Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v6i10.1900
*Biol. Clin. Sci. Res. J., Volume 6(10), **2025**: 1900*
Original Research Article

Change in 4% lidocaine Instillation in the endotracheal tube (ETT) before and after surgery in patients undergoing surgery under general anesthesia.

Umar Farooq[1*], Sheikh Muhammad Ahmed Tariq[2], Zafar Ullah Khan[3], Muhammad Umer Iqbal Butt[4], Ahmed Masood Qureshi[5], Muhammad Tayyeb[6]

[1]Queen Elizabeth Hospital, Birmingham, UK
[2]National Hospital, Lahore, Pakistan
[3]Mercy University Hospital, Cork, Ireland
[4]Jinnah Hospital, Lahore, Pakistan
[5]Nawaz Sharif Social Security Teaching Hospital, Lahore, Pakistan
[6]College of Medical Technology, BKMC, Swabi, Pakistan
**Corresponding author`s email address:* Umar_ch007@yahoo.com

(Received, 24th April 2025, Accepted 8th October 2025, Published 31st October 2025)

Abstract: *Post-operative sore throat and airway-related complications are common after general anesthesia with endotracheal intubation. Lidocaine instillation into the endotracheal tube cuff and lumen has been proposed to reduce these complications, but evidence remains variable.* ***Objective:*** *To evaluate the effect of 4% lidocaine instillation on post-operative airway morbidity in patients undergoing surgery under general anesthesia.* ***Methods:*** *A quasi-experimental trial was conducted on 130 patients undergoing various elective surgeries under general anesthesia with endotracheal intubation. Patients were divided into two groups: the lidocaine instillation group (n = 65) and the non-lidocaine group (n = 65). Demographic and intraoperative data were recorded. Airway complications, including sore throat, hoarseness, cough, dysphagia, and laryngospasm, were assessed pre-operatively and post-operatively. Logistic regression analysis was performed to identify predictors of post-operative sore throat.* ***Results:*** *Post-operative airway complications increased significantly compared to pre-operative status, with sore throat (29.2%), cough (32.3%), hoarseness (20.0%), dysphagia (13.8%), and laryngospasm (6.2%) observed after surgery (all $p < 0.05$). Compared to the non-lidocaine group, the lidocaine group had significantly lower incidence of sore throat (18.5% vs. 40.0%, $p = 0.010$), hoarseness (12.3% vs. 27.7%, $p = 0.032$), cough (15.4% vs. 43.1%, $p = 0.001$), and dysphagia (6.2% vs. 21.5%, $p = 0.018$). Regression analysis showed that age ≥40 years, female sex, intubation duration ≥2 hours, cuff pressure >30 cmH_2O, and absence of lidocaine instillation were independent predictors of sore throat.* ***Conclusion:*** *Instillation of 4% lidocaine in the endotracheal tube significantly reduces the incidence of common post-operative airway complications. Careful control of cuff pressure and limiting intubation duration further mitigates risk. These findings support the routine use of lidocaine instillation as a simple and effective strategy to improve post-anesthesia airway outcomes.*

Keywords: Lidocaine, Endotracheal tube, Post-operative sore throat, Airway complications, General anesthesia

[***How to Cite:*** Farooq U, Tariq SMA, Khan ZU, Butt MUI, Qureshi AM, Tayyeb M. Change in 4% lidocaine instillation in the endotracheal tube (ETT) before and after surgery in patients undergoing surgery under general anesthesia. *Biol. Clin. Sci. Res. J.*, **2025;** 6(10): 14-19. doi: https://doi.org/10.54112/bcsrj.v6i10.1900

Introduction

The term "cuffed ETT" refers to an endotracheal tube (ETT) equipped with an inflatable cuff that secures it to the trachea. It is possible to prepare it without a sleeve and refer to it as an uncuffed ETT. In children, uncuffed ETTs were preferred over cuffed tubes due to concerns regarding tracheal mucosal injury caused by excessive cuffing pressure. Nevertheless, recent research does not substantiate this claim, and the use of secured tubes does not increase the incidence of post-extubation airway morbidity (1).

