Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 03, 2023

The effect of lidocaine jelly on a taper-shaped cuff of an endotracheal tube on the postoperative sore throat: A prospective randomized study in Shyam shah medical college Rewa

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Article History: Received: 12-04-2023 **Revised:** 02-05-2023 **Accepted:** 16-05-2023

Abstract

Background: Postoperative sore throat (POST) following general anesthesia with endotracheal intubation is a common complication. We hypothesized that lidocaine jelly applied to the tapered cuff of the endotracheal tube (ETT) might decrease the incidence of POST most commonly arising from endotracheal intubation.

Methods: A total of 208 patients under general anesthesia were randomly assigned into 1 of 2 groups. In the lidocaine group (n=104), the distal part of ETTs with tapered-shaped cuff was lubricated with lidocaine jelly. In the control group (n=104), the distal part of ETTs with tapered-shaped cuff was lubricated with normal saline. The incidence of POST, hoarseness, and cough in the postanesthesia patients was compared.

Results: The overall incidence of POST was higher in the lidocaine group than in the normal saline group [60 (58%) vs 40 (39%), *P*=.006]. The incidence of POST at 1hour postoperatively was higher in the lidocaine group than in the normal saline group [53 (51%) vs 32 (31%), *P*=.003]. The overall incidence of hoarseness for 24hours postoperatively was comparable (*P*=.487). The overall incidence of cough for 24hours postoperatively is higher in the lidocaine group (*P*=.045).

Conclusion: The lidocaine jelly applied at the distal part of ETT with tapered-shaped cuff increased the overall incidence of POST in patients undergoing general anesthesia.

Keywords: gels, intubation, lidocaine, pain, pharyngitis, postoperative

Introduction

Postoperative sore throat (POST) is a common and distressing side effect of a general anesthesia.[1,2] This complication may negatively impact quality of life.[3,4] The incidence of POST is known to be vary, with a range of 7% to 90%.[1,4,5] Prophylactic management of POST is recommended to improve the quality of postoperative care.[6]

Local anesthetics have been implemented for the prophylaxis in an effort to decrease the incidence, or intensity and duration of POST.[1] Lidocaine has been used, both intravenously and topically, in an effort to prevent POST.[7–10] Recent meta-analysis showed that lidocaine

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 03, 2023

prevents POST.[1] The effect of lidocaine jelly for POST prevention, however, remains controversial.[4,11]

A conventional endotracheal tube (ETT) has a cylindrical cuff, whereas the TaperGuard ETT (Covidien, Athlone, Ireland) has a tapered-shaped cuff to decrease micro-aspiration and ventilator-associated pneumonia.[12,13] The incidence of POST varies, depending upon the type of ETT implemented at the time of surgery.[14] There are few reports regarding the effect of the ETT with tapered-shaped cuff, with regard to the prevalence and severity of POST. Moreover, there has been no investigation as to the effects (or potential benefit) of lidocaine jelly when it has been applied to an ETT taper-shaped cuff, in diminishing or obviating POST.

We hypothesized that lidocaine jelly, applied on the taper-shaped cuff of ETT, might and probably could reduce the incidence, severity, and duration of POST emanating from endotracheal intubation.

Methods

Study population

After obtaining the Institutional Ethics Committee approval, written informed consent was obtained from each patient. This investigation was registered at ClinicalTrials. This was a prospective, randomized, double-blind, single-center, placebo-controlled, and parallel group study. A total of 210 patients were recruited to participate. The patients were of American Society of Anesthesiologists Physical Status I and II, aged 18 to 80 years, and were scheduled to undergo laparoscopic cholecystectomy under general anesthesia. Patients with any history of pre-existing sore throat, recent upper respiratory infection, asthma, chronic obstructive pulmonary disease, chronic cough, friable teeth, concurrent, incidental use of lidocaine and dexamethasone, recent nonsteroidal anti-inflammatory drug medication intake, presence of a gastric tube, previous head or neck surgery, anticipated difficulty with intubation, Mallampati grade>2, rapid sequence induction, more than one attempt at intubation, or known allergies to lidocaine jelly were excluded from this study.

