Effects of Application of 2% Lignocaine Jelly and Thermal Softening of Oral Endotracheal Tubes on Post-operative Sore Throat and Hoarseness

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ABSTRACT

Background

Sore throat and hoarseness are common after general anesthesia with endotracheal intubation. Although most of them are mild in severity, they still cause major patient dissatisfaction. There are many pharmacological and non-pharmacological methods to reduce it, but only a few have promising results and minimal side effects.

Objective

To compare the incidence of sore throat and hoarseness in the post-anesthesia care unit and 24 hours after general anesthesia between these groups.

Method

We enrolled 162 patients scheduled for elective abdominal surgery under general anesthesia. This study compared the two routine techniques used at our institute to reduce postoperative sore throat and hoarseness. Patients intubated with lubricated tubes soaked in room temperature saline were assigned to the Normal Tube (NT) group, while those intubated with tubes soaked in saline warmed to 40°C were assigned to the Thermal Tube (TT) group. Numerical data were analyzed using Student's t-test and ANOVA test, whereas categorical variables were analyzed using Pearson's Chi-square test.

Result

At Post Anesthesia Care Unit (PACU), sore throat occurred in 24.69% (17.29% Normal Tube (NT) group vs 7.40% Thermal Tube (TT) group) and hoarseness in 9.87% (7.40% Normal Tube (NT) group vs 2.47% Thermal Tube (TT) group). At 24 hours, sore throat was 20.37% (16.04% Normal Tube (NT) group vs 4.32% Thermal Tube (TT) group), and hoarseness 9.25% (7.40% Normal Tube (NT) group vs 1.85% Thermal Tube (TT) group).

Conclusion

Based on our findings, we recommend routinely using thermally softened endotracheal tubes lubricated with 2% lignocaine jelly for all intubations under general anesthesia, as this significantly reduces postoperative sore throat and hoarseness in the Post Anesthesia Care Unit and at 24 hours.

KEY WORDS

Endotracheal tube, General anesthesia, Hoarseness, Intubation, Sore throat, Thermal softening

INTRODUCTION

Endotracheal intubation is widely used during general anesthesia (GA) to facilitate mechanical ventilation and to protect the airway. Some degree of airway damage can occur in almost all intubated patients, whether they are intubated for a short or long period.[1] Sore throat and hoarseness are common complications following endotracheal (ET) intubation, resulting from injury and inflammation of the throat, larynx, and trachea.[2] Incidence of sore throat after GA with ET intubation has been reported to be (14 to 50)%, occurring 24 hours after extraction of the ET tube.[3] Though a sore throat may look like a minor complication, it leads to major patient dissatisfaction. It is the eighth most common undesirable complication for patients after surgery.[4] The prevalence of hoarseness was reported to be (11-19)% in orthopedic surgery.[5] Complications during or after intubation can leave a bad memory of anesthesia and the operating room for the patient. Pharmacological and non-pharmacological measures have been used in the past to reduce the incidence of sore throat and hoarseness. But limited measures have promising results, and many pharmacological measures were related to various side effects. In our institute, we use two techniques to reduce postoperative sore throat and hoarseness after endotracheal intubation: lubricating tubes with 2% lignocaine jelly and thermally softening tubes before use. So the purpose of this study is to evaluate the effect of softening the tip of the endotracheal tube with normal warm saline before intubation in reducing the incidence of hoarseness and sore throat after removal of the ET tube.

METHODS

This prospective, single center observational cohort study was conducted in the main operating theater of Dhulikhel Hospital, Kathmandu University School of Medical Sciences (KUSMS), from Feb. 1 to Aug. 31, 2024. Written informed consent was obtained from all patients. Ethical approval was granted by the KUSMS Institutional Review Committee on Jan. 4, 2024 (Reg. No.09/24). Eligible 162 Nepalese participants aged 18-65 years, American Society of Anesthesiology (ASA) grade I and II, either gender, scheduled for elective abdominal surgery under general anesthesia, were involved in the study. Exclusion criteria were pre-existing clear sore throat or hoarseness for any reason, previous laryngeal surgery, presence of tracheostomy, cervical spine abnormally, respiratory tract infections, surgery of head, neck and chest, abnormal positioning during the surgery, history of reflux, pushing or coughing when removing ET tube, severe difficult intubation (more than 2 attempts of laryngoscopy), documented difficult airway on Pre-anesthetic checkup (PAC) evaluation (Mallampati > 3), nasogastric tube placement, use of Nitrous oxide during surgery, pregnancy, surgery of duration more than 2 hours and surgery order than abdominal surgery. All patients were randomly assigned to one of two groups in a 1:1 ratio using computer-generated randomization and a sealed-envelope technique by an anesthesiologist not involved in the study. In this study, we compared two routine techniques that are commonly practiced at our institute to reduce postoperative sore throat and hoarseness. Patients who were intubated with tubes immersed in normal saline at room temperature and lubricated with 2% lignocaine jelly were assigned to the NT group, whereas patients who were intubated with the tubes immersed in normal saline warmed to 40°C in an incubator and lubricated with 2% lignocaine jelly were assigned to the TT group.

