CASE REPORT

Acquired laryngomalacia as a cause of post-extubation respiratory failure in patient with postoperative seizure and central pontine myelinolysis after craniotomy

Yusuke Akimoto[1], Natsuki Bando[2], Hiroki Sato[2], Koji Sato[2], Kazuki Momota[2], Toshiyuki Nunomura[3], Yoshitoyo Ueno[2], Manabu Ishihara[2], Natsuki Tane[1], Taiga Itagaki[3], and Jun Oto[1, 2]

[1]Emergency and Critical Care Medicine, Tokushima University Graduate School of Biomedical Sciences, Tokushima, Japan, [2]Emergency and Critical Care Medicine, Tokushima University Hospital, Tokushima, Japan, [3]Emergency and Disaster Medicine, Tokushima University Hospital, Tokushima, Japan.

Abstract : Background : Laryngomalacia is a congenital abnormality of the larynx that commonly occurs in children and rarely in adults. We report the first case of acquired laryngomalacia mainly due to postoperative seizure and central pontine myelinolysis after scheduled craniotomy. Case presentation : A 69-year-old man was admitted to the hospital for elective craniotomy for craniopharyngioma. After the surgery, he developed refractory seizure and required intubation and mechanical ventilation in the intensive-care unit (ICU). After treatment for the seizure, he was extubated. However, immediately after extubation, he developed stridor and respiratory retraction. We performed fiberoptic laryngoscopy and confirmed that the epiglottis had collapsed into the posterior wall of the pharynx during inspiration, which was suspected to be laryngomalacia. He received invasive mechanical ventilation for two days following re-extubation. After the second extubation, he developed stridor again due to acquired laryngomalacia. Six days later, his respiratory condition had worsened, and he received re-intubation and tracheostomy. After ICU discharge, central pontine myelinolysis was diagnosed by magnetic resonance imaging. Conclusions : Adult-onset laryngomalacia is a rare cause of upper airway obstruction but should be considered as a cause of postoperative extubation failure. We should not delay performing fiberoptic laryngoscopy to evaluate this pathology and provide optimal treatment. J. Med. Invest. 69 : 316-319, August, 2022

Keywords **:** *acquired laryngomalacia, extubation failure, postoperative seizure, central pontine myelinolysis*

INTRODUCTION

Laryngomalacia is defined as the collapse of supraglottic structures during inspiration, leading to upper airway obstruction. It is the most common cause of stridor in children, especially infants, and usually shows complete resolution by 12 to 18 months (1).

Adult-onset laryngomalacia, also known as acquired laryngomalacia, is very rare, with only a few cases reported (2-10). The main causes of adult-onset laryngomalacia are secondary acquired pathophysiological conditions due to head injuries (2), stroke (3), or neck/mouth surgery (4-6), which may require partial laryngectomy or even tracheostomy (11). Although there have been a few case reports of acquired laryngomalacia immediately after extubation or decannulation caused by head injuries or mouth/neck surgeries (2, 5), to our knowledge, none have been reported in scheduled postoperative neurosurgical patients.

We herein report a case of acquired laryngomalacia as a cause of extubation failure after scheduled craniotomy for craniopharyngioma with refractory seizure and central pontine myelinolysis.

Received for publication July 12, 2022 ; accepted August 3, 2022.

Address correspondence and reprint requests to Jun Oto, Emergency and Critical Care Medicine, Tokushima University Graduate School of Biomedical Sciences, Kuramoto 3-18-15, Tokushima City, Tokushima, 770-8503, Japan and Fax : +81-8-633-9339. E-mail : joto@tokushima-u.ac.jp

CASE PRESENTATION

A 69-year-old man was admitted to our hospital for scheduled craniotomy for craniopharyngioma. There were no abnormal findings during surgery. The surgery was completed without any adverse events and total operation time was 6 hours 42 minutes. After the surgery, he was extubated successfully but developed postoperative diabetes insipidus and was treated with hydrocortisone and vasopressin infusion in the ward. On the 2nd postoperative day, hyponatremia (serum sodium ; 124 mEq/L) mainly due to syndrome of inappropriate secretion of antidiuretic hormone (SIADH) was detected, and vasopressin infusion was stopped. However, on the 3rd postoperative day, polyuria and hypernatremia (serum sodium ; 154 mEq/L) was revealed, and vasopressin infusion was re-started.

