New, safe and simple endoscopic cricopharyngeal myotomy with a curved rigid laryngoscope: A case report

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Abstract. Endoscopic cricopharyngeal myotomy (ECPM) is a safe and minimally invasive technique that is used to treat patients whose esophageal inlet fails to open because of specific diseases, such as Wallenberg's syndrome and neuromuscular diseases. The present study described the performance of a new, safe and simple ECPM using a curved rigid laryngoscope, which is used for endoscopic laryngopharyngeal surgery for patients with dysphagia due to pharyngeal residue after swallowing. The patient was an 80-year-old woman with laryngeal palsy caused by lower cranial nerve palsy after cranial base schwannoma surgery. ECPM was performed with a curved rigid laryngoscope. The postoperative course was good; postoperative rehabilitation eliminated the residue after swallowing a thickened solution and mealtimes were shorter than before surgery. This procedure allows the hypopharynx to be widely expanded and it is possible to develop a wider surgical field than when using a direct laryngoscope. In addition, this procedure appears to be relatively easy to perform if the surgeon is familiar with the curved rigid laryngoscope technique.

Introduction

In general, surgery to improve swallowing includes laryngeal elevation, cricopharyngeal myotomy, pharyngeal flap surgery, and arytenoid adduction. A combination of these procedures is performed depending on the pathophysiology of each case. With respect to operative indications, the patient's condition and prognosis are the most important eligibility factors, because postoperative rehabilitation is also necessary to improve swallowing function. Cricopharyngeal myotomy is often combined with other swallowing improvement procedures, especially with laryngeal elevation. It is often performed simultaneously through an external cervical incision in the same surgical fields. However, only cricopharyngeal myotomy may be indicated in specific diseases such as Wallenberg's syndrome and neuromuscular diseases in which there is failure to open the esophageal inlet. Endoscopic cricopharyngeal myotomy (ECPM), reported by Halvorson and Kuhn (1) and Pitman and Weissbrod (2), may be considered for such cases.

ECPM is a safe and minimally invasive technique, but it has not become widely used. In 2011, Chitose *et al* improved on this technique and reported a method in which the incised mucosa is sutured at the end to close the posterior pharyngeal space (3). We have performed this procedure in a few cases in our institution. In one of these cases, it was difficult to insert the Weerda distending operating laryngoscope (Karl Storz, Tuttlingen, Germany) in the proper position, and repeated manipulation resulted in the application of excessive force to the pharyngeal mucosa, causing mucosal damage. Furthermore, when resecting the cricopharyngeal muscle, the pharyngeal venous plexus bled, and the amount of bleeding was even greater, making it impossible to stop the bleeding with a laser and forceps in that operative field. Ultimately, hemostasis was achieved through an external cervical incision.

Recently, endoscopic laryngopharyngeal surgery (ELPS) using a curved rigid laryngoscope (Sato's Curved rigid laryngoscope, Nagashima Medical Instruments Company, Tokyo, Japan) has been used for the treatment of superficial cancer of the hypopharynx (4). The curved rigid laryngoscope expands the hypopharynx more widely than the diverticuloscope and does not compress the pharyngeal mucosa. Therefore, damage to the oral and pharyngeal mucosa is unlikely to occur. Moreover, along with greater flexibility, there is less restriction of the movement of surgical instruments and less interference between instruments (Fig. 1). Surgical instruments such as electrocautery and suction coagulators can be inserted and can stop bleeding more reliably than a CO_2 laser, even in cases of massive bleeding. We have performed ECPM using a curved

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Abbreviations: ECPM, endoscopic cricopharyngeal myotomy; ELPS, endoscopic laryngopharyngeal surgery; PGA, polyglycolic acid; VF, videofluorography; PPN, peripheral parenteral nutrition

Key words: dysphagia, cricopharyngeal myotomy, ECPM, dysfunction of the esophageal inlet, upper esophageal sphincter myotomy

rigid laryngoscope for patients with laryngeal palsy after skull base surgery. A new method of ECPM is presented, and its advantages and applications are discussed.