Study procedures and anesthesia

Patients were randomly assigned to 1 of 2 groups: the lidocaine group and normal saline group.

In the lidocaine group, the ETTs with tapered-shaped cuff from the distal tip to the distal vocal cords marker were lubricated with lidocaine jelly (Instillagel, 2% jelly; CliniMed Limited, High Wycombe, UK). In the control group, the ETTs with tapered-shaped cuff from the distal tip to the distal vocal cords marker were lubricated with normal saline.

The patients were monitored with electrocardiography, noninvasive blood presssure, pulse oximetry, acceleromyography (TOF-watch SX; MSD BV, Oss, the Netherlands), and a bispectral index monitor (A-2000 XP; Aspect Medical Systems, Newton, MA). Anesthesia was induced with propofol 2 mg/kg and sufentanil .5 μg/kg. Rocuronium 0.6 to 0.8 mg/kg was administered to facilitate endotracheal intubation, while train-of-four counts were monitored with acceleromyography at the adductor pollicis muscle. An ETT with a tapered-shaped cuff was inserted by an experienced anesthesiologist (HCK). Blinding group allocation was impossible because the nature of lubricants is different from that of normal saline. ETTs of internal diameter 7.0 and 7.5 were used for females and males, respectively. Direct laryngoscopy with either a Macintosh 3 or 4 laryngoscope blade (Mercury Medical, Clearwater, FL) was used for intubation. The ETT was inserted so that the vocal cords were located between the 2 indicator marks on the distal part of the tube shaft. Successful intubation was confirmed by end-tidal capnography. The tracheal tube cuff was inflated with air and the cuff pressure was adjusted to 20 mm Hg using a calibrated cuff manometer

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(Portex, Smiths Medical, Germany). The pressure of ETT cuff was maintained 20 mm Hg throughout the surgery. Anesthesia was maintained with desflurane inhalation and intermittent injection of sufentanil 0.3 μg/kg. The depth of anesthesia was adjusted to maintain the bispectral index in a range of 40 to 60 and mean blood pressure within ±20% from baseline, respectively. At the beginning of the skin closure, meperidine (1 mg/kg) for postoperative pain management was administered in both groups.

After the surgery, glycopyrrolate 0.01 mg/kg and pyridostigmine 0.3 mg/kg were infused to reverse residual neuromuscular relaxation. Oropharyngeal suction was gently performed under direct vision to avoid trauma to the tissues before extubation. Extubation of ETT was performed when the train-of-four ratio was >90% and adequate spontaneous breathing and response to verbal commands were confirmed. After extubation, patients were transferred to the postanesthesia care unit.

Outcomes measurements

The Cormack and Lehane grade for laryngoscopic view assessment were recorded by the investigator performing tracheal intubation (HCK). The time-to-intubation was measured as the duration between inserting the laryngoscope blade into the patient's mouth and checking the end-tidal CO_2 >30 mm Hg. The mean arterial blood pressure and heart rate were measured immediately before intubation and 2 minutes after intubation.

The incidences of sore throat and hoarseness were monitored by a "blind" investigator (JDS) at 1, 6, 12, and 24 hours postoperatively. Sore throat was assessed at rest. Sore throat was graded on a 4-point scale (0–3): 0, no sore throat; 1, mild sore throat (complains of sore throat only on asking); 2, moderate sore throat (complains of sore throat on his/her own); and 3, severe sore throat (change in voice or hoarseness, associated with throat pain). Hoarseness was graded on a 4-point scale (0–3): 0, No complaint of hoarseness; 1, minimal hoarseness (minimal change in quality of speech of which patient answers in the affirmative only when asked); 2, moderate hoarseness (moderate change in quality of speech of which the patient complains on his/her own); 3, severe hoarseness (gross change in the quality of voice perceived by the observer). Postoperative cough was graded on a 4-point scale (0–3): 0, No cough; 1, mild cough; 2, moderate cough; 3, severe cough.[15] Other side effects such as throat numbness, nausea, and vomiting were also recorded.

