Subglottic Jet Ventilation for Pediatric Microlaryngosurgery: A Case Report

Junko Miyawaki, MD,* Shinjiro Shono, MD,† Kiyoshi Katori, MD,‡ Tadakazu Sakuragi, MD,§ Kazuo Higa, MD||

Department of Anesthesiology, Fukuoka University School of Medicine, 45-1, 7-chome, Nanakuma, Jonan-ku, Fukuoka 814-0180, Japan

A 6-year-old girl with laryngeal papillomatosis underwent ablation of the tumors with Nd-YAG laser under microlaryngosurgery. During the surgery, she was managed with subglottic high-frequency jet ventilation using a stainless steel cannula made from a nerve block needle. It was passed through the light channel of the suspension laryngoscope and firmly affixed to it. There was no hypoxia or barotrauma to the lungs during the surgery. The postoperative course was uneventful. © 2003 by Elsevier Science Inc.

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Introduction

Patients are managed with high-frequency jet ventilation (HFJV) during laser microlaryngeal surgery, because this type of surgery requires an unobstructed and quiet operative field. A self-centering jet cannula is inserted into the trachea to avoid barotrauma related to HFJV during laser microlaryngeal surgery in adults.1 There is, however, no established safe method of fixation of a jet cannula in the trachea during laser microlaryngeal surgery in infants and children. We report a child who underwent laser microlaryngeal surgery with subglottic HFJV. A stainless steel cannula was passed through the light channel of the suspension laryngoscope and affixed to it. The perioperative course was uneventful.

Case Report

A 6-year-old girl, weighing 13.5 kg, had increasing hoarseness and wheezing with occasional dyspnea as a result of laryngeal papillomatosis. She was admitted to our hospital where she was scheduled to undergo resection of the tumors with forceps under suspension microlaryngosurgery, with endotracheal intubation. However, the endotracheal tube (ETT) obstructed the surgical field and the tumors could not be resected completely. She was then scheduled for ablation of the tumors with Nd-YAG laser. After detailed discussions and agreement with the parents and the surgeons, subglottic HFJV was selected.
Oral diazepam 5 mg and subcutaneous atropine 0.1 mg were given 2 hours and 30 minutes, respectively, before she arrived in the operating room (OR). Monitors included electrocardiography (ECG), noninvasive blood pressure (BP) measurement, and pulse oximetry (SpO₂). Anesthesia was induced with sevoflurane 5% and nitrous oxide 70% in oxygen. The trachea was intubated with a 4.0 mm ID ETT after intravenous (IV) vecuronium 1.5 mg was given. The patient’s head was rested on a doughnut pillow and fixed to the operating table with adhesive tape.

Because cannulae for subglottic HFJV in infants were not commercially available in Japan, we used a stainless steel cannula (23 cm in length, 2.4 mm ID and 2.7 mm OD), which was fashioned from a nerve block needle (Hakko, Nagano, Japan) and marked off in centimeters from the needle tip. This tip was made blunt so as not to traumatize the trachea wall (Figure 1). As shown in Figure 1 and Figure 2, the cannula, over which the female end of an IV extension tube was fitted in tightly, was inserted through the light channel on the left side of the suspension laryngoscope. The cannula was advanced parallel to the ETT and into the trachea. Its distal end was positioned 1 cm below the glottis. The cannula was firmly fixed to the suspension laryngoscope by plugging the female end of the extension tube over the cannula into the light channel of the suspension laryngoscope. HFJV was begun through the cannula after removal of the ETT.

HFJV was set at a driving pressure of 14 psi (724 mmHg), a frequency of 200/min, an inspiratory phase of 30%, an F₁O₂ of 0.25, and a high-pressure alarm and cut-off of 40 cm H₂O (Acutronic VS 150 S, Jona-Rapperswil, Switzerland). The ventilator was not equipped with a distal airway pressure monitor or end-tidal carbon dioxide analyzer. Ablation of the tumors was easily performed with Nd-YAG laser. This procedure lasted 10 minutes. Arterial blood gas analysis performed 9 minutes after start of the surgery showed a pH of 7.63, PO₂ 140 mmHg, and PCO₂ 20 mmHg. The duration of HFJV was 30 minutes, during which the time pulse oximeter showed 100% O₂ saturation. The trachea was re-intubated with a 4.5 mm ID ETT after the laser microlaryngeal surgery. Dexamethasone 1 mg was given IV. Spontaneous respirations resumed 25 minutes after re-intubation of the trachea. The ETT was removed after IV neostigmine 0.5 mg and atropine 0.25 mg were given to antagonize the residual neuromuscular blockade. There was no barotrauma to the lungs. The patient’s hoarseness, wheezing, and dyspnea disappeared. The perioperative course was uneventful. She was discharged 7 days after the surgery. There was no recurrence of the laryngeal papillomatosis.

Discussion

Because laser microlaryngeal surgery requires an unobstructed and quiet operative field, anesthesia is maintained with either supraglottic or subglottic HFJV, without endotracheal intubation. Tubeless supraglottic HFJV is used in laser microlaryngeal surgery, even in infants and children; however, the ventilator was not available at our hospital. Subglottic HFJV is performed either with the transglottic or transtracheal approach. Because transglottic HFJV is less invasive than transtracheous approach.
transtracheal approach, we selected transglottic subglottic HFJV for our patient.

Barotrauma, such as pneumothorax, pneumomediastinum, and pneumopericardium, is a complication of subglottic HFJV even in patients without airway obstruction. It is caused by endobronchial migration of the jet catheter and submucosal injection of jetted gas as a result of whiplash movement of the jet catheter. Fixation of the jet catheter is essential so as to avoid barotrauma. A self-centering subglottic catheter has been developed for HFJV in adults. However, a safe method of fixation of the jet catheter for infants and children during subglottic HFJV has not been established. Tsui, Woo and Lo reported a 2-month-old infant with multiple granulomas of the vocal cords who underwent laser microlyngoscopy. A stainless steel suction tube was used as a subglottic HFJV cannula, and it was positioned manually. We passed a stainless steel cannula through the light channel of the suspension laryngoscope and positioned it 1 cm distal to the glottis. Since the cannula was firmly fixed to the laryngoscope, it did not move in the trachea and its depth below the glottis did not change during HFJV. However, our patient was hyperventilated during HFJV. A small, flexible, self-centering jet catheter equipped with distal airway pressure monitor and carbon dioxide analyzer would greatly improve anesthetic management of infants and children who undergo laser microlyngoscopy.

In conclusion, we managed a child with laryngeal papillomas who underwent laser microlyngosurgery with subglottic HFJV through a stainless steel cannula that was fixed firmly to the laryngoscope.

References