

Nasotracheal Intubation

A Randomized Trial of Two Methods

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Background: Several techniques have been suggested to reduce the trauma of nasotracheal intubation, although no comparative studies exist. The authors evaluated red-rubber catheters as a guide to nasotracheal intubation.

Methods: Children presenting for elective surgery were randomized to undergo red-rubber catheter-guided nasotracheal intubation or to have the nasotracheal tube alone inserted. After general anesthesia and paralysis with vecuronium, the nares were prepared with topical vasoconstrictor. The nasotracheal tube was softened with warm water. In the catheter-guided group, the nasotracheal tube tip was fitted to the trailing end of the red-rubber catheter, and the two were advanced together. The red-rubber catheter was retrieved from the nasopharynx, disconnected, and removed. In the other group, the nasotracheal tube was advanced blindly into the nasopharynx. In both groups, intubation was then completed during direct laryngoscopy using Magill forceps. A blinded observer swabbed the pharynx and rated the severity of bleeding based on reference photographs.

Results: Age, weight, snoring history, and difficulty of intubation were not different between groups. Obvious bleeding was lower using the red-rubber catheter technique (10 vs. 29%, $P = 0.013$), which took longer to perform (74 vs. 56 s, $P = 0.02$).

Conclusions: Although the incidence of bleeding in both groups was similar, severity of bleeding was reduced in the catheter-guided group during nasotracheal intubation. Use of a red-rubber catheter may reduce the trauma associated with nasotracheal intubation.

SURGICAL procedures in the oral cavity often require nasotracheal intubation (NTI) to facilitate surgical access. The potential for trauma is inherently greater with NTI than with orotracheal intubation because the tube passes through the narrow nasal passages.

Advancement of the nasotracheal tube (NETT) can traumatize nasal passages, causing bleeding, bacteremia, avulsion of a turbinate, or even retropharyngeal dissection. In prospective series, the incidence of bleeding is

high, ranging from 18 to 77%, even in experienced hands.¹⁻⁶

The intermediate step in NTI, usually performed blindly as the NETT is passed from the naris to the nasopharynx, is particularly traumatizing. Many suggestions have been made to reduce the potential for trauma at this juncture (see Discussion), but comparative studies are lacking. The only prospective trials have been to document the efficacy of warming the NETT in hot water before insertion^{5,6} and the use of a vasoconstrictor.⁷

We performed a randomized, controlled, blinded study to determine the incidence of bleeding with controls *versus* a technique that uses a red-rubber catheter passed in advance of the endotracheal tube.⁸

Methods

After institutional approval (Children's Hospital and Regional Medical Center, Seattle, WA) and informed parental consent, we enrolled children from 4 to 10 yr of age presenting for dental care during general anesthesia for whom NTI was planned. Exclusion criteria were a history of latex allergy, recurrent epistaxis, nasal polyposis, risk of gastroesophageal reflux, or any contraindication to NTI, such as previous palatoplasty, cyanotic heart disease, chronic sinusitis, abnormal coagulation status, use of antiinflammatory medication in the preceding week, or a difficult or potentially difficult airway.

Demographics recorded were sex, weight, and age. Patients received a standardized anesthetic, including midazolam premedication (0.5 mg/kg), inhalational sevoflurane induction, vecuronium (0.1 mg/kg), topical vasoconstrictor (4 drops oxymetazoline in each naris), preoxygenation, and maintenance with halothane or isoflurane. A nasal RAE uncuffed tube with a Murphy eye was selected for the patient according to the formula $(\text{age}/4) + 3.5$, and the endotracheal tube was softened with warm water.⁵

Patients were randomized by a computer-generated random table to one of two groups, using sealed envelopes that were opened at the induction of anesthesia. Intubations were performed by the anesthesiologist assigned to the case, encompassing 12 anesthesiology faculty and 20 anesthesia residents. In the catheter-guided group, the red-rubber catheter was advanced into the nasopharynx. The trailing end of this catheter was fitted around the tracheal tip of the NETT, and the two were advanced together through the nasopharynx. The red-rubber catheter was withdrawn from the oropharynx

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Received from the Department of Anesthesiology, Children's Hospital and Regional Medical Center, Seattle, Washington. Submitted for publication March 14, 2001. Accepted for publication July 19, 2001. Supported by the Department of Anesthesiology, Children's Hospital and Regional Medical Center, Seattle, Washington.

