CASE REPORT

Glottal Closure Surgery for Dysphagia Associated with Cerebral Hemorrhage, Tongue Defect, and Sarcopenia: A Case Report

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Background: Dysphagia occurs often after oral cancer surgery. However, no case of dysphagia in combination with cerebral hemorrhage, tongue defect, and sarcopenia has been reported. We describe the case of a 70-year-old man with dysphagia associated with a cerebral hemorrhage, tongue defect, and sarcopenia who received rehabilitation nutrition and underwent glottal closure. Case: At age 48 years, the patient had the left part of his tongue removed because of cancer. Twenty-two years later, he developed dysphagia and right hemiplegia after a cerebral hemorrhage. The patient was diagnosed with sarcopenia based on a low left handgrip strength (10 kg) and reduced calf circumference (26.5 cm). The patient’s Functional Oral Intake Scale (FOIS) score was 1, and his tongue muscle mass indicated atrophy, making the maximum tongue pressure difficult to measure. Palatal augmentation prostheses (PAP) were made to increase swallowing and tongue pressures, and nutritional intake was changed from nasal tube feeding to a gastric fistula. Nutritional intake was increased to 2400 kcal/day and protein intake to 96 g/day. Although rehabilitation nutrition using PAP improved the patient’s nutritional status, the dysphagia did not improve, and therefore he underwent glottal closure. This resulted in a weight gain of 13.7 kg and increased tongue muscle strength and volume. The patient’s FOIS score increased to 7 (i.e., total oral diet with no restrictions) at 5 months after discharge. Discussion: Glottic closure surgery may be useful for improving oral ingestion, nutritional status, and activities of daily living.

Key Words: glottal closure; malnutrition; sarcopenia; swallowing disorder; tongue cancer

INTRODUCTION

Sarcopenia is characterized by a decrease in muscle mass and strength, which can lead to sarcopenic dysphagia. Rehabilitation nutrition is required to treat sarcopenia and sarcopenic dysphagia.1) Sarcopenia is an independent risk factor for dysphagia among elderly hospitalized patients,2) and is also often observed after oral cancer surgery. We describe a patient with severe dysphagia associated with cerebral hemorrhage, left hemiglossal defect, and sarcopenia who was treated with rehabilitation nutrition and glottal closure. To the best of our knowledge, this is the first case of dysphagia with these complications.

CASE

A 70-year-old man was admitted to our hospital because of left temporal and parietal lobe hemorrhages following a
craniotomy removal (Fig. 1). On acute hospital admission, the patient’s height was 165 cm, body weight was 52.7 kg, and body mass index (BMI) was 19.4 kg/m². At admission, the serum albumin level was 4.4 g/dL, the C-reactive protein (CRP) level was 4.9 mg/dL, and the Barthel index (BI) score was 5 points. Moreover, the Mini Nutritional Assessment Short Form (MNA-SF) score was 0, indicating malnutrition. After 97 days, he was admitted to a rehabilitation hospital.

Diagnosis and Observations at Admission

The initial evaluation at admission showed the patient had oral dysfunction, dysphagia, dysarthria, and higher brain dysfunction (sensory aphasia). Oral diadochokinetic testing was impossible because the patient had undergone a tracheotomy. The score on the Raven’s Colored Progressive Matrices was 20 points (average age value, 26.9 ± 5.3). The patient’s ability to understand was good at the short-sentence level, but expression was difficult because of the tracheotomy. An attention disorder and right hemispatial neglect were also observed.

The patient also had right hemiplegia and severe motor paralysis and sensory disturbance, with a BI score of 10 points (Table 1). The grip strength was 10 kg for the left hand, the MNA-SF score was 0, and nutrients were administered using a nasogastric tube. Over a 3-month period, the patient’s body weight declined by 8.4 kg to 44.3 kg. Laboratory tests showed a serum albumin level of 3.0 g/dL and a CRP level of 4.9 mg/dL. The deterioration in his condition was therefore caused by the combined effects of cerebral hemorrhagic sequelae, aspiration pneumonia, inflammatory disease caused by invasive inflammation, dysphagia, environmental conditions, and malnutrition. The patient also suffered from hospital-associated, iatrogenic deconditioning (because of being bedridden for about 3 months), severe oral dysfunction, and dysphagia. At admission to the rehabilitation hospital, the calf circumference (CC) was 26.5 cm and the handgrip strength was 10 kg; the patient was diagnosed as