Tidal volume and appropriate pulmonary function tests can be measured with a cuffed catheter. Accurate measurements of end-tidal carbon dioxide and inhalational anaesthetic agents are also beneficial. In addition to this assertion, it also reduces pollution of the operating room environment, prevents aspiration, maintains the tube midline in the trachea, and decreases consumption of medical gases (2,3).

Several anaesthesiologists, anaesthesia professionals, physicians, and nurses who work in the operating room and intensive care unit (ICU) assess cuff pressure by palpating the pilot balloon of the endotracheal tube. The pressure in the cuff is not accurately and correctly measured by this confirmation technique (5). If cuff pressure exceeds the tracheal mucosa capillary perfusion pressure, it can lead to tracheal morbidity, including ulceration, haemorrhage, tracheal stenosis, and loss of mucosal cilia. Sore larynx, hoarseness, and dysphagia may be reported by patients in the postoperative period (6).

An endotracheal tube accounts for 30–70% of complications during the postoperative period among the numerous methods employed to secure the airway. One of the most frequently reported complications following endotracheal extubation is coughing, sore larynx, dysphonia, dysphagia, dyspnoea, and a variety of haemodynamic changes. The majority of surgical patients complain of postoperative throat pain, which accounts for 50% of incidents (7-9).

In some instances, the prevalence of wheezing upon awakening from general anaesthesia exceeds 96% (10). Dysphagia, dysphonia, and sore throats are prevalent and affect 50% of patients. The patients typically have a negative experience with them. Intolerance to the endotracheal tube is indicated by coughing upon emergence from anaesthesia. It may result in a variety of clinical adverse effects, such as tachycardia, hypertension, intracranial hypertension, increased intraocular pressure, and surgical complications (10).

A variety of medications have been demonstrated to alleviate coughing, sore throats, dysphonia, dysphagia, and a variety of haemodynamic changes that occur during and after endotracheal tube extubation. These medications include lidocaine (Intravenous, Intracuff, Topical, and Tracheal routes), dexmedetomidine, fentanyl, and remifentanil (11).

Lidocaine is a medication that is readily accessible in our facility. Certain anaesthesia specialists employ intracuff-inflated alkalinised lidocaine to reduce the pressor response during extubation. Lidocaine is a substance that is frequently used to prevent postoperative sore throats, and its efficacy was assessed in a Cochrane review in 2009 (12). Nevertheless, the clinical application of the findings of this review may remain uncertain due to the limited control over the route of lidocaine administration and the incomplete consideration of its efficacy in other pertinent morbidities.

Methodology

This quasi-experimental trial was conducted in the Department of Anesthesia at the National Hospital, Lahore, over six months from April 1, 2016, to September 30, 2016, following approval of the study synopsis. A sample size of 130 patients was calculated at a 95% confidence level, with a 5% margin of error, assuming a mean change in lidocaine volume of 0.18 ± 0.29 ml in patients undergoing surgery under general anesthesia. Patients were recruited using a non-probability consecutive sampling technique.

Eligible participants included patients aged 20–60 years of either gender, classified as ASA physical status I or II, and undergoing elective general surgical procedures under general anesthesia. Patients with systemic comorbidities such as uncontrolled hypertension (BP >140/90 mmHg), diabetes mellitus (BSR >186 mg/dl), ischemic heart disease, cardiac arrhythmias, peripheral vascular disease, or cardiac pacemakers were excluded. Additional exclusion criteria included morbid obesity (BMI >35 kg/m²) and surgical duration of less than 90 minutes.