On the 3rd postoperative day, he developed convulsions of the left upper and lower extremities and loss of consciousness on the ward and was transferred to the intensive-care unit (ICU) for treatment of refractory seizure. He was intubated with an 8.0-mm-internal-diameter endotracheal tube, and electroencephalography showed epileptic waves. He was treated with fosphenytoin 22.5 mg/kg/day following 6 mg/kg/day for 2 days, midazolam 0.28 mg/kg/h for 20 h, lacosamide 200 mg/day, and perampanel 4 mg/day. On the 3rd ICU day, we retested electroencephalography and confirmed that the epileptic waves had disappeared. On the 6th ICU day, he passed the spontaneous awakening trial (SAT) with a Richmond Agitation Sedation Scale (RASS) of -1 and Glasgow Coma Scale of E3VTM6 and the spontaneous breathing trial (SBT) with pressure support of 5 cmH_2O, positive end-expiratory pressure (PEEP) 5 cmH_2O, F_IO_2 0.21% for 2 h, as well as a negative cuff leak test. He was

then extubated.

However, immediately after extubation, he developed stridor with a retractive breathing pattern, indicating upper airway obstruction, and then the respiratory rate increased to 36 breaths/min, and SpO_2 decreased to 70%. We attempted sputum suctioning, but only a small amount of serous sputum could be drawn. The stridor was slightly alleviated by raising the mandible. We performed fiberoptic laryngoscopy in the supine position with O_2 10 L/min via a nasal cannula and observed that the epiglottis had collapsed into the posterior wall of the pharynx during inspiration without laryngeal edema (Fig. 1). His respiratory status did not improve, so he was reintubated.

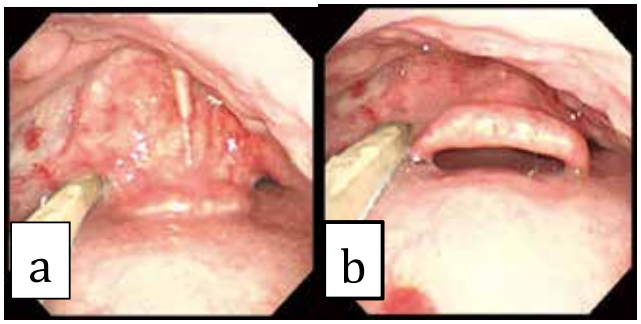

Figure 1. Fiberoptic laryngoscopy immediately after the first attempt at tracheal extubation. a) Inspiration phase. The epiglottis collapsed into the posterior wall of the pharynx and obstructed the airway. b) Expiration phase. The epiglottis recovered somewhat, and the airway was open, but the upper airway space was quite narrow.

On the 8th ICU day, after passing the SAT and SBT, he was re-extubated in the presence of an otolaryngologist. Immediately after re-extubation, the stridor and respiratory retention appeared again, and the otolaryngologist performed fiberoptic laryngoscopy. The otolaryngologist diagnosed him with laryngomalacia and bilateral vocal fold paralysis (Fig. 2). Compared to the first instance of extubation, his stridor and breathing pattern tended to be improved, so we did not perform re-intubation.

