図3　肺炎を繰り返す高齢者の MRI 像
（両側大脳基底核領域におけるラクナ梗塞の
重要性）

誤嚥性肺炎を疑う愁訴・症状

　高齢者の肺炎の症状としては，青壮年者の肺炎と同様に咳，痰，発熱，呼吸困難がみられるが，高齢患者ではその20〜30％に典型的な症状を欠くケースがあり注意が必要である．すなわち，いつもより元気がない，食欲低下，意識障害，不穏，せん妄，失禁等の非典型的症状を呈することもある．食事中のむせ込み，食後の嗄声および繰り返す微熱等は誤嚥を疑う根拠となる．これらの症状に，周囲にウイルスをはじめ原因となる病原体の流行感染もなく，誤嚥の直接確認あるいは誤嚥を起こしやすい基礎疾患の存在が確認されれば本疾患と診断される[4,5]．

不顕性誤嚥の予防策（表2）[3-5]

　誤嚥性肺炎の最良の予防法は，脳血管障害ならびに脳変性疾患の適切な予防ならびに治療であるが，他に，降圧剤の ACE 阻害薬，ドーパミン作動薬のアマンタジン，抗血小板薬のシロスタゾール，漢方薬の半夏厚朴湯，クエン酸モサプリド等

表2　不顕性誤嚥の予防法

1．薬物療法
　a）ACE 阻害薬
　b）ドーパミンおよびアマンタジン
　c）シロスタゾール
　d）半夏厚朴湯
　e）クエン酸モサプリド
2．口腔ケア
3．食後2時間の座位保持
4．抗精神病薬の使用頻度の抑制

　　　　(Ohrui, 2005)[3] (嚥下性肺疾患研究会，2003)[4]
　　　　　　　(大類・他，2010)[5]を参考に作成

の不顕性誤嚥の予防薬は肺炎のハイリスク高齢患者において肺炎の予防効果を有する[3-5]．
（1）アンジオテンシン変換酵素（ACE）阻害薬
　ACE は SP の分解酵素の1つであり，降圧剤の ACE 阻害薬を投与すれば SP の分解も阻害される．そのため，咽頭および喉頭，気管粘膜の SP の濃度が高くなり，嚥下反射および咳反射が正常化し肺炎の発症を抑制する[3,5]．
（2）ドーパミン作動薬
　嚥下反射の低下した脳血管障害患者に L-DOPA を点滴投与したところ，嚥下反射が著明に改善した．また，大脳基底核からのドーパミン遊離促進薬であるアマンタジンには，肺炎の抑制効果が確認されている[3,5]．
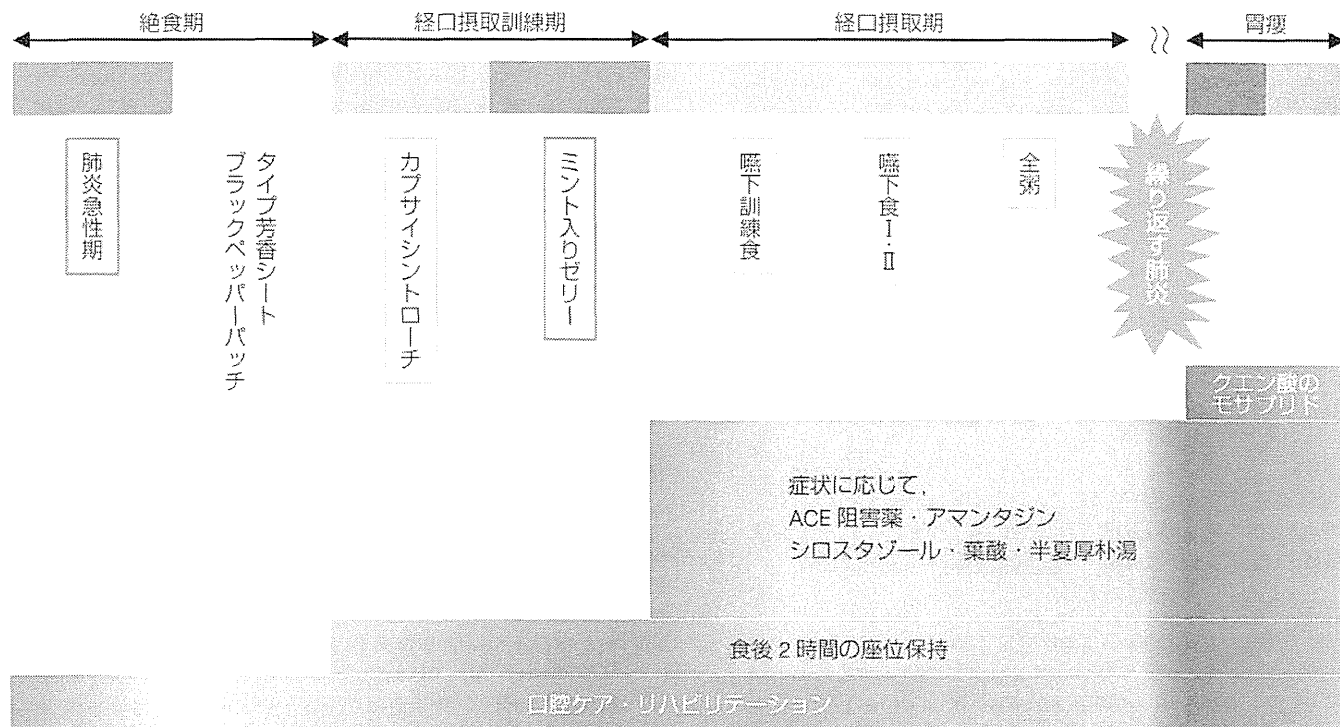（3）シロスタゾール
　シロスタゾールは，抗血小板作用とともに脳血管拡張作用をもつわが国で開発された薬剤であり，その投与が脳梗塞の再発を予防し，さらに脳血管障害を有する患者における肺炎発症率を40％に低下させることが確認されている[3,5]．
（4）半夏厚朴湯
　漢方薬の半夏厚朴湯を脳変性疾患患者に投与すると，嚥下反射時間が改善することが明らかにされている．また，長期療養型病院に入院中の患者に半夏厚朴湯を投与した結果，非投与群に比べ肺炎の発症が有意に抑制されることが明らかにされた[3,5]．
（5）クエン酸モサプリド
　胃運動を改善し食物の胃食道逆流を予防するク

図4 誤嚥性肺炎患者の絶食から経口再開まで——再誤嚥予防のためのプロトコール（東北大学老年科）

（大類・他，2010）[5]

エン酸モサプリドの食前投与が，経皮内視鏡的胃瘻造設術（PEG）施行患者において，肺炎の予防効果を有しかつ生命予後も有意に改善させた[3,5]．

（6）誤嚥性肺炎のその他の予防法（表2）

その他の予防として，食後2時間の座位保持および抗精神病薬の使用頻度の抑制が有用である．

以上の薬剤および口腔ケアや咽頭のアイスマッサージ等のリハビリテーションを積極的に組み合わせて用い，不顕性誤嚥からの肺炎を予防する（図4）[3,5]．

おわりに

近年，MRIによる脳ドック検診の普及に伴い，65歳以上の健常人の約2割に大脳基底核近傍のロイコアライオーシス等の脳虚血所見が認められると報告されており，このような人では大脳基底核のドーパミンの減少があり，不顕性誤嚥から肺炎発症の可能性が高いと考えられる．肺炎はわが国のような超高齢社会ではより身近な疾患であり，再発性かつ難治性である一方，かなりの程度予防が可能であることが明らかにされ，今後は，ハイリスク群を早期に同定し積極的に予防策を講じることが重要と考えられる．

