



Protecting the tracheal tube cuff: a novel solution

Adam Abel¹, David A. Behrman¹, Jon D. Samuels²

¹Department of Dentistry, Oral and Maxillofacial Surgery, New York Presbyterian Hospital - Weill Cornell Medical Center, New York, NY, USA

²Department of Anesthesiology, New York Presbyterian Hospital - Weill Cornell Medical Center, New York, NY, USA

We describe the successful insertion of a nasotracheal tube following repeated cuff rupture. The patient was a 55-year-old woman with a history of nasal trauma and multiple rhinoplasties, who underwent elective LeFort I osteotomy and bilateral sagittal split osteotomy for correction of skeletal facial deformity. During fiberoptic bronchoscope-guided nasal intubation after the induction of general anesthesia, the tracheal tube repeatedly ruptured in both nares, despite extensive preparation of the nasal airways. We covered the cuff with a one-inch tape, intubated to the level of the oropharynx, pulled the tracheal tube out through the mouth, and removed the tape. The tracheal tube was then backed out to the level of the uvula, and was successfully advanced.

Keywords: Complications; Cuff Rupture; Endotracheal Tube; Nasotracheal Intubation.



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INTRODUCTION

Nasotracheal intubation is required for many maxillofacial surgical procedures performed under general anesthesia. Inherent to the success of nasotracheal intubation is the knowledge of the anatomy of the nasopharyngeal airway and patient-specific anatomical aberrancies that may exist. Unusual or unexpected conditions experienced in the operation theater may necessitate seldom-used maneuvers, or conversion to orotracheal intubation should nasotracheal intubation prove difficult or impossible.

CASE REPORT

A 55-year-old woman, weighing 60 kg and measuring

170 cm in height, with a surgical history of multiple rhinoplasties secondary to prior trauma, presented with complaints of poor mastication, facial myalgia, and nasal obstruction. Oral examination revealed traumatic malocclusion, with edge-to-edge incisal relation, mandibular laterognathia, and left lateral and posterior apertognathia. Nasal examination revealed an S-shaped nasal dorsum, constricted nasal tip, septal deviation to the right, and a positive Cottle maneuver. A standard orthognathic evaluation was performed using models, radiographs, facial measurements, cephalometric analysis, and 3D surgical planning. She declined additional rhinoplasty and was subsequently admitted for planned LeFort I osteotomy and bilateral sagittal split osteotomy for correction of skeletal facial deformity.

The patient was premedicated in an upright position with 0.05% oxymetazoline topical spray in both nostrils for mucosal vasoconstriction. Following supine positio-

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Corresponding Author: Adam Abel, Department of Dentistry, Oral and Maxillofacial Surgery, New York Presbyterian Hospital - Weill Cornell Medical Center, New York, NY, USA

E-mail: adam.abel01@gmail.com

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ning and pre-oxygenation, general anesthesia was induced with a 4 mg midazolam, 50 mcg fentanyl, 150 mg propofol, and low-dose (0.06 mcg/kg/min) remifentanyl infusion. After ensuring adequate face mask ventilation, an intubating dose of rocuronium (50 mg) was administered. Peripheral muscle relaxation was documented using a TOF-Watch[®] accelerometer (Organon, Swords Co., Dublin, Ireland). Serial dilation of the bilateral nasal passages was performed with lubricated nasopharyngeal airways progressing from 26F (8 2/3 mm outer diameter) to 32F (10 2/3 mm). The patient was easily positive-pressure mask ventilated (Grade 1) and full view of the vocal cords (Cormack-Lehane grade 1) was attained by passage of a fiberoptic bronchoscope (FOB) via the right naris, considering the known leftward septal deviation. A soft nasal RAE (named after the inventors; Ring, Adair, Elwyn) tube with 6.0 mm internal diameter (Portex[®] North Polar Ivory Endotracheal Tube [Nasal], Smiths Medical, Hythe, Kent, UK) was placed atraumatically over a 11304 BDXK Flexible Intubation Video Endoscope[®] Set 4.0 × 65 (Karl Storz-Endoskope, El Segundo, CA, USA) attached to an 8402 ZX Storz C-MAC[®] tower (Karl Storz-Endoskope, El Segundo, CA, USA). The FOB-guided nasotracheal intubation technique was chosen because, at our academic institution, it is considered the standard of care for patients undergoing Lefort I osteotomy, as many of them present constrained, retruded, or hypoplastic midface anatomy.

