

The Efficacy of Intervention for the Prevention of Aspiration Pneumonitis in Recipients of Non-oral Nutrition

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Received date: November 28, 2017; Accepted date: December 11, 2017; Published date: December 12, 2017

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Abstract

Objective: We provided continuous training targeting the oral cavity and neck region to elderly, bedridden recipients of non-oral nutrition in addition to conventional physical interventions, with the aim of investigating changes in feeding and swallowing function.

Method: Bedridden (and caregiver's extensive care-requiring), non-tracheotomized patients with a conscious level of 1 or 2 on the Japan Coma Scale (three inclusion criteria) were eligible. We enrolled 13 patients (5 men, 8 women; mean age: 85.2 ± 6.4 years) meeting the three criteria specified in the Setting, who had been receiving nutrition nasogastrically, *via* a gastrostomy tube, or by central venous hyperalimentation.

Intervention was provided three times weekly, as additional interventions to conventional physical function training. The interventions were 1) neck stretching, 2) facilitation of swallowing response, 3) stimulation of the oral cavity, and 4) positioning into an anti-gravity posture (in a position with the back elevated 60° from the bed).

Comparative assessments covered 1) intraoral saliva volume, 2) swallowing response time, 3) neck muscle hardness, 4) lip opening width, and 5) aspiration pneumonitis status at the initiation of training and the completion of training three months later.

Results: All assessments showed significant changes in a beneficial direction post-training relative to pre-training. Additionally, no participant experienced recurrent aspiration pneumonitis.

Conclusion: Selection of suitable training for the target function site, and continuous implementation of that training, are important for achieving efficacy.

Keywords: Dysphagia; Gastrostomy; Therapeutics

Introduction

Life expectancy in Japan is the longest in the world according to data in World Health Statistics 2016 [World Health Organization (WHO)] [1]. However, the prolongation of healthy life expectancy is pointed out to be small relative to that of life expectancy, and this may be explained as an effect of population ageing and a range of diseases. Pneumonia emerged as the third most common cause of death in the Japanese population in 2011, which was closely linked to the increase of the disease in older people. Over 95% of the deaths due to pneumonia reportedly occur in elderly people, with aspiration pneumonitis accounting for more than 70% of pneumonia cases in this segment of the population [2].

A therapeutic approach to repeated aspiration pneumonitis involves initiating tube feeding with a gastrostomy. In 2015, proportions of

patients receiving tube feeding were investigated by the Japan Association of Medical and Care Facilities, which found that 47% of patients received nutrition *via* gastrostomy and 40% received nutrition nasogastrically [3].

On the other hand, increased tube feeding replicates diseases which create a requirement for care provision, and the proportion of being used for bedridden patients as alternative alimentation tends to be high [4].

One aspect of this phenomenon is that tube feeding heightens the risk of aspiration pneumonitis [5]. This issue must be recognized, and techniques to combat it are required. Oral care-based approaches are adopted for patients receiving alternative alimentation as a preventative method to minimize saliva-induced aspiration pneumonitis. Suitably performed oral care is shown to reduce the risk of aspiration pneumonitis [6] and may reduce pneumonia mortality rate [7]. Many bedridden patients receive alternative alimentation, and

the approaches taken in such cases include range-of-joint-motion training to prevent contracture, positioning to prevent bed sores and maintain functional position, and ambulatory or sedentary training aimed at improving respiration and circulation [8]. However, the above-stated approaches are intended to reduce the burden of care. Functional aspects of feeding and swallowing cannot be easily monitored once non-oral nutrition is initiated and there are virtually no approaches in existence.

In this study, we aimed to provide continuous training targeting the oral cavity and neck region to elderly bedridden recipients of non-oral nutrition, in addition to conventional physical interventions and investigate changes in swallowing function.