Preparation of ET tube: In our institute, two techniques are commonly used to prepare endotracheal tubes. High volume/low pressure cuff tubes (7.5 mm ID for males, 7.0 mm ID for females) were checked for leakage. Two 500 mL saline bottles were prepared—one at room temperature and one heated to 40 °C in an incubator, then wrapped in aluminum foil to prevent heat loss and maintain blinding. The cuff was deflated, and the distal end of one third of the tube was immersed in sterile saline for 10 minutes. In the TT group, tubes were immersed in warmed saline; in the NT group, in room temperature saline. Just before intubation, the tube was withdrawn, the tip and cuff lubricated with 2% lignocaine jelly, and handed to a blinded anesthesiologist for intubation. Both groups received lignocaine jelly, while the TT group additionally benefited from thermal softening to reduce sore throat and hoarseness.

Anesthesia management: Patients were assessed in the PAC for GA fitness, kept NPO (6 h solids, 2 h liquids), and premedicated with pregabalin 75 mg and pantoprazole 40 mg the night before and at 6 am for anxiolysis and acid prophylaxis. They were educated about the research questionnaire. In the OR, IV access was secured with an 18 G cannula, RL infused at 100 mL/hr, ASA monitors applied (ECG, NIBP, SpO_2), and baseline vitals recorded. An anesthesia nurse prepared the GA trolley with drugs, instruments, and a PVC endotracheal tube according to group allocation determined by the randomization chart and sealed envelope. As per the institutional protocol, after 3 min preoxygenation, patients received fentanyl 1 µg/kg, propofol 1.5 mg/kg, and vecuronium 0.1 mg/kg. Bag mask ventilation was performed with oxygen enriched air via a circle system for 5 min., and anesthesia was maintained with 1 MAC isoflurane. Intubation was done using a Macintosh blade (size 3 or 4) and a PVC ET tube provided by the anesthesia nurse according to group allocation. The intubating anesthesiologist noted any vocal cord lesions (petechiae, redness, edema, bleeding, granuloma) and recorded Cormack–Lehane (C L) grade. Resistance to ET tube passage was graded as: 0 – none, I – mild, II – moderate, III – severe. Cases with C L grade >II, use of bougie, cricoid pressure, or optimal external laryngeal manipulation of airway (OELMA) maneuver were excluded from further evaluation. Total intubation time was recorded; patients requiring > 25 seconds were excluded. Intubation time

was defined as the interval from laryngoscopy insertion to removal. Attempts at intubation were documented, and cases needing more than one attempt were excluded from further evaluation. Endotracheal intubation was confirmed by chest rise, auscultation, and capnometry. The cuff was inflated with 5–10 mL air until oral leakage ceased, and intra cuff pressure maintained at 20–30 cm H_2O using a manometer. After confirming correct depth, the tube was secured. Immediately after intubation, vitals were monitored and managed as needed. Mechanical ventilation was set to volume control mode (tidal volume 6–8 mL/kg, PEEP 5 cm H_2O, RR 14–18/min) to maintain $etCO_2$ at 30–40 mmHg. Anesthesia depth was maintained with 1–1.5 MAC isoflurane in oxygen enriched air, with analgesics and muscle relaxants administered per hospital protocol. All patients received paracetamol 1 g IV; fentanyl 0.5 µg/kg was added if required. Total intraoperative analgesic use was calculated and compared between groups. IV fluids were administered for maintenance, deficit replacement, and fluid shifts. At the end of surgery, vocal cords were re examined with a video laryngoscope to detect any lesions or trauma, and findings were compared with preoperative status. Gentle oral suctioning was performed, and patients were assessed for spontaneous ventilation and recovery from muscle relaxants. Train-of-four counts were monitored at the adductor pollicis with an acceleromyograph. Reversal agents (neostigmine and glycopyrrolate, weight based) were administered, and extubation performed once patients responded to verbal commands and achieved adequate minute ventilation. Airway patency was assessed post extubation, with oropharyngeal airway used if required. Patients were then transferred to the Post Anesthesia Care Unit (PACU) for monitoring of post anesthesia complications. All the patients were evaluated for sore throat and hoarseness for 60 minutes in PACU and after 24 hours of surgery by the anesthesiologists. Sore throat was defined as a continuous painful or scratchy feeling of the throat, and the severity of the sore throat was classified as subjective: Grade 0 – no, Grade I – mild, Grade II – moderate, Grade III – severe. Hoarseness was defined as the acoustic sound quality of the preoperative voice. Severity of hoarseness was classified both subjectively and objectively. Grade 0 – No (no complaint of hoarseness by patients, as well observed by anesthesiologist), Grade I – Mild (Subjective) (patient complained of hoarseness but not observed by anesthesiologist), Grade II – Moderate (Objective) (patient complained of hoarseness and observed by anesthesiologist), and Grade III – Severe (Objective) (patient complained of hoarseness and observed by anesthesiologist).