The primary endpoint was the incidence of POST between groups during 24 hours postoperatively. Secondary endpoints were the incidence of POST and hoarseness at postoperative 1, 6, 12, and 24 hours postoperatively, as well as cough, throat numbness, nausea, vomiting, and use of additional analgesics during 24 hours postoperatively.

Statistical analysis

A previous study demonstrated that the incidence of POST was about 36% during 24 hours following the intubation with ETT of tapered-shaped cuff.[16] Assuming that this incidence would decrease to 18% in the lidocaine group, 94 patients would be required in each group to reach statistical significance with $\alpha=0.05$ and $\beta=0.20$. Considering a 10% dropout rate and a 100% compliance rate, 105 patients per group were included.

Statistical analyses were performed using IBM SPSS Statistics software (ver. 22.0; IBM CORP., Armonk, NY). The incidence of POST, hoarseness, cough, throat numbness, nausea, vomiting, and the use of additional analgesics were assessed using the Chi-square test, or if there were ≤5 values per cell, the Fisher exact test. Continuous variables were compared using Student *t* test after a normality test. The alpha value was adjusted with Bonferroni correction to compare the POST and pain score between the 2 groups at each time point. The *P* values were compared to adjust alpha values. Otherwise, a *P* value<.05 was

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considered to indicate a significant difference. Data are presented as mean±standard deviation or number (percentage).

Results

A total of 224 patients from November 2021 to February 2023 were screened and 14 patients were excluded: 4 patients for multiple intubation attempts, 4 patients for Mallapati grade >2, 2 patients for chronic obstructive pulmonary disease, 2 patients for chronic cough, and 2 patients for friable teeth. One patient in each group was not followed, leaving 208 patients in the final analysis (Fig. (Fig.1).1). There were no differences in the patient characteristics between the groups (Table (Table11).