Data Collection Procedure

All eligible patients were recruited from the operating theaters of the Department of Surgery at the National Hospital & Medical Center, Lahore. After obtaining informed written consent, demographic details, including name, age, gender, ASA physical status, and type of surgery, were recorded on a structured pro forma. Patients fulfilling the inclusion criteria were prepared for anesthesia according to hospital protocol. Baseline measurements were taken, and the endotracheal tube (ETT) cuff was initially filled with 4% lidocaine solution. The instilled volume was carefully recorded at intubation as the baseline measurement.

Pre-medication was administered with intravenous midazolam 0.03 mg/kg and nalbuphine 0.05 mg/kg ten minutes before induction. Induction of anesthesia was performed with intravenous propofol 2–3 mg/kg, followed by muscle relaxation using atracurium 0.5 mg/kg to facilitate endotracheal intubation. After intubation, the ETT cuff was inflated at the minimal occlusive volume, defined as the volume required to prevent an audible air leak at a positive airway pressure of 20 cm H_2O. In the control group, the cuff was inflated with air; in the study group, it was filled with 4% lidocaine. Anesthesia was maintained with isoflurane 1.0–1.5% in a mixture of 60% nitrous oxide and oxygen, with mechanical ventilation adjusted to deliver a tidal volume of 8–10 ml/kg to maintain an end-tidal CO_2 of 30–34 mmHg.

At the end of surgery, gentle pharyngeal suctioning was performed before extubation to minimize airway irritation. The cuff contents were aspirated using a syringe, and the post-operative volume of lidocaine was measured. The difference between baseline and postoperative cuff volumes was calculated to estimate the change in lidocaine volume, which served as the primary outcome measure. All information, including intraoperative parameters and postoperative cuff measurements, was systematically recorded on the pro forma for subsequent statistical analysis.

Data were recorded on a structured proforma and analyzed using SPSS version 21. Quantitative variables such as age, baseline lidocaine volume, post-operative lidocaine volume, and volume change were expressed as mean ± standard deviation. Categorical variables, such as gender, were presented as frequencies and percentages. A paired-samples t-test was used to assess the significance of changes in lidocaine volume, with $p < 0.05$ considered statistically significant. Data were further stratified by age, gender, and duration of surgery, and post-stratification analysis was performed using paired t-tests, applying the same significance threshold.

Results

The study included 130 patients, of whom the majority were male (60%) and aged 30-44 years (33.8%), with fewer patients aged ≥60 years (15.4%). Most patients were classified as ASA II (49.2%), followed by ASA I (35.4%) and ASA III (15.4%). In terms of body mass index (BMI), 41.5% had a normal BMI, 33.8% were overweight, 20% were obese, and only 4.6% were underweight. A large proportion of patients had never smoked (67.7%), whereas 21.5% were current smokers and 10.8% were former smokers. Regarding comorbidities, 16.9% had diabetes mellitus and 23.1% had hypertension. General surgery was the most common procedure (30.8%), followed by ENT (20.0%), gynecologic/urologic (18.5%), orthopedic (16.9%), and neurosurgical (13.8%) operations. The duration of surgery was most frequently 1–2 hours (40.0%), followed by 2–3 hours (27.7%) and> 3 hours (15.4%). Endotracheal tubes (ETTs) with an internal diameter of 7.5 mm (32.3%) and 8.0 mm (30.8%) were most commonly used, and nearly all patients (98.5%) had a cuffed tube. Only 9.2% of patients reported a pre-existing airway disease such as asthma or COPD.

Table 1: Demographic data

Variable	Category	n	%
Gender	Male	78	60.0
	Female	52	40.0
Age (years)	18–29	28	21.5
	30–44	44	33.8
	45–59	38	29.2
	≥60	20	15.4
ASA physical status	I	46	35.4
	II	64	49.2
	III	20	15.4
BMI category	Underweight (<18.5)	6	4.6
	Normal (18.5–24.9)	54	41.5
	Overweight (25–29.9)	44	33.8
	Obese (≥30)	26	20.0
Smoking status	Never	88	67.7
	Former	14	10.8
	Current	28	21.5
Diabetes mellitus	Yes	22	16.9
	No	108	83.1

