Ventilation via Cut Nasotracheal Tube During General Anesthesia

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Many patients with disabilities need recurrent dental treatment under general anesthesia because of high caries prevalence and the nature of dental treatment. We evaluated the use of a nasal device as a possible substitute for flexible laryngeal mask airway to reduce the risk of unexpected failure accompanying intubation; we succeeded in ventilating the lungs with a cut nasotracheal tube (CNT) with its tip placed in the pharynx. We hypothesized that this technique would be useful during dental treatment under general anesthesia and investigated its usefulness as part of a minimally invasive technique. A prospective study was designed using general anesthesia in 37 dental patients with disabilities such as intellectual impairment, autism, and cerebral palsy. CNT ventilation was compared with mask ventilation with the patient in 3 positions: the neck in flexion, horizontal position, and in extension. The effect of mouth gags was also recorded during CNT ventilation. The percentages of cases with effective ventilation were similar for the 2 techniques in the neck extension and horizontal positions (89.2–97.3%). However, CNT ventilation was significantly more effective than mask ventilation in the neck flexion position (94.6 vs 45.9%; $P < .0001$). Mouth gags slightly reduced the rate of effective ventilation in the neck flexion position. Most dental treatments involving minor oral surgeries were performed using mouth gags during CNT ventilation. CNT ventilation was shown to be superior to mask ventilation and is useful during dental treatment under general anesthesia.

Key Words: General anesthesia; Cut nasotracheal tube.

People with oral diseases often need to visit the dental office several times during a single treatment period because of the nature of dental treatment, which may include laboratory work such as the manufacture of crowns and inlays. People with disabilities such as cerebral palsy, intellectual disability, and autism may not be able to cooperate with dental staff satisfactorily.¹ They may need repeated dental treatment under general anesthesia, as they are more prone to dental caries and other oral diseases. Although there is a low rate of unexpected anesthetic-related failures, such as “inability

to intubate or ventilate” or injuries to oral tissues, complications may occur during general anesthesia in these patients.^{2–7} Therefore, for these patients it is preferable to adopt a method of general anesthesia that is as minimally invasive as possible. We prefer to use laryngeal mask airways only for cavity preparation, wherein it is not necessary to administer muscle relaxants and perform laryngoscopy. Dental treatment can be performed using a flexible laryngeal mask airway (FLMA)⁸; however, its flexible tube sometimes interferes with dental procedures that need to be performed with precision, particularly those involving proper occlusion of the teeth. It is difficult to master the technique of using FLMA as a nasal airway.⁹

We evaluated a nasal device as a possible substitute for the FLMA and hypothesized that effective ventilation

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A cut tube and a normal tube.

would be possible with a nasotracheal tube with an inflated cuff inserted to a position very close to the epiglottis. We investigated the effectiveness of ventilation using a cut nasotracheal tube (CNT) placed in the pharynx to evaluate the usefulness of this new method in dental treatment under general anesthesia (Figure).

METHODS

After the Hospital Ethics Committee had approved this study, we included 37 disabled patients (27 male and 10 female) with American Society of Anesthesiologists physical status 1 or 2 who were scheduled for dental treatment under general anesthesia. Informed consent was obtained from each patient's parents. We did not need to exclude any patients because none of them were at increased risk for aspiration, nor did any have limited head and neck movement. The subjects consisted of 10 patients with intellectual impairment, 10 with autism, 13 with cerebral palsy, and 4 with other disabilities such as Cornelia de Lange syndrome and Cohen syndrome. Their mean age was 26.1 years (SD 13.6; range 10–66), height was 155.2 cm (SD 14.9), and weight 46.7 kg (SD 16.4).

Anesthesia in the dental chair was induced with midazolam 0.05 mg/kg, atropine sulfate 0.01 mg/kg, and a propofol infusion 2 mg/kg, and was maintained with propofol. Starting with 8 mg/kg/h, a dental anesthesiologist titrated propofol (7.1 [2.0] mg/kg/h on average) to provide an adequate level of anesthesia for each procedure during the research. In the first step (mask ventilation step), the dental anesthesiologist ventilated the patient's lungs with oxygen at 6 L/min via a facemask after loss of the eyelash response. In the second step (CNT ventilation step), an endotracheal

