Case Report
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Air leakage due to the cuff hanging on the vocal cords during nasotracheal intubation: a case report

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Nasotracheal intubation is commonly performed under general anesthesia in oral and maxillofacial surgery. For the convenience of surgery, nasal Ring-Adair-Elwyn (RAE) tubes are mainly used. Because the nasal RAE tubes were bent in an "L" shape, the insertion depth was limited. Particularly, it is necessary to accurately determine the appropriate depth of the RAE tubes in children. Several types of nasal RAE tubes are used in the medical market, which vary in material and length.

We performed endotracheal intubation using a nasal RAE tube for double-jaw surgery, but air leakage persisted even when the air pressure in the cuff was increased. When checked with a laryngoscope, it was confirmed that the tube was pushed out, and the cuff was caught on the vocal cords, causing air leakage. Since inserting the tube deeply did not solve the problem, replacing it with a nasal RAE tube (Polar™, Preformed Tracheal Tube, Smith Medical, Inc., USA) did not cause air leakage; thus, we reported this case.

Keywords: Cuff Leak; Intubation; Nasotracheal; Oral and Maxillofacial Surgery; Ring–Adair–Elwyn Tube; Vocal Cords.

INTRODUCTION

Oral endotracheal intubation interferes with the visual field and manipulation during surgery because most oral and maxillofacial surgeries are performed through the oral cavity. Therefore, in most cases, the airway is secured by nasotracheal intubation [1,2]. Because the nasal Ring-Adair-Elwyn (RAE) tubes undergo bending, the tube connector is faced upward when the tube is fixed, and there is less risk of blockage or twisting than when bending a typical tube. Because the maximum depth is predetermined by the preformed bend, this can be a disadvantage for patients who need to insert the tube deeper.

We present a case of a patient who underwent oral and maxillofacial surgery who had cuff leakage immediately after nasotracheal intubation, which was resolved after replacing the tube from another manufacturer.

CASE REPORT

This report was presented after receiving approval from the IRB (IRB No. ERI 23002) and obtaining written informed consent from the patient.

A 28-year-old male patient (American Society of Anesthesiologists Physical Status Class II; weight, 60 kg; height, 171 cm) visited the Seoul National University

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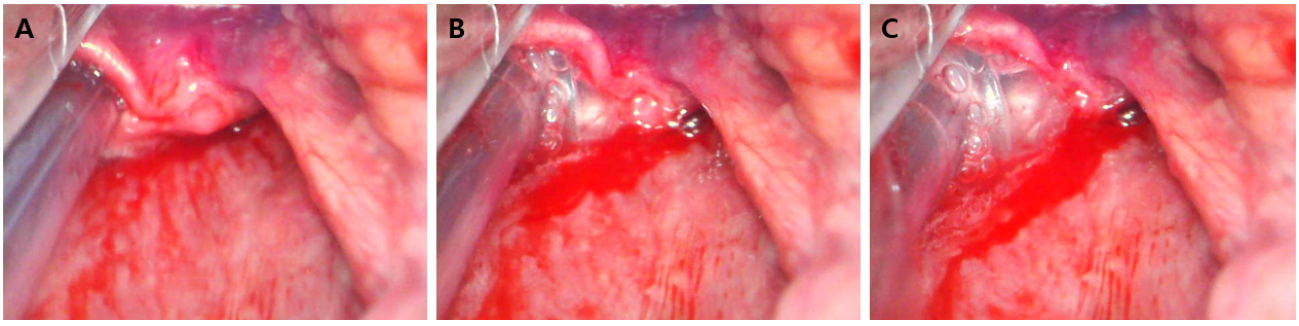

Fig. 1. Videoscopic view of the supraglottis. (A) Nasal Ring–Adair–Elwyn (RAE) tube in situ. (B, C) The cuff protrudes from the vocal cord.

Dental Hospital for orthognathic surgery. Regarding past history, he underwent Le Fort I osteotomy, intraoral verticosagittal ramus osteotomy, and genioplasty 9 years ago. However, right mandibular swelling occurred 3 months postoperatively, and incision and drainage was performed for treatment of right mandibular angle abscess.

The patient visited the hospital again to undergo Le Fort I osteotomy and bilateral sagittal split ramus osteotomy due to facial asymmetry. In the airway evaluation, neck extension was normal, and mouth opening was four finger breadths. There were no specific anatomical abnormalities in the nasal cavity on skull anteroposterior and facial computed tomography. No specific findings were found on other blood tests, chest radiography, and electrocardiography (ECG).

Consent for surgery and anesthesia was obtained from the patient. General anesthesia was induced after establishing routine patient monitoring (pulse oximetry, end-tidal carbon dioxide, ECG lead II with continuous ST-segment analysis, and noninvasive blood pressure monitoring) and bispectral index. After sufficient preoxygenation, anesthesia was induced with lidocaine (30 mg), propofol (120 mg), and rocuronium (35 mg). After loss of consciousness, inhalation anesthesia was induced using 8% sevoflurane. After the train of four reached zero, a nasal RAE tube (Shiley™, Nasal RAE Tracheal Tube Cuffed Murphy Eye, Covidien, Ireland) with internal diameter (ID) of 7.0 mm was inserted into the left nostril, and nasotracheal intubation was performed using a video laryngoscope (VL3D™, HugeMed™, China) and Margill forceps.

