Risk Factors for Postoperative Sore Throat After Nasotracheal Intubation

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Objective: Postoperative sore throat is relatively frequent complication after orotracheal intubation. However, there are few reports about postoperative sore throat in nasotracheal intubation. In this retrospective study, we investigated the risk factors of postoperative sore throat in nasotracheal intubation.
Methods: Anesthesia records of patients 16 to 80 years of age who underwent nasotracheal intubation were included. Patients underwent oral and maxillofacial surgery from February 2015 until September 2018. Airway device (Macintosh laryngoscope, Pentax-AWS, or McGRATH video laryngoscope, or fiberoptic scope), sex, age, height, weight, American Society of Anesthesiologists classification, intubation attempts, duration of intubation, intubation time, tube size, and fentanyl and remifentanil dose were investigated. Fisher exact test, Wilcoxon rank sum test, Welch *t* test, and Steel-Dwass multiple test were used, and a multivariable analysis was performed using stepwise logistic regression to determine the risk factors of postoperative sore throat.
Results: A total of 169 cases were analyzed, and 126 patients (74.6%) had a postoperative sore throat. Based on the univariate analysis of the data, 12 factors were determined to be potentially related to the occurrence of a postoperative sore throat. However, after evaluation using stepwise logistic regression analysis, the 2 remaining variables that correlated with postoperative sore throat were airway device ($P < .05$) and intubation attempts ($P = .04$). In the model using logistic regression analysis, the fiberoptic scope had the strongest influence on the incidence of sore throat with reference to Pentax-AWS (odds ratio = 5.25; 95% CI = 1.54–17.92; $P < .05$).
Conclusion: Use of a fiberoptic scope was identified as an independent risk factor for postoperative throat discomfort. Compared with direct laryngoscopy and other video laryngoscopes, the use of a fiberoptic scope had a significantly higher incidence of sore throat.

Key Words: Nasotracheal intubation; Airway device; Sore throat; General anesthesia.

Postoperative sore throat is a common complication following general anesthesia with orotracheal intubation. It has been reported as one of the most undesirable postoperative outcomes and may influence patient satisfaction the most.[1–4] However, there is very little information regarding postoperative sore throat following nasotracheal intubation,[1] which may be accomplished directly or indirectly. Direct laryngoscopy is widely used tracheal intubation[5–7]; however, difficult and failed intubations still occur.[6,8,9] Difficulty with tracheal intubation can lead to problems like vocal cord damage and hypoxemia.[5–10]

Recognition of the limitations of direct laryngoscopy has led to the development of airway devices that do not require a direct glottic view.[7] Several studies have reported on the use of video laryngoscopes for patients who are difficult to intubate.[10–13] Video laryngoscopy enables clear visualization of the larynx and can help facilitate easy intubation, although it is no guarantee for success as intubation is impacted by many factors including airway anatomy, prior history of difficult intubation, and the anesthesia provider's clinical skills and experience.[5,14–16] In cases involving significant edema, infection, deformities of facial and/or pharyngeal structures, or trauma, many anesthesiologists prefer the use of a flexible fiberoptic scope for

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nasotracheal intubation.[14] Although direct and video laryngoscopy can provide an unimpeded view of the airway during intubation, Magill forceps are often needed to manipulate nasotracheal tube passage through the glottis.[17–19] Additionally, advancement of the endotracheal tube (ETT) over the fiberoptic scope is performed blindly,[20–22] and resistance may occur during as the ETT passes through the vocal cords due to impingement on the arytenoid cartilages, interarytenoid soft tissue, the anterior commissure of the glottis, or the anterior wall of the cricoid cartilage.[15,16] Even under ideal views, successfully guiding the ETT into the trachea is sometimes more difficult for nasotracheal compared with orotracheal intubation and may take longer, resulting in a postoperative sore throat.[12]

The primary aim of this study was to determine the incidence of and risk factors for postoperative sore throat following nasotracheal intubation for oral and maxillofacial surgery. Secondary aims were to assess the degree and duration of postoperative sore throat and the incidence of hoarseness associated with nasotracheal intubations. We hypothesized that postoperative sore throat is influenced by the intubating conditions and utilized airway devices, especially the use of a fiberoptic scope, which would have higher incidence or more severe sore throat due to difficulty advancing the ETT.

METHODS

The Ethics Review Board of Kyushu University Hospital approved this retrospective study (Approval No. 30-351) on November 20, 2018. The study period was from February 2015 until September 2018. Patients who underwent general anesthesia for oral and maxillofacial surgery except for trauma and reconstruction were included. Patients who had upper respiratory tract disease, gastric regurgitation, and preoperative hoarseness or sore throat were excluded.