Following confirmation of the subglottic endotracheal position, 6 cc of air was used to inflate the cuff. A cuff leak was identified auditorily via insufficient tidal volume and airway pressure on mechanical ventilation. Additional air was added to the cuff without resolution, at which time a cuff tear was identified. Owing to easy mask ventilation, endoscopic visualization, and adequate pulmonary reserve, the patient was extubated and re-intubated in a similar fashion with a new 6.0 mm soft nasal RAE endotracheal tube through the left naris. A cuff leak was identified again. Intubation via the right naris using soft nasal RAE through a nasopharyngeal airway conduit was unsuccessful because the naso-

pharyngeal airway could not be dislodged and did not permit cuff inflation. Thereafter, Rusch[®] AGT Nasal Cuffed Endotracheal Tubes with internal diameter 6.0 mm (Teleflex, Morrisville, NC, USA) were selected for their slightly smaller outer diameter and were inserted successively through both nares under FOB guidance with similar results. Between the intubation attempts, the patient was successfully mask-ventilated to provide adequate oxygenation and was administered additional propofol to maintain adequate depth of anesthesia. At no point of time was vocal cord edema or nasopharyngeal bleeding observed. Therefore, the surgeon posited that there may be burs in both nasal airways. To test this hypothesis, the cuff of a new Portex[®] endotracheal tube was encircled with a 1-inch plastic tape (3M 850 Polyester Film Tape, 3M, Saint Paul, MN, USA) to protect against the presumed sharp, aberrant, and protrusive nasal anatomy. The endotracheal tube was placed over a nasal FOB, passed through the ___ naris, and retrieved trans-orally using Magill forceps. The tape was removed to permit cuff function, and the tube was backed out till the oropharynx, and then advanced into the trachea. The process of retrieving the tube trans-orally and re-passing it took approximately 20 s, of which 5 s were required to remove the tape occluding the cuff. Subsequently, successful cuff inflation was confirmed, and the planned surgical procedure was performed without further complications.

Postoperatively, the authors evaluated preoperative CT images to identify the potential etiology of the multiple ruptured endotracheal tubes. The patient's nasal cavity demonstrated a large left concha bullosa and a contralaterally deviated septum with a spur-like convexity (Fig. 1).

DISCUSSION

Nasotracheal intubation is necessary for many oral surgical procedures requiring uninhibited access to the oral cavity or planned maxillomandibular fixation. The

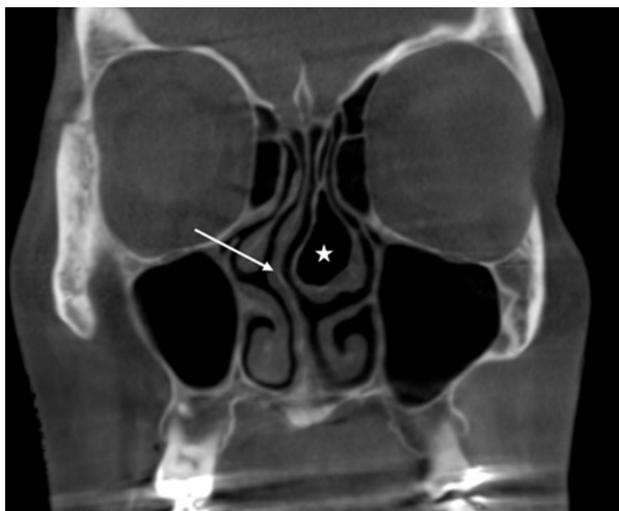


Fig. 1. CBCT image in coronal plane demonstrating the midface and paranasal sinus anatomy. Left concha bullosa (star) and rightward deviated nasal septum with spur convexity (arrow) are identified. CBCT, cone-beam computed tomography.

nasal RAE tube was created for nasotracheal intubation with a preformed bend to avoid interference with the surgical workspace. The principles and practice of nasotracheal intubation have been discussed elsewhere [1,2] and will not be described here. Insertion of the nasal RAE tube is performed by the anesthesia team either with the patient awake, but under sedation, and a combination of topical local anesthetic administration and airway nerve blocks; or more commonly, under induction of general anesthesia, using either McGill forceps or flexible FOB guidance and the Seldinger technique. FOB-guided nasotracheal intubation can be performed using a tube-first or bronchoscope-first technique. In this case, the anesthesia team chose the latter technique. While bronchoscope-first techniques have the advantage of potentially allowing the anesthesiologist to visualize aberrant anatomy prior to tube advancement, it may require additional force to be applied to the tube to overcome frictional forces, placing the cuff at a higher risk of tear if exposed to sharp anatomy.

In the present case, the airway was rendered insensate with extensive topical application of local anesthesia. “Asleep” nasal FOB-first intubation was routine and easy, with no aberrant anatomy visualized; however, the



Fig. 2. Distal ends of Portex 6.0 mm ID nasotracheal tubes demonstrating unaltered cuff (left) and post-event reproduction of cuff protected with occluding tape (right). Note the small tab of tape which was constructed to facilitate timely removal during intubation.

tracheal tube cuff developed a tear via both nares. Rupture occurred with both types of nasal RAE tubes— the longer, more pliant Portex[®] North Polar Ivory Endotracheal Tube, and the shorter, stiffer Rusch[®] AGT nasal cuffed endotracheal tube (Teleflex, Morrisville, NC, USA). The former is the preferred device in these cases, as it is believed to decrease the chance of ipsilateral naris trauma. When tracheal tube cuff leakage was detected, we first switched sides and then switched to the latter device in both nares, always with the same result. Since we had used the smallest manufactured size of Portex[®] tubes, the only remaining choices were to use a smaller Rusch[®] tube, a suboptimal choice, as the tubes decrease in length concomitant with size, or to awaken the patient and cancel the surgery. At this point, the surgeon posited that there may be burs in both nasal airways. To protect the delicate tracheal tube cuff, we encircled it with tape (Fig. 2), which was removed after pulling the distal portion of the tube out through the oral cavity.