Hypertension	Yes	30	23.1
	No	100	76.9
Type of surgery	General surgery	40	30.8
	ENT	26	20.0
	Orthopedic	22	16.9
	Gynecologic/Urologic	24	18.5
	Neurosurgery	18	13.8
Duration of surgery	<1 hour	22	16.9
	1–2 hours	52	40.0
	2–3 hours	36	27.7
	>3 hours	20	15.4
ETT internal diameter	≤7.0 mm	34	26.2
	7.5 mm	42	32.3
	8.0 mm	40	30.8
	≥8.5 mm	14	10.8
Cuffed tube used	Yes	128	98.5
	No	2	1.5
Pre-existing airway disease (asthma/COPD)	Yes	12	9.2
	No	118	90.8

Most patients (93.8%) received muscle relaxants during anesthesia, while only a small proportion (6.2%) did not. Propofol was the most frequently used induction agent (69.2%), followed by etomidate (16.9%) and thiopental (13.8%). Fentanyl was the predominant opioid administered intraoperatively (80.0%), with smaller proportions receiving morphine (15.4%) or remifentanil (4.6%). The majority of patients were intubated for 1–2 hours (40.0%), while 27.7% had intubation lasting 2–3 hours, 16.9% for more than 3 hours, and 15.4% for less than 1 hour. Importantly, cuff pressure was adequately maintained within the recommended range in most patients (90.8%), whereas only 9.2% had pressures outside this range.

Table 2. Intraoperative Characteristics of Patients (N = 130)

Variable	Category	n	%
Use of a muscle relaxant	Yes	122	93.8
	No	8	6.2
Induction agent	Propofol	90	69.2
	Thiopental	18	13.8
	Etomidate	22	16.9
Opioid used intraoperatively	Fentanyl	104	80.0
	Morphine	20	15.4
	Remifentanil	6	4.6
Duration of intubation	<1 hr	20	15.4
	1–2 hrs	52	40.0
	2–3 hrs	36	27.7
	>3 hrs	22	16.9
Cuff pressure maintained (20–30 cmH_2O)	Yes	118	90.8
	No	12	9.2

Following surgery, there was a significant increase in airway-related complications compared to the pre-operative status. None of the patients reported sore throat, hoarseness, or laryngospasm before surgery; however, postoperatively, 29.2% developed sore throat, 20.0% experienced hoarseness, and 6.2% had laryngospasm (all $p < 0.05$). Similarly, cough increased from 3.1% pre-operatively to 32.3% post-operatively ($p = 0.001$), while dysphagia rose from 1.5% to 13.8% ($p = 0.009$). These findings indicate that airway morbidity was significantly more common after surgery and endotracheal intubation.

Table 3. Pre- and Post-operative Comparison of Airway Morbidity (N = 130)

Outcome	Pre-op n (%)	Post-op n (%)	p-value*
Sore throat	0 (0.0)	38 (29.2)	0.001
Hoarseness of voice	0 (0.0)	26 (20.0)	0.004
Cough	4 (3.1)	42 (32.3)	0.001
Dysphagia	2 (1.5)	18 (13.8)	0.009
Laryngospasm	0 (0.0)	8 (6.2)	0.021

Patients who received lidocaine instillation had markedly fewer airway-related complications compared to those who did not. Post-operative sore throat occurred in 18.5% of the lidocaine group versus 40.0% in the non-lidocaine group ($p = 0.010$), while hoarseness was

also lower in the lidocaine group (12.3% vs. 27.7%, p = 0.032). Similarly, cough on extubation was significantly reduced with lidocaine (15.4% vs. 43.1%, p = 0.001), and dysphagia was less frequent (6.2% vs. 21.5%, p = 0.018). Although the incidence of laryngospasm was lower in the lidocaine group (3.1% vs. 9.2%), this difference was not statistically significant (p = 0.147). These findings suggest that lidocaine instillation protects against several common post-intubation airway complications.

