A New Technique to Reduce Epistaxis and Enhance Navigability During Nasotracheal Intubation

Kwang Suk Seo, MD*
Jae-Hun Kim, MD†
Sol Mon Yang, MD†
Hyun Jeong Kim, MD*
Jae-Hyon Bahk, MD†
Kwang Won Yum, MD*

BACKGROUND: Epistaxis is the most common complication of nasotracheal intubation. We compared endotracheal tubes (ETT) obturated with an inflated esophageal stethoscope with normal ETTs with regard to the prevention of epistaxis and navigability, both with and without thermosoftening.

METHODS: Dental surgical patients requiring nasotracheal intubation were randomly allocated into 1 of 4 groups (n = 50 each): Group 1, nonthermosoftened ETTs; Group 2, nonthermosoftened ETTs obturated with an inflated esophageal stethoscope; Group 3, thermosoftened ETTs; and Group 4, thermosoftened ETTs obturated with an inflated esophageal stethoscope. Navigability of ETTs through the nasal cavity and postintubation epistaxis were evaluated.

RESULTS: Navigability of ETTs through the nasal cavity was the worst in Group 1 (P < 0.001). Epistaxis was the most severe in Group 1, similar between Groups 2 and 3, and the least severe in Group 4 (P < 0.001).

CONCLUSION: The use of esophageal stethoscope-obturated ETTs was effective, and comparable to thermosoftening, in preventing epistaxis associated with nasotracheal intubation. Thermosoftened, obturated ETTs were more effective than simple thermosoftened ETTs in reducing epistaxis.

(Nasotracheal intubation may cause nasal mucosa or concha damage (1). The most common complication associated with nasotracheal intubation is epistaxis (2,3). Even obstruction of an endotracheal tube (ETT) by a torn nasal tissue has been reported (4,5).

Nasal and nasopharyngeal mucosal damage during nasotracheal intubation seems to be caused by a rigid tip or a sharp-edged Murphy eye of conventional ETTs (6–8). Many methods have been suggested to decrease trauma associated with nasotracheal intubation, including thermosoftening of the ETT (7,9), use of a red rubber airway or catheter as a guide (6,10), and obturation of the nasotracheal tube with an intraluminal balloon at the ETT tip (8,11).

Obturation of the ETT tip with an inflated esophageal stethoscope has been suggested (11), but not tested, for reducing epistaxis. We hypothesized that the round, obturated ETT tip would facilitates easy passage through the nasal cavity, minimizing nasal trauma. This study was performed to assess whether obturation of a conventional, Murphy-tipped ETT with an inflated stethoscope reduces epistaxis and enhances navigability through the nasal cavity, and to compare the benefit (if any) of obturation with that of thermosoftening.

METHODS

After obtaining IRB approval and written informed consent, 200 adult patients, who were ASA physical status I or II and <65-yr-old, were enrolled. All patients were scheduled for elective dental surgery requiring nasotracheal intubation to optimize the surgical approach. Procedures comprised 68 orthognathic surgeries, 7 mandible fracture fixations, 44 benign tumor excisions, 15 surgical tooth extractions, 6 plate removals, 30 oral cancer surgeries, 24 multiimplant insertions, 4 abscess drainages, and 2 temporomandibular joint surgeries. Patients were excluded if they had a documented history of difficult intubation, a potentially difficult airway suggested by physical examination, obstructive sleep apnea, a history of nasal surgery, nasal trauma, nasal deformity, recurrent epistaxis, or bleeding diathesis, a history of taking anticoagulant drugs, or risks for aspiration.

No preanesthetic medication was administered. After applying routine monitoring, such as an electrocardiogram, pulse oximetry, capnometry, and noninvasive arterial blood pressure, patients were placed in the supine position with the head on a 8-cm-high pillow. After anesthesia induction using propofol 1.5 mg/kg IV after lidocaine 30 mg IV, and neuromuscular blockade with vecuronium 0.1 mg/kg IV, the lungs were...
ventilated with 7–8 vol % sevoflurane in 100% O₂ via a facial mask.