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RIVASTIGMINE DERMAL PATCH SOLVES EATING PROBLEMS IN AN INDIVIDUAL WITH ADVANCED ALZHEIMER'S DISEASE

To the Editor: Alzheimer's disease (AD) is the most common progressive neurodegenerative disorder and a leading cause of dementia in elderly adults.[1] In 2003, AD was the fifth leading cause of death in individuals aged 65 and older in the United States. The best current estimates indicate that median survival after the onset of symptoms of dementia ranges from 3 to 6 years, shorter than previously estimated.[2] Swallowing dysfunction with or without aspiration pneumonia is a major cause of morbidity and mortality in individuals with end-stage AD.[3,4] Herein is reported an individual with advanced AD with swallowing problems and recurrent pneumonias who was successfully treated with a rivastigmine transdermal patch.

An 81-year-old woman was diagnosed with AD in 2005, manifesting as gradually progressive short-term memory loss, with a sharper decline during the past 3 years despite vigorous treatment with donepezil. Magnetic resonance imaging revealed brain atrophy, especially in the hippocampus. She had repeated episodes of aspiration pneumonia, malnutrition, dehydration, falls and femoral neck fracture, and sarcopenia. In February 2011, she was hospitalized for recurrent aspiration pneumonia and unresponsiveness. On admission, she was diagnosed as having AD according to the Functional Assessment Staging Scale, spending the entire day in a wheelchair, speaking only several words, and requiring complete support for eating and toileting. She was successfully treated using intravenous antibiotics and hydration. After pneumonia treatment, her oral intake was poor, and she occasionally refused to eat. She was taking just one or two spoonfuls of food or some juice. A bedside swallowing evaluation revealed mild oral dysphagia with delayed swallowing latency (4.2 ± 0.2 seconds).[3,4] Although a mechanically altered diet or nutritional supplements were ordered, her weight declined from 42 to 35 kg, and she developed a pressure ulcer on her hip over the next 3 months. It took a long time to hand feed and deliver oral medications, but her son did not agree to placement of a long-term feeding tube. In June 2011, she was discharged home to be cared for by her son. Her family physician and nurses provided intravenous hydration three times a week. In October 2011, her family physician decided to use a rivastigmine transdermal patch (Rivastach patch) instead of donepezil, and she was titrated from an initial dose (4.5 mg in a 2.5-cm^2 patch per day) to a maintenance dose (18 mg in a 10-cm^2 patch per day) by 2.5 cm^2 at 4-week intervals over 16 weeks. At a dose of 9 mg (5 cm^2) per day, her oral intake improved dramatically, and she gained weight. A bedside test revealed that her swallowing function had improved and that the swallowing latency had shortened (3.1 ± 0.3 seconds).[3,4] Her unresponsiveness was partially resolved, and the pressure ulcer resolved. Her clinical condition has been maintained under treatment with rivastigmine patch until now (May 2012).

DISCUSSION

AD is characterized by progressive cholinergic failure with an extensive loss of cholinergic neurons.[5] It has previously been shown that cholinergic neurons might be involved in the regulation of normal swallowing function,[6] indicating that cholinergic dysfunction might impair swallowing reflex in individuals with advanced AD.[5,6] Acetylcholinesterase (AChE) and butyrylcholinesterase (BuChE) can regulate the action of acetylcholine in the human brain, and BuChE is capable of compensating for low AChE activity.[7,8] Thus BuChE may become more important as AD progresses, and there is growing evidence that BuChE, as well as AChE, is a clinically relevant treatment target in AD.[7,8] Rivastigmine is the first approved transdermal patch for individuals with AD and has a dual inhibitory action of AChE and BuChE.[7,8] A clinical study demonstrated that rivastigmine dose-dependently inhibited BuChE activity.[7] Rivastigmine might therefore improve swallowing function by slowing the degradation of acetylcholine in the cholinergic nervous system in individuals with advanced AD.

CONCLUSION

In addition to a better tolerability profile than oral rivastigmine, transdermal delivery may allow better delivery for individuals with AD with swallowing disorders. Rivastigmine transdermal patch may enable individuals with advanced AD with eating problems take meals orally.

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RESEARCH STUDIES

POTENTIAL EFFECT OF SCREENING FOR SUBTLE COGNITIVE DEFICITS ON HOSPITAL READMISSION

To the Editor: Several conditions that significantly affect functionality and independence may be subtle and go unrecognized, potentially leading to nonadherence to medical recommendations and readmission. Existing risk-prediction models for hospital readmission have been shown to perform poorly.[1] Studies suggest that unrecognized cognitive deficits may exist after the illness that necessitated the admission was successfully treated, resulting in an unappreciated risk for readmission.

The risk of cognitive impairment increases with age and is amplified with hospitalization resulting in significant morbidity.[2] The frequency of cognitive impairment ranges from 15% to 35% in hospitalized elderly adults on general medicine services but may be even higher.[3] Identifying vulnerable individuals with cognitive deficits at the time of hospital admission is critical to prevent, establish a diagnosis of, and treat delirium.[4] Cognitive impairment is also associated with depression in late life and correlates with poorer quality of life and greater healthcare use.[5] Identification of subtle cognitive deficits can prove to be challenging, because many cognitively impaired individuals with intact language and memory can be perceived to be functionally independent. Executive cognitive functions are cognitive processes that orchestrate complex, goal-directed actions.[6] Impairment of the former undermines an individual's independence by interfering with the direction, planning, execution, and supervision of complex behavior. Screening individuals for obscured cognitive impairment at the time of hospital discharge could be the first step in early identification of mild to moderate cognitive impairment and allow for interventions to reduce related disability and avoidable readmissions.

This study examined subtle cognitive deficits that often go undetected in association with delirium, depression, and executive dysfunction. Individuals aged 65 and older admitted with diagnoses of congestive heart failure, exacerbation of chronic obstructive pulmonary disease, pneumonia, or myocardial infarction regardless of motor deficits were included. Exclusion criteria were admission from a skilled nursing or assisted living facility, medical history of dementia or cognitive impairment, English as a secondary language, and an education level less than high school.

A trained nurse screened older patients on Day 2 or 3 of admission. All individuals were screened for delirium using the Confusion Assessment Method,[7] instrumental activities of daily living using Lawton's scale, executive dysfunction using the Controlled Oral Word Association Test, and the oral version of the Trail-Making Test Part B. Depression screening was performed using the Patient Health Questionnaire. The comparison (control) group consisted of age-matched elective surgical postoperative patients without a diagnosis of dementia or the aforementioned four diagnoses and not admitted from a nursing or assisted living facility.

The study sample consisted of 43 cases and 27 controls. Rates of delirium, depression, and executive dysfunction were 15.2%, 19.6%, and 83.7%, respectively, in the study group and 7.7%, 0%, and 50%, respectively, in the control group. Rate of readmission within 1 calendar year was evaluated; 21 of the 23 (91.3%) readmitted cases and three of the five (60%) readmitted controls tested positive for executive dysfunction ($P < .05$).