Patients received no premedication and were continuously monitored using pulse oximetry, electrocardiography, a noninvasive blood pressure cuff, and a bispectral index (BIS) monitor. Patients were placed supine with their head resting on a pillow. General anesthesia was induced with propofol 1-2 mg/kg, atropine 0.1-0.5 mg, remifentanil infusion 0.1-0.5 μg/kg/min, and fentanyl 1-4 μg/kg. Facilitated with rocuronium, nasotracheal intubation was performed using either a traditional laryngoscope with a Macintosh blade (Smiths Medical Japan), one of two video laryngoscopes (Pentax-AWS; Pentax Corporation or McGRATH; Covidien), or a flexible fiberoptic scope (HOYA). Intubation was performed with a cuffed 6.5 to 7.5 mm ID nasotracheal tube (Portex; Smiths Medical Japan) sized using the formula for age, height, or weight.[2] If necessary, Magill forceps were used to advance the ETT into the trachea. Either the resident or attending anesthesiologist performed the intubation. After confirming successful endotracheal positioning, the ETT cuff was inflated with air to maintain 20 cm H_2O pressure. Anesthetic maintenance as determined by each anesthesiologist was sevoflurane 1%-2.5%, isoflurane 1%-2%, or desflurane 3%-6%, plus oxygen/air (0.7-2/1.3-2 L/min), with end-tidal carbon dioxide maintained at 35 to 45 mm Hg and BIS between 37 and 64. In addition, fentanyl 100-500 μg and remifentanil infusions 0.1-0.5 μg/kg/min were administered for analgesia to all patients, and at the end of the procedure a diclofenac suppository 50-100 mg was inserted. Additional neuromuscular blocking drugs were used if necessary. During surgery, local anesthesia with a vasoconstrictor (lidocaine with 1:200,000 epinephrine) were used in all cases. The dose of local anesthesia was dependent on the surgeon.

After surgery, all anesthetics were discontinued following tracheal or gastric suctioning. Mechanical ventilation was stopped once the patients regained spontaneous respiratory efforts. After observing spontaneous regular respirations and upper airway patency, patients were smoothly extubated awake. Once respiratory and hemodynamic parameters were stable, patients were transferred back to their rooms.

The following variables were recorded: airway device, sex, age, height, weight, American Society of Anesthesiologists classification, intubation attempts, duration of intubation, intubation time, tube size, and fentanyl and remifentanil dosing. The presence, duration, and severity of laryngeal discomfort and the incidence of hoarseness were recorded postoperatively. An independent observer asked patients about laryngopharyngeal discomfort and hoarseness at 2 and 24 hours following surgery. If the occurrence of laryngeal discomfort was recorded, its intensity was assessed using a 0- to 100-mm visual analog scale (VAS), where 0 mm represented no pain and 100 mm the worst pain imaginable.

Statistical Analysis

Nonparametric methods were used to statistically evaluate the data using R version 4.0.2 (R Foundation for Statistical Computing). Fisher exact test, Wilcoxon rank sum test, Welch *t* test, and Steel–Dwass multiple comparisons were used to compare the groups for univariate analysis. Multivariate analysis was performed using stepwise logistic regression to separately determine

Table 1. Univariate Analysis: Postoperative Sore Throat Risk Factors*

	Sore throat group (n = 126)				*Nonsore throat group (n = 43)*				
	DL	*McGRATH*	*Pentax-AWS*	*FIO*	*DL*	*McGRATH*	*Pentax-AWS*	*FIO*	*P value*
Airway device	41	28	23	34	9	15	15	4	<.05†
Sex, m/f	20/21	17/11	12/11	23/11	6/3	7/8	10/5	1/3	1†
Age, y	38.8 ± 17.7	44.1 ± 18.4	37.7 ± 18.4	52.9 ± 18.9	66.2 ± 12.2	51.5 ± 21.5	44.1 ± 20.1	25.3 ± 7.4	.12‡
Height, cm	161.9 ± 9.0	166.6 ± 8.0	164.8 ± 8.5	163.6 ± 6.2	163.7 ± 9.7	159.0 ± 13.4	165.2 ± 6.6	161.2 ± 8.2	.39‡
Weight, kg	59.3 ± 14.0	60.0 ± 11.1	62.1 ± 13.2	59.1 ± 11.8	63.1 ± 13.4	54.5 ± 10.0	63.1 ± 8.6	56.0 ± 7.4	.82‡
ASA classification, 1/2/3	32/9/0	17/11/10	15/8/0	11/22/1	0/9/0	7/8/0	9/6/0	2/2/0	.06§
Intubation attempt, 1st, 2nd, 3rd	29/6/6	27/0/1	21/1/1	27/6/1	9/0/0	12/2/1	15/0/0	4/0/0	.04‡
Duration of intubation, min	209.7 ± 92.0	241.0 ± 125.8	201.9 ± 65.0	246.9 ± 143.9	243.1 ± 68.6	213.2 ± 105.	210.5 ± 95.3	211.0 ± 42.9	.69‡
Intubation time, s	95.8 ± 86.1	81.4 ± 64.8	82.3 ± 75.9	102.9 ± 54.2	59.6 ± 24.2	91.9 ±80.4	69.9 ± 33.7	134.0 ± 65.9	.35‡
Tube size, 6/6.5/7/7.5/8	1/12/12/16/0	0/4/9/15/0	0/4/8/11/0	0/6/8/20/0	0/0/4/5/0	0/5/4/5/1	0/4/1/10/0	0/2/1/1/0	.99‡
Fentanyl, μg	326.8 ± 141.9	391.1 ± 169.1	350.0 ± 87.2	333.8 ± 161.7	377.8 ± 122.7	293.3 ± 293.3	360.0 ± 102.0	375.0 ± 109.0	.82‡
Remifentanil, μg	2296.5 ± 2025.6	2806.6 ± 1932.7	2706.2 ± 1730.5	2402.8 ± 2096.3	1684.5 ± 1063.9	1730.6 ± 1474.8	2432.6 ± 1294.1	2208.1 ± 753.9	.07‡