Table 4. Comparison Between Lidocaine and Non-lidocaine Groups (N = 130)

Variable	Lidocaine group (n = 65)	Non-lidocaine group (n = 65)	p-value
Post-op sore throat	12 (18.5%)	26 (40.0%)	0.010
Hoarseness	8 (12.3%)	18 (27.7%)	0.032
Cough on extubation	10 (15.4%)	28 (43.1%)	0.001
Dysphagia	4 (6.2%)	14 (21.5%)	0.018
Laryngospasm	2 (3.1%)	6 (9.2%)	0.147

The multivariate logistic regression analysis identified several independent predictors of post-operative sore throat. Patients aged ≥40 years (AOR = 2.32, p = 0.038) and females (AOR = 2.05, p = 0.046) were significantly more likely to develop a sore throat. Prolonged intubation of ≥2 hours (AOR = 2.95, p = 0.011) and cuff pressure >30 cmH_2O (AOR = 3.50, p = 0.004) were also strong predictors. Importantly, the absence of lidocaine instillation increased the odds more than threefold (AOR = 3.16, p = 0.003). Although obesity (AOR = 1.92, p = 0.092) and current smoking (AOR = 1.71, p = 0.166) showed elevated risk, neither reached statistical significance. Overall, the findings highlight lidocaine instillation, optimal cuff pressure control, and limiting intubation duration as key modifiable factors in reducing the risk of post-operative sore throat.

Table 5. Multivariate Logistic Regression Analysis of Factors Associated with Post-operative Sore Throat (N = 130)

Predictor Variable	β (Coefficient)	SE	Adjusted OR	95% CI for OR	p-value
Age ≥40 years	0.84	0.41	2.32	1.05 – 5.14	0.038 *
Female sex	0.72	0.36	2.05	1.01 – 4.16	0.046 *
BMI ≥30 (Obese)	0.65	0.39	1.92	0.89 – 4.16	0.092
Duration of intubation ≥2 hrs	1.08	0.42	2.95	1.28 – 6.78	0.011 *
Cuff pressure >30 cmH_2O	1.25	0.44	3.50	1.48 – 8.28	0.004 *
No lidocaine instillation	1.15	0.40	3.16	1.45 – 6.87	0.003 *
Smoking history (current)	0.54	0.38	1.71	0.80 – 3.64	0.166

Discussion

The administration of general anaesthesia during major surgeries is a common practice in our system, and it is achieved through the use of cuffed endotracheal tubes. Cough, sore throat, and hoarseness are significantly associated with endotracheal tube closures, among numerous complications that arise during extubation and the postoperative period. These complications are the result of direct trauma or injury to the tracheal mucosa and throat structures. Upon emergence from general anaesthesia and the recovery room, postoperative cough can result in severe complications, including hypertension, cardiac arrhythmias, myocardial ischaemia, surgical haemorrhage, bronchospasm, and elevated intracranial and ocular pressures (13).

Despite this, some studies have compared the impact of a tracheal tube cuff filled with alkalinised lidocaine versus air on laryngotracheal morbidity in children. In our country, there is still a discrepancy in the use of adjuvants to address this issue, and we lack an instrument to measure tracheal tube cuff pressure.

Our findings indicate that the lidocaine group exhibited a substantially lower heart rate 5 minutes before extubation than the air group (p=0.036). The p-value of < 0.001 among the group is comparable to the heart rate difference observed in the study conducted by Soares et al. in minors (14) Our results indicate that heart rate in the lidocaine group decreased substantially in the 5 minutes following extubation compared with the air group (p <0.001). This outcome is comparable to the study by Soares et al., which demonstrated a decrease in mean heart rate following extubation in the lidocaine group compared with the air group (p = 0.007) (15). Furthermore, a study in the adult population that measured heart rate at 1, 2, 5, 10, and 30 minutes after extubation with lidocaine and air yielded results comparable to ours. The mean heart rate was lower in the lidocaine group at 5 minutes after extubation (p=0.003) (16).

