

## SYSTEMATIC REVIEW

## Impact of topical airway anesthesia on immediate postoperative cough/bucking: a systematic review and meta-analysis



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### KEYWORDS

Airway management;  
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period;  
Airway extubation

### Abstract

**Background:** Postoperative cough may occur after tracheal intubation, but it is indistinct which drug is best at diminishing these events. Additionally, airway reflexes are commonly accompanied by severe hemodynamics responses during emergence.

**Objectives:** To evaluate the role of topical airway anesthesia on immediate post-extubation cough/bucking and extubation time.

**Methods:** Randomized clinical trials from MEDLINE, EMBASE, CENTRAL, and LILACS published until December 23, 2020 were included. Our primary outcome was postoperative cough/bucking incidence which was compared between local anesthetics and controls. Extubation times were likewise considered. Predisposition appraisal and subgroup, affectability investigations were likewise performed.

**Results:** The pooled analysis found a 45% reduction in cough incidence after treatment with topical airway local anesthetic (RR = 0.55; 95% CI: 0.42 to 0.72;  $p < 0.001$ ). The number needed to treat (NNT) was 4.61. The intervention showed no differences in reduction of the extubation time (mean difference = -0.07; 95% CI: -0.14 to 0.28;  $p = 0.49$ ).

**Conclusion:** Topical airway anesthesia demonstrated better than placebo or no medication in reducing immediate post-extubation cough/bucking. Further studies could have this objective to combine the different ways to perform better outcomes for patients.

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## Introduction

The procedures of intubation and extubation are known to cause pain and discomfort. Postoperative cough, sore throat, hoarseness of voice and laryngospasm are kinds of distressing sequelae after tracheal intubation. In any case, it is hazy which drug is best at diminishing these events. Additionally, airway reflexes are commonly accompanied by severe hemodynamic responses during emergence.<sup>1-6</sup>

Perioperative respiratory adverse events (mainly bucking and coughing) frequently occur during extubation and may lead to negative outcomes, increasing morbidity and mortality of patients. These events can trigger negative pressure pulmonary edema, an abrupt increase in intraocular, intrathoracic, intraabdominal, and intracranial pressure.<sup>5-8</sup>

Several techniques have been applied to attenuate extubation reaction during rise as intravenous (IV) medications (local anesthetics, opioids, dexmedetomidine),<sup>9-11</sup> jelly medications on endotracheal tube cuff (lidocaine, corticosteroids, water-soluble lubrication, vegetable gum),<sup>5,6,12</sup> local anesthetics intracuff (local anesthetic, alkalized or not),<sup>13-15</sup> nebulized anesthetics or laryngotracheal topicalization<sup>1,3,4,8,16-21</sup> with anesthetics (local or others),<sup>20-22</sup> translaryngeal injection, and/or airway nerve blocks.<sup>23</sup>

Topical local anesthetic administration reduces the risk of perioperative respiratory adverse events in elective endotracheal intubation. Be that as it may, conclusive proof of its adequacy stays subtle, due, to some degree, to the wide inconstancy in the procedure for showering topical anesthetic.<sup>3,6,24</sup>

Local anesthetic jelly could have lubricating properties to limit the potential harm to the tracheal mucosa and stifling bucking. Its job in avoidance of postoperative cough, sore throat, and hoarseness is not effective.<sup>5</sup>

Considering assessing the viability of topical airway anesthesia has yielded opposing outcomes. A few investigations have shown great viability of this technique in preventing laryngospasm, sore throat, cough, and agitation as well.<sup>1-3,18,22</sup> In any case, others found that there is no profit by topical anesthesia and even report an expanded incidence of perioperative airway complications brought about by the incitement from the spray itself.<sup>8,25,26</sup>

The target of this investigation is to assess the role of topical airway anesthesia on immediate postoperative coughing and extubation time.

## Methods

### Search methods for identification of reviews

To search in MEDLINE papers with terms: (1) topical anesthesia OR topical airway anesthesia; (2) anesthesia, local/methods OR Anesthetics, Local OR Lidocaine; (3) Intubation OR Intubation, Intratracheal/methods OR Intubation, Intratracheal/adverse effects OR Airway Management/methods OR Extubation OR Cough; (4) 1 AND 2 AND 3. The period searched was between (1966/01/01[Date - Entry]: 2020/12/23[Date - Entry]).