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using Magill forceps, disconnected from the NETT, and removed. The intubation was then completed during direct laryngoscopy using Magill forceps. In the control group (NETT group), the softened NETT was advanced blindly into the nasopharynx, and intubation was completed during direct laryngoscopy with the Magill forceps. The number of attempts through each naris was recorded, as was the level of training of the anesthesiologist performing the intubation, and his or her assessment of the difficulty of intubation *versus* other nasal intubations on a scale from 1 to 10.

The dentist performing the surgery remained outside the room during intubation and acted as the blinded observer to assess bleeding, using the following method to grade bleeding in the pharynx immediately after intubation. Using Magill forceps and folded 4 × 4-in gauze, the dentist swabbed the posterior pharynx in a square pattern and then removed the gauze to inspect it for blood and tissue. This was graded as either “trace of blood” or “obvious bleeding,” with the aid of illustrative photographs as a reference.

Statistics

Sample size estimation was based on a previous report of a 33% incidence of bleeding.² Results from the current study were deemed to be clinically significant if this rate of bleeding could be cut by two thirds. The sample size estimate, based on an α of 0.05 and a β of 0.2 to detect a reduction in bleeding from 33 to 10%, was 49 patients per group. Data are presented as median (25th percentile, 75th percentile). Ordinal values and nonparametric continuous data were compared using the Wilcoxon rank sum test, and proportions were compared using the Fisher exact test.

Results

Groups were similar with respect to age, weight, and history of snoring, previous tonsillectomy, or recent cold (table 1). As indicated in table 1, intubation with the red-rubber catheter method was associated with a significant reduction in obvious bleeding. The red-rubber catheter technique took longer to perform than control intubations, although there was no difference between groups in the self-rated difficulty of performing the intubation. There were significantly more attempts at intubation in the control group, and both nares were entered significantly more often in the control group. The right nare was entered in 71% of patients, and the left nare was entered in 40% of patients. In the control group, in which the asymmetric endotracheal tube tip made first contact with the mucosa, the right nare was entered in 69% of patients, and the left nare was entered in 51% of patients.

The presence of particulate matter was noted in only two patients, one in each group. Bleeding was severe

Table 1. Comparison of Intubation Techniques

	NETT Only N = 51	Red Rubber Catheter N = 52	P Value
Female	23 (45%)	21 (40%)	0.69
Age (yr)	5.3 (4.3, 6.7)	5.3 (4.6, 6.6)	0.81
Weight (kg)	20 (18, 23)	20 (17, 23)	0.81
Snoring history	23 (45%)	20 (38%)	0.55
Recent URTI	15 (29%)	15 (29%)	1.0
Attending intubated	24 (47%)	29 (56%)	0.43
Intubation attempts	1 (1, 2)	1 (1, 1)	0.0018
Both nares entered	9 (18%)	1 (2%)	0.008
Difficulty rating	1 (1, 3)	2 (0.3, 3)	0.76
Time to intubate (s)	59 (42, 88)	74 (56, 87)	0.045
Obvious bleeding	15 (29.4%)	5 (9.6%)	0.013

Values are median (25th, 75th percentile) or N (%), as appropriate.

NETT only = blind nasal advancement of nasotracheal tube; red rubber catheter = nasal advancement of red rubber catheter, with nasotracheal tube attached to trailing end of catheter; recent URTI = upper respiratory tract infection within preceding 3 weeks.

enough to require suctioning in addition to throat swabbing in four patients. In one patient, the leak around the NETT was large, necessitating a change of tube; study endpoints were collected before this tube was changed. Children who had undergone previous tonsillectomy or adenoidectomy (10 patients) had the same incidence of bleeding during intubation as those who had not ($P = 0.36$). Similarly, those who had a history of recent upper respiratory infection (within the preceding 3 weeks) were not at greater risk of bleeding during NTI ($P = 0.35$).

