계명의대학술지 제34권 1호
Keimyung Med J
Vol. 34, No. 1, June, 2015

A Case of Laryngeal Web Injury during Intubation in Pediatric Patient

Tae Hee Kim, M.D., Dong Chan Ko, M.D., Jung Woo Pin, M.D., Won Jun Choi, M.D., Kyoung Ho Ryu, M.D.

Department of Anesthesiology and Pain Medicine, Kangbuk Samsung Hospital, Sungkyunkwan University School of Medicine, Seoul, Korea

Received: March 20, 2015
Accepted: April 22, 2015
Corresponding Author: Kyoung Ho Ryu, M.D., Department of Anesthesiology and Pain Medicine, Kangbuk Samsung Hospital, Sungkyunkwan University School of Medicine, 29 Saemunan-ro, Jongno-gu, Seoul 110-746, Korea
Tel: +82-2-2001-2316
E-mail: kyoungho.ryu@samsung.com

• The authors report no conflict of interest in this work.

Laryngeal web is a rare congenital disease, and its incidence has been estimated to be 1 in 10,000 live births. A 4-year-old female child with laryngeal web was scheduled for laryngeal web removal. Smooth intubation without causing damages to the laryngeal web is important during induction. Also, it is very important to select the appropriate tube size during pediatric anesthesia. There is lack of a registered cuffed micro-laryngeal surgery (MLS) tube 3.5 mm inner diameter (ID) in Korea, and also our hospital did not have an uncuffed MLS tube 4.0 mm ID. Therefore we could not select the appropriate size of the laser tube. The patient's laryngeal web was slightly injured during intubation. We report a case of laryngeal web injury caused by intubation for laryngeal web removal and wish to state that there is lack of a registered laser tube in the size, such as a cuffed MLS tube 3.5 mm ID.

Key Words : CO_2 laser, Laryngeal web, Pediatric, Uncuffed laser tube

Introduction

Laryngeal web is a rare congenital disease, and its incidence has been estimated to be 1 in 10,000 live births [1,2]. Generally, surgery is performed after growth. If the symptoms are severe, emergency surgery is performed during the neonatal period [2,3]. During intubation, laryngeal web injury may occur, and if it occurs, it may increase the risk of laryngeal spasm and recurrence of laryngeal web [4]. Therefore, when we give anesthesia for laryngeal web surgery, smooth intubation is required, and this can be achieved by using the

appropriate size of the endotracheal tube [4,5]. We report a case of laryngeal web injury caused by intubation during surgery and we provide a review of the literature related to the appropriate endotracheal tube selection during laryngeal web surgery.

Case Report

A 16.5 kg, 107 cm, 4-year-old female child was sent for CO_2 laser excision of laryngeal web after she had been diagnosed with congenital laryngeal web. At birth, she had hoarse voice or high pitch voice when she cried, and when she had a fever, airway obstruction was occasionally observed. There was no special medical history and vital signs were within normal limits. It showed stridor during the process of inhalation and exhalation under physical examination. Preoperative blood test, chest X-ray and electrocardiogram were within normal limits. Direct flexible laryngoscopy done preoperatively by ENT surgeons revealed an anterior web at the level of vocal cord covering 50% of the glottic opening (glottic laryngeal web type II). These findings are shown in Fig. 1.

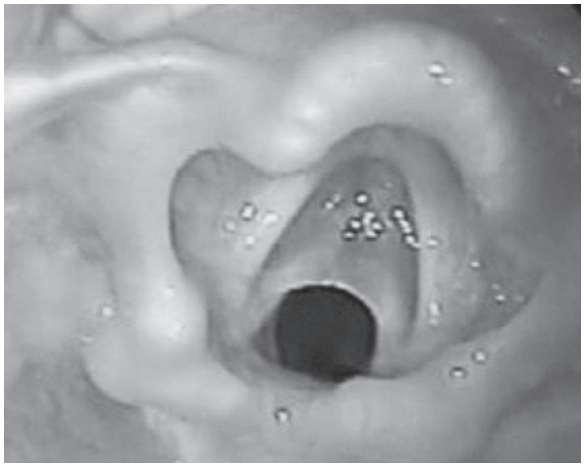

Fig. 1. Direct flexible laryngoscopic view during otolaryngologic examination. An anterior laryngeal web at the level of vocal cord could be observed.

