

The effects of combined early oral health care  
and early mobilisation on the incidence of stro  
ke-associated pneumonia

(脳卒中関連肺炎の発生率に対する早期口腔ケアと早  
期離床の併用効果)

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## ABSTRACT

**Objective:** To investigate the effects of combined early oral healthcare and early mobilisation on the incidence of stroke-associated pneumonia during hospitalisation of acute stroke patients.

**Materials and Methods:** In this single-centre, non-blinded, before-and-after cohort study, patients received basic stroke rehabilitation by a multidisciplinary team within 72 h of symptom onset from July to September 2016 and from July to September 2018. Patients were divided into two groups: 1) patients who received combined early oral healthcare and early mobilisation (early intervention group) (n=107), and 2) patients who received usual care (control group) (n=107). The relationship between the stroke-associated pneumonia incidence and prognosis was examined.

**Results:** The early intervention group had a significantly lower incidence of stroke-associated pneumonia than the control group (0.93% vs. 7.48%;  $P=0.01$ ). Moreover, the early intervention group had a significantly lower proportion of patients who died or required medical care because of recurrent pneumonia at discharge (0.93% vs. 5.6%;  $P=0.04$ ). In contrast, there were no significant differences between the two groups regarding the Revised Hasegawa's Dementia Scale on day 14 (22.5 vs. 23;  $P=0.87$ ), Functional Independence Measure on day 14 (112 vs. 116;  $P=0.06$ ), and rate of total

oral diet (Food Intake LEVEL Scale  $\geq 7$ ) at discharge (95.2% vs. 93.5%;  $P=0.55$ ).

**Conclusions:** Combined early oral healthcare and early mobilisation by a multidisciplinary team significantly decreased the stroke-associated pneumonia incidence within 7 days and reduced the percentage of patients who died or required medical care because of recurrent pneumonia after stroke.

## INTRODUCTION

Pneumonia after stroke, which influences mortality (1) and duration of hospitalisation (2), has been a common critical issue in stroke patients. In 2015, the Pneumonia in Stroke Consensus Group proposed the diagnostic criteria of stroke-associated pneumonia (SAP), which is defined as a spectrum of lower respiratory tract infections in the first 7 days after stroke (3). A systematic review and meta-analysis reported that the incidence of SAP was 14% (4). There are several mechanisms of SAP onset, such as aspiration related to consciousness disturbance and dysphagia, stroke-induced immunodepression due to pathogenic bacteria, and immunological changes (5). Several studies have reported that stroke severity evaluated by the National Institutes of Health Stroke Scale (NIHSS) and modified Rankin Scale (mRS) scores (6–8), old age (6–8), dysphagia, and aspiration, are risk factors of SAP (9). Additionally, several studies have described various approaches to prevent SAP, such as swallowing evaluation strategy (10), pharmacological strategies (administration of antibiotics (11), angiotensin-converting enzyme [ACE] inhibitor (12), or metoclopramide (13), and early mobilisation (14,15). However, evidence proving the efficacy of these strategies is insufficient (16). Many reports have demonstrated that oral health care (OHC) reduces the risk of pneumonia in elderly individuals; however, evidence that OHC reduces the

risk of pneumonia in stroke patients is insufficient (17). In recent years, international guidelines recommend that patients with dysphagia be treated by a stroke multidisciplinary team (MDT) (18,19). Some studies have demonstrated that promoting oral feeding in acute stroke patients decreased the incidence of respiratory infections (20). However, strategies to effectively utilise an MDT have not been elucidated, and there are only a few reports regarding early mobilisation. Therefore, this study aimed to investigate the effects of combining early OHC, which is part of basic care for pneumonia prevention and early mobilisation in addition to rehabilitation by an MDT to reduce the incidence of SAP in acute stroke patients.