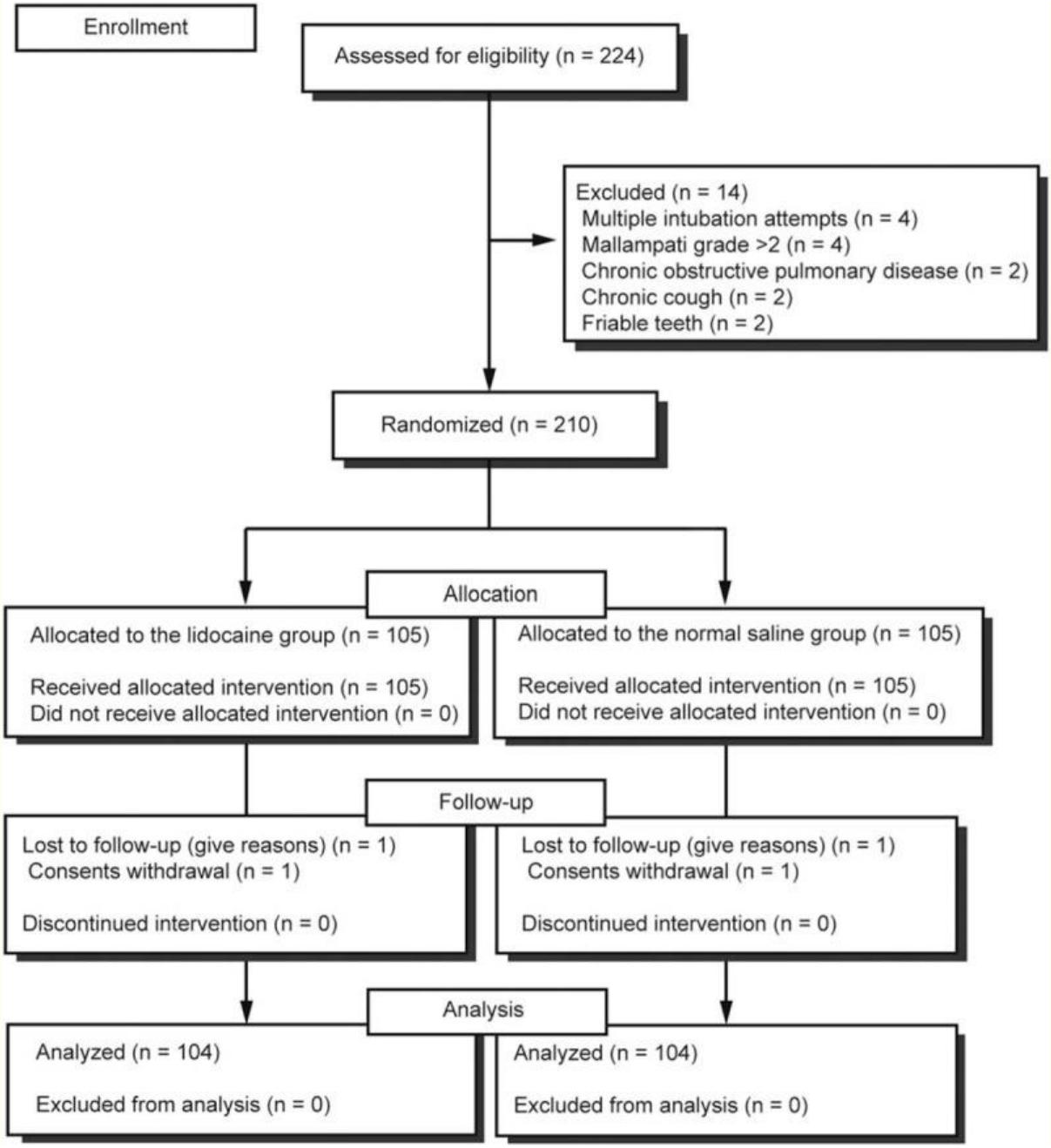

Figure 1

CONSORT diagram for the investigation. Two hundred ten patients were randomized and one patient in each group was excluded from final analysis due to consent withdrawal.

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Table 1: Patient and anesthetic characteristics.

	Lidocaine (n=104)	Normal saline (n=104)	P
Age, y	58±15	56±16	.446
Female/male	71 (68%)/33 (32%)	62 (60%)/42 (40%)	.194
Weight, kg	63±11	65±11	.171
Height, cm	160±9	161±8	.259
Body mass index, kg/m^2	24.5±3.8	24.9±3.7	.239
ASA-PS, I/II	51 (49%)/53 (51%)	56 (54%)/48 (46%)	.488
Time to intubation, s	18±11	18±10	.584
Duration of tracheal intubation, min	68±46	62±39	.976
Mallampati grade, I/II	32 (31%)/72 (69%)	42 (40%)/62 (60%)	.148
C-L grading scale, I/II/III	29 (28%)/59 (57%)/ 16 (15%)	33 (32%)/56 (54%)/15 (14%)	.820
Mean arterial pressure, mm Hg			
Before intubation	79±14	80±13	.773
2 min after intubation	98±19	101±22	.489
Heart rate, beats/min			
Before intubation	76±14	74±13	.144
2 min after intubation	92±16	92±21	.741

Values are presented as the mean±SD or the number (%) of patients.
ASA-PS = American Society of Anesthesiologists physical status, C-L = Cormack-Lehane.

The overall incidence of POST was higher in the lidocaine group than in the normal saline group [60 (58%) vs 40 (39%), difference 19%, 95% confidence interval (95% CI) 5–32, *P*=.006, Table Table2,2, Fig. Fig.2].2]. The incidence of POST at 1 hour postoperatively was higher in the lidocaine group than in the normal saline group (*P*=.003). The incidence of POST at postoperative 6, 12, and 24 hours was comparable between groups. The overall incidence of hoarseness for 24 hours postoperatively was comparable [58 (56%) vs 53 (51%), difference 5%, 95% CI -9 to 19, *P*=.487]. The incidence of hoarseness was similar at postoperative 1, 6, 12, and 24 hours between the lidocaine and normal saline group (*P*=.567, *P*=.544, *P*=.354, and *P*=.092, respectively). The overall incidence of cough (during the course of the entire investigation) was higher in the lidocaine group than in the normal saline group [29 (28%) vs 17 (16%), difference 12%, 95% CI 0–23, *P*=.045, Fig. Fig.3].3]. The incidence of cough at postoperative 1 hour is higher in the lidocaine group than in the normal saline group (*P*=.002). The incidence of cough was comparable at postoperative 6, 12, and 24 hours between the lidocaine and normal saline group (*P*=.810, *P*=.561, and *P*=.043, respectively).