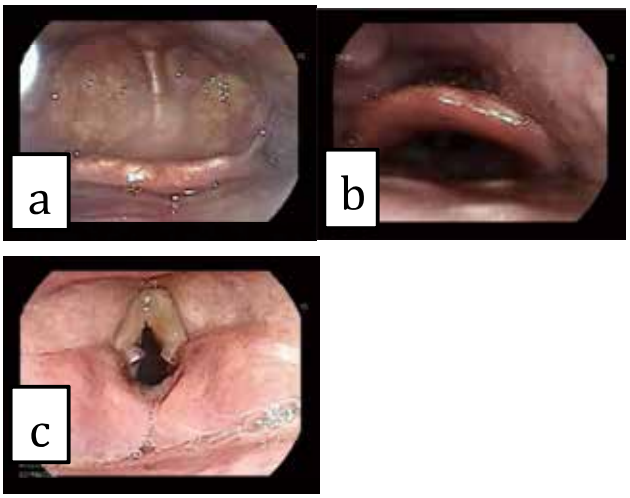

Figure 2. Fiberoptic laryngoscopy after the second attempt at tracheal extubation. a) Inspiration phase. The epiglottis collapsed again and obstructed the airway. b) Expiration phase. The epiglottis appeared to be recovering a little better than before. c) Vocal cords during vocalization. Bilateral vocal cord paralysis was noted.

On the 11th ICU day, he was discharged from the ICU without respiratory support. However, two days later, he developed respiratory failure, perhaps due to aspiration pneumonia on the ward, and was re-admitted to the ICU. The otolaryngologist performed fiberoptic laryngoscopy again and found that acquired laryngomalacia and vocal cord paralysis remained, so he was intubated again, and tracheotomy was performed on the 2nd re-admission for ICU day. He was weaned from mechanical ventilation and discharged on the 4th re-admission for ICU day. Five days after ICU discharge, magnetic resonance imaging showed a central hyperintense lesion of the pons on T2- and diffusion-weighted imaging, and we diagnosed him with central pontine myelinolysis, which might have contributed to vagal nerve dysfunction and led to his acquired laryngomalacia and vocal fold paralysis (Fig. 3).

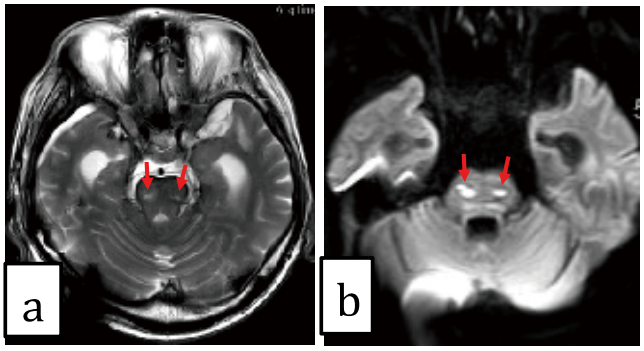

Figure 3. Magnetic resonance imaging findings five days after ICU discharge. Magnetic resonance imaging demonstrated a central hyperintense lesion within the pons on T2- (Figure 3a) and diffusion-weighted imaging (Figure 3b), which indicated central pontine myelinolysis (red arrows).

DISCUSSION

We reported a case of acquired laryngomalacia immediately after extubation in a patient who was treated for refractory seizure and central pontine myelinolysis following scheduled craniotomy. This is the first case report to describe extubation failure mainly due to acquired laryngomalacia after scheduled craniotomy in an elderly patient.

Laryngomalacia is the most common cause of stridor in children. The mechanism underlying laryngomalacia in that population is thought to be different from the mechanism involved in adult-onset laryngomalacia (12). Although the mechanism of laryngomalacia in children is not well understood, it is believed to involve a combination of morphological and histological abnormalities of the epiglottis, such as a long, tubular or omega-like shape with immature cartilage (1). In contrast, adult-onset laryngomalacia is commonly characterized by abnormal movement of the epiglottis with a normal structure and no histological abnormalities (12).

Adult-onset laryngomalacia can be divided into "idiopathic" and "acquired" forms (11). Idiopathic cases typically involve healthy adult males, 30 to 70 years old, with gradually progressive inspiratory dyspnea and slight deformity of the epiglottis (7). Regarding acquired cases, there have been some case reports that acquired cases usually occur after head injuries (2), neurological stroke (3), and neck or mouth surgery (4-6). The mechanisms underlying acquired cases include the loss of neuromotor tone of the pharynx due to central nervous system injury

or surgical resection of the suprahyoid muscle group or hyoid epiglottic ligament (2). Anatomical narrowing of the pharyngeal cavity mainly due to laryngeal edema or insult following mouth surgery may predispose the epiglottis to collapse into the posterior wall of the pharynx during inspiration via the Bernoulli phenomenon (2). In addition, there are some studies reporting that neurodegenerative diseases, such as multiple system atrophy (9) and Alexander's disease (10), and age-related fragility of the glottal ligaments (13) may also be causes of acquired laryngomalacia.