It was possible to identify a large prevalence of executive dysfunction in a population at high risk for readmission. Screening older patients, in particular those with underlying diagnoses known to have a high risk for readmission for subtle cognitive deficits, may help to direct interventions and the allocation of limited resources to improve healthcare outcomes, including prevention of readmission.

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Survival period after tube feeding in bedridden older patients

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Aim: We prospectively studied survival periods after tube feeding.

Methods: Participants were 163 bedridden older patients suffering from dysphagia.

Results: A wide range of survival periods after tube feeding were observed within half a year without tube feeding after being bedridden. After this initial period, survival periods after tube feeding were limited to approximately half a year. Survival periods after tube feeding were positively proportional to the length of time patients were free from pneumonia after tube feeding. After tube feeding, patients died from pneumonia within half a year, and the frequency of pneumonia was 3.1 ± 2.7 times (mean $\pm$ SD) before death.

Conclusion: Survival periods after tube feeding for less than 1 year were primarily determined by being bedridden for more than half a year without tube feeding and once pneumonia occurred; patients who were tube fed did not survive for more than half a year. **Geriatr Gerontol Int 2012; 12: 317–321.**

Keywords: bedridden, dysphagia, frail older patients, terminal medicine, tube feeding.

Introduction

A rapid increase in the number of frail older patients in Japan forces us to confront the serious decision of whether or not to treat frail older patients with feeding tubes in the terminal stage.[1] In Japan, as a result of a combination of strong family emotions, religion, social traditions and public opinion, it is very common to place feeding tubes when patients are suffering from serious dysphagia. Kosaka *et al.* surveyed families who cared for bedridden older patients in the terminal stage as to whether the families would choose a feeding tube or not to treat patients with dysphagia.[2] As a result, approximately 90% of families caring for such patients refused the option of feeding tubes if the patients suffered from dysphagia. After receiving informed consent by explaining that approximately 90% of families had

denied feeding tubes, the proportion of feeding tubes for bedridden older patients in the terminal stage decreased by half.[3]

In either case of refusing or accepting the option of feeding tubes, families wanted to know the prognosis after tube feeding. There have been conflicting reports on the clinical benefit of tube feeding for patients with dementia.[4,5] However, the situation of terminal care in Japan is quite different from Western countries. So far, there have been no studies on the survival period and factors that determine survival periods after tube feeding in Japan. Families might make a reasonable decision on the option of feeding tubes if the prognosis after tube feeding was explained. In the present study, survival periods after tube feeding and factors that determine survival periods in 163 bedridden older patients suffering from dysphagia were prospectively analyzed for as long as 7 years.

Methods

Eligible bedridden older patients were aged >65 years and were terminal patients who required tube feeding, because they had developed difficulty maintaining

Table 1 Primary diagnosis for patients who underwent feeding tubes

Cerebrovascular disease	No. patients
Acute stroke	46
CVD without acute stroke	52
Degenerative disorder	
Alzheimer's disease	29
Parkinsonism	8
Others	1
Traumatic brain damage	4
Infections diseases	2
Hypoxic brain damage	3
Others	
Congestive heart failure	6
Postoperation	6
Bone fracture	3
Debility	1
Epilepsy	1
Ileus	1
Total	163

CVD: cerebrovascular disease.

Table 2 Direct cause of death

Diagnosis	No. patients (%)
Pneumonia	111
Other infections	17
Decrepitude	16
Heart disease	8
Renal disease	3
Malignant tumor	3
Bleeding of digestive organ	1
Cerebrovascular disease	1
Others	3
Total	163

adequate nutrition orally, and their cognitive function was extremely poor and not improving. Bedridden older patients were patients who suffered three to six limitations of the activities of daily living (ADL), including eating, getting in and out of a bed or chair, getting around inside the home, dressing, bathing, and using the toilet.[6] Patients stayed in a long-term care facility for several reasons, including physical and mental disabilities as a result of cerebral strokes and/or neurodegenerative diseases, and at the request of the patients' families. Primary diagnosis for patients who underwent feeding tubes is shown in Table 1. The clinical conditions of these patients continued to deteriorate to the point where they did not have any conscious awareness, although they occasionally opened their eyes and expressed voices. However, the eye movements and voices they expressed were not discernible. With the consent of team staff, including nurses and caregivers, we took informed consent from patients' families to accept the option of feeding tubes. For the purpose of the present study, we excluded patients who had metastatic cancer who were or were not receiving cancer therapy ($n = 7$), because cancer itself limits survival period. Patients with brain stem infarcts were also excluded from the present study ($n = 1$), because brain stem lesions usually lead to difficulties in swallowing and are therefore known to be a potential risk for pneumonia. All other patients with well-documented cerebral hemisphere stroke were included.

We prospectively followed up 163 patients in the terminal stage with dysphagia (80.9 ± 7.9 years,

mean ± SD): 77 women (83.0 ± 7.5 years, mean ± SD) and 86 men (79.0 ± 7.5 years, mean ± SD) who were bedridden at Hikarigaoka Sperman Hospital, a geriatric long-term care facility in Sendai City, Japan. Eligible patients were followed up from 1999 to 2007, and examined for frequency of tube feeding and incidence of pneumonia or other infections, such as urinary infection, decubitus and other episodes. Criteria for diagnosis of pneumonia were: (i) a new pulmonary infiltrate seen on a chest radiograph; and (ii) one of the following features: cough, and temperature greater than 37.8°C or subjective dyspnea.[7] Antibiotics and hydrations were medicated for treating pneumonia following the clinical standard. The protocol adhered to the recommendation of the declaration of Helsinki for Human Experimentation (World Medical Association, 2000). Informed consent was taken in every patient at the entrance of the study.

Tube feeding was placed through percutaneous endoscopic gastric tube (PEG). After consensus with families, nasogastric tubes were initially placed in 23 patients, but nasogastric tubes were substituted with PEG when tube feeding was prolonged by more than 2 weeks. We included both patients with PEG and nasogastric tubes for 2 weeks, followed by PEG together in the following analysis. Survival periods after tube feeding correlated with the duration without tube feeding after being bedridden and the duration free from pneumonia after tube feeding. Data are expressed as mean ± SD. An analysis of variance (ANOVA) was carried out to correlate survival periods and was followed by the least significant deference test for multiple comparisons. A *P*-value less than 0.05 was considered statistically significant.