Table 2: Incidence and severity of postoperative sore throat, hoarseness, and cough.

	Lidocaine (n=104)	Normal saline (n=104)	Difference (95% CI)	P
Sore throat				
Overall incidence	60 (58%)	40 (39%)	19% (5–32)	.006
Postoperative 1 h (none/mild/moderate/severe)	51/42/7/4	72/25/5/2	20% (6–33)	.003
Postoperative 6 h (none/mild/moderate/severe)	70/28/5/1	83/15/5/1	13% (0–25)	.041
Postoperative 12 h (none/mild/moderate/severe)	87/16/0/1	88/14/2/0	1% (-10 to 12)	.849
Postoperative 24 h (none/mild/moderate/severe)	96/7/0/1	97/5/2/0	1% (-7 to 9)	.789
Hoarseness				
Overall incidence	58 (56%)	53 (51%)	5% (-9 to 19)	.487
Postoperative 1 h (none/mild/moderate/severe)	67/29/7/1	63/34/7/0	4% (-10 to 17)	.567
Postoperative 6 h (none/mild/moderate/severe)	75/27/1/1	71/29/4/0	4% (-9 to 17)	.544
Postoperative 12 h (none/mild/moderate/severe)	88/14/1/1	84/20/0/0	4% (-7 to 15)	.354
Postoperative 24 h (none/mild/moderate/severe)	98/5/0/1	91/12/1/0	7% (-2 to 16)	.092
Cough				
Overall incidence	29 (28%)	17 (16%)	12% (0 to 23)	.045
Postoperative 1 h (none/mild/moderate/severe)	75/28/1/0	93/8/1/2	17% (6 to 28)	.002
Postoperative 6 h (none/mild/moderate/severe)	95/9/0/0	94/10/0/0	1% (-8 to 10)	.810
Postoperative 12 h (none/mild/moderate/severe)	103/1/0/0	102/2/0/0	1% (-4 to 7)	.561
Postoperative 24 h (none/mild/moderate/severe)	101/3/0/0	104/0/0/0	3% (-2 to 9)	.043

Values are presented as the number (%) of patients.
CI = confidence interval.

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Figure 2: Percentage severity of postoperative sore throat in the lidocaine and normal saline group.