Sample size was calculated based on a previous study reporting a 14–50% incidence of sore throat after endotracheal intubation. We considered a 50% absolute reduction with thermal softening of the tube as clinically significant. Using two independent study groups, a dichotomous (yes/no) primary endpoint, a 1:1 enrollment ratio, a type I error of 0.05, a type II error of 0.01, and 90% power, the required size was determined to be 162 patients (81 per group). Continuous numerical data were expressed as mean and standard deviation (for normally distributed data) or median and inter-quartile range (for data that are not normally distributed). Categorical data were expressed as frequencies, ratios, percentages, and numbers. Normally distributed numerical data were analyzed using a two-tailed Student t-test. Skewed numerical data were analyzed using the one-way ANOVA test. Categorical variables were analyzed using Pearson's Chi-square test. A p-value less than 0.05 was considered statistically significant, and less than 0.01 as highly significant. Data was checked, entered, and analyzed using SPSS version 24 for Windows (IBM Corp., Armonk, NY, USA). Microsoft Word and Excel were used to generate graphs and tables.

RESULTS

A total of 198 patients were included in the study. Out of which, 162 were enrolled, and 36 patients were excluded from the study for further evaluations. Among these 36 patients, 12 had difficult intubation (8 with more than 25 seconds duration of laryngoscopy and 4 with more than one attempt to laryngoscopy), 10 patients had long duration of surgery (more than 2 hours), 8 patients had CL grade more than II and required either cricoid pressure or OLEMA maneuver or use of gum elastic bougie, and 6 patients had persistent cough after extubation. Excluded patients were still given standard care according to institutional guidelines, even though they were not included in the study to avoid affecting the results. The overall incidence of sore throat at PACU was 24.69% (40 out of 162 patients), of which 17.29% (28 patients) were in the NT group, and 7.40% (12 patients) were in the TT group. Similarly, the incidence of hoarseness at PACU was 9.87% (16 out of 162 patients), of which 7.40% (12 patients) were in the NT group, and 2.47% (4 patients) were in the TT group. The incidence of Sore throat after 24 hours of GA was 20.37% (33 out of 162 patients), of which 16.04% (26 patients) were in the NT group, and 4.32% (7 patients) were in the TT group. As well as the incidence of hoarseness after 24 hours of GA was 9.25% (15 out of 162 patients), of which 7.40% (12 patients) were in the NT group, and 1.85% (3 patients) were in the TT group. This difference in findings between the two groups was statistically significant (Table 1, Fig. 1, p-value < 0.05). The severity of sore throat and hoarseness at PACU and 24 hours after GA was less severe in the TT group compared to the NT group. A statistically significant number of patients in the NT group had a higher grade of sore throat and hoarseness compared to the TT group, both at PACU and 24 hours after GA (Table 1, Fig. 2, p-value < 0.05).

Demographic variables (age, gender, and weight) were comparable between the two groups (Table 2). We did not

observe any significant difference in the hemodynamic parameters (HR, SBP, MBP, and DBP) before and after ET intubation between the two groups (Table 3, p-value > 0.05). No statistical difference was observed between the two groups in terms of clinical variables like ASA grade, smoking history, duration of surgery, duration of anesthesia, total analgesia used during the surgery, and intraoperative use of steroids (Table 2, p-value > 0.05). The variables related to airway, like Mallampati grade, CL grade, intubation time, resistance of tube during intubation, vocal cord lesion, intracuff pressure, and intracuff volume of air, were also comparable between the two groups (Table 2, p-value > 0.05).