* Quantitative or qualitative data were shown in means ± SD or number of occurrences, respectively. ASA, American Society of Anesthesiologists; DL, direct laryngoscopy with Macintosh blade; FIO, fiberoptic scope.
† Fisher exact test used to compare the groups for univariate analysis.
‡ Welch *t* test used to compare the groups for univariate analysis.
§ Wilcoxon rank sum test used to compare the groups for univariate analysis.

Table 2. Logistic Regression (Multivariate Analysis) for Postoperative Sore Throat Occurrence*

Airway device	*Odds ratio (95% CI)*	*P value*
Fiberoptic scope	5.25 (1.54–17.92)	<.05
McGRATH	1.18 (0.48–2.94)	.71
Macintosh laryngoscope	2.64 (0.98–7.08)	.05
The attempt of intubation (first/second/third)	1.73 (0.70–4.28)	.23

* In the comparison of airway devices, odds ratios and *P* values were calculated with reference to the Pentax-AWS.

risk factors for postoperative sore throat. All values are expressed as mean ± SD or number of occurrences (n) for quantitative or qualitative data, respectively. Statistical significance was set at a $P < .05$.

RESULTS

A total of 169 cases were enrolled in this retrospective study. There were no intraoperative respiratory complications. Of the 169 cases, 126 (74.6%) reported a postoperative sore throat. The order in terms of descending sore throat incidence was fiberoptic scope 92%, direct laryngoscopy 82%, McGrath 65%, and Pentax-AWS 60% (Table 1).

Per the univariate analysis, we identified 12 factors potentially related to the occurrence of a postoperative sore throat (Table 1). However, after evaluation using stepwise logistic regression analysis, 10 were excluded due to lack statistical significance ($P > .05$), leaving only airway device ($P < .05$) and intubation attempts ($P = .04$).

In the model using logistic regression analysis, only the use of a fiberoptic scope had a strong influence on the incidence of sore throat with reference to Pentax-AWS (odds ratio = 5.25; 95% CI = 1.54–17.92; $P < .05$; Table 2). Pentax-AWS was used as a reference because odds ratios of the other 3 devices compared with it were all >1, suggesting Pentax-AWS was the least influential device.

The severity (postoperative pain as measured by the VAS scale) and duration of postoperative sore throat as well as the incidence of hoarseness following surgery are shown in Table 3. For subjects reporting postoperative sore throat (n = 126), there was a significant difference in VAS means at 2 hours and 24 hours only between the Pentax-AWS and the fiberoptic scope groups ($P < .05$). A similar significant difference in the recovery time for sore throat resolution was noted only between the Pentax-AWS and fiberoptic scope groups ($P < .05$). Hoarseness occurred in 3.6% to 13% of patients.

Table 3. Postoperative Outcomes Following Nasotracheal Intubation Among 4 Intubation Devices*

	Macintosh laryngoscope, n = 41	*McGRATH, n = 28*	*Pentax-AWS, n = 23*	*Fiberoptic scope, n = 34*
Postoperative pain (VAS) at 2 hours after surgery, mm	38.2 ± 31.9	33.2 ± 29.1	28.1 ± 21.4†	46.5 ± 23.7†
Postoperative pain (VAS) at 24 hours after surgery, mm	24.9 ± 24.5	19.3 ± 20.2	11.8 ± 13.9†	29.1 ± 24.0†
Recovery, no. of days	3.0 ± 2.0	2.9 ± 1.7	2.3 ± 1.7†	4.8 ± 3.8†
Hoarseness, n (%)	5 (12)	1 (3.6)	3 (13)	4 (12)

* VAS and recovery were analyzed by Steel-Dwass multiple comparison, and Hoarseness by Fisher exact test. Values shown as means ± SD. VAS, visual analog scale.