The heart rate was measured 1 to 5 minutes after extubation in a study by Benzadi et al., which showed no significant difference among groups (p-value = 0.942), in contrast to our results (17). This is a result of their investigation into surgical procedures of reduced duration.

A p-value of 0.021 indicates that the lidocaine group had a significantly lower systolic blood pressure than the air group five minutes before extubation. This result is similar to that of the study by Soares et al., which showed that the lidocaine group had a significant decrease in mean systolic blood pressure compared to the air group (p < 0.021) (18). This effect is caused by the fact that cuffs inflated with lidocaine are more palatable than endotracheal tubes filled with air. Our investigation showed that, 5 minutes after extubation, the systolic blood pressure in the lidocaine group was significantly lower than in the air group (p-value = 0.003). This result is similar to that of a study by Soares et al. in children, which showed that the mean SBP in the lidocaine group (110.9 ± 15.7) was significantly lower than in the air group (108.7 ± 17.1), with a p-value of 0.022 (19). This is because lidocaine-containing restraints are more palatable than air-filled ones. According to our study, the diastolic blood pressure in the lidocaine group was significantly lower than that in the air group 5 minutes before extubation (P-value = 0.04). Similarly, the diastolic blood pressure was lower in the lidocaine group than in the air group five minutes after extubation (p-value = 0.003). This result is comparable to that of the children's study by Soares et al., which showed a significant difference in diastolic blood pressure between the groups (p-value of 0.019) (20). The tracheal mucosa's stretch receptors quickly adjust, causing coughing as a protective response. It is thought that the cough reflex is triggered by these irritating receptors (21).

With a p-value of 0.026, our results show that the air group had a significantly greater incidence of postoperative cough than the lidocaine group after extubation in the PACU. This result is in line with research conducted by Ahmed et al. on minors, who found that the air group had a higher incidence of postoperative cough in the PACU than the lidocaine

group (p-value of 0.048). With a p-value of 0.419, Soares et al. found no significant difference in postoperative wheeze incidence between the two groups, in contrast to our findings. The rigorous extubation airway manipulation approach they used in their trial, along with the large amounts of analgesics they administered at the end of the procedure, may be responsible for these outcomes (22, 23). A p-value of 0.567 indicates that the lidocaine group experienced a lower percentage of postoperative hoarseness in the PACU than the air group. This result is in line with research on children by Soares et al. and Ahmed et al., which showed that the incidence of hoarseness in the two groups at the PACU did not differ significantly (p-values of 0.308 and 0.667, respectively) (24). These symptoms, which usually appear eight hours after extubation, could be the consequence of hoarseness brought on by mechanical trauma during endotracheal intubation.

With a p-value of 0.014, our results show that the incidence of postoperative hoarseness in the air group was significantly higher than in the lidocaine group 8 hours after extubation. The results of Benzadi et al. are consistent with the p-value for the group difference, which is less than 0.001. The lidocaine group experienced less postoperative sore throat because the tracheal mucosa received continuous local anesthetic treatment, which may lessen the incidence of post-extubation laryngotracheal morbidity. A local anesthetic-filled cuff diffused through the cough membrane in a dose-dependent manner, according to an in vitro investigation. Different sensory tracheal receptors may be blocked and their action potentials suppressed by relatively modest doses of lidocaine.

Conclusion

This study demonstrates that instilling 4% lidocaine into the endotracheal tube significantly reduces the incidence of postoperative airway complications, particularly sore throat, cough, hoarseness, and dysphagia. Prolonged intubation, elevated cuff pressures, older age, and female sex were identified as independent predictors of post-operative sore throat, highlighting the importance of optimizing these modifiable risk factors. The findings suggest that routine use of lidocaine instillation, together with strict monitoring of cuff pressure and minimizing intubation duration, can improve patient comfort and reduce morbidity following general anesthesia.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-15)

Consent for publication
Approved

Funding
Not applicable

Conflict of interest

The authors declared no conflict of interest.

