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Relationship between swallowing function and breathing/phonation

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ABSTRACT

Objective: Clarification of the association between the swallowing function and respiratory and phonatory functions.

Methods: The subjects were 30 patients with a chief complaint of swallowing disorder with clear consciousness capable of retaining a sitting position. Patients with organic and functional diseases of the larynx were excluded. Twenty-two and eight patients were male and female, respectively, and the mean age was 77.0 ± 14.6 years old. The chest expansion score was measured as an index of the respiratory function, and the maximum phonation time (MPT) was measured as an index of the phonatory function. The presence or absence of aspiration was judged using videoendoscopic swallowing study (VESS) and videofluoroscopic swallow studies (VFSS). The patients were divided into those with and without aspiration, and the chest expansion score and MPT were compared. In addition, the distance of laryngeal elevation was measured in the lateral view of VFSS, and its correlations with the chest expansion score and MPT were closely analyzed. To evaluate reliability of the test, the distance of laryngeal elevation and videoendoscopic score were compared between the presence and absence of aspiration.

Results: The distance of laryngeal elevation was significantly shortened and the videoendoscopic score was significantly higher in the group with aspiration, as previously reported. On comparison of the chest expansion score between the groups with and without aspiration, no significant difference was noted at the axillary or xiphoid process level, and shortening was significant only at the 10th rib level in the group with aspiration. On comparison of MPT, it was significantly shortened in the group with aspiration. In addition, a significant positive correlation with the distance of laryngeal elevation was noted in both chest expansion score and MPT.

Conclusion: It was suggested that declines of the respiratory and phonatory functions are risk factors of aspiration through limiting laryngeal elevation, and the chest expansion score at the 10th rib level and MPT are useful for screening of aspiration.

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1. Introduction

Swallowing is described as 'a reflex movement controlled by the central pattern generator located in the medulla oblongata' in various literatures, but we encounter fewer cases of swallowing disorder associated with impairment of the medulla oblongata in actual clinical practice, and it occurs due to respiratory and circulatory disorders and impairment of posture retention in far more cases. Therefore, it should be recognized that swallowing disorder itself is not a disease, and it is a secondary pathology caused by poor general condition. For treatment, approaches from 2 aspects: local factors, such as the oral cavity, pharynx and larynx, and systemic factors, such as respiration, circulation, and posture, are important [1]. For the local factors, various rehabilitations aiming at improvement of mobility of the tongue, hyoid bone, and larynx have been reported [2–4], but the effect is insufficient in many cases although it was effective to some extent. As its background, the effect of rehabilitation on the local factors may be not readily exhibited because the preparation for the systemic factors is insufficient. It has been reported that mobility of the supra- and infrahyoid muscles related to elevation and decent of the hyoid bone and larynx important for swallowing is associated with the respiratory and phonatory functions and upright posture supporting the trunk and skull [5], and improvement of local mobility thorough a systemic approach is expected. Regarding systemic rehabilitation of swallowing disorder, the importance of respiratory rehabilitation, such as lung physiotherapy, and vocal exercise has been pointed out, but there were fewer descriptions on 'what grade' of disturbance of breathing and phonation influences the swallowing function, or 'what type' of breathing and vocal exercises is effective, and the target and index of training of rehabilitation staff (physical and speech–language–hearing therapists) have not been clarified. In this study, we measured the chest expansion score as an index of the respiratory function and maximum phonation time (MPT) as an index of the phonatory function and analyzed their associations with the fluoroscopic evaluation of the swallowing function to investigate the associations between the respiratory and phonatory functions and swallowing function.

2. Materials and methods

2.1. Subjects

The subjects were 30 patients who visited the Department of Otolaryngology of Nippon Medical School Musashikosugi Hospital for a chief complaint of swallowing disorder with clear consciousness capable of retaining a sitting position between January 1, 2016 and July 31, 2016. Twenty-two and eight patients were male and female, respectively, and the mean age was 77.0 ± 14.6 years old. Patients with organic disease, such as tumor, and functional disease, such as vocal cord paralysis, in the larynx were excluded.

2.2. Method

Study 1: Comparison of the distance of laryngeal elevation during swallowing and videoendoscopic score between the groups with and without aspiration.

Videoendoscopic swallowing study (VESS) and videofluoroscopic swallow studies (VFSS) were performed in all patients, and the endoscopic swallowing evaluation score [6] on VESS proposed by Hyodo et al. [6] and distance of laryngeal elevation on VFSS were compared between the groups with and without aspiration.

VESS was performed using a flexible video scope for nasopharyngeal use (ENF-VH type, Olympus) and video-recorded on a DVD recorder, employing the procedure of videoendoscopic evaluation of swallowing and video endoscopic score proposed by Hyodo et al. [6]. A laryngeal endoscope was inserted through the nasal cavity in a resting sitting position and fixed to the posteroinferior soft palate. The patient was instructed to retain 3 mL of colored water in the oral cavity and then swallow it. The evaluation items were 4 parameters of the video endoscopic score (the degree of saliva retention in the epiglottic vallecular and pyriform sinus while not swallowing, glottis closure and cough reflex inductivity, swallowing reflex inductivity during swallowing, and pharyngeal clearance in colored water swallowing), and all these were evaluated by 4-step grading scored as 0–3. The condition becomes poor as the score comes close to 3, and the

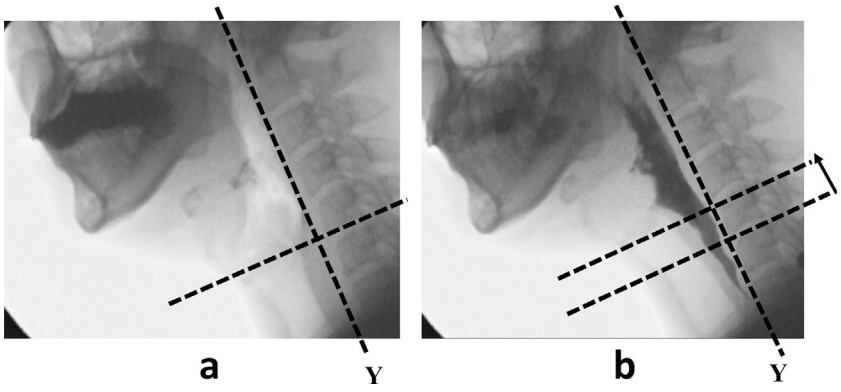

Fig. 1. Measurement of laryngeal elevation during swallowing.
A virtual straight line passing the second cervical vertebral surface was drawn on the anterior cervical spinal surface and set as a Y-axis in the lateral fluoroscopic view. The positions of the lower end of the cricoid cartilage at rest (a) and the maximum elevation (b) were plotted. The distance between these positions on the Y-axis was measured (→) and presented relative to the vertical thickness of the second cervical vertebra regarded as 100%.

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