The procedure of information extraction was performed utilizing a convention adjusted from PRISMA statement, counting the investigation, identification information, time of the examination conduction, structure, inclusion and exclusion criteria, demographic characteristics, outcomes measures, statistical analysis, and limitations (Fig. 1).

We looked at the Cochrane Central Register of Controlled Trials (CENTRAL); MEDLINE (1966 to December 2020); EMBASE (1974 to December 2020); and LILACS (1982 to December 2020). We utilized the referred MeSH and free text terms to search MEDLINE and CENTRAL.

### Criteria for considering reviews for inclusion

Two review authors autonomously checked on and chose preliminaries from the list items, and surveyed reads for appropriateness, methodology, and quality. Zones of contradiction or vulnerability were arbitrated by different agents. The agreement between two autonomous analysts during the full-content audit was viewed as excellent ( $k = 0.89$ ; 95% CI: 0.82 to 0.96)

The independent variables were the type of local anesthetic, dose, and treatment period. The outcomes researched were incidence of emergence cough/bucking and extubation time.

For studies to be remembered for the meta-analysis, they needed to meet the accompanying criteria: (1) they had to be a clinical trial design; (2) they needed to look at least two groups (local anesthetic vs. control); and (3) they had proportions/relative risk/mean with relating 95% CIs, or with adequate information for calculation.

No confinements were set for members' ages or definition of cough as used in individual studies. Studies with laryngeal mask airways, nasal intubation, and airway nerve block were excluded.

### Data collection and analysis

We analysed data using RevMan5.0 software. We pooled the included investigations to yield the relative risks of severe/moderate cough with 95% confidence intervals (CI) or standard errors.

### Selection of reviews

#### Data extraction and management

Data were extracted using a standardized form. Information extracted included: type of design study; age and gender of members; number of members; randomization strategy; type of surgery; surgery duration; ASA (American Society of Anesthesiologists) physical status; incidence and grade of cough during extubation; time to extubation; improvements in parameters: local anesthetic compared with placebo or other drug groups; laryngospasm; airway obstruction severity; adverse events. The GRADE (Grading of Recommendations, Assessment, Development and Evaluations) tool was adopted to evaluate the studies quality of evidence. All the studies presented a moderate to high GRADE certainty ratings. All the studies were clinical trials, most part with double blind evaluation. The extubation