Table 1. Clinical parameters during hospitalization, at transfer, and before and after home discharge

<table>
<thead>
<tr>
<th></th>
<th>At hospital admission</th>
<th>At transfer</th>
<th>Before home discharge</th>
<th>After home discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m²)</td>
<td>16.3</td>
<td>17.3</td>
<td>18</td>
<td>21.3</td>
</tr>
<tr>
<td>BI (points)</td>
<td>10</td>
<td>45</td>
<td>45</td>
<td>65</td>
</tr>
<tr>
<td>FOIS (points)</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Maximum tongue pressure (kPa)</td>
<td>Difficult to measure</td>
<td>1.9</td>
<td>2.3</td>
<td>5.4</td>
</tr>
<tr>
<td>MASA (points)</td>
<td>84/200</td>
<td>118/200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suction of sputum (times/day)</td>
<td>30 or more</td>
<td>3–5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MNA-SF (points)</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>
having sarcopenia based on a CC <30 cm, which represents the cutoff value for decreased skeletal muscle mass in older hospitalized male patients.5)

**Oral Condition and Oral Function**

The intraoral findings indicated that the patient had not previously worn a PAP.6) He had experienced numerous episodes of aspiration pneumonia that required frequent suctioning (about 30 times/day) because of the large amount of saliva and sputum. Evaluation of oral function showed right facial nerve palsy; restricted range of movement of the oral organs (tongue, lips, and cheek); decreased muscle strength, speed, and dexterity; and an inability to close the left lip (Fig. 2A–D).

Examination of tongue function showed that the range of motion was restricted and the muscular strength was decreased. This severe oral dysfunction was caused by the combined effects of an organic defect of the tongue and the sequelae of cerebral hemorrhage. Maximum tongue pressure was not measurable.

**Swallowing Function**

We did not carry out an examination of swallowing function because there was a high aspiration risk in doing a videofluoroscopic (VF) examination. Moreover, training with a bolus or observation using a bolus would not be possible if we performed the VF. Defective bolus formation, bad bite retention in the oral cavity, and poor feeding were observed during both the preparation and oral periods. The patient had retardation of the swallowing reflex. Furthermore, organic and functional swallowing assessments were difficult because a tracheal cannula was present. The Functional Oral Intake Scale (FOIS) score was 1 (nil by mouth) and the Mann Assessment of Swallowing Ability (MASA) score was 84/200, indicating severe dysphagia.

**Management and Outcome Interventions**

Figure 3 shows the clinical course of the patient and the interventions carried out.

**Nutrition Support**

On discharge from the acute hospital, the patient was being administered 1008 kcal/day: 900 kcal by nasal feeding tube and 108 kcal by peripheral parenteral nutrition. There was no nutrition support team intervention in our hospital. On admission, nutrition care management was discussed with a dentist, a registered dietitian, and the rehabilitation staff. Monthly rehabilitation conferences were held with the physician, rehabilitation staff, dental hygienist, nurse, registered dietitian, and a social worker. We examined the nutritional dose while taking into consideration the patient’s progress at each rehabilitation session, the patient’s condition, and the workload of the rehabilitation workers.

Enteral nutrition via a nasogastric tube was started on the day of admission. The patient’s total daily energy expenditure was 1234 kcal, with a calculated basal energy expenditure of 1028 kcal using the Harris-Benedict equation; the activity factor was 1.2 and the stress factor was 1.0. The patient was not suffering from renal failure, so to target weight gain and minimize malnutrition, total nutritional intake of 1720 kcal/day (1300 kcal of nasogastric tube nutrition and 420 kcal of peripheral parenteral nutrition), with a protein intake of 45.0 g/day (1.0 g/kg body weight/day) was provided. During the first month of hospitalization, the patient had continual fever because of pneumonia. Therefore, in the second month, we changed from providing nutrients via a nasal tube to gastrostomy management. To improve nutritional status, the patient’s intake was increased further to 2400 kcal/day with a protein total of 96.0 g/day (2.2 g/kg body weight/day). Because of his malnutrition status and low body weight, we aimed to increase the patient’s weight by more than 2 kg in 1 month, to achieve an increase of 6 kg in 3 months, based on 600 kcal/day of total energy expenditure.