Anesthesia was maintained with an oxygen/air mixture and adjusted for desflurane (6–8%). The patient was maintained on volume-controlled mechanical ventilation with 500 mL tidal volume at a respiratory rate of 12 breaths/min. Immediately after setting the ventilator, there was a sound of air leakage in the oral cavity at a peak inspiratory pressure of 20 cmH_2O. The air leak did not improve even though balloon inflation was continued. When we checked the supraglottic area using a video laryngoscope, it appeared that the cuff was caught on the vocal cords (Fig. 1). We attempted to insert the tube deeply several times and fix it, but the air leakage was not resolved. Because of the preformed bend, which is characteristic of the nasal RAE tube, it was impossible to insert it deeper. Therefore, it was exchanged with a slightly longer nasal RAE tube (Polar™, Preformed Tracheal Tube, Smith Medical, Inc, USA) with ID of 7.0 mm (Fig. 2). Subsequently, air leakage was not noted, and the surgery proceeded as scheduled.

DISCUSSION

Intubation is an essential element of general anesthesia. Proper tube insertion depth is important to prevent complications, such as cuff leakage, accidental extubation, vocal cord trauma, and endobronchial intubation.

If cuff leakage occurs after intubation, the risk of inadequate ventilation, failure of inhalational anesthetic delivery, and aspiration increases. The causes of cuff

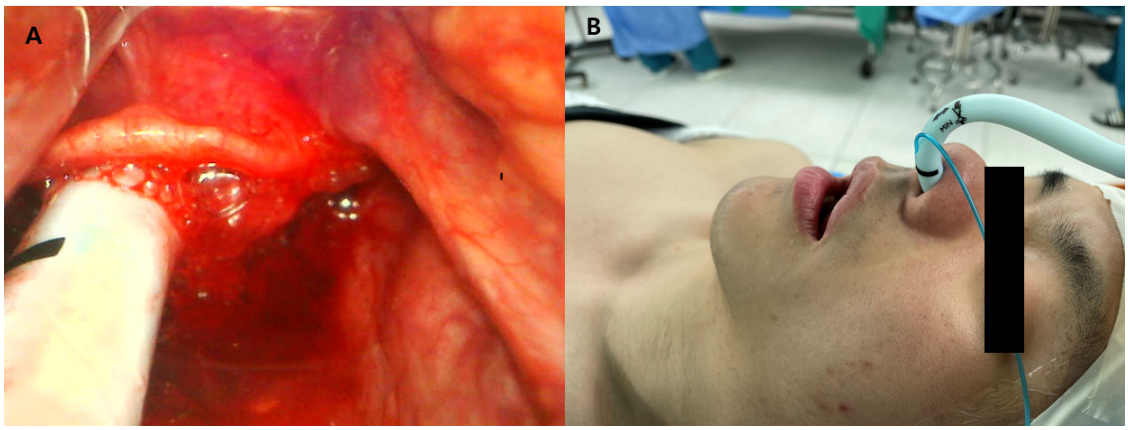

Fig. 2. (A) After tube exchange (Polar™, Preformed Tracheal Tube, Smith Medical, Inc, USA), the depth of the cuff is confirmed by the guide mark. (B) Depth in the nostril during intubation.

leakage include an incompetent inflation valve, punctured pilot balloon, punctured inflation line, defective intramural part of inflation line, asymmetrical cuff, punctured or torn cuff, underinflation of the cuff, accidental extubation, cuff over the vocal cords, wide discrepancy between the endotracheal tube (ETT) and tracheal diameters, and high peak airway pressure [3,4].

To determine the appropriate depth of the tube during tracheal intubation, we must consider the length of the tube tip over the vocal cords, length between the vocal cords and carina, and changes in the position of the head and neck. The length of the tube tip crossing the vocal cords was the sum of the distance between the vocal cords and upper margin of the cuff, length of the cuff, and distance between the lower margin of the cuff and tube tip. Previous studies have shown that the appropriate depths of the ETT in adults are 1.5–2.5 cm between the upper margin of the cuff and vocal cord and 3–7 cm between the carina and tube tip [5,6].

At an appropriate depth, tube manufacturers may place one or two guide marks on the tube near the cuff. One guide mark was placed at the vocal cord level, and the tube with two guide marks was placed at the vocal cord between the two guide marks.

In 1991, Mehta reported that guide marks on the tube provided a reliable method for placing the tip of the tracheal tube in the proper position [5].

A previous study on patients undergoing head and neck surgery using nasal RAE tubes also reported that the patient's height, long operative time, and right-sided surgical site were associated with shallow tube depth. This may be due to the limitations of the already determined tube depth and changes in the position of the head and neck during surgery [5,7,8].