Premedication was atropine which was intramuscularly administered to the patient at a dose of 0.1 mg. After she had arrived in the operation room, heart rate was 88 beats/min, body temperature was 36.9℃, respiration rate was 20 times/min, blood pressure was 100/60 mmHg, and oxygen saturation was 100%. Using 100% oxygen, we oxygenated the patient before anesthesia. Induction was carried out with an intravenous injection of thiopental 75 mg and rocuronium 10 mg.

After adequate muscle relaxation, an endotracheal intubation was attempted with a uncuffed MLS tube (Safety-Flex™ Extra Soft, Covidien, USA) 3.5 mm ID to reach 16 cm marking of the tube at the upper lip without resistance. Respiratory sound at both lungs was symmetrically clear. Using the method of pressure-controlled ventilation, necessary measures were taken to ensure that the mean airway pressure, respiration rate, maximal airway pressure, and I:E ratio were in the range of 20 mmHg, 20 times per minute, 40 mmHg, and 1 : 2, respectively. However, the desired ventilation was unavailable since the tidal volume was found to lie between 50-70 ml and oxygen saturation was decreased by 92%. To maintain more adequate ventilation, we reattempted with a cuffed MLS tube (Laser-Shield®II Endotracheal tube, Medtronics, USA) 4.0 mm ID, which could be negotiated but with slight resistance. Respiratory sound at both lungs was symmetrically clear. Using pressure-controlled ventilation, we maintained 15 mmHg in mean airway pressure, respiration rate by 20 times per minute, and 40 mmHg in maximal airway pressure while 1 : 2 in the ratio of I : E; tidal volume and oxygen saturation were also maintained between 90-110 ml and 98-100%, respectively. Anesthesia

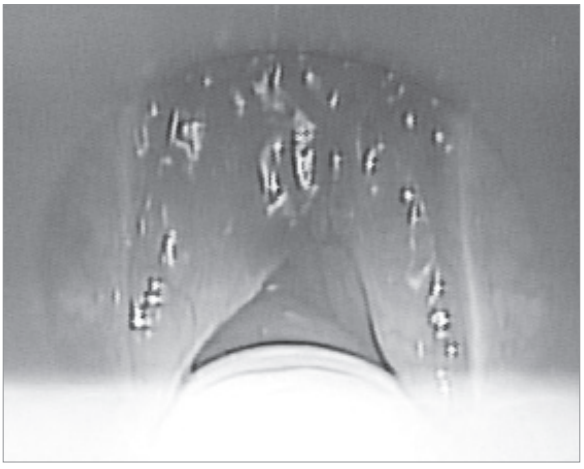

Fig. 2. Surgical microscopic view after intubation. It showed slightly injured laryngeal web with laryngeal swelling.

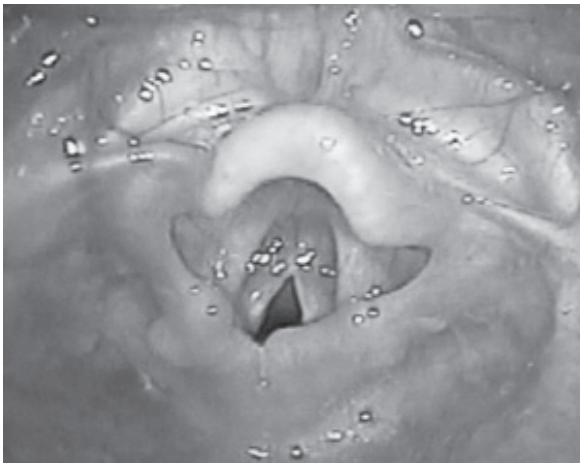

Fig. 3. Direct flexible laryngoscopic view postoperative 1 month later. It showed that the majority of laryngeal web had been removed.

was maintained with oxygen, air and Sevoflurane.