Results

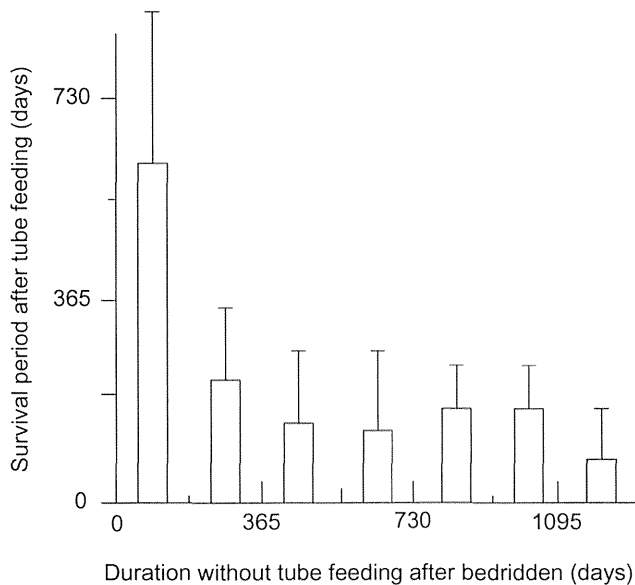Direct causes of death are shown in Table 2. Pneumonia was the most frequent cause of death. The average

Figure 1 Average survival periods after tube feeding after half a year without tube feeding after being bedridden were significantly shorter than that before half a year ($P < 0.01$). Survival periods after tube feeding more than 3 years without tube feeding after being bedridden are summarized.
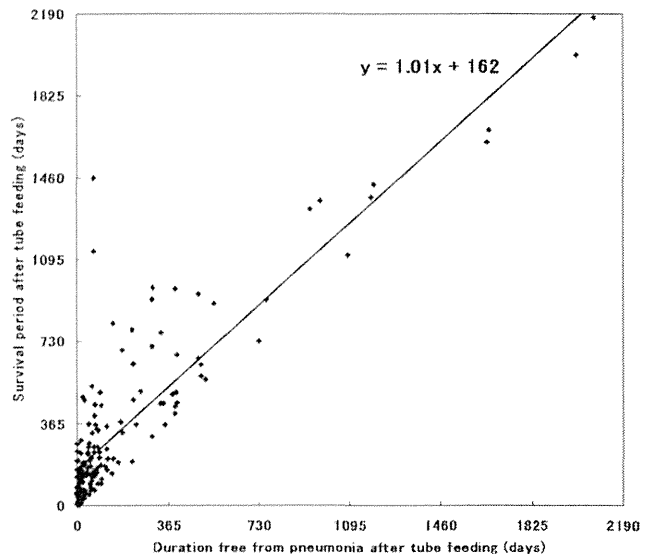

Figure 2 Survival period after tube feeding (y) was proportional to duration free from pneumonia after tube feeding (x), as $y = 1.01x + 162$ ($P < 0.001$).

survival period after tube feeding was 377 ± 35 days. The average survival period after tube feeding was more than one and half a years within half a year without tube feeding after being bedridden (Fig. 1). Average survival periods after tube feeding were approximately half a year or less after half a year without tube feeding after being bedridden. Survival periods after tube feeding (y) were positively proportional to length of time free from pneumonia after tube feeding (x) as $y = 1.01x + 162$ ($P < 0.001$; Fig. 2). Average survival periods after pneumonia were 156 ± 16 days. A total of 104 patients suffered from pneumonia before tube feeding, whereas 59 patients did not suffer from pneumonia before tube feeding. A previous history of pneumonia before tube feeding significantly shortened survival periods after tube feeding (279 ± 34 days) compared with patients without a previous history of pneumonia (554 ± 70 days; $P < 0.001$). After tube feeding, there were no significant differences in survival period after pneumonia between patients with and without a previous history of pneumonia before tube feeding, and both patients with and without a previous history of pneumonia are included in Figure 2. Frequencies of pneumonia after tube feeding averaged 3.1 ± 2.7 (mean $\pm$ SD) times and were independent of period after tube feeding. As the average survival period after tube feeding was approximately 1 year, the relative impact for a survival period less than 1 year (where less than 1 year and more than 1 year corresponded to 0 and 1, respectively) versus

sex, age, primary diagnosis for patients, previous history of pneumonia before tube feeding, urinary infection, decubitus and duration of being bedridden of more than half a year without tube feeding were assessed using multiple logistic regression (where sexes of male and female corresponded to 0 and 1, ages more than 80 years and less than 80 years corresponded to 0 and 1, primary diagnosis of patients of cerebrovascular diseases and the others corresponded to 0 and 1, positive and negative previous history of pneumonia before tube feeding corresponded to 0 and 1, positive and negative urinary infection corresponded to 0 and 1, positive and negative decubitus corresponded to 0 and 1, and duration of being bedridden of more than half a year without tube feeding and less than half a year corresponded to 0 and 1, respectively). Multiple logistic regression of the relationship between survival period after tube feeding less than one year and duration of being bedridden of more than half a year without tube feeding was significant (odds ratio = 8.4; 95% CI 2.3–30.5, $P < 0.001$), and was not significant for other factors.

Discussion

In the present study, it was suggested that after being bedridden for more than a half year, feeding tubes could prolong the survival period by only half a year. For patients suffering from pneumonia after tube feeding, the average survival period was shorter than half a year, during which the patients suffered from frequent pneumonia and died. There have been contradictory reports

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on the effect of tube feeding on the prevention of pneumonia. Survival after tube feeding was variable and survival was over a year in many of the patients.[8] In contrast, Murphy and Lipman suggested no survival benefit in patients with dementia who received artificial feeding by percutaneous endoscopic gastrostomy.[9] Tokunaga *et al.* suggested that a feeding tube neither reduces aspiration pneumonia nor improves survival in patients with a history of pneumonia.[10] Finucane *et al.*[4] reviewed whether tube feeding in patients with advanced dementia can prevent aspiration pneumonia, prolong survival, reduce the risk of pressure sores or infections, improve function, or provide palliation. They found no evidence to suggest that tube feeding improves any of these clinically important outcomes. Furthermore, the risk was substantial. They suggested that the widespread practice of tube feeding should be carefully reconsidered, and for severely demented patients the practice should be discouraged on clinical grounds. In patients aged more than 80 years, the ratio of aspiration pneumonia was approximately 90% in hospitalized pneumonia.[11] Nakajoh *et al.* found that tube feeding might be beneficial in patients with dysphagia, but when protective reflexes of aspiration, such as swallowing and cough reflexes, were degraded beyond certain thresholds, tube feeding could not prevent pneumonia anymore.[12] In the present study, we observed that pneumonia determined the survival period after tube feeding. It is likely that once pneumonia had developed under tube feeding, as a result of severely impaired protective reflexes of aspiration beyond certain thresholds, tube feeding was no longer effective to prevent pneumonia[13,14,15].

The prevalence of tube feeding has not been consistently reported.[16] According to the Ministry of Health and Welfare statistics in Japan in 2008, approximately 70 000 patients were tube fed per year. Of the 70 000 patients, more than 60 000 frail older patients were tube fed. The difference in the acceptance of tube feeding between the reality of being tube fed and the thought of rejecting tube feeding might be a result of Japanese morals. Japanese families find it hard to accept death, even in patients who have severely impaired cognition, no will and who are bed bound.[17] Rejecting tube feeding in approximately 90% of the families caring for these terminal patients might decrease tube feeding by half.[3] Onishi *et al.*[18] reported that approximately half of families were satisfied with gastrostomy tube feeding. The quality of informed consent for placement of the gastrostomy tube was inadequate in a large community-teaching hospital.[19] The present prognostic date might support the options to be decided by families as to whether or not to allow tube feeding. The present study might be important in constructing a medical consensus of life-extending care in terminally ill older patients.[20]

Disclosure statement

The authors declare no conflict of interest.

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ORIGINAL ARTICLE: EPIDEMIOLOGY,
CLINICAL PRACTICE AND HEALTH

Relationship between oral bacteria count and pneumonia onset in elderly nursing home residents

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Aim: Oral bacteria, which are a source of infection for aspiration pneumonia, were examined in frail older adults with the aim of establishing a standard bacteria count that indicates the risk of pneumonia onset in this group.