Methods

Participants

Participants in this study were hospitalized, bedridden patients needing caregiver's general nursing support and with a conscious level of 1 or 2 on the Japan Coma Scale, who had not undergone a

tracheotomy. We enrolled 13 participants who satisfied these three conditions (5 men, 8 women; mean age: 85.2 ± 6.4 years).

Nine of these patients had been diagnosed with a cerebrovascular disease and four with a degenerative disease.

Participants were receiving nutrition nasogastrically in five cases, *via* gastrostomy in seven cases, and by central venous hyperalimentation in one case. Participants had been receiving non-oral nutrition for a mean period of 24.8 ± 12.0 months. All participants had previously shown aspiration pneumonitis. This study was conducted after approval by the Ethics Committee of Nagasaki University.

Outcomes

Participants were subject to Assessments 1 to 5 listed below at the initiation of training and after the completion of training three months later. The methods and standards applied for Assessments 1 to 5 are indicated in Table 1. All assessments were conducted with the participant in a uniform position with the back elevated 60° from the bed.

Assessment	Method	Standards
1) Intraoral Saliva Volume	A Mucus® oral cavity moisture content measurement device (Life Co., Ltd.) was used. The Mucus® was placed inside a disposable cover, and held on the dorsum of the tongue at a point 10 mm from the tip for measurement. The covers were exchanged between measurements.	Results are expressed in 0.1% units. The mean value from three measurements was adopted as the intraoral saliva volume. A moisture volume of at least 30% is normal.
2) Swallowing Response Time	A Littman® 4100 model electronic stethoscope (Littman Co., Ltd.) was used to detect the sound of salivary swallowing produced at the pharynx, by cervical auscultation on the right side of the neck	The times from the first to the second and third swallowing responses were measured, and the time between the second and third swallowing responses was adopted as the swallowing response time.
3) Neck Muscle Hardness	A Neutone TDM-N1 muscle hardness tester (Try-All Corporation) was used. With the patient's back elevated 60° above the bed, the muscle hardness tester was held perpendicular to the left and right sides of the neck (upper trapezius muscle fibers) for measurement.	Results are expressed 0.1 Tone units. The mean value from three measurements was adopted as the neck muscle hardness value.
4) Lip Opening Width	Measurement was performed using a ruler with the lips in a naturally open state.	Results are expressed in 1 mm units. The value obtained from a single measurement was adopted as the lip opening width.
5) Aspiration pneumonitis Status	Medical records were examined to determine whether or not participants had been diagnosed with aspirational pneumonia during the training period.	Any diagnosis of aspiration pneumonitis was to be recorded.

Table 1: Assessment Methods and Criteria.

Interventions

Each participant underwent the interventions (training and positioning) stated below on an individual basis in addition to range-of-joint-motion training and physical strength training they had been receiving prior to the intervention.

The participants received training three times weekly. On each training day, participants underwent training with their back elevated

60° from the bed or sitting in wheelchair on the following three items: 1) neck stretching, 2) facilitation of swallowing response, and 3) oral cavity stimulation. In addition to Interventions 1 to 3, participants underwent positioning into an anti-gravity posture as Intervention 4 (with the participant's back elevated 60° from the bed). Details on the training and positioning methods for Interventions 1 to 4 are indicated in Table 2.

Content	Method
Neck Stretching	Six directional muscle groups (for backward-forward, left-to-right and rotational movements of the neck) were stretched. Stretching was performed five times in each direction for 15 to 20 s.

Facilitation of Swallowing Response	A finger was placed on each side of the thyroid cartilage, and the fingers were moved up and down from the thyroid cartilage to the underside of the lower jaw a number of times. The participation was instructed to swallow after the downward finger movement. The time to the third successive swallowing after the end of the facilitation was regarded as time for one training session.
Stimulation of the Oral Cavity	Scented tissues for oral care (Wakodo Inc.) were used to massage the lips and oral cavity for three minutes.
Positioning	Each participant was positioned into an anti-gravity posture for two hours twice a day (morning and afternoon) [with their back elevated 60° above the bed].