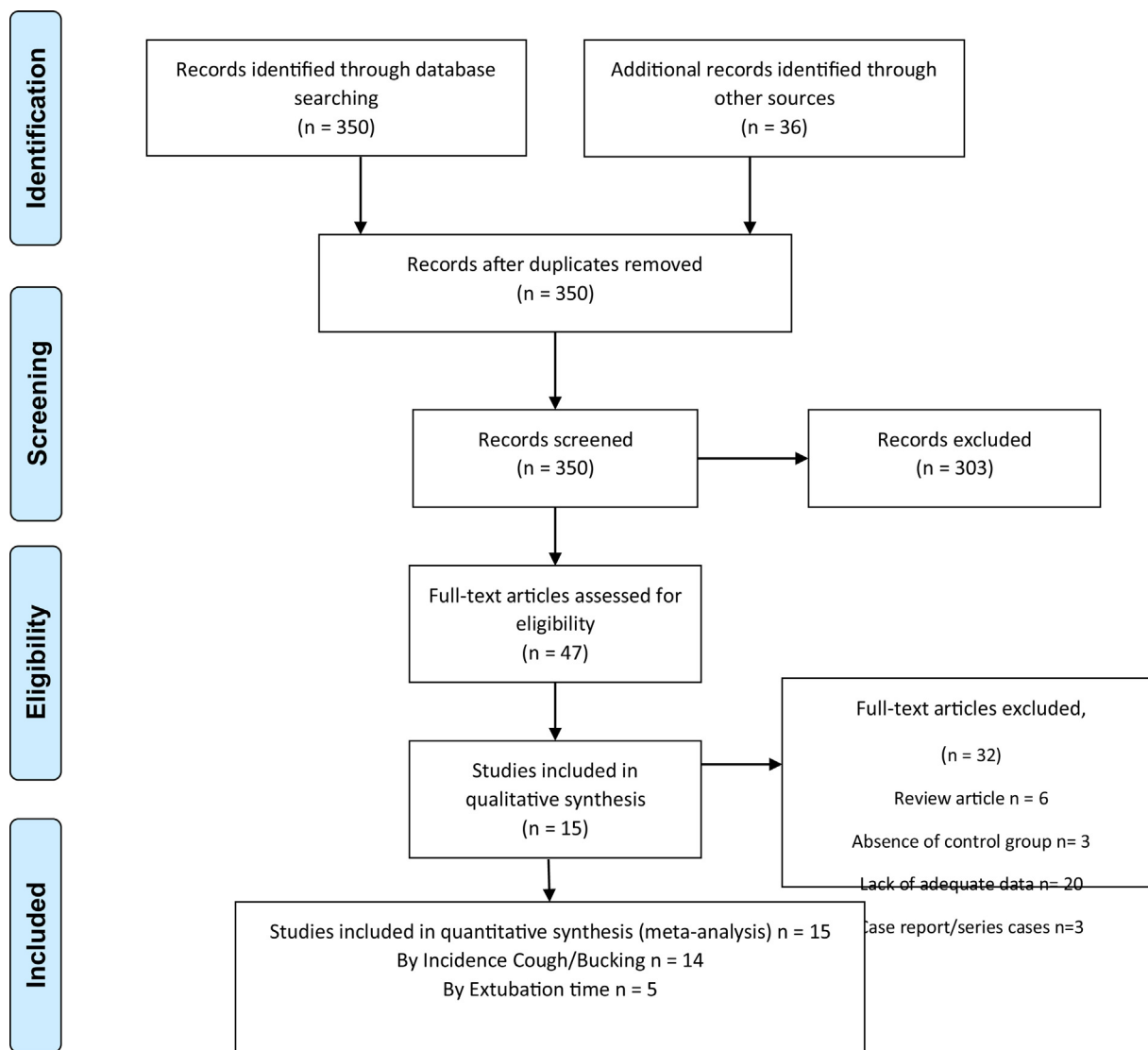


Figure 1 Flowchart of study selection.

times results demonstrate a low heterogeneity and risk of bias. The indirectness was not a problem because the intervention is low cost, accessible, and has a little execution difficulty.

### Assessment of methodological quality of included reviews

#### Data synthesis

We introduced all point gauges as means  $\pm$  SE or risk ratios (RR). We utilized forest plots to show the results. For dichotomous factors, we determined a fixed-effect risk ratio (RR) with 95% confidence intervals (CI) for individual studies.

We measured heterogeneity among the pooled estimates by utilizing the  $I^2$ . We performed affectability investigations contrasting random-effects and fixed-effect models. Potential for publication bias was assessed using the Egger test, Higgins test, and funnel plots (Fig. 2).<sup>27</sup>

### Results

The electronic database looked through of 350 articles. There were 15 articles<sup>3,4,6,14–16,28–36</sup> that met the inclusion criteria and were included in the analysis (Fig. 1). The features of the included studies are introduced in Table 1. Articles or studies with unpublished or ongoing studies were not included in this meta-analysis.

#### Incidence of immediate post-extubation cough/bucking

A random effect model was utilized for the examination because high heterogeneity existed among the studies ( $\text{Tau}^2 = 0.15$ ;  $p < 0.0001$ ;  $I^2 = 74.0\%$ ). The pooled analysis found a 45% reduction in cough incidence after treatment with topical airway local anesthetic (RR = 0.55; 95% CI: 0.42 to 0.72;  $z = 4.32$ ;  $p < 0.001$ ) (Fig. 3). The absolute risk reduction (ARR)