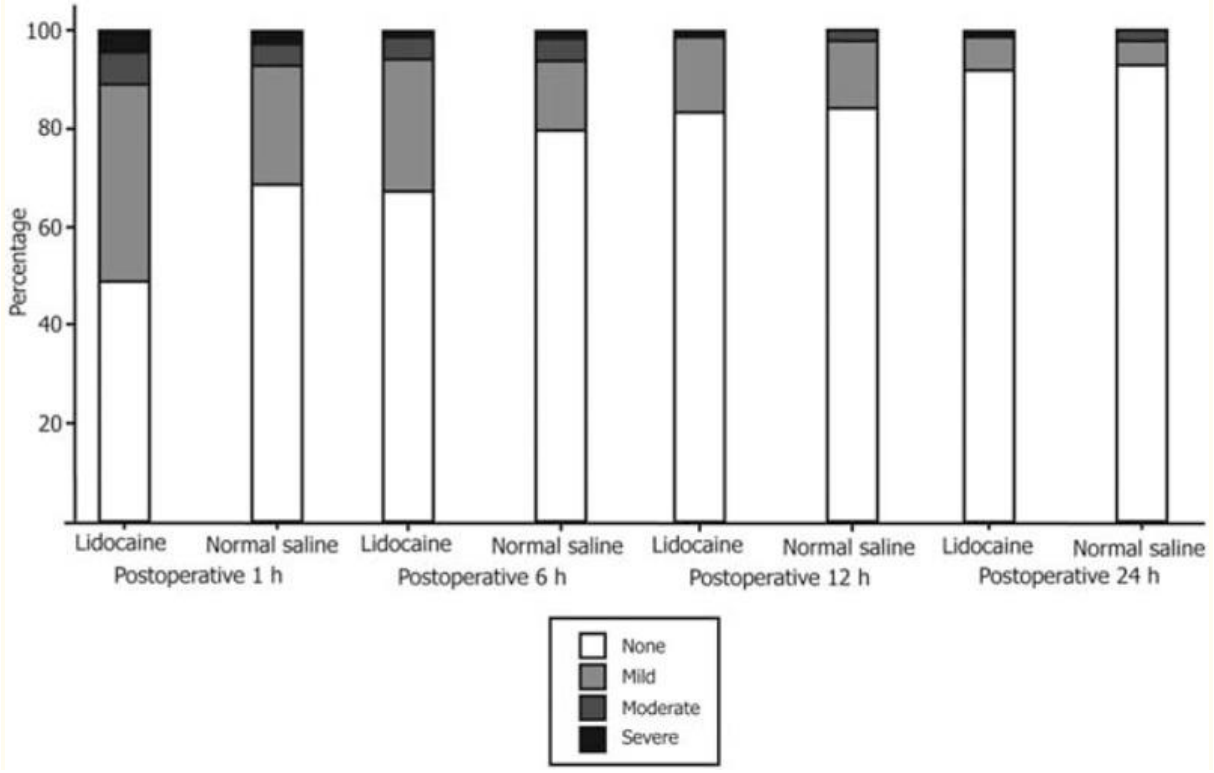
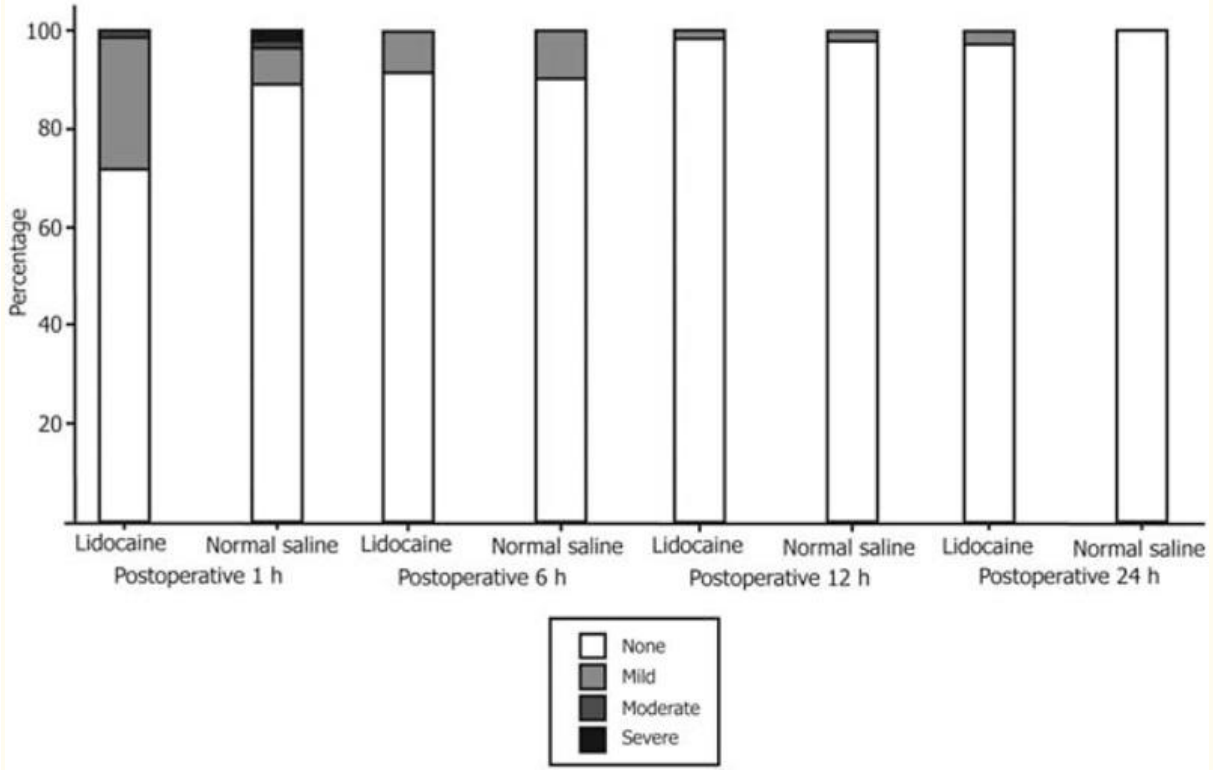