† Indicates pairs with significant differences ($P < .05$).

DISCUSSION

In this study, we found the incidence of postoperative sore throat associated with nasotracheal intubations was 74.6% for oral and maxillofacial surgery. Of the 2 postoperative sore throat risk factors identified by univariate analysis, only use of a fiberoptic scope was determined to be statistically significant. Additionally, the higher postoperative sore throat pain scores that took longer to resolve for the fiberoptic scope group were only significant when compared with the Pentax-AWS group. Differences between all other pairs of airway devices in terms of postoperative sore throat, recovery, or hoarseness lacked significance.

It has been reported that the incidence of postoperative sore throat following nasal intubation was higher than that following oral intubation (60%).[3,4] Nasal intubation involves the insertion and passage of the tube from the naris through the nasal cavity to the nasopharynx, which is typically performed blindly and may result in tissue damage.[10,17,21,22] In addition, it has been reported that even when a fiberoptic scope is used, it could be difficult to advance the ETT over the scope and into the trachea due to impediment by the epiglottis, pyriform fossa, or arytenoids.[1,21] This could lead to increased intubation times and possibly more throat pain postoperatively. In this study, intubation time was not found to be a statistically significant factor even though use of a fiberoptic scope did lead to prolonged intubation times compared with other airway devices. However, postoperative sore throat was correlated with use of a fiberoptic scope for intubation.

In clinical practice, direct or video laryngoscopy has been used to advance the tube into the trachea under visualization by manipulating the ETT directly during nasotracheal intubation.[18–20] In these nasotracheal intubation cases, instrumentation with Magill forceps is often needed to guide the tip of tube into the glottis.[20,23] Pressing the distal end of the tube inferiorly with the Magill forceps prevents the tube from catching at the anterior larynx and facilitates smooth advancement into the larynx and the trachea. Accordingly, shorter intubation times, easy intubation and higher success rates of intubation associated with Magill forceps have been reported for nasotracheal intubation.[24]

Several methods have been suggested for reducing postoperative sore throat. In clinical practice, the diameter of the nasotracheal tube size was usually determined by the use of the tube size formula of age, height, or weight.[2] The use of smaller diameter tubes might reduce intubation time and postoperative sore throat or hoarseness.[2–4,15,25] In addition, monitoring the ETT cuff pressure to avoid excessive pressures might also reduce mucosal damage.[26] The application of lidocaine gel to the ETT cuff has been reported to increase the incidence of hoarseness.[26,27] Rotation of a beveled tracheal tube might reduce the difficulty in advancing the ETT as it often allows the bevel to skim past any impingements with ease.[17] In addition, we might have been able to improve pain relief during procedure by altering or maximizing the dosing of opioid (fentanyl) and nonopioid (diclofenac) analgesics.

Limitations

There were also several limitations to this study. In our clinical practice, local anesthesia with a vasoconstrictor (eg, lidocaine with epinephrine) is used to decrease systemic toxicity and increase the duration of local anesthetic action within the operative site. Although lidocaine with epinephrine is commonly used throughout the world and can last for several hours, the average total intubation time for our study was >200 minutes. Accordingly, the effects of the intraoperative local anesthetic may have no longer been effective for postoperative surgical pain relief. We thought a major limitation or potential confounding variable of this study could be patients being unable to distinguish between surgical pain and intubation-related throat pain. Although throat pain and surgical site pain may occur at different sites, patients might have difficulty differentiating between the 2.

Intraoperative analgesics (fentanyl/diclofenac) were given during the case that could also impact the patient's perception of sore throat and/or hoarseness during early recovery (at 2 and 24 hours). We did not evaluate postoperative fentanyl/diclofenac dosing and its potential impact on postoperative sore throat. In addition, we did not evaluate if "bucking" or coughing occurred during emergence/extubation, which certainly could impact postoperative throat pain. The selection of the tube size was dependent on anesthesiologist preference, and the level of experience of the anesthesiologist performing the intubation was not recorded or assessed. In addition, we did not determine from the medical record how many nasotracheal intubations used Magill forceps. In the future, it would be ideal to thoroughly consider these matters.

CONCLUSIONS

This study demonstrated an overall incidence of 74.6% for postoperative sore throat associated with nasotracheal intubations for oral and maxillofacial surgery. Use of a fiberoptic scope was identified as an independent risk factor for throat discomfort postoperatively. Compared with direct laryngoscopy and other video laryngoscopes, the use of a fiberoptic scope had higher incidence a sore throat, possibly due to difficulty advancing the ETT blindly into the trachea.

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