**Table 1** Description of the studies included in meta-analysis.

Trial	Sample size	Male %	ASA physical status	Duration (min)	Surgery types	Anesthesia maintenance	Intervention/ Comparator	Outcomes
Arslan 2013	54	87.0	I-II	16.4 ± 4.4	Laryngeal microsurgery	Sevoflurane	1 - Lidocaine 10% spray	No reduction in cough incidence and laryngospasm. Agitation lower in lidocaine group.
Bousselmi 2014	80	Sex ratio 1.2 to 2.3	I-III	14.9 ± 5.3	Not described	Propofol + Remifentanil	2 - Saline spray	Reduction in cough incidence and sore throat.
				82 ± 34			1 - Saline instillation + saline cuff	
				80 ± 42			2 - Saline instillation + lidocaine cuff	
				72 ± 32			3 - Lidocaine instillation + saline cuff	
				76 ± 36			4 - Lidocaine instillation + lidocaine cuff	
D'Aragon 2013	116	0%	I-II	30-120	Elective gynecologic procedure	Desflurane	1 - 4% lidocaine 4 mL spray + lidocaine cuff	Reduction in cough incidence (NNT 3.05). No influence in sore throat.
		All female					2 - 4% lidocaine 4 mL spray + NS cuff	
							3 - NS spray + lidocaine cuff	
							4 - NS spray + NS cuff	
Diachun 2001	46	Not described	I-III	Not described	Non ear, nose and throat surgery	Isoflurane +N2O	1 - Lidocaine 2% TT 2 mg.kg <sup>-1</sup> spray	Reduction in cough incidence.
Dutta 2016	45	42.2	I-III	Not described	Not described	Sevoflurane	1 - Lidocaine 10% TT 1.5 mg.kg <sup>-1</sup> 2- NS i.v + NS spray 3 - Dex 0.3 ug. kg <sup>-1</sup> + NS spray	No reduction in cough and extubation time
Fang 2018	52	25.0	I-II	Until 4 hours	Thyroidectomy	Propofol + Remifentanil	1 - Ropivacaine 0,75% 6 mL	Reduction in cough. No influence on sore throat and extubation time.

Table 1 (Continued)

Trial	Sample size	Male %	ASA physical status	Duration (min)	Surgery types	Anesthesia maintenance	Intervention/ Comparator	Outcomes
Gupta 2006	50	Not described	Not described	Not described	Carotid endarterectomy	Volatile	2 - Saline 6 mL 1 - Lidocaine 4% 4 mL TT	Reduction in cough.
Jee 2003	75	70.6	Not described	106.8 ± 44.7  123.4 ± 55.9	Orthopaedic, plastic, lower abdominal surgery	Enflurane	2 - NS 4 mL TT 1 - No drug	Reduction in number of coughs (5 and 10 min).
Lee 2011	55	61.8	I	28.9 ± 7.2  30.1 ± 7.9	Laryngeal microscopic surgery	Sevoflurane + N2O	1 - Lidocaine 10% TT 1.5 mg.kg <sup>-1</sup>	No reduction in cough incidence, reduction in number of coughs.
Li 2016	322	56.5	I-III	90.7 ± 23.6  86.9 ± 30.3	Urology, otolaryngology, ophthalmologic, orthopedic	Sevoflurane	2 - No treatment Lidocaine 2% TT 4 mg.kg <sup>-1</sup>	Reduction in cough, laryngospasm, desaturation. No influence on extubation time.
Paltura 2018	64	45.3	I	20 to 25 min	Suspension laryngoscopy for benign laryngeal diseases	Sevoflurane	Saline 0,9% 4 mL 1 - Lidocaine 10% spray 7 puffs	No reduction in cough incidence and extubation time. Agitation lower in lidocaine spray group.
Shabnum 2017	60	61.6	I-II	240 ± 18.67	Craniotomies	Isoflurane	2 - Lidocaine 2% 1 mL (cotton swap) 3 - Control (nothing applied) 1 - IV Lignocaine 2% 1.5 mg.kg <sup>-1</sup> + intratracheal placebo	Reduction in cough incidence. No influence in extubation time.

Table 1 (Continued)

Trial	Sample size	Male %	ASA physical status	Duration (min)	Surgery types	Anesthesia maintenance	Intervention/Comparator	Outcomes
				244.5 ± 16.08			2 intratracheal lignocaine 2% 1.5 mg.kg <sup>-1</sup> + IV placebo	
				265 ± 18.17			3 - IV + intratracheal placebo	
Soltani 2002	204	57.8	I-II	45 ± 0.6	Cataract surgery	Halothane + N2O	1 - lidocaine 10% spray distal end ETT	I.V. lidocaine promotes reduction in cough incidence. No influence in extubation time.
							2 - lidocaine 10% spray laryngopharyngeal structures	
							3 - 2% lidocaine jelly ETT	
							4 - i.v. Lignocaine 2% 1.5 mg.kg <sup>-1</sup> at the end of surgery	
							5 - 2% lidocaine intracuff	
							6 - normal saline end ETT	
Yamasaki 2013	60	45.0	I-II	124 ± 52	Tympanoplasty	Propofol + Remifentanil	1 - Lidocaine 4% 3 mL transtracheal	Reduction in cough/severe cough.
				226 ± 54			2 - No medication	
Zamora Lozano 2007	78	48.7	I-II	60-120 min	General, gynaecology, orthopedic, ophtalmological, plastic, urological	Volatile	1 - Lidocaine 2% TT 5 mL	Reduction in cough.
							2 - Lidocaine 2% IV 5 mL	
							3 - Saline 0,9% 5 mL	
							4 - Lidocaine 2% 5 mL intracuff	