DISCUSSIONS

Physical trauma during laryngoscopy and intubation might be the determining factor for sore throat, whereas hoarseness is more related to other factors, like smoking history, and intubation duration, as well as direct trauma to the vocal cords and their inflammation caused by the ET tube.[6,10] Post-operative sore throat and hoarseness associated with ET tube intubation are influenced by many other factors, like gender, size of the tube and type of cuff, intra-cuff pressure, type and duration of the surgery.[9,11-15] Various pharmacological and non-pharmacological methods have been used to minimize post-operative sore throat and hoarseness, including the use of intravenous dexamethasone.[16] Magnesium lozenges, lignocaine gel or spray, betamethasone gel, gargling of green tea after removal of ET tube benzylamine hydrochloride topical or spray, ketamine gargle, inhaled fluticasone.[5,17-22] Among these measures, the anti-inflammatory effects of corticosteroids might minimize the incidence of sore throat and hoarseness, but significant side effects should not be ignored, which include an increase in blood pressure, suppression of natural steroid production, increase in blood sugar level, especially in diabetic patients. Similarly, lignocaine gel only causes local anesthesia but does not have the necessary anti-inflammatory properties.[23] The desired effects of using green tea on the prevention of sore throat and hoarseness have not been achieved.[24] Sore throat and hoarseness are very common with tracheal intubation using a double-lumen tube (DLT) in comparison to a single-lumen tube, because of the severity of the airway injuries caused by DLTs.[25-27] Similarly, nasotracheal intubation is much more related to sore throat and hoarseness compared to orotracheal intubation due to its more traumatic passage in the airway.[28]

In comparison to these pharmacological and non-pharmacological measures, thermal softening is a simple and easily applicable method with no side effects related to pharmacological measures like local numbness, burning or stinging sensation, nausea/ vomiting, or cough. During intubation, to put the ET tube at the correct place, they should pass through the airway cavities, mainly the vocal

Table 1. Comparison of Incidence of sore throat and hoarseness.

Variables	NT Group	TT Group	P-value
Incidence of sore throat at PACU (Y: N)	28:53	12:69	0.004*
Severity of sore throat at PACU (0: I: II: III)	53:19:6:3	69:10:2:0	0.020*
Incidence of Hoarseness at PACU (Y: N)	12:69	4:77	0.035*
Severity of Hoarseness at PACU (0: I: II: III)	69:6:6:0	77:4:0:0	0.033*
Incidence of sore throat 24 hours after GA (Y: N)	26:55	7:74	0.000*
Severity of sore throat 24 hours after GA (0: I: II: III)	55:24:2:0	74:7:0:0	0.000*
Incidence of Hoarseness 24 hours after GA (Y: N)	12:69	3:78	0.015*
Severity of Hoarseness 24 hours after GA (0: I: II: III)	69:6:6:0	78:3:0:0	0.023*

Pearson's Chi-Square test, P-value <0.05-significant, P-value < 0.01-highly significant. SD – standard deviation