## **METHODS**

### **Study design and patient selection**

This was a before-and-after cohort study that included consecutive patients diagnosed with acute stroke in our hospital from July to September 2016 and from July to September 2018. The swallow evaluation team was formed in 2017 and performed fiberoptic endoscopic evaluation of swallowing in the acute stroke unit. Based on the previous research, we introduced OHC and early mobilisation as standard care for stroke patients in early 2018. From May 2018, a dental hygienist instructed nurses on

how to assess the patient and select necessary supplies, and in turn, the dental hygienist verified the nurse's procedures. From June 2018, we applied a protocol for early mobilisation in which the patient was encouraged to be out of bed. Thus, we conducted this retrospective analysis of patients who received stroke rehabilitation from July to September 2018 to ensure that staff were familiar with the practices for combined early oral health care (within 24 h by nurses trained in providing OHC) and early mobilisation in addition to the usual stroke rehabilitation program. The combination of early oral care (within 24 h by nurses trained to provide OHC) and early mobilisation was performed in addition to the usual stroke rehabilitation for 3 months from July to September 2018. There have been several reports on the association between stroke and season (21). Therefore, for our control cohort, we considered the season in 2018 and selected data from the same season in 2016 when OHC and mobilisation were not optimised. Acute stroke was defined as an ischaemic stroke or cerebral haemorrhage that was diagnosed based on symptoms and results of computed tomography or magnetic resonance imaging performed as routine inspection within 3 days after stroke onset. Initial rehabilitation started from the day of admission. The exclusion criteria were as follows: mRS score of 3–5, coma on admission, presence of advanced cancers, and discharge or death within 7 days of admission. The study design was approved by

the Ethics Committee of Hirosaki Stroke and Rehabilitation Centre (21A007) and conformed to the tenets of the Declaration of Helsinki. The ethics committee did not require the collection of informed consent for this study; however, patients could opt out of the research by following instructions on the hospital webpage.

### **Clinical characteristics**

The following patient characteristics were determined based on data obtained from the medical records: sex, age of onset, NIHSS on the day of admission, Hasegawa dementia scale-revised (HDSR) (22) on the day of admission, mRS score before the stroke, vascular risk factors, type of stroke (haemorrhage or ischaemic), and dysphagia grade using the Food Intake Level Scale (FILS) (Tables 1 and 2) (23) on the day of admission.

### **Treatment**

All patients underwent rehabilitation for stroke within 24 h of admission by an MDT consisting of doctors, nurses, physical, occupational, and speech therapists, pharmacists, and nutritionists. A dental hygienist intervened in the treatment only when requested by nurses in the control period.

### **Intervention**

All patients in the post-intervention period received an early intervention (EI) program that included two elements: (1) intensive OHC and (2) early mobilisation.

#### 1) Intensive OHC

OHC was initiated by nurses within 24 h of stroke onset. All nurses were trained by a dental hygienist on how to brush the patient's teeth and apply oral moisturiser. The hygienist triaged all patients who needed dental treatment and informed the dentists.

#### 2) Early mobilisation

Early mobilisation was initiated within 24 h of stroke onset and continued until discharge and focused on sitting, standing, and walking activities as well as being out of bed (14) within 48 h; however, if the patient's intracranial pressure increased significantly or blood pressure decreased by more than 30 mmHg while standing, these interventions were not carried out.

### **SAP**

SAP was defined as a lower respiratory tract infection occurring within the first 7 days after stroke onset (3) and was diagnosed based on (1) the presence of at least one of the following: fever ( $>38^{\circ}\text{C}$ ), leukopenia (white blood cell [WBC] count  $<4,000/\text{mm}^3$ ) or leukocytosis (WBC count  $>12,000/\text{mm}^3$ ) in patients aged  $>70$  years; and (2) at least two of the following: changes in the character of sputum, worsening cough, lung or



bronchial breath sounds, and worsening of gas exchange with or without typical chest radiography changes according to the recommendations from the Pneumonia in Stroke Consensus Group.

### **Data collection and clinical outcomes**

The primary outcome was the rate of SAP. The secondary outcomes were mortality, the proportion of patients on total oral diet, length of hospital stay, and neurological outcomes, including the NIHSS score on day 14, Functional Independence Measure (FIM) score on day 14, mRS score at discharge, and location where the patient continued recovery after discharge (e.g., home, hospital, or nursing home).