In the present case, despite symptoms of upper-airway obstruction not being seen immediately after scheduled craniotomy, the patient developed upper-airway obstruction due to laryngomalacia and failed extubation at six days after surgery. Because there were no symptoms of upper airway obstruction immediately after the scheduled surgery, the main cause of laryngomalacia may not have been a direct effect of craniotomy but rather refractory seizure and/or central pontine myelinolysis following craniotomy. Central diabetes insipidus or SIADH caused by craniopharyngioma is one of the most common postoperative complications (14) and can lead to hyponatremia due to SIADH and/or hypernatremia mainly due to diabetes insipidus. Furthermore, rapid correction or overcorrection of hyponatremia may cause seizures and central pontine myelinolysis (15). We speculated that the refractory seizure and central pontine myelinolysis in the present patient may have damaged the central nervous system, especially the vagal nerve function at the brainstem level, and contributed to a decrease in the laryngeal tone and induction of acquired laryngomalacia (16).

The diagnosis and optimal treatment of acquired laryngomalacia may be challenging. In our case, we were able to promptly detect laryngomalacia by performing flexible fiberoptic laryngoscopy immediately after the appearance of stridor and respiratory retention. The delay of a diagnosis and optimal treatment for upper-airway obstruction due to laryngomalacia may cause refractory hypoxemia and cardiac arrest (17). Takeshita *et al*. reported that repetitive postoperative extubation failure and cardiac arrest due to acquired laryngomalacia occurred in an elderly patient, and emergency tracheostomy was required to stabilize the patient's respiratory condition (17). Fibroscopic laryngoscopy just after extubation may play an important role in detecting laryngomalacia and leading to optimal treatment when symptoms such as stridor and respiratory retention occur. Direct observation of the downward collapse of the epiglottis during inspiration by fibroscopic laryngoscopy is the only way to diagnose laryngomalacia appropriately, and it is impossible to detect it after intubation.

The management of acquired laryngomalacia varies among patients and depend on the laryngeal structure, functional abnormalities and underlying pathology. If the patient's respiratory status is stable, epiglottectomy or laser epiglottoplasty is an optional treatment (2, 11) ; however, in case of upper airway obstruction, prompt tracheostomy as well as intubation until improving the underlying secondary disease are needed (11, 17). The main causes of upper airway obstruction after extubation include glossoptosis and laryngeal edema, which can be predicted by the cuff-leak test and are commonly treated by corticosteroid and/or nebulized epinephrine (18). We should keep in mind that laryngomalacia is a possible cause of post-operative extubation failure and perform fiberoptic laryngoscopy to detect acquired laryngomalacia when a patient develops upper airway obstruction despite being fully conscious with a negative cuff leak test, as in this case, especially in patients with central nervous system injury.

CONCLUSION

We should remain alert that postoperative seizure and central pontine myelinolysis after craniotomy may cause acquired laryngomalacia and postoperative extubation failure. We should not delay performing fiberoptic laryngoscopy in cases of post-extubation failure, as fibroscopic laryngoscopy is the only way to diagnose acquired laryngomalacia. An inadequate diagnosis of laryngomalacia may cause repetitive extubation failure and lead to a poor outcome.

CONFLICT OF INTEREST

The authors have no relevant financial relationships to disclose.

ACKNOWLEDGEMENTS

We would like to thank to the physicians among the otorhinolaryngology, neurosurgery and nursing staff in Emergency and Critical Care Medicine of Tokushima University Hospital for making the diagnosis of acquired laryngomalacia and performing the medical treatments.