Methods: A survey of bacteria count in the saliva using a simple instrument for measurement of the number of oral bacteria, along with factors including swallowing function and nutritional status, was carried out in 691 elderly individuals requiring care (137 men; mean age 82.6 ± 8.3 years; 554 women; mean age 88.0 ± 7.1 years; total mean age 86.7 ± 7.8 years) at 16 nursing homes in Japan. All participants gave their consent for inclusion in the present study. During a 6-month follow-up period, participants who developed pneumonia were identified, and relationships between the factors measured at the start of the period and pneumonia onset were examined.

Results: During the 6-month follow-up period, 33 participants (4.8%; 5 men, 28 women; mean age 88.3 ± 7.4 years) developed pneumonia. Pneumonia onset was significantly associated with reduced activities of daily living, swallowing dysfunction and undernourishment. Logistic regression analysis identified a saliva bacteria count of $10^{8.5}$ colony-forming units/mL as an independent explanatory factor for pneumonia onset ($P = 0.012$, $RR = 3.759$).

Conclusions: Oral bacteria count of $10^{8.5}$ colony-forming units/mL saliva in an elderly person requiring care was identified as a risk factor for pneumonia onset. **Geriatr Gerontol Int 2015; 15: 417–421.**

Keywords: aspiration pneumonia, oral bacteria count, oral health care.

Introduction

Older adults are known to have a high incidence of aspiration pneumonia, and this is believed to be associated with intraoral bacteria infection.[1] Many bacteria that are specific causative agents of pneumonia are present in the oral cavity,[2] and it is difficult to selectively reduce the number of pneumonia-causing bacteria. Oral care can lead to favorable changes in the composition and abundance of oral bacteria,[3,4] and it has been reported that specialist oral care can reduce the number of days of fever and the frequency of pneumonia onset,[5,6] as well as reduce the mortality rate from pneumonia.[7]

Terpenning *et al.* discussed the economic effectiveness of carrying out oral care in these cases, and also calculated the cost of oral care in terms of human resources.[8] They found that oral care is highly effective. We determined the oral bacteria count in older adults requiring care using a simple instrument recently developed for the measurement of the number of oral bacteria,[9,10] and investigated the relationship between the oral bacteria count and subsequent pneumonia onset. We then used these findings to identify individuals at high risk of pneumonia onset. We expect that this type of screening program will enable the implementation of intensive oral care for high-risk individuals and will contribute to the prevention of aspiration pneumonia onset, which is significant from the perspective of medical economics.

The present study focused on the number of oral bacteria, which are a source of infection in aspiration pneumonia, with the aim of establishing a standard oral bacteria count for assessing the risk of pneumonia onset.

Methods

Participants

The survey was carried out in 691 older adults requiring care (137 men; mean age 82.6 ± 8.3 years; 554 women; mean age 88.0 ± 7.1 years; total mean age 86.7 ± 7.8 years) at 16 nursing homes in Japan who gave their consent to participate in the present study. We explained the purpose and procedure of the study to the participants both orally and in writing, and we obtained written informed consent from all participants or their families. The study was approved by the ethics committee of The Nippon Dental University, School of Life Dentistry at Tokyo.

Bacteria count

Oral bacteria count was determined using saliva collected from the sublingual area within 30 min of waking. To obtain a specimen, we rinsed a cotton swab in saliva in the floor of the oral cavity for 10 s. Participants were not permitted to eat or drink between waking and saliva collection. Bacteria were enumerated using a simple instrument for the measurement of the number of oral bacteria developed by Hamada *et al.*[9] and Kikutani *et al.*,[10] and counts were stratified into the following categories (colony-forming units [CFU]/mL): $<10^{6.5}$; $\geq10^{6.5}$ to $<10^{7}$; $\geq10^{7}$ to $<10^{7.5}$; $\geq10^{7.5}$ to $<10^{8}$; $\geq10^{8}$ to $<10^{8.5}$; $\geq10^{8.5}$ to $<10^{9}$; and $\geq10^{9}$.

Comorbidities

Comorbidities in participants were determined from medical records.

Swallowing disorders

Swallowing disorders were defined as being present in cases where choking or accidental aspiration were present, as well as in cases exhibiting a gargling sound on auscultation of the neck region[11] after swallowing 3 mL of water.

Nutritional status

Nutritional status of participants was determined by calculating body mass index (BMI) from height and weight. BMI < 18.5 was considered to show undernourishment.

Xerostomia

The presence or absence of xerostomia was assessed according to the following categories reported by Kakinoki *et al.*: dry, mildly dry, wet (normal) and wet (high).[12] Dry and mildly dry categories indicate the presence of xerostomia.

Activities of daily living

Evaluation of activities of daily living was carried out using the Barthel Index 1.[13]

Survey of aspiration pneumonia

The follow-up period was 6 months, and onset of aspiration pneumonia during this period was assessed. Pneumonia was diagnosed by each participant's primary physician. Criteria for diagnosis of pneumonia were a new pulmonary infiltrate seen on a chest radiograph and one of the following features: cough, temperature greater than 37.5°C or subjective dyspnea.

Statistical analysis

The χ^2-test was used to assess the relationship between pneumonia onset and various factors, and to test the cut-off point for bacteria count with respect to pneumonia onset. In addition, onset and bacteria count were analyzed using multiple logistic regression analysis to identify statistically significant levels.

Statistical analysis was carried out using PASW Statistics 18 (IBM, Tokyo, Japan) with a 95% significance level.

Results

Onset of pneumonia

A total of 33 participants (4.8%; 5 men, 28 women; mean age 88.3 ± 7.4 years) developed pneumonia during the 6-month follow-up period. No differences in distribution as a result of sex or age were observed. The Barthel Index was significantly lower among participants who developed pneumonia (pneumonia group; 14.71 ± 24.65) than among those of who did not (non-pneumonia group; 33.46 ± 27.95; $P = 0.007$). The proportion of participants with malnourishment was greater in the pneumonia group (40.7%) than in the non-pneumonia group (31.4%; $P = 0.2$). Dysphagia was also significantly more common in the pneumonia group (56.3%) than in the non-pneumonia group (39.0%; $P = 0.04$). No significant differences were found between the two groups with respect to the incidence of comorbidities, with the exception of heart disease and dementia (Table 1).

Table 1 Pneumonia onset and baseline characteristics

	Pneumonia (+)	Pneumonia (–)	P-value
Total % of men	15.0	20.4	0.40
Age (years)	88.36 ± 7.47	86.63 ± 7.81	0.31
Barthel Index score	14.71 ± 24.65	33.46 ± 27.95	0.007
Nutritional status (% malnourished)	40.7	31.4	0.20
Presence of swallowing disorder (%)	56.3	39	0.04
Presence of xerostomia (%)	43.8	34.7	0.193
Presence of cerebrovascular disease (%)	39.3	47.9	0.242
Presence of ischemic heart disease (%)	42.9	22.3	0.02
Presence of hypertension (%)	46.4	38.9	0.271
Presence of diabetes mellitus (%)	10.7	15.36	0.353
Presence of dementia (%)	78.6	58.7	0.026

Data are expressed as mean ± standard deviation.

Table 2 Relationship between pneumonia onset and bacteria count

Bacteria count, log (CFU mL-1)	Pneumonia (+)	Pneumonia (–)	Total
<6.5	2	39	41
≥6.5–<7	1	29	30
≥7–<7.5	6	114	120
≥7.5–<8	5	218	223
≥8–<8.5	10	165	175
≥8.5–<9	7	70	77
≥9	2	23	25
Total	33	658	691

CFU, colony-forming unit.

