very often seen option for daily feeding to substitute oral feeding. But long-term placement may be another risk factor to lead to AsP. The reasons could be due to: loss of anatomical integrity of the esophageal sphincters, increase in the frequency of transient lower esophageal sphincter relaxations, and desensitization of the pharyngoglottal adduction reflex.¹² Furthermore, tube feeding may alter the environment of the oral ecosystem and lead to oral indigenous microbiota disruption, allowing health-threatening bacteria to thrive.²⁴ These observations may explain part of the reason why we have higher incidence of AsP in our study since all studied subjects were long-term placed with nasogastric tube. In addition, Leibovitz¹³ concluded that the alterations in saliva might be related to the risk of AsP. This may explain the patients with dry mouth in our study had 4.23 times higher risk to have AsP as compared to the patients without dry mouth.

Poor oral hygiene contributes to complications of stroke or neuromuscular diseases: the impairment of cognition of patients, paralysis of extremity, especially in upper limb impact hand manual dexterity in tooth brushing, in-ability to express what they suffer, immobility, and dysphagia. Lack of oral care knowledge, attitude and skills of caregivers or giving inappropriate advice regarding oral care to the patients for whom they were caring also plays an

important risk factor.¹⁵ However, Preston further advocated that deficiencies exist in the knowledge of health care workers both in hospitals and in the community setting, and nurses in a community setting were less knowledgeable or likely to give advice to older people.²⁵ All of these barriers will lead to poor oral hygiene of those DPNgTF, and damage the oral health and finally cause AsP. The subjects in our study were all bed-ridden in community dwelling, had severe disability and lack of activities of daily life, their daily health care including oral hygiene is mostly covered by caregivers. Poor oral-care-related knowledge and skills of caregivers will highly impact their oral hygiene and health, and lead to a high risk factor to AsP. In our study, the oral hygiene parameters of halitosis, deposition of oro-pharyngeal secretion, dry mouth and closing mouth and not allow to brush appearing in the DPNgTF had a significantly higher prevalence of AsP than those persons without these hygiene parameters. The outcome of oral care to DPNgTF is not appropriate, even though the caregivers have been trained, registered and having full practice experience in daily care. The appropriate oral care of brush at least twice a day (after getting up or meal and before sleeping) and using the toothbrush to brush the tooth should be taught to the caregivers.

Since our patients were dependent on taking care of their daily life activities and oral care by caregivers, it is very important for nurses or caregivers in communities to have proper awareness and correct daily practical skills of oral care. Unfortunately, researchers found that elderly residents were generally not concerned about their oral health unless they are in pain, which causes them to have poor oral hygiene and health status.^{26,27} Despite of 96% homecare workers thinking it was necessary to provide oral health care, only 11% of them put oral care into practice on a daily basis.²⁸ Only 58% of nursing homes and 8% of residential homes have formal oral care policy, their training in oral care is not universal.²⁹ Talbot et al.¹⁶ surveyed oral care training course for nurses in the wards of stroke units, and showed that only a third of units received oral care training in one year. The use of oral care assessment tools and protocols is limited and not all units have access to toothbrushes, toothpaste or chlorhexidine. The provision of dental care for institutionalized elderly is inadequate, dental treatment is rare and dental needs are frequently

unmet.³⁰ Although the nursing staff recognize oral care as part of their role and take an empathic and caring approach to its delivery,²⁶ They face barriers in lack of training, time constraints associated with workload, and poor understanding of the processes causing dental disease.

Using a sponge stick should not be recognized as a proper tool of oral care for dentate. In our study, more than 92% of caregivers provided oral care for DPNgTF only by used the sponge stick not brush. A sponge stick does not brush out the dental plaque in gingival sulcus, interproximal, palatal mucosal and oropharyngeal areas or dentures effectively. The accumulation of colonized pathogens could serve as a reservoir for recurrent lower respiratory tract infections in dysphagia patients.³⁰ Therefore, Few papers have mentioned what frequency of tooth brushing is efficient for the long-term care needs of frail older patients. Our results showed that caregivers brush patients' teeth by sponge stick and after getting up have high risk to have AsP than oral care by toothbrush and before sleeping. It is obvious that improper oral care tools and timing could be risk factors of AsP. If patients do not brush their teeth carefully after meals or before sleeping, the consumed food and deposition of oro-pharyngeal secretion will be pocketed and attach in the mucobuccal fold, palatal, tongue base and oropharyngeal areas of the mouth and then could be fermented during sleep to become dental plaque and deposition of oropharyngeal secretion leading to AsP. This is one of the reasons why oral care implemented after getting up has a higher risk for AsP than implemented at other times.

In conclusion, poor oral hygiene (such as halitosis, deposition of oropharyngeal secretion, dry mouth and resistance to be brushed) could be one of the important predict risk factors to cause AsP. The most improper oral care behavior of caregivers are brushing teeth by sponge stick not using a toothbrush, and oral care implemented after getting up not before sleeping. Though oral cleaning is routine care behavior for these cases, inappropriate cleaning timing and tools will lead to poor oral health conditions and increase the risk of pneumonia. Meanwhile, for cases with combined tube feeding and oral feeding, if the caregivers lack relevant swallowing training, the risk of pneumonia will be greatly increased. Addressing a guideline or standard oral care protocol for caregivers is helpful to improve their oral care behaviors through career education courses.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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