REFERENCES

1. Ayari S, Aubertin G, Girschig H, Van Den Abbeele T, Mondain M : Pathophysiology and diagnostic approach to laryngomalacia in infants. Eur Ann Otorhinolaryngol Head Neck Dis 129 : 257-263, 2012
2. Woo P : Acquired laryngomalacia : epiglottis prolapse as a cause of airway obstruction. Ann Otol Rhinol Laryngol 101 : 314-320, 1992
3. Archer SM : Acquired flaccid larynx. A case report supporting the neurologic theory of laryngomalacia. Arch Otolaryngol Head Neck Surg 118 : 654-657, 1992
4. Chetty KG, Kadifa F, Berry RB, Mahutte CK : Acquired laryngomalacia as a cause of obstructive sleep apnea. Chest 106 : 1898-1899, 1994
5. Mima H, Ishida H, Yamazaki K : Acquired laryngomalacia as a cause of airway obstruction immediately after unilateral mouth floor surgery. Anaesthesia 51 : 1152-1154, 1996
6. Keshwani M, Karim HMR, Gourh G : Floppy epiglottis together with extra-laryngeal mass causing an inducible laryngeal obstruction and hypoxemic event in an adult : A case report. Saudi J Anaesth 14 : 400-402, 2020
7. Kanemaru S, Kojima H, Fukushima H, Tamaki H, Tamura Y, Yamashita M, Umeda H, Ito J : A case of floppy epiglottis in adult : a simple surgical remedy. Auris Nasus Larynx 34 : 409-411, 2007
8. Harries PG, Randall CJ : Adult floppy epiglottis : a simple surgical remedy. J Laryngol Otol 109 : 871-872, 1995
9. Shimohata T, Shinoda H, Nakayama H, Ozawa T, Terajima K, Yoshizawa H, Matsuzawa Y, Onodera O, Naruse S, Tanaka K, Takahashi S, Gejyo F, Nishizawa M : Daytime hypoxemia, sleep-disordered breathing, and laryngopharyngeal findings in multiple system atrophy. Arch Neurol 64 : 856-861, 2007
10. Ishikawa M, Shimohata T, Ishihara T, Nakayama H, Tomita M, Nishizawa M : Sleep apnea associated with floppy epiglottis in adult-onset Alexander disease : a case report. Mov Disord 25 : 1098-1100, 2010
11. Hey SY, Oozeer NB, Robertson S, MacKenzie K : Adult-onset

laryngomalacia : case reports and review of management. Eur Arch Otorhinolaryngol 271 : 3127-3132, 2014
12. Kletzker GR, Bastian RW : Acquired airway obstruction from histologically normal, abnormally mobile supraglottic soft tissues. Laryngoscope 100 : 375-379, 1990
13. Sawatsubashi M, Umezaki T, Kusano K, Tokunaga O, Oda M, Komune S : Age-related changes in the hyoepiglottic ligament : functional implications based on histopathologic study. Am J Otolaryngol 31 : 448-452, 2010
14. Drapeau A, Walz PC, Eide JG, Rugino AJ, Shaikhouni A, Mohyeldin A, Carrau RL, Prevedello DM : Pediatric craniopharyngioma. Childs Nerv Syst 35 : 2133-2145, 2019
15. Kawahara I, Tokunaga Y, Ishizaka S, Yagi N : Reversible clinical and magnetic resonance imaging of central pontine myelinolysis following surgery for craniopharyngioma : serial magnetic resonance imaging studies. Neurol Med Chir (Tokyo) 49 : 120-123, 2009
16. Landry AM, Thompson DM : Laryngomalacia : disease presentation, spectrum, and management. Int J Pediatr 2012 : 753526, 2012
17. Takeshita J, Nishiyama K, Fujii M, Tanaka H, Beppu S, Sasahashi N, Shime N : Repetitive postoperative extubation failure and cardiac arrest due to laryngomalacia after general anesthesia in an elderly patient : a case report. J Anesth 31 : 779-781, 2017
18. Pluijms WA, van Mook WN, Wittekamp BH, Bergmans DC : Postextubation laryngeal edema and stridor resulting in respiratory failure in critically ill adult patients : updated review. Crit Care 19 : 295, 2015