Discussion

Using a red-rubber catheter to guide a softened NETT, we found a decrease in severity of nasopharyngeal bleeding *versus* using the softened NETT alone. There were fewer attempts at intubation, and intubation took longer with the red-rubber catheter technique.

Trauma is inevitable when a large tube is passed through the narrow nasal passages. Several suggestions to facilitate passage of the tube have been made; these suggestions can be divided into three groups. (1) A tube passed through the lumen of the NETT and beyond its tip prevents blockage of the NETT lumen, helps to part the tissues for its passage, and (if a suction catheter is used) can clear the secretions encountered.⁴ However, the resulting step in diameter from the inner catheter to the NETT presents a rough edge at the advancing tip that could traumatize the nasal passage. (2) The nasal passage can be prepared by passing a series of nasal airways, purportedly to dilate the passage,⁹ although this consumes time and resources and requires multiple passes, which may increase trauma. (3) The distal end of the endotracheal tube can be covered to minimize trauma from the leading edge, *e.g.*, with a fingertip from a rubber glove. However, this poses the risk of a misplaced foreign body.¹⁰ Of all the suggestions, the tech-

nique using a red-rubber catheter fitted over the end of the NETT⁸ appealed to us as a simple and atraumatic technique.

Other suggestions for reducing trauma during NTI have been made. A prospective controlled study showed a significant reduction in bleeding when the tube was softened by soaking it in hot water, as we did.^{5,6} Second, because nasal diameters fluctuate in cycles,¹¹ it is helpful to select the most patent naris before intubation by comparing airflow or probing with a swab used to apply topical vasoconstrictor.¹²

There was no detected difference in the self-reported difficulty of performing either intubation technique. However, we did not formalize our assessment of difficulty of intubation and did not distinguish between various difficulties in visualizing the larynx, adequacy of relaxation, or insertion of the tube, as previously published.¹³

Our results may have been subject to the Hawthorne effect, *i.e.*, a change in behavior due to an awareness of being studied.¹⁴ The person performing intubation may have proceeded more cautiously than usual, knowing that bleeding was being assessed. This effect is probably the same for both groups and would thus only influence the overall rate of bleeding.

We chose to study this age range to emphasize the age range when adenoidal hypertrophy is likely to be prevalent. We used muscle relaxation to ensure that patient movement did not exacerbate nasal trauma during intubation. When NTI is used for potentially difficult airways (*e.g.*, trismus, temporomandibular joint dysfunction, or known difficult laryngoscopy), it is important to maintain spontaneous ventilation. We specifically excluded difficult airways because this was not a proven airway technique. We can only speculate that our conclusions apply to the awake or the anesthetized, spontaneously ventilating patient.

Our method of assessing bleeding was simple and reproducible but has its weaknesses. It is difficult to ensure that the technique of swabbing the pharynx was consistent. It was not practical to have the same dentist act as observer for all patients, but the same research associate was present for all studies, helping to keep the technique consistent by advising the dentist. Swabbing may not have retrieved all blood in the pharynx. Although direct visualization of the pharynx would have been more sensitive in this regard, quantitation of bleed-

ing would have been more difficult. It would be difficult to quantify bleeding during emergence from anesthesia in children; we have not assessed bleeding after *removal* of the NETT,⁷ when further bleeding may have occurred as the tamponade effect of the tube pressing on the nasal mucosa was released.

Blood in the airway can make an easy intubation difficult, obscuring the view of the larynx and increasing the potential for aspiration of blood. If this technique can decrease bleeding, we speculate that it may therefore increase patient safety. Minor drawbacks to the technique are that it requires an additional disposable item and entails exposure to latex. Future studies may be able to show further reductions in severity of bleeding or ease of performing NTI when alternative techniques are prospectively compared.

The authors thank Bryan Williams, D.D.S., M.S.D., M.Ed. (Director, Department of Dental Medicine, Children's Hospital and Regional Medical Center, Seattle, Washington, and Affiliate Associate Professor, Departments of Pediatric Dentistry and Orthodontics, Faculty of Dentistry, University of Washington), and the Department of Dental Medicine for helping with the study.

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