Figure 3: Percentage severity of cough in the lidocaine and normal saline group.



The incidence of postoperative nausea [25 (24%) vs 30 (29%), difference 5%, 95% CI -8 to 17, *P*=.432], vomiting [7 (7%) vs 8 (8%), difference 1%, 95% CI -7 to 9, *P*=.789], and throat

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numbness [15 (14%) vs 11 (11%), difference 4%, 95% CI -6 to 14, *P*=.402] during the study period was comparable between the lidocaine and normal saline group.

Discussion

This investigation demonstrated that the lidocaine jelly applied at the distal part of ETT with tapered-shaped cuff increased the overall incidence of POST. The lidocaine jelly also increased the incidence of cough compared with the normal saline at postoperative 1 hour.

The incidence of POST is influenced by many factors such as ETT cuff design and pressure, intubation procedure, movement of ETT during surgery, coughing on the ETT, and pharyngeal suctioning during extubation.[14,17,18] The proposed mechanism of POST is thought to be an inflammation through injury of the pharyngeal and tracheal mucosa by traumatic laryngoscopy and contact with the ETT cuff.[3,19–21] Lidocaine with analgesic and anti-inflammatory effect may be optimal choice for the prevention of POST after general anesthesia with ETT intubation. Previous investigations have shown that topical application of lidocaine reduced the incidence of POST.[4,10,22] Lidocaine jelly among various topical application methods, however, have shown equivocal results in terms of pro-active POST prevention.[4,10] In our study, lidocaine jelly applied on the ETT with tapered-shaped cuff increased the incidence of POST by 20% at 1 hour postoperatively. This deleterious effect of lidocaine jelly at early postoperative period may increase the overall incidence of POST by 23%. The lidocaine jelly in our investigation contains several agents such as chlorhexidine gluconate, methyl hydroxybenzoate, and propyl hydroxybenzoate for antiseptic effect. Chlorhexidine gluconate can cause hypersensitivity reactions.[23] Methyl hydroxybenzoate and propyl hydroxybenzoate are chemical allergens that may induce allergic dermatitis.[24,25] Such additive agents for the prevention of infection may be irritative to the upper airway of patients. The additive agents including methyl hydroxybenzoate and propyl hydroxybenzoate may form the dry sediments. Such sediments in the patients' trachea may irritate the airway and increase cough and POST. The chemical and mechanical irritation by additive agents may increase the incidence of POST in our investigation.

Postoperative cough can increase complications, including bronchospasm, hypertension, cardiac disease, bleeding, bronchospasm, increased intraocular and intracranial pressure, and postoperative surgical complications.[10,26,27] These complications can result in hypoxemia, myocardial ischemia, and brain injury.[28,29] Development of a cough after general anesthesia may be due to irritation and inflammation of respiratory tract by ETT.[4] Topical application of lidocaine to soothe the respiratory tract mucosa may represent a reasonable, pro-active means of preventing post-ETT cough.[30] As well, ETT cuff design and ETT lubricants have been known to influence the incidence and severity of postoperative cough.[31] Tapered-shaping of the cuff of ETT may enhance the effect of topical agents by keeping the agents at the level of the contact area between ETT and respiratory mucosa. Previous investigation demonstrated that lidocaine jelly applied on the ETT with barrel-shaped cuff prevents cough at immediate postoperative period.[4] In our investigation using ETT with tapered-shaped cuff, however, the incidence of cough at early postoperative period was higher in the lidocaine group by 17% than the normal saline group. This deleterious effect of lidocaine jelly at early postoperative period may increase the overall incidence of cough by 12%. The chemical and mechanical irritation by additives in lidocaine jelly may be enhanced by the tapered-shaped cuff of ETT. There is a relationship between the frequency of cough and that of POST.[10] In our investigation, the incidence of POST and cough is higher in the lidocaine group at the immediate postoperative period. Cough is thought to increase the injury of the tracheal mucosa, which is associated with POST.[32] The higher incidence of cough in lidocaine group may contribute to the higher incidence of POST in our investigation.