### **Statistical analysis**

The data distribution was performed using the Shapiro–Wilk test. All P-values were calculated using two-tailed tests and were considered statistically significant at a value  $<0.05$ . All statistical analyses were performed using JMP® version 14 (SAS Institute Inc., Cary, NC, USA). Continuous and ordinal variables are expressed as medians (interquartile range, IQR) and numbers (%), respectively. The Mann–Whitney U test was performed to compare between-group differences according to the data distribution. Categorical variables are expressed as numbers (%) and were compared using Fisher's exact and the chi-square tests.

## **RESULTS**

### **Patient characteristics**

Of the 413 stroke patients treated in our hospital, 102 and 97 were excluded from the control and EI groups, respectively, because they either had an mRS score of  $>3$  before stroke onset, started therapy after 3 days from stroke onset, or received an incomplete treatment protocol within the first 7 days from stroke onset (Fig 1). The clinical characteristics for the patients in each group are shown in Table 2. Among the 214 patients who received stroke care from the MDT within 3 days of stroke onset, 107, which happened to be the same sample size, were each allocated to the control and EI groups. Patient characteristics did not differ significantly between the two groups (Table 2). The incidence of SAP was too low to perform a multivariate analysis.

### **Clinical outcomes**

Table 3 shows the incidence of SAP (primary outcome), mortality, the proportion of patients who were out of bed within 48 h, FIM at discharge, FILS at discharge, HDSR on day 14, and the location where the patient continued recovery after discharge (secondary outcomes) for the EI and control groups. The EI group had a significantly

lower incidence of SAP than the control group (0.93% vs. 7.48%;  $P = 0.035$ ). Two patients in the EI group died due to pneumonia and gastrointestinal bleeding. Among patients who were out of bed within 48 h, the median time for patients to be out of bed in the EI group was significantly shorter than that in the control group (72 h vs. 160 h;  $P = 0.0115$ ). The two groups had no significant differences regarding HDSR on day 14 (22.5 vs. 23;  $P = 0.87$ ), FIM on day 14 (112 vs. 116;  $P = 0.06$ ), the proportion of patients on total oral diet (FIMS  $\geq 7$ ) at discharge (95.2% vs. 93.5%;  $P = 0.55$ ), or the proportion of patients who died or required medical care because of recurrent pneumonia at discharge (0.93% vs. 5.6%;  $P = 0.12$ ). However, the location where the patient continued recovery after discharge was significantly different between the EI and control groups ( $P = 0.03$ ).

## DISCUSSION

In this cohort of patients with acute stroke who received rehabilitation within 72 h of symptom onset, our results demonstrated that combined early OHC and early mobilisation in addition to rehabilitation by an MDT significantly decreased the incidence of SAP within 7 days. Furthermore, EI succeeded in reducing the proportion of patients who required medical care because of recurrent pneumonia and other

complications at discharge. We hypothesised that this strategy might also reduce the incidence of complications several months after a stroke.

The Japanese guidelines on stroke management recommend that patients with dysphagia must undergo evaluation for oral intake function and be treated by an MDT. However, few studies have described the implementation of an MDT to treat dysphagia (18,19). Aoki et al. (19) reported that an MDT approach with nine professionals, including doctors, dentists, nurses, physical therapists, occupational therapists, speech therapists, managerial dieticians, dental hygienists, and pharmacists, significantly decreased the rate of SAP. In contrast, another study reported that an MDT did not decrease the rate of SAP; however, the study did not provide the incidence of SAP; therefore, the evidence for their result was weak (18). In the present study, all patients underwent rehabilitation by an MDT composed of eight professionals, including doctors, nurses, physical, occupational and speech therapists, managerial dieticians, dental hygienists, and pharmacists. Subsequently, the patients in the post-intervention group received professional OHC and early mobilisation. Our results showed that the strategy of combining early OHC and early mobilisation in addition to the standard stroke rehabilitation with an MDT significantly decreased the rate of SAP. To the best of

our knowledge, this study is the first to demonstrate that therapeutic factors have a significant impact on reducing the rate of SAP using an MDT approach.