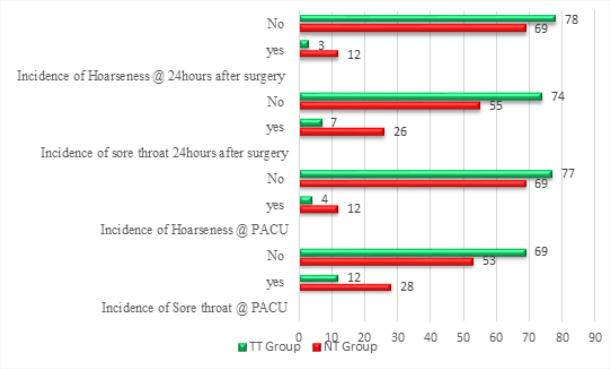

Figure 1. Incidence of sore throat and hoarseness

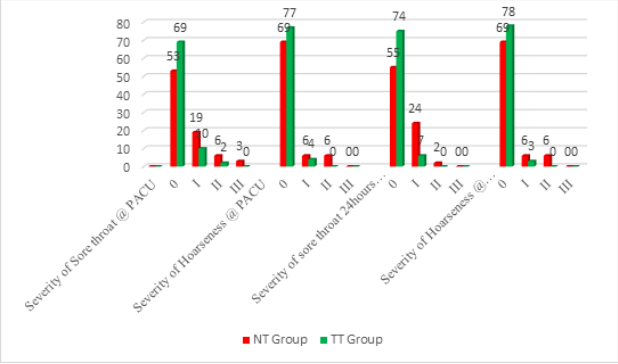

Figure 2. Severity of sore throat and hoarseness

cords. Vocal cords are the most vulnerable area to be affected by intubation, as it is the narrowest part. Similarly, inflation of the ET tube cuff and stimulation of the mucosa by the pressure are other contributing factors for airway injuries and the cause for post-operative sore throat and hoarseness.[21] By application of heat (immersing the tube at 40°C of NS), the tube will be more flexible and softer, so that we can decrease the severity of airway trauma during intubation, mainly by decreasing inflammation by suppressing the damage-sensing ion channels, i.e.,

Table 2. Comparison of demographic and clinical variables

Variables	NT Group	TT Group	P-value
Age (years) (mean±SD)	42.42±15.91	42.89±13.92	0.842
Weight (kgs) (mean±SD)	66.72±11.74	65.15±9.50	0.352
Gender (M: F)	28:53	25:56	0.615
ASA grade (I: II)	49:32	51:30	0.746
Smoking history (Yes: No)	13:68	8:73	0.242
Mallampati grade (I: II)	34:47	42:39	0.208
CL grade (I: II)	60:21	59:22	0.844
Intubation time (Seconds) (mean±SD)	14.51±3.95	14.73±3.95	0.721
Resistance to tube during intubation (0: I: II: III)	74:7:0:0	75:6:0:0	0.772
Vocal cord evaluation for lesion preoperatively (Y: N)	11:70	12:69	0.822
Vocal cord evaluation for postoperative lesions (Y: N)	10:71	12:69	0.646
Intracuff pressure (cm of H_2O) (mean±SD)	24.42±3.20	24.91±2.51	0.277
Intracuff Volume of air (ml) (mean±SD)	5.36±1.09	5.33±1.16	0.890
Duration of Surgery (minutes) (mean±SD)	81.68±41.60	79.95±48.23	0.807
Duration of Anesthesia (minutes) (mean±SD)	113.99±44.63	106.46±51.49	0.327
Total analgesia used during the surgery [inj. Fentanyl mcg (mean±SD)	115.12±21.89	109.57±24.22	0.128
Intraoperative use of steroids (Y: N)	16:65	11:70	0.292

Pearson's Chi-Square test, P-value < 0.05-significant,
P-value < 0.01-highly significant. SD – standard deviation

Table 3. Comparison of hemodynamic parameters

Variables	NT Group	TT Group	P-value
SBP (Before Intubation) (mean±SD)	127.40±18.18	128.58±19.60	0.691
SBP (After Intubation) (mean±SD)	129.37±23.23	132.65±20.86	0.345
MBP (Before intubation) (mean±SD)	96.42±13.14	99.51±15.81	0.179
MBP (After intubation) (mean±SD)	99.07±18.97	101.40±14.72	0.380
DBP (Before Intubation) (mean±SD)	79.73±11.76	79.67±11.70	0.973
DBP (After Intubation) (mean±SD)	82.35±18.19	83.98±13.92	0.523
HR (Before intubation) (mean±SD)	76.00±11.18	76.59±12.82	0.754
HR (After intubation) (mean±SD)	79.00 ± 14.68	81.63 ± 14.74	0.257

One-way ANOVA test, P-value < 0.05-significant,
P-value < 0.01-highly significant. SD – standard deviation

transient receptor potential A1 [TRPA1].[29] Thermal softening of DLT and nasal ET tube reduces the incidence of post-operative airway injury-related complications like sore throat and hoarseness.[30] As well as epistaxis after nasal intubations.[31] Use of silicone rather than polyvinyl chloride DLT significantly decreases the incidence of post-operative sore throat, which seems to be due to the softer characteristics of silicone.[32] Jiang et al. used intravenous dexamethasone for 13 patients in the thermal softener group and 12 patients in the control group. In their study, it was revealed that postoperative intravenous dexamethasone could effectively decrease the incidence of sore throat. However, after the elimination of patients taking dexamethasone, the results did not change.[33]