Case report

Methods. The instruments used were a curved rigid laryngoscope (Sato's Curved rigid laryngoscope, Nagashima Medical Instruments Company), apical curved video scope (ENDOEYE FLEX, Olympus, Tokyo, Japan), electrocautery scalpel, bipolar forceps, grasping forceps, suction coagulator (Karl Storz, Tuttlingen, Germany), apical flexible electrocautery scalpel (KD600 apical flexible electrocautery scalpel, Olympus), and electrocautery body (High-Frequency Surgery Equipment VIO 3, ERBE, Tübingen, Germany). The electrocautery body setting was in cut mode Dry 60W/effect 4 and soft coag mode 30W/effect 3. Fig. 2 shows the curved rigid laryngoscope and surgical instruments, and Fig. 3 shows the surgical situation regarding the curved rigid laryngoscope.

The surgical technique was as follows. First, the pharynx was expanded with a curved rigid laryngoscope, and then the clear field of view for identifying the cricopharyngeal muscle was developed by the apical curved videoscope. The cricopharyngeal muscle could be recognized as a submucosal ridge on the posterior wall of the esophageal inlet. (Fig. 4A). Subsequently, a mucosal incision was made with an electrocautery scalpel (Fig. 4B), and the submucosa and dorsal surface of the cricopharyngeal muscle were dissected by bipolar forceps. The cricopharyngeal muscle was identified and freed from the surrounding area (Fig. 4C). The next step was cutting the cricopharyngeal muscle. Bipolar cautery should be used as much as possible before cutting muscle. Because the cricopharyngeal muscle has a venous plexus, its blood flow varies from person to person. The cricopharyngeal muscle is a transverse muscle, so resection should proceed until the transverse muscle is no longer present (Fig. 4D). Buccopharyngeal fascia, the sparse connective tissue beyond the cut muscle, should be preserved as much as possible (Fig. 4E). After the resection, hemostasis was confirmed, and a polyglycolic acid (PGA) sheet was cut into small pieces and applied with fibrin glue (Fig. 4F).

Case presentation. The patient, an 80-year-old woman, presented with laryngeal paralysis due to inferior cranial nerve palsy after skull base nerve sheath tumor surgery and consequent dysphagia and visited Nagoya University Hospital in December 2017. The patient showed significant residue on preoperative videofluorography (VF) after swallowing some thickened water (Fig. 5A). No compensatory swallowing technique of any kind was effective. The possible causes of this swallowing disorder were as follows: Decreased pharyngeal pressure; failure of opening of the esophageal inlet; and failure of cricopharyngeal muscle relaxation. Considering her age and physical condition, a less invasive and time-saving procedure was needed. Therefore, ECPM with the ELPS technique was selected based on our previous experience.

The patient was kept off food and drink for one week postoperatively. During this period, the patient was managed on tube feeding and peripheral parenteral nutrition (PPN). Swallowing training was initiated when no leakage and no mediastinal complications were seen on the first VF study after surgery. The patient underwent rehabilitation, including Shaker exercise, chin push-pull maneuver, and head rotation position swallowing, for one month. Improvement of swallowing function was observed after one month of rehabilitation. The residue almost disappeared on thickened liquid swallowing (Fig. 5B), and the time for meals was shorter than before surgery.

Discussion

ECPM was performed using a curved rigid laryngoscope in a patient with impaired opening of the upper esophageal sphincter (UES) without any postoperative complications, and residue reduction after swallowing was confirmed. This procedure was developed based on the report of ECPM by Chitose *et al* (3). In our institution, we have experienced difficulties in surgical field development and postoperative complications with Chitose's method. We had considerable experience with ELPS using a curved rigid laryngoscope for superficial pharyngeal cancer. The curved laryngoscope is placed slightly cephalad of the vocal cords, and the hypopharynx is expanded by raising the curved laryngoscope forward. This allows the hypopharynx to be widely expanded, and the entire area can be observed, even the esophageal inlet. The cricopharyngeal muscle can be seen as a circular ridge at the esophageal inlet. Therefore, we decided to use the curved rigid laryngoscope for ECPM. Using the curved rigid laryngoscope, it was possible to develop a wider surgical field than when using the Weerda distending operating laryngoscope.