Setting the cut-off point

Table 2 shows the relationship between pneumonia onset and bacteria count category. In order to identify an index for carrying out specialist oral care, the following oral bacteria count cut-off points were considered (CFU/mL): $\geq10^{7.5}$, 10^8, $10^{8.5}$ and 10^9. The models with $\geq10^8$ CFU/mL and $\geq10^{8.5}$ CFU/mL as cut-off points showed significant differences in the incidence of pneumonia ($\geq10^8$ CFU/mL: $RR = 1.052$, 95% CI 0.988–1.120, $P = 0.041$; $\geq10^{8.5}$ CFU/mL: $RR = 1.037$, 95% CI 1.000–1.076, $P = 0.029$; Table 3).

Logistic regression analysis

A logistic regression model was used to examine whether an established cut-off value for oral bacteria count could be a factor in predicting pneumonia onset. The correlation matrix for the tested factors is shown in Table 4. As the Barthel Index showed a significant correlation with bacteria count, it was excluded from the logistic regression analysis to avoid multicollinearity.

Oral bacteria count $\geq10^{8.5}$ CFU/mL was an independent explanatory factor for pneumonia onset ($P = 0.012$, $RR = 3.759$, 95% CI 1.332–10.611; Table 5).

Discussion

Aspiration pneumonia develops when pathogenic bacteria are drawn from the oral cavity or pharynx into the trachea during respiration.[1] Aspiration of bacteria in oropharyngeal secretions is considered to be a major risk factor for nosocomial pneumonia in older adults;[14,15] therefore, poor oral hygiene is thought to be an important cause of pneumonia. Oral bacteria count can be reduced through specialist oral care.[3,4] In a random intervention study at a nursing home, the incidence of pneumonia was reduced through oral care intervention.[5,7] Abe et al. identified a relationship between saliva bacteria count and visual evaluation of tongue coating and dental plaque, as well as a relationship between the results of visual evaluation and pneumonia onset.[16,17] It has been reported that, as a result of the wide varieties of weak pathogenic bacteria that can cause aspiration pneumonia, bacteria count is a more important indicator than bacterial type or species in the prevention of aspiration pneumonia.[18] As bacteria count is likely to be a useful parameter for evaluating the risk of aspiration pneumonia, saliva bacteria count was used as an indicator of the oral environment in the present study.

The mechanism of aspiration pneumonia onset involves not only bacteria as the source of infection, but also includes aspiration as the route of infection and undernourishment as a factor in the status of the infected host.[19] Specifically, swallowing function plays a significant role in the onset of aspiration pneumonia,[20,21] and the need to evaluate swallowing function in the prevention of aspiration pneumonia has often been reported. Teramoto et al. described the "swallowing

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Table 3 Relationship between pneumonia onset and cut-off point

	Bacteria count (log)	Pneumonia (+)	Pneumonia (−)	*P*-value	RR	Lower	Upper
Model 1	≥7.5	72.7%	72.3%	0.57	1.001	0.964	1.039
Model 2	≥8	57.6%	39.2%	0.029	1.037	1	1.076
Model 3	≥8.5	27.3%	14.1%	0.041	1.052	0.988	1.12
Model 4	≥9	6.1%	3.5%	0.338	1.036	0.922	1.165

RR, relative risk.

Table 4 Correlation matrix for tested factors

		Bacteria count category	Barthel Index	Age	Nutritional status	Swallowing disorder
Bacteria count category	Correlation	1.000	−0.146	−0.019	−0.069	−0.035
	P-value		0.001	0.676	0.093	0.369
Barthel Index	Correlation	−0.146	1.000	−0.125	0.167	−0.360
	P-value	0.001		0.009	0.000	0.000
Age	Correlation	−0.019	−0.125	1.000	0.003	−0.037
	P-value	0.676	0.009		0.948	0.421
Nutritional status	Correlation	−0.069	0.167	0.003	1.000	−0.112
	P-value	0.093	0.000	0.948		0.006
Swallowing disorder	Correlation	−0.035	−0.360	−0.037	−0.112	1.000
	P-value	0.369	0.000	0.421	0.006	

Table 5 Logistic regression analysis of independent predictors for pneumonia onset

	B	SE	*P*-value	Relative risk (95% confidence interval)	
Sex (reference, male)	−0.288	0.672	0.688	0.750	0.201–2.800
Age	−0.020	0.034	0.552	0.980	0.980–1.047
Nutritional status (reference, malnourished)	0.211	0.520	0.685	1.235	0.445–3.424
Swallowing disorder (reference, presence)	−0.362	0.492	0.462	0.696	0.265–1.827
Bacteria count category (reference, <log 8.5)	1.324	0.529	0.012	3.759	1.322–10.611

provocation test" and the "simple swallowing provocation test" as effective methods for testing swallowing function in the prediction of aspiration pneumonia onset.[22] Poor nutritional status is associated with reduced immune function, and has been identified as a cause of various infectious diseases in older adults.[23,24]

Few reports on the relationship between pneumonia onset and oral bacteria have taken swallowing function and nutritional status into account, and these studies were limited to univariate analysis[25] or the addition of variables, such as the presence of periodontal disease or tooth decay and the use of artificial teeth.[19,26] The present study included swallowing function and nutritional status in the evaluation of pneumonia onset risk, and used multivariate analysis to determine a cut-off point at which oral bacteria count alone increases the risk of pneumonia.

A limitation of the present study was the use of a prospective cohort. Future studies should include oral care interventions in older adults with various oral bacteria counts in order to investigate whether reducing the oral bacteria count to a set level is effective in reducing the incidence of pneumonia. We set the observation period for 6 months in the present study. The reason why the follow-up period was 6 months in the present study was that the previous study reported that oral care intervention for approximately 6 months was required for significantly decreasing the number of oropharyngeal bacteria.[27] In this regard, in cases of prolongation of oral care intervention, there is a possibility of producing different results.

In the present study, pneumonia onset was observed for all bacteria count categories, suggesting that controlling oral bacteria might not completely prevent

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pneumonia onset; however, the presence of oral bacteria in saliva at a level of $10^{8.5}$ CFU/mL or higher in an older adult was identified as a risk factor for pneumonia onset in the present study.

Acknowledgements

Disclosure statement

The authors declare no conflict of interest.