In the present study, we observed that the incidence of SAP in the control group was lower than that in a previous systematic review and meta-analysis (6.6% vs. 14%) (4). This may be due to two reasons. First, the standard rehabilitation offered by the MDT may have been effective in reducing the incidence of SAP. Second, the patients in the present study may have experienced less severe stroke compared to those in previous reports because patients who underwent surgery or were comatose were excluded in this study.

Several studies have indicated that poor oral hygiene increases the risk of pneumonia in elderly patients (24). However, evidence of an optimal approach for providing OHC to stroke patients is weak (25,26). We believe that early OHC, which would subsequently reduce pathogens in the lungs, is essential but insufficient to decrease the incidence of SAP.

Few studies have reported that physical therapy provided by physical or occupational therapists reduces the rate of SAP, and only one study has demonstrated that postural changes and passive mobilisation reduced the incidence of SAP in patients with non-severe stroke (14). A previous study demonstrated that the sitting position improved

Glasgow Coma Scale (GCS) scores in patients with cerebral disorders (26). We hypothesised that early mobilisation would improve consciousness disturbance and swallowing dysfunction.

In this study, the response to stimuli in the EI group was better than that of the control group; however, the GCS score, HDSR, and proportion of patients on total oral diet intake ( $FILS \geq 7$ ) on discharge were not different between the two groups. It is possible that the effects of EI were not detected by conventional evaluation items.

SAP significantly impacts the prognosis of patients, length of hospitalisation, and medical cost (5). In the present study, the proportion of patients who required medical care because of recurrent pneumonia and other complications at discharge was significantly lower in the EI group than in the control group. This showed that the combination of early OHC and early mobilisation performed by an MDT may improve the prognosis of patients with acute stroke.

Our study had four limitations. First, we could not perform a multivariate analysis because the incidence of SAP was low; therefore, these results may be insufficient to prove the effectiveness of the intervention. Second, the present study had a selection bias because of its retrospective nature. Third, it is possible that medical care improved over the two-year period; however, only the intervention changed. Fourth, we did not

define OHC and the criteria for dental treatment, which was decided by a dental hygienist because there is little evidence regarding oral care practice in stroke patients who are most dependent on oral care.

In conclusion, our results could help prevent SAP within 7 days in acute stroke patients. Combined early OHC and early mobilisation in addition to rehabilitation with an MDT significantly reduced the proportion of patients who died or required medical care because of recurrent pneumonia. This study provided insights into improving the prognosis of patients with acute stroke. We believe that a randomised controlled trial with a larger patient population is worth conducting to verify these results.

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6    **Author Contributions**

7    Ayaka Fujita: Writing - Original Draft, Conceptualisation, Methodology Collection and  
8    Assembly of Data, Drafting of the Article and Critical Revision of the Article for  
9    Important Intellectual Content.

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89    **Figure legend**

90    **Fig. 1** Flow diagram of the study

91    Prior period (control group) and later period (intervention group)

**Table 1. Food Intake Level Scale**

| <b>Food Intake Level Scale</b>  |
|---|
| <b>No oral intake</b><br><br>Level 1: No swallowing training is performed except for oral care.<br><br>Level 2: Swallowing training not using food is performed.<br><br>Level 3: Swallowing training using a small quantity of food is performed.   |
| <b>Oral intake and alternative nutrition</b><br><br>Level 4: Easy-to-swallow food less than the quantity of a meal (enjoyment level) is ingested orally.<br><br>Level 5: Easy-to-swallow food is orally ingested in one to two meals, but alternative nutrition is also given.<br><br>Level 6: The patient is supported primarily by ingestion of easy-to-swallow food in three meals, but alternative nutrition is used as a complement.   |
| <b>Oral intake alone</b><br><br>Level 7: Easy-to-swallow food is orally ingested in three meals. No alternative nutrition is given.<br><br>Level 8: The patient eats three meals by excluding food that is particularly difficult to swallow.<br><br>Level 9: There is no dietary restriction, and the patient ingests three meals orally, but medical considerations are given.<br><br>Level 10: There is no dietary restriction, and the patient ingests three meals orally (normal). |