The major difference between the present technique and Chitose's method (3) is the suture of the pharyngeal mucosa after cricopharyngeal myotomy. The posterior pharyngeal space is exposed after cricopharyngeal myotomy. The posterior pharyngeal space is connected to the dangerous space that connects the deep cervical spaces to the mediastinum, and infection or abscess can be fatal. Pitman and Weissbrod also recommended preservation of the buccopharyngeal fascia, which is the shallow layer of the posterior pharyngeal space, to prevent connection to this dangerous space (2). In this technique, the operative field is wider than that with the microscope used in conventional ECPM, and the use of a videoscope with a movable tip makes it possible to observe the tissue from multiple directions. Connective tissue attached to the cricopharyngeal muscle can be recognized more clearly, and connective tissue from the back surface of the cricopharyngeal muscle to the buccopharyngeal fascia can be recognized and preserved more reliably than with conventional techniques. Therefore, only the cricopharyngeal muscle can be reliably resected, and the pharyngeal venous plexus can be recognized in advance, allowing resection while preparing for hemostasis. In the unlikely event of bleeding, surgical instruments such as electrocautery and suction coagulators can be inserted to stop the bleeding more reliably than a CO_2 laser. Furthermore, Chitose *et al* (3) reported that the mucosal suture was sutured perpendicular to the direction of the cut so that the esophageal inlet was wider. In the present case, we tried to minimize the opening of the posterior pharyngeal space with our procedure and to fix the PGA sheet with fibrin glue after cricopharyngeal myotomy. Since the surgical field for this procedure is originally dirty, we believe that it makes more sense to leave it open rather than closed, so as not to trap saliva and bacterial flora. However, in terms of further widening

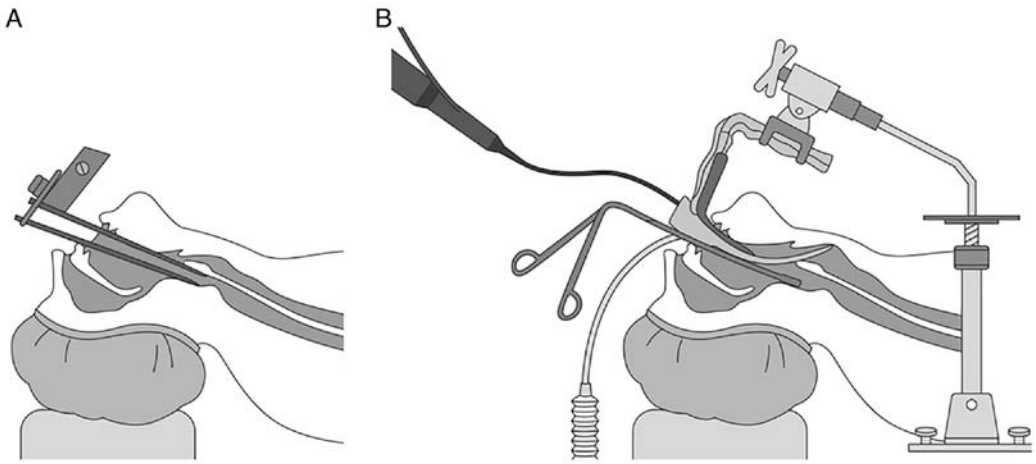

Figure 1. The difference in the surgical field between the (A) direct laryngoscope and the (B) curved rigid laryngoscope.