tube (Parker Flex-Tip, High Volume Low Pressure, Cuffed; Parker Medical, Highlands Ranch, Colo) was placed through the nostril into the pharynx. The tube tip was brought out through the mouth using Magill forceps and cut off without damaging the cuff. The average length of the cut-off tips was 17.4 mm (SD 1.6). The cut endotracheal tube was inserted back into the mouth, and its new tip was advanced to a location approximately 3 mm from the epiglottis. For these procedures, we used a laryngoscope to find the original tip of the tube and to visualize the new tip in relation to the epiglottis. The cuff was inflated to 15–20 mL. Then, the lungs were ventilated with oxygen at 6 L/min via the tube at a pressure <20 cm of H₂O to prevent gastric insufflation.¹⁰ In each step, the effectiveness of ventilation was recorded in the following 3 positions: the neck in flexion, neck horizontal position, and neck in extension. In the second step, the effect of a mouth gag was investigated. We judged appropriate ventilation by noting when movement of the thorax with assisted ventilation was greater than during nonassisted spontaneous respiration.

The dental anesthesiologist placed a gauze throat pack in the pharynx to prevent loss of foreign objects and inserted a catheter through the other nostril to a location close to the cuff to withdraw any water, blood, and saliva. The dentist-in-charge performed the treatment with the patient's mouth held open (average opening 37.5 mm [SD 6.5]) with a mouth gag during general anesthesia with CNT after recording ventilation in the 3 positions. The types of dental treatments performed were classified as conservative treatment such as caries cavity filling, or oral surgery such as tooth extraction and gingivectomy.

The chi-square test was used to analyze data on the percentage of successful ventilation attempts for each ventilation method in each neck position as well as the percentage of successful attempts with and without a mouth gag during CNT ventilation in each neck position.

RESULTS

The percentages of cases in which effective ventilation was achieved were similar between mask and CNT ventilation in the neck extension and horizontal neck positions. However, the effectiveness of CNT ventilation was significantly higher than mask ventilation in the neck flexion position (Table 1).

Use of a mouth gag slightly reduced the rate of effective ventilation in the neck flexion position but not in other positions during CNT ventilation (Table 2).

Table 1. Numbers and Percentages of Cases in Which Ventilation Using a Cut Nasotracheal Tube (CNT) or Mask Was Effective

Types of Ventilation	Extension, N (%)	Horizontal, N (%)	Flexion, N (%)
CNT ventilation	36 (97.3)	35 (94.6)	35 (94.6)*
Mask ventilation	36 (97.3)	33 (89.2)	17 (45.9)*

* The chi-square test was used for statistical analysis. Statistically significant difference ($P < .0001$).

Most of the dental treatments involving minor oral surgery were performed using mouth gags during CNT ventilation (Table 3).

DISCUSSION

CNT ventilation was shown to be more effective than mask ventilation during general anesthesia. The main reason was thought to be that the inflated cuff could push the tongue base upwards and seal the pharynx to some extent. In CNT ventilation, we were able to advance the tube with an inflated cuff to a position very close to the epiglottis without inducing laryngospasm after removal of the tip. Then, we could inflate the cuff to block water from the mouth. In this way, we succeeded in preventing airway obstruction and coughing. In addition, we were able to demonstrate the usefulness of CNT ventilation during dental treatment under general anesthesia since we could ventilate the lungs with a wide mouth opening in different neck positions. Ventilation methods in which nonintubated endotracheal tubes with inflated cuffs are used as nasal or oral airways have been reported to be effective during induction of general anesthesia.^{11,12} However, these methods require closure of the patient's mouth or elevation of the jaw and cricoid pressure, which is therefore unsuitable for continuing dental treatment. Before adopting the CNT ventilation technique, we had used an uncut endotracheal tube successfully as a nasopharyngeal airway during dental treatment under general anesthesia approximately 1000 times. In this method, an endotracheal tube with a noninflated cuff

Table 2. Numbers and Percentages of Cases in Which Ventilation With a Cut Nasotracheal Tube Was Effective With and Without a Mouth Gag

Types of Ventilation	Extension, N (%)	Horizontal, N (%)	Flexion, N (%)
Without mouth gag	36 (97.3)	35 (94.6)	35 (94.6)
With mouth gag	36 (97.3)	35 (94.6)	30 (81.1)

* The chi-square test was used for statistical analysis. There were no statistically significant differences.