Murphy-tipped, preformed ETTs (RAETM Nasal, Mallinckrodt Medical, Athlone, Ireland) were used for nasotracheal intubation. A 7.0-mm internal diameter ETT was used for men and a 6.5-mm internal diameter ETT for women. Patients were randomized to one of following four groups using sealed envelopes opened after induction of anesthesia.

Group 1: ETTs were put into a bottle of sterilized saline at room temperature (24°C ± 1°C).
Group 2: ETTs obturated with an inflated esophageal stethoscope were put into a bottle of sterilized saline at room temperature (24°C ± 1°C).
Group 3: ETTs were put into a bottle of sterilized saline warmed to 40°C ± 1°C.
Group 4: ETTs obturated with an inflated esophageal stethoscope were put into a bottle of sterilized saline warmed to 40°C ± 1°C.

In Groups 2 and 4, the proximal end of a 12F pediatric esophageal stethoscope (Premier series™, De Royal Industries, Inc., Powell, TN) was connected to a 10-mL syringe via a 3-way stopcock. Air inside the distal balloon of a stethoscope was completely aspirated using the syringe before insertion into the ETT. After lubrication with water-soluble jelly, the stethoscope was advanced into the ETT and positioned with its tip protruding about 0.5 cm out of the distal end of the ETT. Injecting about 2 mL of air and locking the 3-way stopcock kept the distal tip of the balloon inflated (11) (Fig. 1). All ETTs, with or without an inflated esophageal stethoscope, were lubricated with water-soluble jelly immediately before intubation.

During the preanesthetic interview, patients were questioned as to which nostril was easier to breathe through. The selected nostril was chosen for intubation. If breathing conditions were equal bilaterally, then the left nostril was chosen because of surgeons’ preference.

Figure 1. Esophageal stethoscope and endotracheal tube combination. The proximal end of a pediatric esophageal stethoscope was connected to a syringe via 3-way stopcock with its tip protruding about 0.5 cm out of the distal end of an endotracheal tube. Injecting about 2 mL of air and locking the 3-way stopcock keeps the distal tip of the balloon inflated. Inset: Enlarged view of the endotracheal tube tip.
Epistaxis and Navigability During Nasotracheal Intubation

Table 1. Patient and Intubation Characteristics

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>39 ± 17</td>
<td>36 ± 17</td>
<td>38 ± 16</td>
<td>37 ± 15</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>60 ± 11</td>
<td>62 ± 12</td>
<td>66 ± 15</td>
<td>62 ± 10</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>165 ± 9</td>
<td>168 ± 8</td>
<td>167 ± 9</td>
<td>167 ± 7</td>
</tr>
<tr>
<td>ASA grade (I/II)</td>
<td>36/14</td>
<td>42/8</td>
<td>40/10</td>
<td>42/8</td>
</tr>
<tr>
<td>Intubation characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nostril (right/left)</td>
<td>22/28</td>
<td>18/32</td>
<td>23/27</td>
<td>19/31</td>
</tr>
<tr>
<td>Attempts (1/2/3)</td>
<td>45/5/0</td>
<td>46/3/1</td>
<td>47/1/2</td>
<td>44/6/0</td>
</tr>
<tr>
<td>Navigability (smooth/impinged)</td>
<td>27/23*</td>
<td>35/15</td>
<td>39/11</td>
<td>43/7</td>
</tr>
</tbody>
</table>

Values are mean ± sd or number of patients.

Group 1, nonthermosoftened endotracheal tubes; Group 2, nonthermosoftened endotracheal tubes that were obturated with an inflated esophageal stethoscope; Group 3, thermosoftened endotracheal tubes; and Group 4, thermosoftened endotracheal tubes that were obturated with an inflated esophageal stethoscope.

* P < 0.001 versus the other three groups.