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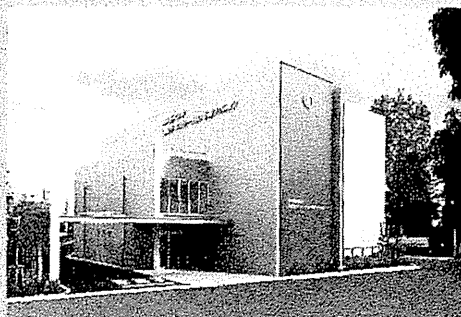
多職種協働現場における
歯科衛生士の役割

多職種協働の重要性が叫ばれるなか，診療所勤務の歯科衛生士にとって，歯科以外の医療職との協働現場の実際について知る機会は，あまり多くないのではないでしょうか．そこで今回編集部では，「日本歯科大学口腔リハビリテーション多摩クリニック」の協力のもと，リハビリテーションの現場において歯科衛生士がどのように多職種と連携をとり，専門性を発揮しているかを取材し，2号にわたってご紹介します．

（編集部・M）

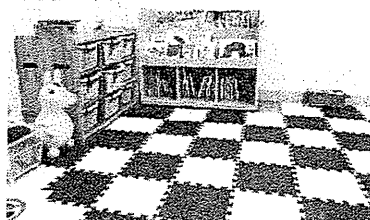※写真はすべて患者さんまたは介助者の方の許諾を得て掲載しています

日本歯科大学口腔リハビリテーション多摩クリニック

1F

待合室
吹き抜けの天井で，明るく開放的な空間となっている

在宅サポートステーション「ほっとっつ」
在宅療養の患者さん向けに，嚥下調整食品や介護用食器具，口腔ケア用品などが販売されている

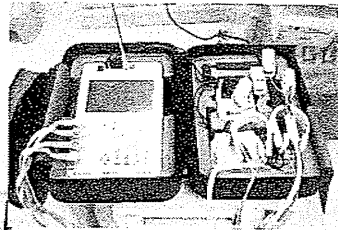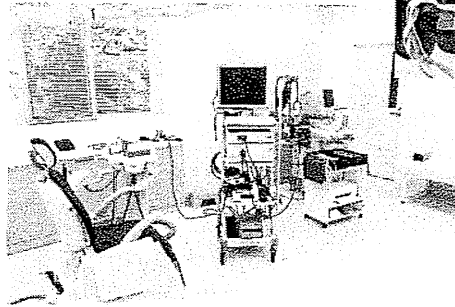**訓練室4（摂食指導室）**
小児の患者さんに対して摂食指導が行われる．患者さんの担任の先生が同席し，指導内容を共有することもある

訓練室5（キッチン）
管理栄養士による検査食の準備や，介護食の調理に関する研修会など多目的に使用

訓練室1（言語聴覚室）
摂食指導室とは異なり，知育玩具が多く置いてある

2F

嚥下内視鏡，超音波（US）画像診断用の機器を完備

▲InBody
（体成分分析装置）
骨格筋や筋肉量，細胞内外の水分量などを測って栄養状態を評価する

◀食べることや話すことに問題を抱えている患者さんに対し，その改善のために必要な歯科治療を行う
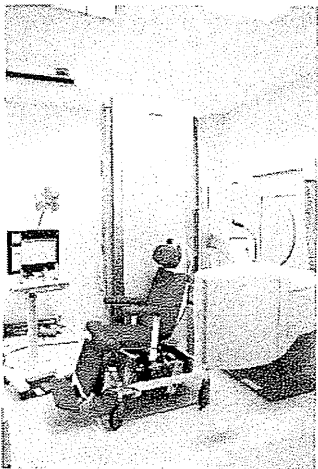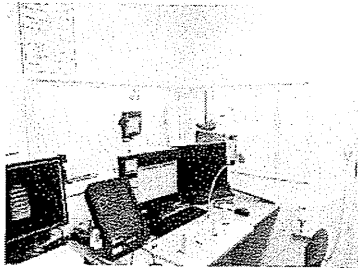
▶診療室
検査には歯科衛生士も立ち会い，記録や介助を行う
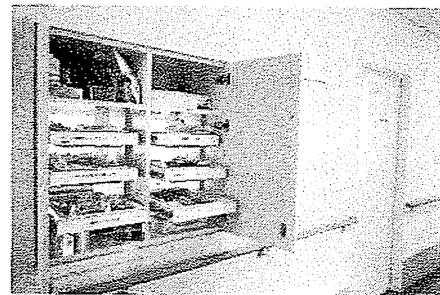
▼準備室（パスボックス）
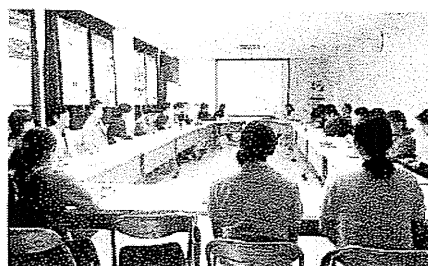消毒室からの器材の運搬時に，パスボックスを介することで清潔域の汚染を防ぐ．患者さん（廊下側）からは見えないよう，扉で隠せる仕様に

▼検査室
嚥下造影検査（VF）機器などがある

▲VF像

3F

職員のランチなどで利用される
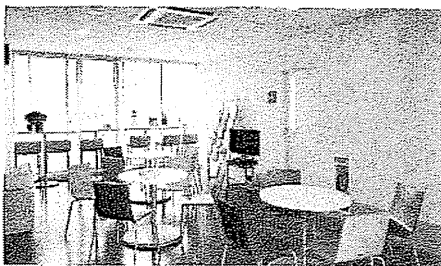
▶セミナー室
毎朝行われる申し送りやカンファレンス，外部の講師を招いての研修会などで使用される

多摩クリニック院長・菊谷 武先生から一言

多職種協働現場

障害者支援施設「杉並育成園　すだちの里すぎなみ」(東京都杉並区).ここではおもに,知的障害を抱える利用者の方に対して,多職種による食事や入浴などの日常生活の援助や自立支援が行われています.歯科衛生士の水上さんに密着し,施設への歯科訪問診療を取材しました！

歯科衛生士
水上美樹さん

施設訪問において歯科衛生士は,多職種からの情報収集を十分に行ったうえで,食事に関する外部観察評価を行い,口腔内の形態を考慮した評価とその結果を歯科医師や多職種に報告しています.また,訪問日以外にも担当歯科医師とつねに対応できる体制づくりに努めています.施設利用者の方々には,もっている機能を維持して安全においしく食事を摂っていただけるようにかかわっています.

いつも一口大はこの大きさで出していますか？

大きな固まりをそのまま口に入れてしまいます

摂食嚥下機能評価表
「全身状態」「口腔内の異常所見」「摂食状況」「現症」「外部観察評価」「手と口の協調（自食機能）」などのチェック項目があり,歯科衛生士による評価と他職種からの情報を統合しながら記録する

患者さんの食事の様子を観察しながら,管理栄養士に食事の形態を確認し,「摂食嚥下機能評価表」に記入していく

頸部に聴診器を当てて嚥下音を聴き,摂食嚥下状態を評価する

今日は食べるスピードが速くて一口量も多いです

緊張しているのかしら？

今後の方針を状態に合わせて検討しましょう

健康状態は良好です

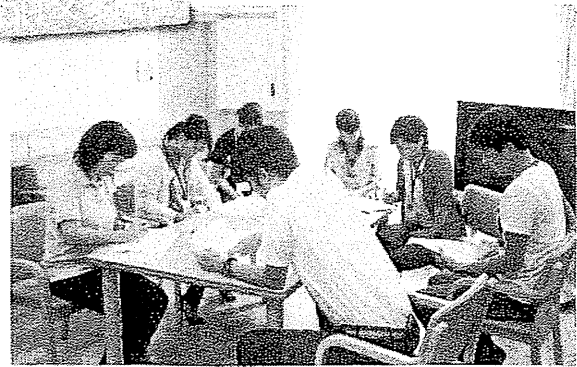食事環境の違いによる患者さんの行動の変化を考慮し,普段の様子を生活支援員に確認しながら,患者さんが食べやすい食事形態を考える