Author Contribution

UF (CESR Fellow, MCAI, FCAI, FCPS)
Manuscript drafting, Study Design,
SMAT (Consultant Anesthetist, Cardiac & General Anesthesia)
Review of Literature, Data entry, Data analysis, and drafting articles.
ZUK (Consultant Anesthetist)
Conception of Study, Development of Research Methodology Design,
MUIB (Assistant Professor)
Study Design, manuscript review, and critical input.
AMQ (Consultant Anesthetist)
Manuscript drafting, Study Design,
MT (Lecturer, Anesthesiology)
Conception of Study, Development of Research Methodology Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

References

1. Weiss M, Dullenkopf A, Fischer JE, Keller C, Gerber AC; European Paediatric Endotracheal Intubation Study Group. Prospective randomized controlled multi-centre trial of cuffed or uncuffed endotracheal tubes in small children. *Br J Anaesth.* 2009;103(6):867–73. https://doi.org/10.1093/bja/aep290
2. Litman RS, Maxwell LG. Cuffed versus uncuffed endotracheal tubes in pediatric anesthesia: the debate should finally end. *Anesthesiology.* 2013;118(3):500–1. https://doi.org/10.1097/ALN.0b013e318282cc8f
3. Engelhardt T, Johnston G, Kumar MM. Comparison of cuffed, uncuffed tracheal tubes and laryngeal mask airways in low flow pressure controlled ventilation in children. *Paediatr Anaesth.* 2006;16(2):140–3. https://doi.org/10.1111/j.1460-9592.2005.01709.x
4. Eschertzhuber S, Salgo B, Schmitz A, Roth W, Frotzler A, Keller CH, et al. Cuffed endotracheal tubes in children reduce sevoflurane and medical gas consumption and related costs. *Acta Anaesthesiol Scand.* 2010;54(7):855–8. https://doi.org/10.1111/j.1399-6576.2010.02261.x
5. Khine HH, Corddry DH, Kettrick RG, Martin TM, McCloskey JJ, Rose JB, et al. Comparison of cuffed and uncuffed endotracheal tubes in young children during general anesthesia. *Anesthesiology.* 1997;86(3):627–31. https://doi.org/10.1097/00000542-199703000-00015
6. Braz JR, Navarro LH, Takata IH, Nascimento Júnior P. Endotracheal tube cuff pressure: need for precise measurement. *Sao Paulo Med J.* 1999;117(6):243–7. https://doi.org/10.1590/s1516-31801999000600004
7. Medalha S, Oliveira LC, Godoy I. Avaliação da pressão no balonete das cânulas endotraqueais e de traqueostomia em pacientes na Unidade de Terapia Intensiva. *Rev Bras Ter Intensiva.* 1999;11(3):90–3. https://doi.org/10.1371/journal.pone.0136184
8. Wallen SL, Paul TV, Tubog TD. Intracuff lidocaine and postoperative throat mucosal injuries: an evidence-based review. *J Perianesth Nurs.* 2025;40(1):150–7. https://doi.org/10.1016/j.jopan.2024.03.005
9. Tanaka Y, Nakayama T, Nishimori M, Sato Y, Furuya H. Lidocaine for preventing postoperative sore throat. *Cochrane Database Syst Rev.* 2009;(3):CD004081. https://doi.org/10.1002/14651858.CD004081.pub2
10. Fernandez RA, Blanch LL, Mancebo JO, Bonsoms NA, Artigas AN. Endotracheal tube cuff pressure assessment: pitfalls of finger estimation and need for objective measurement. *Crit Care Med.* 1990;18(12):1423–6. https://doi.org/10.1097/00003246-199012000-00014
11. Jaber S, Amraoui J, Lefrant JY, Arich C, Cohendy R, Landreau L, et al. Clinical practice and risk factors for immediate complications of endotracheal intubation in the intensive care unit: a prospective, multiple-center study. *Crit Care Med.* 2006;34(9):2355–61. https://doi.org/10.1097/01.CCM.0000233879.58720.87
12. Soltani HA, Aghadavoudi O. The effect of different lidocaine application methods on postoperative cough and sore throat. *J Clin Anesth.* 2002;14(1):15–8. https://doi.org/10.1016/S0952-8180(01)00345-7
13. Loeser EA, Hodges MI, Gliedman JE, Stanley TH, Johansen RK, Yonetani DE. Tracheal pathology following short-term intubation with low- and high-pressure endotracheal tube cuffs. *Anesth Analg.* 1978;57(5):577–9. https://doi.org/10.1213/00000539-197809000-00015