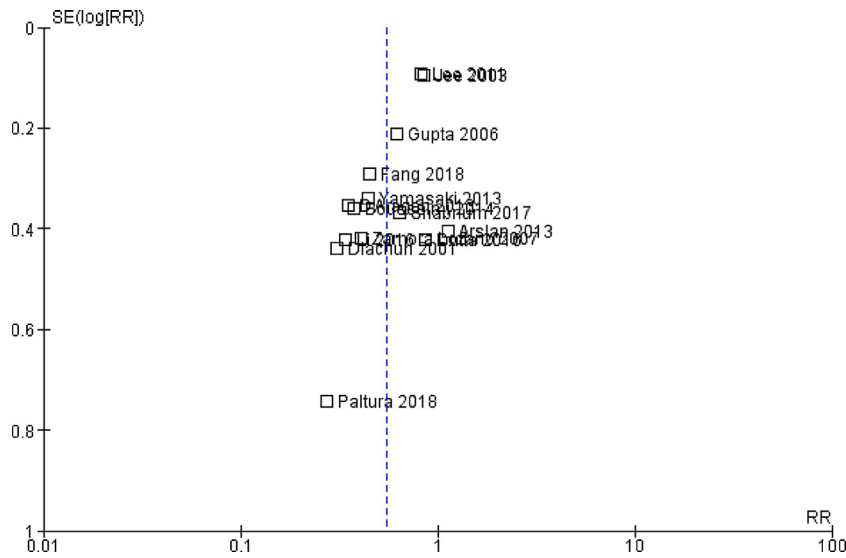


Figure 2 Funnel plot.

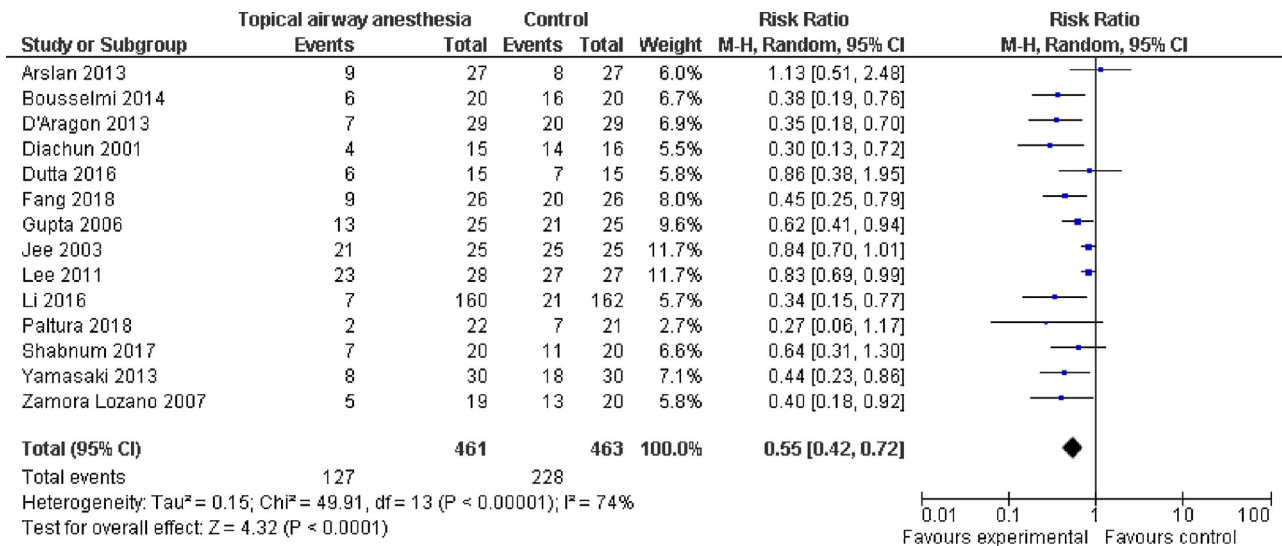


Figure 3 Incidence of immediate post-extubation cough/bucking.

was 21.7%. The number needed to treat (NNT) was 4.61. This analysis included 924 patients in all studies.