The nasal airway may be evaluated preoperatively [3] for patency, nasal septal symmetry, and pathology via patient history, physical examination, and the ability to unilaterally force-ventilate through each nostril when awake. Imaging studies [4], such as coronal radiographs and facial CT, yield additional information and should be available in the operative suite. Residual bony ridges

may be either innate anatomic features or develop after facial trauma or prior orthognathic or intranasal surgery. In this case, aberrant nasal cavity anatomy contributed to repeated rupture of endotracheal tube cuffs, as a large left concha bullosa was present and the contralateral nasal septal deviation with a sharp spur may have been a congenital response to middle turbinate pneumatization or secondary to the previous trauma and rhinoplasty. Numerous case reports have described the management of ruptured tracheal tube cuffs during double lumen tube placement for thoracic surgery [4-8]. Management of the ruptured nasotracheal cuff using nasopharyngeal packing [9] to limit air leak for known difficult airways, or via application of retrievable finger cots or cut glove fingers to protect the tracheal tube cuff has also been described [10,11]. However, the application of a mobile body, even with retrieval sutures, is associated with the risk of aspiration or other complications [12].

Herein, we describe a simple method that requires no additional supplies for prophylaxis against cuff rupture in an otherwise routine airway. Anatomic features predisposing to nasotracheal tube rupture may be identified preoperatively, or discovered after tube placement. In either case, an appropriately sized piece of tape, supplied with a tab for easy removal, is applied. Both nares are prepared in the usual fashion [2], and the FOB jacketed with a nasotracheal tube is advanced through the nasopharynx into the oropharynx. The nasotracheal tube is then pulled out through the mouth without the FOB, the tape is removed, and the cuff is carefully inspected for small tears. Once cuff integrity has been ensured, the tube is withdrawn back into the bottom of the nasopharynx, the FOB is advanced, and inserted through the vocal cords to the carina along with the nasotracheal tube.

When carefully practiced, this technique will add to the armamentarium of the anesthesiologist, and will not cause undue delay in the commencement of the surgery. The senior author now uses this technique in all patients undergoing repeat orthognathic or nasal surgical procedures, in whom altered anatomy may exist.

AUTHOR ORCIDS

Adam Abel: <https://orcid.org/0000-0003-2604-5891>

David A. Behrman: <https://orcid.org/0000-0002-0390-1221>

Jon D. Samuels: <https://orcid.org/0000-0001-9228-7907>

AUTHOR CONTRIBUTIONS

Adam Abel: Conceptualization, Writing - original draft

David A. Behrman: Conceptualization

Jon D. Samuels: Conceptualization, Writing - original draft

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REFERENCES

- Collins SR, Blank RS. Fiberoptic intubation: an overview and update. *Respir Care* 2014; 59: 865-80.
- Prasanna D, Bhat S. Nasotracheal intubation: an overview. *J Maxillofac Oral Surg* 2014; 13: 366-72.
- Smith JE, Reid AP. Asymptomatic intranasal abnormalities influencing the choice of nostril for nasotracheal intubation. *Br J Anaesth* 1999; 83: 882-6.
- Thota RS, Doctor JR. Evaluation of paranasal sinuses on available computed tomography in head and neck cancer patients: an assessment tool for nasotracheal intubation. *Indian J Anaesth* 2016; 60: 960-1.
- Mittal AK, Kulkarni A. A simple method to protect tracheal cuff of double lumen tube from damage during intubation. *J Anaesthesiol Clin Pharmacol* 2012; 28: 417-8.
- Fortier G, St-Onge S, Bussières J. Two other simple methods to protect the tracheal cuff of a double-lumen tube. *Anesth Analg* 1999; 89: 1064.
- Erb J. A less difficult method to protect the tracheal cuff of a double-lumen tube. *Anesthesia & Analgesia* 1998; 87: 1217.
- Sahu S, Sahoo A, Patel GP, Pant KC. Incidental tracheal cuff rupture during placement of double-lumen, what to do? *Int J Crit Illn Inj Sci* 2013; 3: 92-3.
- Kalaria N, Goyal S, Sethi P, Bhatia P. Repeated cuff rupture with nasal intubation: what we learn!!! *Indian J Anaesth*

- 2019; 63: 680-2.
10. Hsu CT, Shih CK, Chau SW, Tseng KY, Chen MK, Cheng KI. Modified glove fingers as an aid for safely navigating endotracheal tube through the nasal cavity and nasopharynx in difficult nasotracheal intubation. *Acta Anaesthesiol Taiwan* 2011; 49: 119-21.
 11. Mahajan R, Gupta R. Another method to avoid trauma during nasotracheal intubation. *Anesth Analg* 2005; 101: 928-9.
 12. Barras JP, Bigler P, Czerniak A. A rare complication of the use of a finger cot to protect the cuff of a tracheal tube during nasotracheal intubation. *Intensive Care Med* 1993; 19: 174-5.