Table 2. Severity of Epistaxis and Incidence of Nasal Complications After Nasotracheal Intubation

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistaxis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>7</td>
<td>16</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>Slight</td>
<td>22</td>
<td>21</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Moderate</td>
<td>19</td>
<td>12</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Severe</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nasal pain</td>
<td>15</td>
<td>12</td>
<td>10</td>
<td>3†</td>
</tr>
<tr>
<td>Persistent bleeding</td>
<td>7 5</td>
<td>5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Difficult nasal breathing</td>
<td>0 0</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Blood crust or mucosal tearing</td>
<td>13</td>
<td>6</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Values are number of patients.

N = 50 in each group.

Group 1, nonthermosoftened endotracheal tubes; Group 2, nonthermosoftened endotracheal tubes that were obturated with an inflated esophageal stethoscope; Group 3, thermosoftened endotracheal tubes; and Group 4, thermosoftened endotracheal tubes that were obturated with an inflated esophageal stethoscope.

The severity of epistaxis was graded according to the distance that blood traveled up the suction catheter and tubing: none = no blood aspirated; slight = blood aspirated by <50 cm; moderate = blood aspirated by 50–300 cm; and severe = blood aspirated by >300 cm. Blood crust or mucosal tearing, on the first postoperative day.

Based on the results of a pilot study (n = 30), a power analysis indicated that 50 patients per group would be sufficient to detect the difference in the severity of epistaxis between the nonthermosoftened groups with or without obturation with a power >80% at the level of significance of 0.05. Data are expressed as mean ± sd or number of patients. Patients’ characteristics were compared by ANOVA or χ² test as appropriate. The Kruskal–Wallis test was used to compare the severity of epistaxis and the multiple comparisons among groups were analyzed by the Wilcoxon’s ranked sum test. Intubation characteristics and postprocedure complications were compared using χ² test or Fisher’s exact test. The SPSS software (version 12.0; SPSS Inc., Chicago, IL) was used. P < 0.05 was regarded as significant.

RESULTS

There were no statistical differences among groups regarding age, sex, height, weight, ASA physical status, types of surgery, choice of nostril, and number of attempts to intubate. There were no intubation failures.

After induction of anesthesia, the ETT, with or without obturation or thermosoftening, was inserted through the selected nostril. If some resistance was felt, the tube was withdrawn or rotated and the following manipulations were applied in sequence (9): (a) counterclockwise rotation with gentle cephalad tilting of the tube, (b) reinsertion into the other nostril, and (c) reinsertion into the other nostril with counterclockwise rotation and gentle cephalad tilting of the tube. Two anesthesiologists (HJK and KSS) performed all intubations. In Groups 2 and 4, after advancing the ETT into the oropharynx, all air inside the esophageal stethoscope was aspirated, and the stethoscope was removed from the ETT. All intubations were completed using a fiberoptic bronchoscope (LF-2, Olympus, Tokyo, Japan).

The anesthesiologists who performed the intubations recorded the number of attempts to insert the ETT into the nasal cavity and estimated the degree of navigability through the nasal passage, defined as smooth or impinged (any subjective feeling of obstruction while passing an ETT) (9). Another anesthesiologist who was blinded to the groups estimated the severity of epistaxis 5 min after the intubation. Epistaxis was measured by aspirating the pharynx using a 14F, 50-cm-long suction catheter connected to a 2.5-m-long suction tubing at a pressure of 100 mm Hg. Epistaxis severity was graded according to the distance that blood traveled up the suction tubing (9,12): none = no blood aspirated; slight = blood aspirated by <50 cm; moderate = blood aspirated by 50–300 cm; and severe = blood aspirated by >300 cm. Before discharge from the postanesthesia care unit, all patients were checked for difficulty with nasal breathing, persistent nasal bleeding, and postoperative nasal pain. The anesthesiologist who had checked epistaxis assessed the nasal damage, such as blood crust and mucosal tearing, on the first postoperative day.
Navigability of the ETT through the nasal cavity was the worst in Group 1 ($P = 0.001$, Table 1). The incidence of nasal bleeding was 86% in Group 1, 68% in Group 2, 64% in Group 3, and 40% in Group 4. Based on the multiple comparisons, Group 1 had the most severe epistaxis, and Group 4 had the least severe epistaxis ($P < 0.001$, Table 2).