**Table 2. Clinical characteristics of the early intervention and control groups**

|  | <b>Early<br/>intervention<br/>group</b><br>(n = 107) | <b>Control group</b><br>(n = 107) | <b>p-value</b> |
|--|--|-----------------------------------|----------------|
| <b>Demographics</b>                            |  |                                   |                |
| Male sex, n (%)                                | 69 (64.5)  | 59 (55.1)                         | 0.16           |
| Age, years (range)                             | 77 (68–83)   | 76 (65.5–83.75)                   | 0.67           |
| <b>Stroke type</b>                             |  |                                   |                |
| Ischaemic stroke, n (%)                        | 94 (88.0)  | 91 (85.1)                         | 0.54           |
| <b>Severity on admission</b>                   |  |                                   |                |
| GCS 13–15, n (%)                               | 96 (90.0)  | 98 (91.6)                         | 0.66           |
| GCS 9–12                                       | 9 (8.4)  | 6 (5.6)                           |                |
| GCS 3–8  | 2 (1.9)  | 3 (2.8)                           |                |
| NIHSS  | 4 (2–7)  | 3 (2–5)                           | 0.09           |
| <b>The grade of dysphagia<br/>on admission</b> |  |                                   |                |
| Fujishima grade $\leq 3$ , n (%)               | 17 (15.9)  | 14 (13.8)                         | 0.55           |
| <b>mRS before onset</b>                        |  |                                   | 0.68           |
| mRS 0, n (%)                                   | 63 (61.8)  | 67 (67.7)                         |                |
| mRS 1, n (%)                                   | 24 (23.5)  | 20 (20.2)                         |                |
| mRS 2, n (%)                                   | 15 (14.7)  | 12 (12.1)                         |                |

\* P < 0.05

n (%) or median (IQR)

GCS: Glasgow Coma Scale

NIHSS: National Institutes of Health Stroke Scale

mRS: modified Rankin scale

**Table 3. Clinical outcomes after rehabilitation**

|  | <b>Early<br/>intervention<br/>group<br/>(n = 107)</b> | <b>Control<br/>group<br/>(n = 107)</b> | <b>p-<br/>value</b> |
|--|---|--|---------------------|
| <b>Primary Outcome, n (%)</b>  |   |  |                     |
| SAP, n (%)   | 1 (0.93)  | 8 (7.48)                               | 0.035*              |
| Death, n (%)   | 0 (0)   | 2 (1.87)                               | 0.09                |
| <b>Secondary Outcome</b>   |   |  |                     |
| Out of bed within 48 hours, n (%)                                    | 101 (94.4)  | 100 (93.5)                             | 0.77                |
| HDSR on 14 days  | 22.5 (10.5–28)  | 23 (11–28)                             | 0.87                |
| FILS $\geq 7$ on discharge, n (%)                                    | 102 (95.3)  | 100 (93.5)                             | 0.55                |
| mRS 3–5, on discharge, n (%)   | 28  | 27                                     | 0.88                |
| FIM on discharge   | 112 (82–119)  | 116 (97–122)                           | 0.06                |
| Recurrent pneumonia, n (%)   | 1 (0.93)  | 6 (5.6)                                | 0.12                |
| Location where the patient continued recovery after discharge, n (%) |   |  | 0.03*               |
| Home   | 76 (71.0)   | 76 (71.8)                              |                     |
| Nursing home   | 29 (27.1)   | 20 (18.7)                              |                     |
| Another hospital   | 2 (1.9)   | 9 (8.4)                                |                     |

\* P < 0.05

n (%) or median (IQR)

SAP: stroke-associated pneumonia

HDSR: Hasegawa's Dementia Scale-Revised

FILS: Food Intake Level Scale

FIM: Functional Independence Measure



**Fig. 1**