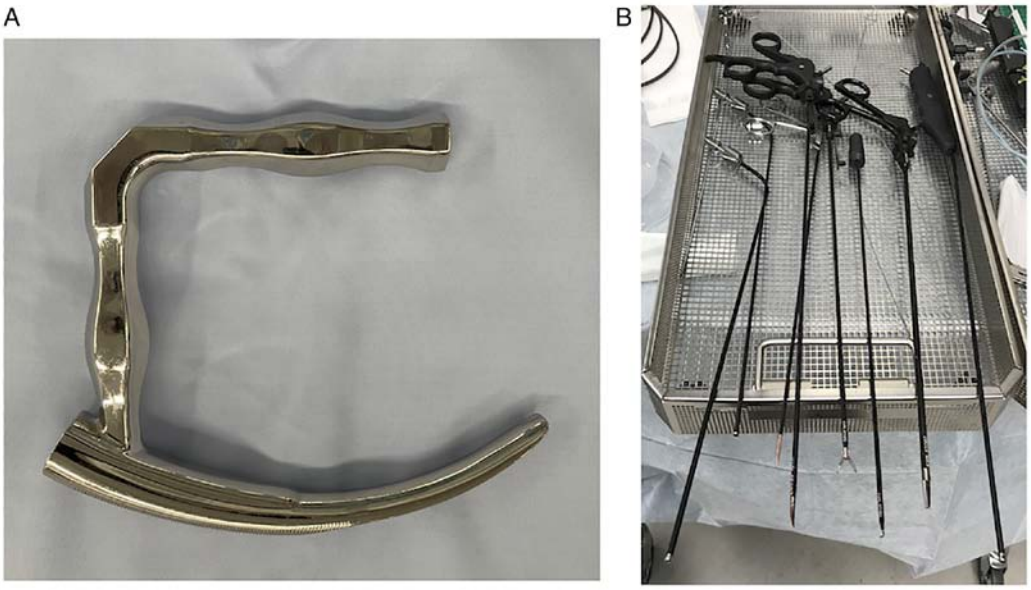

Figure 2. Surgical instruments. (A) Curved rigid laryngoscope. (B) Surgical instruments, from left to right: suction (long, short), grasping forceps (2 curved, 1 straight), curved-tip monopolar, bipolar scissors, suction coagulator.

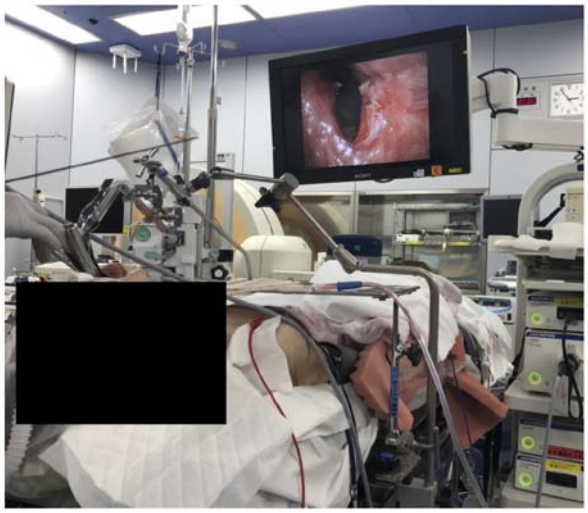

Figure 3. Surgical set-up. Laryngeal expansion with a curved rigid laryngoscope.

the entrance after resection and controlling wound scarring, we believe that suturing to enlarge the resection area is a worthwhile technique. Though this is possible in our technique, it was difficult in the present case because of the scar contracture of the mucosa. If the suture closure can be done with a generous space rather than a tight suture closure, it will likely prevent bacteria from being trapped and prevent scarring of the wound and enlargement of the esophageal inlet. This technique has a wide field of view and easy access to instruments, making it possible to perform such a detailed procedure. This is a future issue for our surgical method.

Furthermore, a better understanding of the anatomy of the pharyngeal lumen is needed. Especially at the beginning of cricopharyngeal myotomy, a high rate of bleeding was observed. Although the bleeding was of venous origin, we had a case in which hemostasis was difficult to achieve. The cricopharyngeal muscle contains the pharyngeal venous plexus. The pharyngeal venous plexus varies from person to person and may be