**Rehabilitation for Oral and Swallowing Dysfunction**

Rehabilitation involved starting oral care, exercise to improve the range of motion of each oral organ, and oral rehabilitation. On admission, left and right deviation was the most impaired aspect of the tongue range of motion. Additionally, as the tongue tip did not touch the patient’s lower lip during tongue protrusion, we carried out automatic and passive training for tongue movement.

In the second month, we constructed a PAP of the maxilla to repair the organic defect of the tongue. This involved creating a PAP of the upper jaw modeled for the organic defect of the tongue with the aim of increasing tongue swallowing pressure.

During the third month, disuse of each oral organ after the left cerebral hemorrhage was addressed by oral rehabilitation using the PAP, tongue resistance training, and pattern coordination training of chewing and swallowing. In the fourth month, techniques included the Mendelsohn maneuver, tongue-hold swallow training, tongue skill training, and dysarthria training. Because of repeated aspiration pneumonia and easy fatigability, the time the patient spent in bed
Fig. 2. (A–D) Initial functional tongue movement. (A) Tongue rightward movement, (B) tongue leftward movement, (C) tongue lifting movement, and (D) tongue protruding movement. (E–H) Functional tongue movement after 6 months of hospitalization. (E) Tongue rightward movement, (F) tongue leftward movement, (G) tongue lifting movement, and (H) tongue protruding movement. (I, J) Functional tongue movement 5 months after discharge. (I) Tongue in resting position, and (J) tongue leftward movement.

Fig. 3. Clinical course and interventions. Oral rehabilitation, dental, rehabilitation, and medical comments are shown. OT, occupational therapist; PT, physical therapist.
increased and his general condition worsened. The patient had lost weight, and the CRP level was 3.0 mg/dL or more; therefore, it was considered that his activity decreased as a result of inflammation due to recurrent aspiration pneumonia. In the fifth month, the tracheal cannula was extubated and 10 days later a VF swallowing test was carried out. The VF findings showed inversion of the epiglottis, residue in the epiglottic valley, and insufficient clearance. After the VF examination, the patient developed a recurrent episode of aspiration pneumonia. Based on a comprehensive examination of his ADLs, MASA, and the results of VF examination, we concluded that he had difficulty ingesting food (Fig. 4).

In the sixth month, the tongue range of motion had improved compared to that at the time of hospitalization. Compensatory organic changes were also associated with the left side organic deficits (Fig. 2E–H). In the seventh month, the patient was transferred to a different hospital, and we requested their otolaryngology department to perform glottal closure (Fig. 5A, B). This procedure closes the left and right vocal cords and separates the airway and the esophagus. At transfer, his BMI was 17.3 kg/m², with a BI score of 45 points, his FOIS score 1, a tongue pressure of 1.9 kPa (with PAP), and a serum albumin level of 3.3 g/dL. His MNA-SF score was 0. Because the patient had developed recurrent aspiration pneumonia, oral intake was difficult and nutrition management with 2400 kcal/day was provided by a gastrostomy feeding tube.

On the 51st day after surgery, the patient was readmitted to our hospital. On discharge after readmission, his body weight was 49 kg, his BMI 18.0 kg/m², his BI score 45 points, his FOIS score 6, his tongue pressure 2.3 kPa, and his serum albumin level 3.4 g/dL. The patient returned home because his respiratory function had improved, he no longer needed sputum suctioning, and he could ingest three meals a day orally by himself. His MNA-SF score was 4 and an improvement in nutritional status and ADLs was observed.