The patient's laryngeal web was slightly injured with laryngeal swelling, as shown in Fig. 2. To alleviate airway edema for an easier surgery, methylprednisolone 16 mg was given intravenously. The surgeon placed wet cotton pledgets around the tube, to protect against laser burns to the airway, as well as on the patient's face, to protect her vision. The laryngeal web was excised with CO_2 laser. The surgery was carried out for 35 minutes. The patient's vital signs during the surgery remained stable. After completion of the surgery and return of spontaneous breathing, the trachea was extubated. In view of tracheal stenosis which may happen suddenly due to airway edema after tracheal extubation, we had the surgeon at standby with adequate preparation for securing a surgical airway. In the recovery room, the patient's vital signs were within normal limits. The occurrence of any possible respiratory failure was carefully observed for 40 minutes. The patient was discharged from hospital two days later. When we examined the patient one month after CO_2 laser therapy, the hoarse sound was significantly improved with no stridor during the process of inhalation and exhalation. Direct flexible laryngoscopy done by ENT surgeons showed that the majority of laryngeal web had been removed, as shown in Fig. 3.

Discussion

Congenital laryngeal webs are rare, and their incidence has been estimated to be approximately 1 in 10,000 live births [1,2]. About 75% occur at the glottic level, and the rest are supraglottic or subglottic [6]. The majority of glottic webs lie anteriorly between the cords; only 1-2% are located posteriorly [1-3]. Congenital webs are usually symptomatic in infancy or early childhood. The diagnosis is suggested by clinical symptoms such as abnormal voice, stridor, and croup. Webs without any clinical symptoms are not treated. Usually the symptomatic laryngeal web is treated by one of the following surgical procedures: surgical division, endoscopic insertion of a keel, or laser treatment [7].

Airway management is difficult in patients with laryngeal web. In particular, smooth intubation without causing damage to the laryngeal web is important during induction. Damage to the laryngeal web that occurs during intubation increases the risk of laryngeal spasm, iatrogenic airway obstruction due to trauma, and recurrence of laryngeal web [4,5]. Therefore, for smooth intubation during laryngeal web surgery in pediatric patients, not only intubation by skilled anesthesiologist, but also selection of the appropriate tube size is important.

In our case, we used the uncuffed MLS tube 3.5 mm ID to minimize damage to the laryngeal web. At first, the trachea was intubated without resistance, but it was difficult to maintain adequate ventilation. There are limitations in the size of MLS tube, as shown in Table 1. There is lack of a registered cuffed MLS tube 3.5 mm ID, and also our hospital did not have an uncuffed MLS tube 4.0 mm ID. Because we did not have an uncuffed MLS tube 4.0 mm ID, we reattempted intubation with a cuffed MLS tube 4.0 mm ID. If we would have used an uncuffed MLS tube 4.0 mm ID, there would have been no laryngeal web damage. The outer diameter (OD) of a MLS tube is larger than the OD of a PVC tube with the same ID. If you cannot use an appropriate laser tube, as in our case, you might consider using a PVC tube for smooth intubation. It would cause lesser laryngeal web damage and maintain adequate ventilation. But, there is a risk of fire with the use of a PVC tube for CO_2 laser surgery. Although it occurs in about 50% of cases, in which the PVC tube comes in contact with the laser beam during laser surgery, if you comply with safety rules during laser surgery, the use of a PVC tube may be safe and it would not ignite even when the PVC tube is in contact with the beam [8]. Another method that uses a metallic tape, a metallic backed surgical sponge, or a material can prevent fire that may result from the contact of the laser beam with the surrounding PVC tube [8,9]. The advantage of using the above-mentioned methods is that we can use a PVC tube. But, a metallic tape may not be able to protect the tube from all kind of lasers and also unwanted parts can be irradiated with the laser beam. There is no effect if the surgical site is located on the distal portion of the tube. If the tube is not wrapped well, it can be exposed to laser through any opening and can kink. The effect cannot be confirmed with the currently available