As in this case, the nasal RAE tube often does not go deeper, owing to the already determined curve. With shallow intubation depth, cuff leakage is caused by the cuff hanging over the vocal cords, and complications may develop by direct injury to the vocal cords or compression of the recurrent laryngeal nerve.

In this case, the cause of cuff leakage was the relatively short nasal RAE tube length, which was resolved by performing tube exchange with other manufacturers. A nasal RAE tube with an inner diameter of 7.0 mm is a commonly used size for adults, with a height of 171 cm. However, air leakage occurred in one patient with a height of 171 cm. This may be because of the relatively short distance from the bending point to the upper margin of the cuff for the patient.

In 2015, Hunyady AI et al. reported that the bend-to-tip distance of preformed ETT differs from manufacturer to manufacturer, and particularly, a difference of up to 2 cm for a nasal tube with an ID of 7.0 mm. In 2001, Rolfe et al. reported that discrepancies exist between manufacturers of preformed nasal tracheal tubes, leading to increased morbidity as a result of incorrect tube

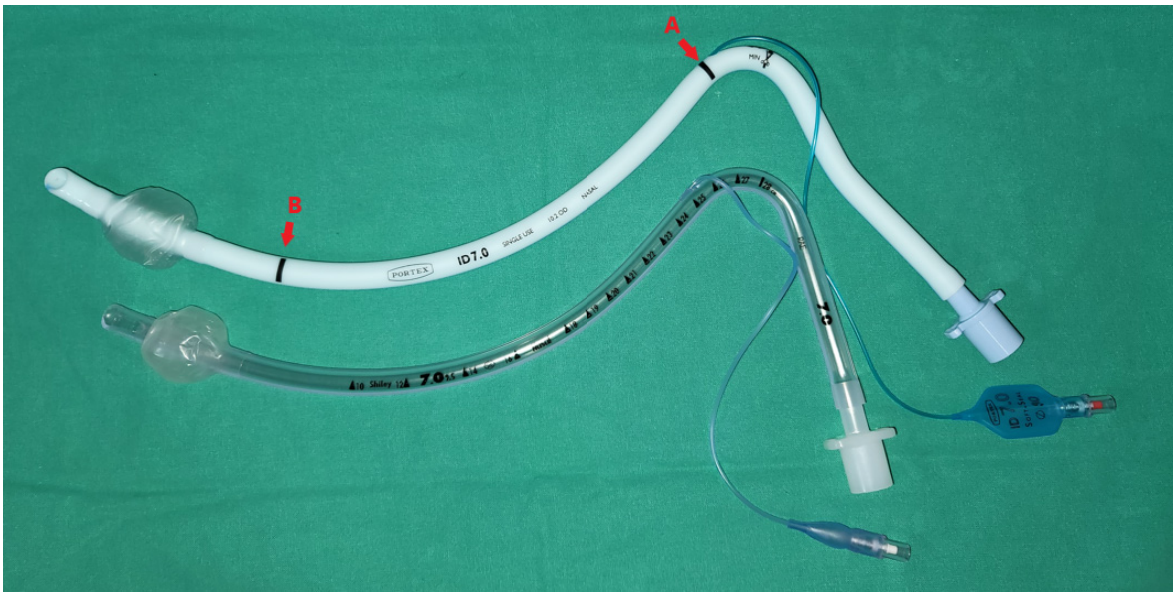

Fig. 3. Comparison of the lengths of the second nasal Ring–Adair–Elwyn (RAE) tube (Polar™, Preformed Tracheal Tube, Smith Medical, Inc., USA) and first nasal RAE tube (Shiley™, Nasal RAE Tracheal Tube Cuffed Murphy Eye, Covidien, Ireland). (A) Guide mark for the level of nares of the second nasal RAE tube (Polar™, Preformed Tracheal Tube, Smith Medical, Inc., USA): The length from the tube tip to guide mark A was 28.5 cm. (B) The guide mark for the level of the vocal cord of the second nasal RAE tube (Polar™, Preformed Tracheal Tube, Smith Medical, Inc., USA) was located 3 cm proximal to the cuff.

placement and repeat nasal intubation [2,9].

The second nasal RAE tube (Polar™, Preformed Tracheal Tube, Smith Medical, Inc., USA) used in this case had one guide mark of 3 cm above the cuff, while the first nasal RAE tube (Shiley™, Nasal RAE Tracheal Tube Cuffed Murphy Eye, Covidien, Ireland) had no guide mark. Both tubes were inserted to the maximum flexion point (bend), but the length from the tube tip to the bend of the first nasal RAE tube (Shiley™, Nasal RAE Tracheal Tube Cuffed Murphy Eye, Covidien, Ireland) was shorter. The cuff diameter differed between 30 and 28 mm. At the same amount of cuff inflation, a smaller cuff diameter would have been pushed out with a rounder and harder shape (Fig. 3).

To prevent this situation, it is important to check the guide mark of the cuff during intubation, and if there is no mark, focus on the upper margin of the cuff passing the vocal cords and entering approximately 2 cm more. Moreover, it is necessary to recognize that the length between the bend and tip may vary depending on the manufacturer and select the manufacturer's tube suitable for the type of surgery and characteristics of the patient.

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