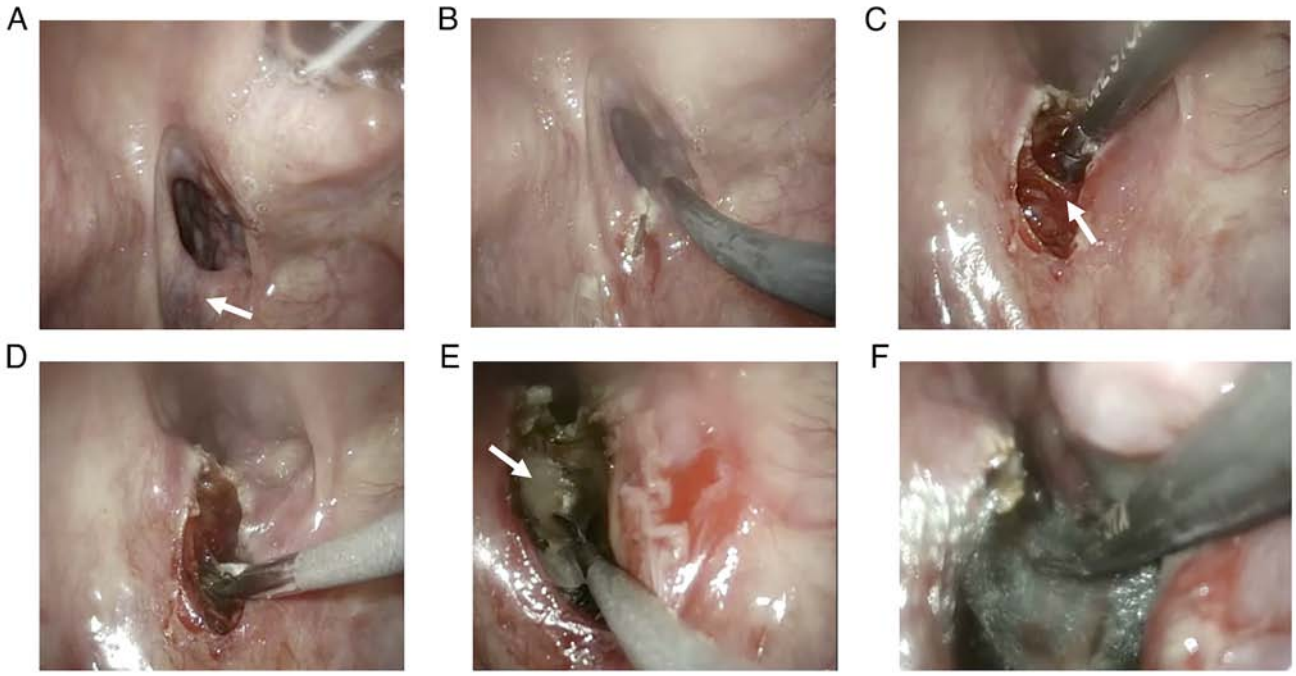

Figure 4. Intraoperative photographs. (A) The field of view for identifying the cricopharyngeal muscle. The arrow in the figure indicates the cricopharyngeal muscle as a submucosal ridge on the posterior wall of the esophageal inlet. (B) Mucosal incision. (C) Detachment of the cricopharyngeal muscle from the surrounding tissue. The arrow in the figure indicates the cricopharyngeal muscle. (D) Cutting of the cricopharyngeal muscle. (E) Buccopharyngeal fascia visible after cutting the cricopharyngeal muscle. The arrow in the figure indicates the buccopharyngeal fascia. (F) Wound protection with a polyglycolic acid sheet after resection.