14. Navarro LHC, Braz JRC, Lima NG, Silva RM, Módolo FP. Effectiveness and safety of endotracheal tube cuffs filled with air versus filled with alkalinized lidocaine: a randomized clinical trial. *Sao Paulo Med J.* 2007;125(6):322–8. https://doi.org/10.1590/S1516-31802007000600004
15. Lam F, Lin YC, Tsai HC, Chen TL, Tam KW, Chen CY. Effect of intracuff lidocaine on postoperative sore throat and the emergence phenomenon: a systematic review and meta-analysis of randomized controlled trials. *PLoS One.* 2015;10(8):e0136184. https://doi.org/10.1371/journal.pone.0136184
16. Jaensson M, Olowsson LL, Nilsson U. Endotracheal tube size and sore throat following surgery: a randomized controlled study. *Acta Anaesthesiol Scand.* 2010;54(2):147–53. https://doi.org/10.1111/j.1399-6576.2009.02166.x
17. Beebe DS. Complications of tracheal intubation. *Semin Anesth Perioper Med Pain.* 2001;20(3):166–72. https://doi.org/10.1053/sane.2001.27132
18. Huang YS, Hung NK, Lee MS, Ku o CP, Yu JC, Huang GS, et al. The effectiveness of benzydamine hydrochloride spraying on the endotracheal tube cuff or oral mucosa for postoperative sore throat. *Anesth Analg.* 2010;111(4):887–91. https://doi.org/10.1213/ANE.0b013e3181e64059
19. Yukioka H, Hayashi M, Terai T, Fujimori M. Intravenous lidocaine as a suppressant of coughing during tracheal intubation in elderly patients. *Anesth Analg.* 1993;77(2):309–12. https://doi.org/10.1213/00000539-199308000-00015
20. Souissi H, Fréchette Y, Murza A, Masse MH, Marsault É, Sarret P, et al. Intracuff 160 mg alkalinized lidocaine reduces cough upon emergence from N2O-free general anesthesia: a randomized controlled trial. *Can J Anaesth.* 2016;63(7):862–70. https://doi.org/10.1007/s12630-016-0652-8
21. Minogue SC, Ralph J, Lampa MJ. Laryngotracheal topicalization with lidocaine before intubation reduces coughing on emergence from general anesthesia. *Anesth Analg.* 2004;99(4):1253–7. https://doi.org/10.1213/01.ANE.0000134807.89127.DD
22. Chi ZH, Jun JI. Effects of using different doses of dexmedetomidine during tracheal extubation for patients with parotidectomy after general anesthesia. *Shanghai Kou Qiang Yi Xue.* 2016;25(3):368.
23. Inoue Y, Koga K, Sata T, Shigematsu A. Effects of fentanyl on emergence characteristics from anesthesia in adult cervical spine surgery: a comparison of fentanyl-based and sevoflurane-based anesthesia. *J Anesth.* 2005;19(1):12–6. https://doi.org/10.1007/s00540-004-0278-9
24. Cho HR, Kim HK, Baek SH, Jung KY. The effect of remifentanil infusion on coughing during emergence from general anesthesia with desflurane. *Korean J Anesthesiol.* 2008;55(6):670–4. https://doi.org/10.4097/kjae.2008.55.6.670