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The implementation of intravenous lidocaine, lidocaine spray applied to the pharyngeal structure, and intra-cuff lidocaine has been studied for the prevention of POST. Intravenous lidocaine increases the time from the conclusion of surgery to removal of the ETT.[10] Systemic lidocaine may also increase the risk of cardiovascular and central nervous system toxicity.[33] Lidocaine spray applied to the oral pharyngeal cavity increases the incidence of POST.[34] Lidocaine spray applied 10 minutes before intubation decreases the incidence of POST.[35] It, however, may increase the preparation time of anesthesia. Intra-cuff lidocaine is effective for the prevention of POST. Intra-cuff lidocaine would, theoretically, reduce or obviate chemical irritation from the additives.[8] It was, however, impossible to inflate the cuff of TaperGuard ETT using liquid agents such as normal saline or lidocaine in our in vivo experiment. In that regards, topical agents to prevent POST would be necessary for those patients undergoing general anesthesia using TaperGuard ETT. Further investigations of the use of topical agents (including lidocaine) without irritative agents or benzydamine are necessary.

The incidence of POST in our investigation was similar with our previous study.[16] The incidence of POST is highest at 1 hour postoperatively in both groups. Previous investigation using ETT with cylindrical-shaped cuff showed that the incidence of POST is the highest at 6 hours after extubation.[8] Anesthetic protocol, types of surgery, and the design of the ETT cuff could influence such a difference in timing of the highest incidence of POST. In the previous investigation,[8] propofol was used as an anesthetic maintenance agent. In our study protocol, desflurane was used instead. The duration of procedure was relatively shorter in our study than that in the previous research.[8] ETT with tapered-shaped cuff was inserted in our study, while ETT with cylindrical cuff was used in the previous study.[8] Such factors may cause the difference in timing of the highest incidence of POST. Future investigation is necessary to evaluate the relationship among POST, anesthetic agents, the type of surgery, and the type of the ETT cuff.

The current investigation had some limitations. First, variables such as sore throat and hoarseness are subjective. POST may be affected by airway management including extubation and oral suctioning. The attending anesthesiologists and the investigator who measured outcome were “blind” to minimize bias. Second, it is impossible to blind the investigator who intubated patients because of the different nature between lidocaine jelly and normal saline. Further investigation using lubricants without irritative agents in the control group may be necessary. The bias was minimized by blinding the investigator who measured postoperative outcomes. Third, coughing on the tube was not measured. Bucking and coughing at emergence from anesthesia is known to increase POST.[4] Future study may be necessitated to evaluate the association with lidocaine jelly and cough on the tube. Fourth, postoperative wound pain was not measured. Wound pain may affect the incidence and severity of POST. Laparoscopic cholecystectomy, however, is minimally invasive surgery. The bias by this factor could be minimized by randomization.

Conclusion

This investigation found the deleterious effect of using the lidocaine jelly on the tapered-shaped cuff of ETT for patients under general anesthesia. The lidocaine jelly applied at the distal part of ETT with tapered-shaped cuff increased the overall incidence of POST and cough in patients undergoing laparoscopic cholecystectomy. The lidocaine jelly containing irritative chemical additives should therefore not be recommended for the prophylactic prevention of POST after general anesthesia, especially using ETT with taper-shaped cuff.

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