Table 2: Intervention Content and Method.

Analysis

Pre- and post-training intraoral saliva volume, swallowing response time, neck muscle hardness, and lip opening width were subject to comparative analysis with the Wilcoxon rank-sum test. Significance levels were set below 5%. A statistical software package, IBM SPSS Statistics 24, was used for these analyses. Effect size ($r=Z/\sqrt{N}$) was calculated for each assessment item showing a significant difference.

	Pre (unit)	Post	P value	Effect size
ISV	20.0 ± 7.7 (%)	26.4 ± 4.0	0.004**	0.84
SRT	212.5 ± 77.4 (s)	160.2 ± 58.9	0.003**	0.86
NMH	24.2 ± 4.7 (Tone)	20.3 ± 4.6	0.013*	0.72
LOW	0.9 ± 0.8 (mm)	1.3 ± 1.2	0.02*	0.67
*: P<0.05 **: P<0.01				
Effect size(r): .10 small< .30; .30 medium< .50; .50 large				

Table 3: Comparison of outcome with before and after intervention (Abbreviations: ISV: Intraoral Saliva Volume; SRT: Swallowing Response Time; NMH: Neck Muscle Hardness; LOW: Lip Opening Width).

Discussion

Study participants were 13 patients who had received non-oral nutrition for a mean period of 24.8 ± 12.0 months. The participants then underwent training on alternate days for a three-month period. Each post-training assessment showed a significant difference relative to pre-training, and all changes were in a beneficial direction. Another positive result was that no patient experienced recurrent aspiration pneumonitis.

Heightened muscle hardness is reportedly associated with a delay in swallowing response time and reduction in saliva volume because it reduces ability to move and movement coordination functionality in various organs [9]. Delayed swallowing response time reportedly increases the risk of aspiration pneumonitis [10]. Based on these reports, we implemented measures (training) for neck stretching to reduce muscle hardness in the neck region, with concomitant measures to facilitate swallowing response and stimulate the oral cavity. We consider these measures were associated with shortening of swallowing response time, increase in saliva volume, and expansion of lip opening width.

Other than the three training measures stated above, participants were positioned into an anti-gravity posture for four hours daily for three months. We consider that this positioning underpinned the training effect, which was reflected in the absence of recurrent aspiration pneumonitis through the training period, and the

Results

Post-training intraoral saliva volume, swallowing response time, neck muscle hardness, and lip opening width showed significant differences relative to pre-training values (Table 3). No patient was diagnosed with aspiration pneumonitis during the three-month training period. Training had an effect on each assessment item.

significant improvements in saliva volume, swallowing response time, and lip opening width. Maintaining an anti-gravity posture reportedly plays an important role in respiration and swallowing motions [11]. Concomitant lung physiotherapy reportedly improves prognosis in patients hospitalized with aspiration pneumonitis [12].

In the current study, we demonstrated that conventional training and care alone are unable to favorably influence feeding and swallowing function. We suggest that the selection of suitable training for the target function site, and continuous implementation of that training, are important for achieving efficacy [12].

Study Limitations

There were issues with the number of participants and standardization of methods in this study resulting from the difficulty in implementing training interventions described here in multiple centers, and these were limitations of the study. A training effect was still noted in the participants, who had been receiving non-oral nutrition for a prolonged period; accordingly, we consider that standardized interventions within one center with concomitant non-oral nutrition will increase the probabilities of preventing aspiration pneumonitis and resuming oral intake in future research.

Conclusion

We implemented four interventions (training and positioning) targeting the oral cavity and neck region, in addition to the limb function training for 13 patients who were receiving long-term non-oral nutrition. Each assessment revealed significant changes in a beneficial direction after the completion of training, with the absence of recurrent aspiration pneumonitis as another positive result. Selection of suitable training for the target function site, and continuous implementation of that training, are important for achieving efficacy.

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