**Outcome**

Five months after discharge, the patient was ingesting three regular meals each day. His body weight was 58 kg and his BMI 21.3 kg/m². His MNA-SF score was 10, and his FOIS score was 7 (total oral diet with no restrictions). There were no episodes of aspiration pneumonia, and his BI score was 65 points. The maximum tongue pressure was 5.4 kPa. After glottal closure, we could not evaluate MASA items 22 (Trachea), 23 (Pharyngeal Phase), and 24 (Pharyngeal Response), so the total score for items 1 to 21 was 112 /170 points.

At the time of discharge to home, his assessment included the following: CC: 27.5 cm; grip strength: right not possible due to paralysis, but the left was 19.5 kg. The patient was
able to ingest three meals a day orally while sitting in a 90° position in a wheelchair without using suction. During the meal, by changing hands and using modified chopsticks and/or a spoon, the size of each mouthful was in the range 15–20 g. Consequently, nutrition improved and the volume of the left tongue further increased (Fig. 2I, J). He was able to eat the same meal as his family, and he could extend his activities, including going out with his family.

**DISCUSSION**

This article reveals two important clinical issues. First, despite rehabilitation nutrition and PAP preparation, oral intake may be difficult in dysphagia patients with complications such as a cerebral hemorrhage, left hemiglossal defect, and sarcopenia. Second, glottal closure surgery may be useful for achieving oral ingestion of three meals daily and can improve nutritional status and ADLs. A PAP is used as a dental approach for rehabilitation of stroke, neuromuscular disorders, swallowing disorders, and patients with dysarthria after head and neck cancer operations.9 However, our patient was not able to ingest orally because of cerebral hemorrhage and also as a consequence of marked deterioration in swallowing function caused by a tongue defect and sarcopenia.

Glottal closure surgery may be useful for enabling patients to ingest three meals orally each day, thereby improving nutritional status and ADLs. Although this procedure causes a loss of vocalization function, it prevented aspiration, enabled oral ingestion, and improved ADLs. This surgery should be considered for patients with severe swallowing disorders. Patients with dysphagia complicated by organic and functional disorders are more likely to have recurrent aspiration pneumonia, resulting in lower nutritional status and impaired ADLs. If rehabilitation and nutrition management are carried out for 5–6 months and improvement is inadequate, it might be necessary to consider surgery as a therapeutic option.

The standard criteria for glottal closure surgery10,12 are as follows:

1. Improvement is not expected with various function training.
2. Sputum sucking disturbed discharge to home.
3. Oral intake could be expected after surgery.
4. Patient agree that he/she lose voice cord function.

In this case, although the patient underwent various long-term rehabilitation treatments, his swallowing function and nutritional condition did not improve. Because of persistent saliva aspiration, recurrent aspiration pneumonia, and difficulty in airway management, he was at risk of death. Further,
the patient’s willingness for oral intake was strong and he finally agreed to undergo glottal closure surgery, even at the risk of losing his vocal cord function.

Glottal closure surgery has also been shown to result in increased body weight and improved swallowing function. Within 5 months after discharge, our patient was consuming sufficient nutrition orally and had improved swallowing function. His chewing was strengthened, and it became possible for him to form a bolus.

Additionally, compensatory feeding ability using the tongue and nasopharyngeal contraction force were acquired, and swallowing function improved. The bolus clearance MASA score was 2 points before surgery, but this improved to 8 points by the time of discharge. The volume of the patient’s tongue increased and he achieved further improvements in ADLs after discharge. Glottal closure surgery may enable oral ingestion of three meals a day and improve nutritional status and ADLs. Continuation of nutrition rehabilitation after surgery is therefore important for further improvement in ADLs.

Oral intake may be difficult in dysphagia patients with complications such as cerebral hemorrhage, a left hemiglos sal defect, and sarcopenia, despite nutrition rehabilitation and the use of a PAP. In the present case, glottal closure surgery was useful for enabling oral ingestion of three meals a day and improving nutritional status and ADLs.

The patient provided informed consent for the publication of his case. The investigations and case study were performed in accordance with the ethical standards established in the 1964 Declaration of Helsinki and later amendments and the ethical guidelines for medical and health research involving human subjects in Japan.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest associated with this manuscript.

REFERENCES