Complications for patients during or after intubation can leave a bad memory of anesthesia and operating room for the patient and, in addition to pain at the surgical site, may bring other pain to the patient, so the purpose of this study is to evaluate the effect of softening the tip of the endotracheal tube with normal warm saline before intubation in reducing the incidence of hoarseness and sore throat after removal of the ET tube. In our institute, we use two techniques to reduce postoperative sore throat and hoarseness after endotracheal intubation: lubricating tubes with 2% lignocaine jelly and thermally softening tubes before use. In this study, we compared two techniques. Patients who were intubated with tubes immersed in normal saline at room temperature and lubricated with 2% lignocaine jelly were assigned to the NT group, whereas patients who were intubated with the tubes immersed in normal saline warmed to 40°C in an incubator and lubricated with 2% lignocaine jelly were assigned to the TT group. The incidence of sore throat at PACU and 24 hours after GA was higher (17.29% and 16.04%) in patients where a normal tube lubricated with 2% lignocaine was used, compared to patients where a thermal softening tube lubricated with 2% lignocaine jelly was used(7.40% and 4.32%). Similarly, the Incidence of Hoarseness at PACU and 24 hours after GA was also higher(7.40% and 7.40%) in patients where a normal tube lubricated with 2%lignociane was used compared to patients where a thermal softening tube lubricated with 2% lignocaine jelly was used (2.47% and 1.85%). These findings were similar to those of a study by Masood et al.[34] However, in contrast to our study, the overall incidence of sore throat and hoarseness in their study was higher. In their study, the incidence of sore throat after 24 hours was 75.8% in the control group vs 20.7% in the interventional group, and hoarseness after 24 hours was 41.4% in the control group vs 17.2% in the interventional group. This might be due to the use of 2% lignocaine jelly for all the patients in addition to the thermally softened endotracheal tube in our study. Yu JH

et al. also showed a significant decrease in the incidence of sore throat 1 hour after extubation with a thermal softening tube compared to the control group (35.1% vs 52.7%).[35] But 24 hours after extubation, the incidence of sore throat and hoarseness was comparable between the two groups. Song et al. compared 2% lignocaine jelly, thermally softened tube, and a combination of these two techniques with the control group on post-operative sore throat.[36] And, concluded that neither 2% lignocaine alone nor thermal softened tube alone decreases the incidence of post-operative sore throat.[36] Although the combination of two techniques (thermally softened tube lubricated with 2% lignocaine jelly) surprisingly resulted in a significant decrease in the incidence of post-operative sore throat, which might be due to additive or synergistic effects.

The incidence of post-operative sore throat following GA varies from 12.1% to 70%, drawing attention to it as an urgent problem to be solved in clinical practice.[37] Most of the time, it can heal by itself and is often overlooked in clinical practice. But sometimes, it can cause tonic spasm of the pharyngeal muscles, leading to dyspnea and dysphagia. In severe cases, aspiration pneumonia may occur, affecting the recovery of the patients after anesthesia, prolonging hospital stay, and reducing the satisfaction of hospitalized patients. Undoubtedly, considering the side effects of drugs, non-pharmacological treatment offers superior prospects and safety. Several reliable non-pharmacological methods, including thermal softening, are available for preventing and managing a sore throat undergoing endotracheal intubation. However, more research is needed to determine the most effective non-pharmacological approach.

Our study had some limitations. Firstly, the incidence of post-operative sore throat and hoarseness can be influenced by the analgesic regimen, such as fentanyl, paracetamol, and ketorolac, which we used in the intraoperative and postoperative period. However, all the patients received fentanyl and paracetamol during the intraoperative period and ketorolac in the postoperative period. The total analgesic used was comparable between the two groups in this study. Secondly, it was difficult to evaluate sore throat and hoarseness objectively. Although we checked airway injury or lesions objectively by laryngoscopy, there was no difference between the two groups. Thirdly, it was difficult to blind the investigator who performed ET intubation, as there might be a chance to differentiate normal tubes from thermally softened tubes. To minimize the potential bias, all the tubes were hidden in the aluminum foil-wrapped bottles and only taken out immediately before intubation, and all the tubes were lubricated with 2% lignocaine jelly. Fourthly, we only included the patients scheduled for abdominal surgeries for a short duration (< 2 hours) and not have features of the difficult airway. So, we cannot generalize the results of our study to patients with difficult airways undergoing long-duration surgery (more than 2 hours) and surgeries other than abdominal surgeries.

CONCLUSION

The thermally softened tube lubricated with 2% lignocaine jelly significantly reduces the incidence of post-operative sore throat and hoarseness 1 hour after GA at PACU and 24 hours after GA with minimal to no side effects. We recommend routinely using thermally softened endotracheal tubes lubricated with 2% lignocaine jelly for all intubations under general anesthesia.

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