Postoperative nasal pain was less frequent in Group 4 than in all the other groups ($P = 0.003$). Mucosal injury was more frequent in Group 1 than in all the other groups ($P = 0.002$, Table 2). There were no significant differences among groups in the incidences of difficult nasal breathing or persistent bleeding. Even in cases of severe bleeding in Groups 2 and 4, fiberoptic bronchoscope-guided intubation provided clear views, succeeding in advancing the fibroscope immediately.

**DISCUSSION**

The esophageal stethoscope-obturated ETT was comparable to the thermosoftened ETT in regard to the incidence and severity of epistaxis. The obturated, thermosoftened ETT was more effective in reducing epistaxis than the thermosoftened ETT. Balloon-obturation or thermosoftening of ETT tips were effective in enhancing navigability through the nasal cavity.

Several methods have been used to reduce epistaxis during nasotracheal intubation. Topical vasoconstrictors, such as epinephrine, phenylephrine, xylometazoline, oxymetazoline, and cocaine, can reduce epistaxis (13,14). However, these have been associated with life-threatening complications such as arrhythmia, myocardial infarction, and cardiac arrest (15–17). Therefore, the use of topical vasoconstrictors should be restricted, especially in patients with coronary artery disease.

Thermosoftening is a well known and effective technique for reducing epistaxis (7,9), but it is not without risks. Overheating can distort and obstruct the ETT, particularly at the tube’s weakest point where the dilation lumen opens into the cuff (18), so that the temperature of saline must be controlled. Therefore, there is a need for a risk-free, economical nasotracheal intubation.

Use of a red rubber catheter or airway (6,10) or obturation of the ETT tip with an intraluminal balloon (8) can also reduce epistaxis. After passing through the nasal cavity, the disposable catheter or airway should be removed through the oral cavity with forceps and discarded. A commercial intraluminal balloon has been developed (8), but is not widely available.

One of our authors (J-HB) suggested in a correspondence that an esophageal stethoscope and ETT combination could reduce the trauma of nasotracheal intubation (11). Indeed, the esophageal stethoscope used for obturating the ETT could then be recycled as a stethoscope for the same patient.

Although a Murphy-tipped ETT is more traumatic than a Magill-tipped ETT (9), only a Murphy-tipped ETT was used in this study because it seems to be used more frequently in clinical anesthesia. Prior studies have shown that a rounder or softer ETT tip is less traumatic for nasotracheal intubation (8,9,12). In this study, the main reason for the effectiveness of the obturated ETT seems to be that, while advancing through the nasal cavity, the advancing surface is a round balloon end. Simultaneous sealing of the Murphy eye may provide additional protection against nasal trauma.

There are some limitations to this study. First, consistent with our routine practice, we did not use a topical vasoconstrictor. Second, as previously mentioned, Magill-tipped ETTs were not studied. A further study about obturation of Magill-tipped ETTs may be needed. Lastly, navigability and postoperative nasal pain could not be quantitatively assessed. There is no practical way to objectively evaluate the navigability through the nasal cavity. For evaluation of the nasal pain, there were confounding factors, such as type of surgery and postoperative analgesia. However, since types of surgeries were evenly distributed among the four groups, we believe that the interpretation of the results would not change.

During nasotracheal intubation, obturation of the ETT with an inflated esophageal stethoscope was as effective as thermosoftening in the prevention of nasal trauma and the navigability through the nasal cavity. The best combination included both thermosoftening and obturation of the ETT to minimize trauma and epistaxis.

**REFERENCES**