看護師から患者さんの食欲や体重,便通など全身状態に関する情報を得る.必要に応じて来院や検査などを歯科医師と検討し,看護師の意見を聴取する

ご家族（介助者）から,自宅での食事の様子や形態を聞き,自宅と施設とで食形態の整合性を図る.専門職ではない介助者の不安な心情に配慮して,わかりやすく説明する

患者さんの口腔内の状況を評価しながら，生活支援の一環である歯磨きの様子を確認．必要に応じて生活支援員に口腔ケアのアドバイスを行う

記入した摂食嚥下機能評価表に基づいて話し合う．摂食場面における異常動作（むせ，食べこぼしなど）については，歯科衛生士から積極的に問題提起をし，原因や解決策，今後の方針を提案する

多職種

利用者の方のケアにおいて，身体の状態を知り，治療や食事の方針を考えていきます．嚥下造影検査などをとおして，患者さんの嚥下機能が解剖学的にどのような状態かを知り，適切な食事のあり方を考えることができます．口腔について深い知識を得る機会は多くないため，歯科衛生士の方が専門的なことをわかりやすく教えてくださることで，患者さんだけではなく私自身も納得のいく改善策を進めることができます．

適切な栄養ケアのために，患者さんの食事の様子をみて，献立を考えます．若くして施設に入られた方が高齢化し，嚥下の問題などが生じて，従来の職種だけでは対処しきれなくなったところに，歯科衛生士，歯科医師の方が参入してくれました．それまでは，食事をつくる際も"なんとなく"で刻んだりとろみをつけたりしていましたが，歯科衛生士の方の助言により個人に合った食形態を提供できるようになりました．

利用者の方に直接かかわりながら，自立を支援しています．障がいをもたれる方にとって，危険な場面は日常に多くあります．食事もそのなかの1つで，嚥下や咀嚼機能の低下に加えて，一口を詰め込みすぎてしまう方は誤嚥や窒息のリスクが高いです．歯科衛生士の方に患者さんの口腔状態を定期的に確認していただくことで，食事の提供方法や食器などの形態を適切に工夫できるようになりました．また歯磨きについても，時間を多く割けない現状に合わせたアドバイスをくださり，とても感謝しています．

施設において歯科衛生士は，歯科医師の指示のもと患者さんをみて，他職種と協働します．そこでは，1人の歯科の専門家として技術を発揮するのはもちろん，女性ならではの細やかさをもって，患者さんやご家族に配慮できることも歯科衛生士の重要な役割ではないでしょうか．歯科医師に対してはつい気構えしてしまうが，歯科衛生士になら壁なく話せるという方はたくさんいらっしゃいます．

そのような立ち位置で歯科の専門性を発揮できる役割を歯科衛生士は担っていると考えます．

多職種協働現場

在宅医療では，ケアマネジャー（介護支援専門員）が立てたケアプランのもと，さまざまな関連機関から患者さんへの介護サービスが提供されます．歯科衛生士の有友さんを中心に，神経性難病を抱える患者・Kさんの在宅医療における歯科訪問診療の様子を取材しました！
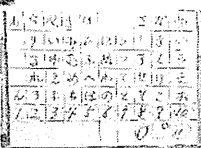
歯科衛生士
有友たかねさん

歯科訪問診療で歯科衛生士は，摂食嚥下機能評価をはじめ，摂食嚥下リハビリテーションや専門的口腔ケアを実施しています．その目的は，患者さんの食べる機能を支えることと誤嚥性肺炎の予防です．さらに，歯科衛生士の役割として重要なのは，地域の在宅支援を行っている医療介護福祉関係者との連携です．これがスムーズに行えることで，はじめて「おいしく安全に食べる口」がつくれます．

歯科衛生士の介助のもと患者さんに食事をしてもらい，飲み込みのタイミングなどを観察しながら歯科医師による嚥下内視鏡検査（VE）にて摂食嚥下評価を行う

発話が困難な患者さんとのコミュニケーションツールとなる

安全に食事を楽しめる方法を考えていきましょう

VEによる摂食嚥下評価に基づき，歯科医師からご主人（介助者）と患者さん本人に今後の方針を説明．栄養状態や嗜好にも配慮し，患者さんにとって食事という行為がつらくならないような方針を考え，アドバイスをする

Kさんは喉頭蓋谷に食べ物が貯留しやすいようですね

ご主人に食事介助をしてもらいながら，VEにて摂食嚥下評価を行う．このとき一口量や背もたれの角度を調節しながら，画像でわかる喉頭の様子の変化などを歯科衛生士・歯科医師から多職種に向けて説明する

患者さんは食後どのような姿勢をとっていますか？

食後の口腔ケアの際に何か気づいたことはありませんか？

介護福祉士や看護師から，患者さんの食事中の様子を聞き出すとともに，食後の姿勢や動作，口腔ケア時の観察点を確認．話し合いから抽出された誤嚥のリスクなどの問題点について，歯科衛生士・歯科医師が解決策を考え，指導する

その日に得た情報から今後の口腔ケアプランを『口腔ケア連携手帳』に記入し，ケアマネジャーから現場の多職種につなげてもらい，全員で共有する

誤嚥を防ぐために一口量を減らし，あごをひいた姿勢にしましょう

実際に現場で口腔ケアを行う介護福祉士から，食物残渣などの情報を得たうえで，ブラッシング方法や洗口剤の選択，使用方法について指導する

口腔ケア連携手帳
どの職種からも自由に記入してもらうことで，歯科衛生士だけでなく，多職種全体からの情報に基づいた口腔ケアプランの構築を図っている

歯科衛生士による口腔ケア．患者さんに，不快感などがないかを文字盤で訊きながら実施する

多職種

看護師：血圧や脈拍，体重などの情報をもとに患者さんの健康を管理します．清潔保持や，服薬の確認なども大切な業務です．
DHとのかかわり：その方に合わせた口腔ケアの物品を紹介してもらうなど，実践的なアドバイスを受けています．特に在宅医療においては，義歯を使われている方や，誤嚥性肺炎の危険性が高い方が多いため，患者さんの状態に合わせた適切な口腔ケアを学ぶことは看護師にとっても非常に意義のあることです．

ケアマネジャー：患者さんの治療や生活を支えるために必要なケアプランを立案し，適した職種をつなげます．
DHとのかかわり：「患者さんには口から食べる喜びをできるだけ長く感じてほしい」という思いは，多職種が共通してもっているものです．経口摂取は全身状態にも大きな影響を与えるため，歯科衛生士のかかわりは良好な在宅生活を継続するうえで大きな意味をもつと思います．

ヘルパー 要介護認定を受けた方を対象に，入浴やトイレ，食事の介助といった身体介護と，家事を中心とした生活援助という2種類のサービスを行っています．
DHとのかかわり：私たちも資格取得のために一通りの勉強はしていますが，口腔について学ぶ機会はあまりありませんでした．歯科衛生士の方に指導していただくことで，患者さんの口の状態や，口腔ケアにおける留意点などがわかり，身体介護において，よりきめ細やかなサービスが提供できるようになりました．

ご家族：たとえば歯ブラシの使い方1つをとっても，自分がこれまで思っていたものと全然違うことがわかりました．普通にご飯が食べられれば，口の中のことなんてほとんど気にしません．歯科の方たちから嚥下内視鏡検査の映像を見せていただいたことで，妻の飲み込みの状態をはじめて知り，ショックすら受けました．実際にこの目で見て，説明を受けることで，状態をより明確に掴むことができました．