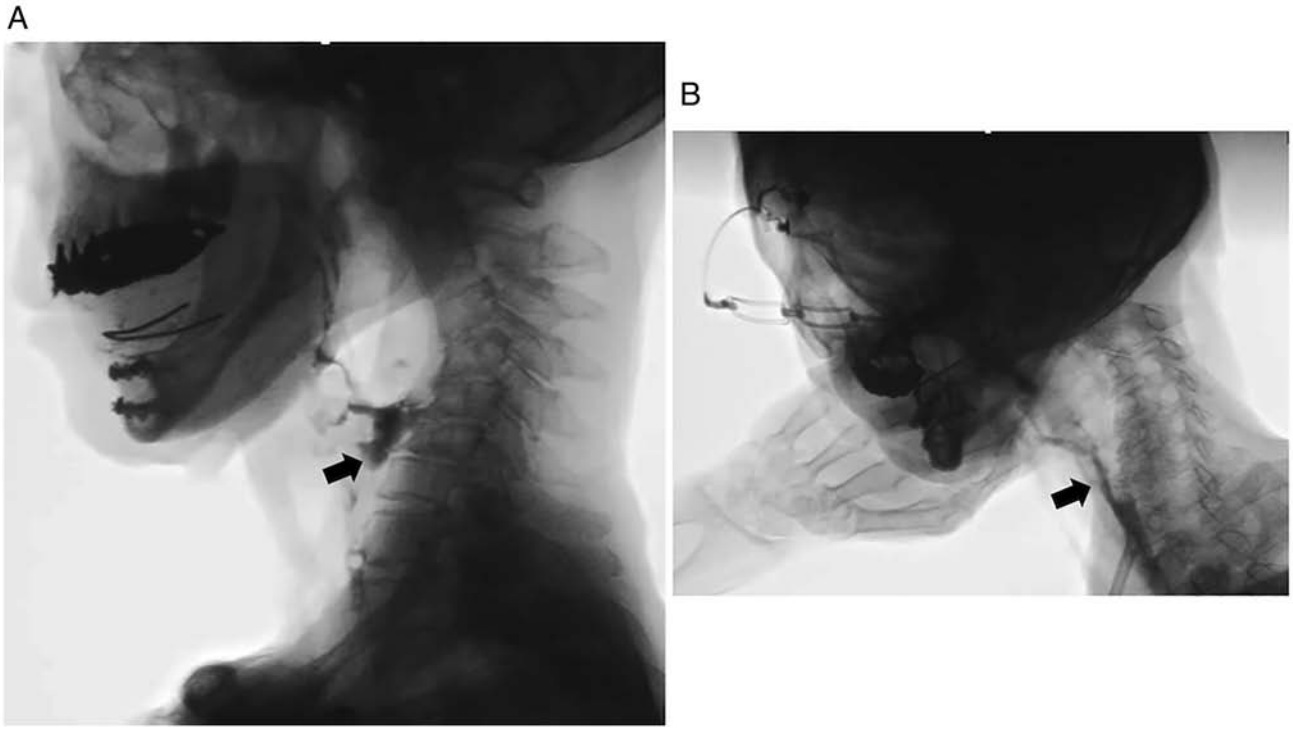

Figure 5. Videofluorographic findings. (A) Preoperative findings. Residue after swallowing. (B) Postoperative findings. Smooth passage with no accumulation using head rotation position swallowing.

mistaken for a tumor on imaging, and some reports recommend making a diagnosis with the venous plexus in mind (5). Massive bleeding may occur if resection is rushed without awareness of the pharyngeal venous plexus. If hemostasis is difficult to achieve, carbonization of the tissue due to cauterization may lead to delayed wound healing, infection, and surrounding scarring. Previous reports have also emphasized the importance of minimally invasive and minimally necessary treatment (2,3).

We believe that this is a relatively easy procedure to perform if the surgeon is familiar with the curved rigid laryngoscope technique. The operative field can be expanded widely, making it easy to manipulate forceps and electrical devices. In addition, the movable videoscope enables multifaceted observation of the pharynx, making it easy to recognize the pharyngeal venous plexus and buccopharyngeal fascia. We also believe that this technique is not only easier to operate, but also safer than conventional techniques. However, there is still room for improvement in the procedure, surgical instruments, and other aspects, and further accumulation of cases and analysis of long-term functional outcomes and postoperative complications are needed. Once established as a technique, cricopharyngeal myotomy will expand the range of indications and benefit many patients.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

TM conceived and designed the study and prepared the manuscript. TM, YF, SY, MaS, NN, MH and MiS conducted data acquisition, data analysis and interpretation. TM, YF, NN and MiS conducted revision of the manuscript for important intellectual property. TM and YF confirmed the authenticity of all the raw data. TM, YF, SY, MaS, NN, MH and MiS read and approved the final manuscript.

Ethics approval and consent to participate

Ethics approval is not applicable. Written informed consent was obtained from the patient for participation in the study.

Patient consent to participate and publication

Written informed consent was obtained from the patient for publication of this study.

Competing interests

The authors declare that they have no competing interests.

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