Table 3. Numbers of Cases Classified by Kind of Treatment*

Conservative Treatment	Minor Oral Surgeries
36	9

* Conservative treatment includes cavity filling and minor oral surgeries include tooth extraction and gingivectomy.

was placed through the nostril into the pharynx with its tip about 10 mm from the epiglottis in order to prevent laryngospasm. Although the tube was effective in supplying oxygen and nitrous oxide gas, it could not completely prevent airway obstruction and water dripping back from the mouth. This was because the cuff was not close to the tongue base and could not seal the airway from the mouth to the larynx even when it was inflated. Consequently, the dentist had to maintain an uncomfortable posture, and the dental hygienist needed to maintain proper head tilt as well as forward jaw thrust to ensure a patent airway. Effective water suctioning was also needed to prevent coughing.

CNT ventilation has some limitations. First, like the laryngeal mask airway, it has poor ability to prevent airway closure compared to ventilation with an endotracheal tube. Thus, anesthesiologists must carefully monitor spontaneous respiration with their hand on the bag during CNT ventilation because the airway may occasionally get obstructed when the operator changes the patient's head tilt or opens the mouth more widely.¹³ In this study, we were unable to achieve good ventilation of the lungs of 2 patients with obstructive sleep apnea syndrome and trismus. Thus, we avoid using this method in patients with morbid obesity or trismus. Secondly, CNT ventilation can induce laryngospasm or gastric insufflation if the tube is inserted too deeply or if the larynx moves during swallowing. Thirdly, we have not investigated its effectiveness while using muscle relaxants. Its use should therefore be limited to cases in which endotracheal intubation can be performed during an emergency.

CONCLUSION

CNT ventilation has been shown to be superior to mask ventilation for dental treatment under general anesthesia, though it has limitations.

REFERENCES

- Asahi Y, Kubota K, Omichi S. Dose requirements for propofol anaesthesia for dental treatment for autistic patients compared with intellectually impaired patients. *Anaesth Intensive Care*. 2009;37:70–73.

2. Burkle CM, Walsh MT, Harrison BA, Curry TB, Rose SH. Airway management after failure to intubate by direct laryngoscopy: outcomes in a large teaching hospital. *Can J Anaesth*. 2005;52:634–640.
3. Johansen K, Holm-Knudsen RJ, Charabi B, Kristensen MS, Rasmussen LS. Cannot ventilate-cannot intubate an infant: surgical tracheostomy or transtracheal cannula? *Paediatr Anaesth*. 2010;20:987–993.
4. Kawamoto M. Management of the difficult airway [in Japanese]. *Masui*. 2010;59:1142–1145.
5. Martin LD, Mhyre JM, Shanks AM, Tremper KK, Kheterpal S. 3,423 emergency tracheal intubations at a university hospital: airway outcomes and complications. *Anesthesiology*. 2011;114:42–48.
6. Ueda N, Krita T, Imai Y, et al. Dental injury associated with general anaesthesia and the preventive measures [in Japanese]. *Masui*. 2010;59:597–603.
7. Adolphs N, Kessler B, von Heymann C, et al. Dentoalveolar injury related to general anaesthesia: a 14 years review and a statement from the surgical point of view based on a retrospective analysis of the documentation of a university hospital. *Dent Traumatol*. 2011;27:10–14.
8. Flynn P, Ahmed FB, Mitchell V, Patel A, Clarke S. A randomised comparison of the single use LMA Flexible with the reusable LMA Flexible in paediatric dental day-case patients. *Anaesthesia*. 2007;62:1281–1284.
9. Ariska H, Matsumoto M, Furuya M, Sakuraba S, Yoshida K. Application of nasal flexible laryngeal mask airway in anesthesia for oral surgery. *J Anesth*. 2007;21:99–101.
10. Ho-Tai LM, Devitt JH, Noel AG, O'Donnell MP. Gas leak and gastric insufflation during controlled ventilation: face mask versus laryngeal mask airway. *Can J Anesth*. 1998;45:206–211.
11. Kristensen MS. Tube tip in pharynx (TTIP) ventilation: simple establishment of ventilation in case of failed mask ventilation. *Acta Anaesthesiol Scand*. 2005;49:252–256.
12. Bund M, Walz R, Lobbes W, Seitz W. A tube in the pharynx for emergency ventilation. *Acta Anaesthesiol Scand*. 1997;41:529–530.
13. Sanuki T, Sugioka S, Hirokane M, et al. Optimal degree of mouth opening for laryngeal mask airway function during oral surgery. *J Oral Maxillofac Surg*. 2011;69:1018–1022.