Table 1. Comparison of outer diameter between endotracheal tube and laser tube using in Korea

ID (mm)	OD (mm)					
	PVC tube * (Mallinckrodt™)		MLS tube † (Safety-Flex™)		MLS tube ‡ (Laser-Shield®II)	
	Uncuffed	Cuffed	Uncuffed	Cuffed	Uncuffed	Cuffed
3.5	4.9	4.9	5.7	–	–	–
4.0	5.6	5.6	6.1	–	–	6.6
4.5	6.2	6.2	–	7.0	–	7.3

* PVC tube (Mallinckrodt™, Covidien, USA), † MLS tube (Safety-Flex™ Extra Soft, Covidien, USA), ‡ MLS tube (Laser-Shield®II Endotracheal tube, Medtronics, USA), ID: inner diameter, OD: outer diameter, –: Not registered.

metallic tape because it is not designed for medical application and it also cannot maintain sterile conditions. Metallic backed surgical sponge has been designed specifically for use in laser surgery. When the sponge is wet, it can prevent heat damage, tissue abrasion, fire, etc. Forced insertion of a metallic backed surgical sponge has been found to cause airway obstruction [8,9].

In conclusion, when using the laser tube during pediatric anesthesia, it is important to select the exact size of the tube to maintain adequate ventilation and to minimize iatrogenic airway obstruction. We are not equipped with all kinds of laser tubes and there is lack of a registered cuffed MLS tube ID 3.5 mm. Therefore, we could not select the appropriate size of the laser tube.

We wish to state that there is lack of a registered laser tube in the pediatric size, such as a cuffed MLS tube ID 3.5 mm. And in such a case, we can use a PVC tube, but there is a risk of fire with the use of PVC tube. More investigation is needed to increase fire resistance of PVC tubes so they can be used safely in surgery performed with CO_2 laser.

References

1. Benjamin B. Chevalier Jackson Lecture. Congenital laryngeal webs. *Ann Otol Rhinol Laryngol* 1983; **92**:317–26.
2. Mahfouz AK, Rashid M, Reddy P. Anaesthetic management of congenital laryngeal web presenting with acute upper airway obstruction. *Middle East J Anaesthesiol* 2010;**20**:719–21.
3. Holinger PH, Brown WT. Congeniral webs, cysts, laryngoceles and other anormalies of the larynx. *Ann Otol Rhinol Laryngol* 1967;**76**:744–52.
4. Nicol JW, Yradley MP, Bull PD. Posterior vocal cord adhesion: an unusual complication of endotracheal intubation. *Br J Clin Pract* 1994;**48**:278–9.
5. Chong ZK, Jawan B, Poon YY, Lee JH. Unsuspected difficult intubation caused by laryngeal web. *Br J Anaesth* 1997;**79**:396–7.
6. Legasto AC, Haller JO, Giusti RJ. Tracheal web. *Pediatr Radiol* 2004;**34**:256–8.
7. Cummings CW. *Otolaryngology Head and Neck Surgery*. 5th ed. London: CV Mosby; 2010. p. 2912–22.
8. Ko SO, Kong MH, Kwak YR, Kwon MI, Kwon JY, Kim KS, *et al. Anesthesia and Pain Management*. 2nd ed. Seoul: Elsevier; 2009. p. 1732–4.
9. Butterworth JF, Mackey DC, Wasnick JD. *Morgan and Mikhail's Clinical Anesthesiology*. 5th ed. New York: McGrawHill Companies Inc.; 2013. p. 776–7.