### Extubation time

We further examined the influence of the topical airway local anesthetic in the extubation time. In this analysis, we used a fixed effect because of low heterogeneity (Chi<sup>2</sup> = 1.94; p = 0.75; I<sup>2</sup> = 0.0%). The intervention showed no differences in reducing the extubation time (mean difference = -0.07; 95% CI: -0.14 to 0.28; z = 0.69; p = 0.49) (Fig. 4). This second analysis included 512 participants in all studies.

### Discussion

This systematic review demonstrated that the local anesthetics used as topical tracheal would do well to diminish the

rate of periextubation cough/bucking in comparison with either placebo or no medication. It also demonstrated that the local anesthetics used as tracheal or topical application did not influence on the extubation time as well.

There is a meaningful relationship between frequency of cough and the first-hour sore throat.<sup>1,35,36</sup> There are several morbid and physiological outcomes of development emergence coughing and they have prompted numerous examinations looking at changed drugs to diminish periextubation coughing. Lam and colleagues<sup>13</sup> meta-analysis found that intracuff lidocaine significantly decreased postoperative coughing when contrasted and control groups, fundamentally the same as our discoveries. Also, Rajendram et al.<sup>37</sup> meta-analysis determined the intracuff lidocaine to be the most effective at preventing peri-extubation coughing and IV lidocaine was the least effective, among other IV medications. In other recent meta-analyses, Tung et al.<sup>10</sup> found that lidocaine altogether diminished postoper-



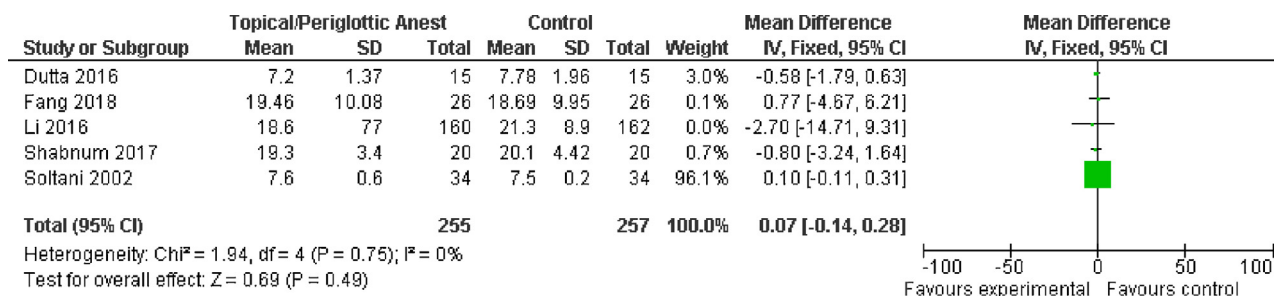


Figure 4 Extubation time in minutes.

active coughing when contrasted and control groups, like our discoveries as well. In our study we also found local anesthetics to be likely very effective in reducing emergence cough.

Topical airway anesthesia is not a recent strategy. Franz Kuhn (1866–1929), a German surgeon, made a noteworthy viable and logical commitment towards the advancement of modern anesthesia and emergency medicine. In 1900, he had developed a metallic endotracheal tube. Kuhn performed tracheal intubation using this method in the alert patient, utilising local anaesthesia – with cocaine – of the upper aviation routes, or under general anesthesia with chloroform.<sup>38</sup>

The impact of site-coordinated topical airway local anesthetic, splashed by an atomizer straightforwardly onto supraglottic, glottis, and subglottic zones, even direct vision, has a wide variability, and it should be seen as a peripheral blockade. The various strategies for lidocaine spray may significantly affect results. To accomplish ideal impact of topical airway anesthesia, spray over supraglottic, glottis, and subglottic regions is suggested.<sup>3,39</sup>

It is known that surgical stimuli are not constant during operation. Imagining a graph of surgical stress, the intubation is considered one of the greatest nociceptive stimuli in the perioperative period. This is the reason for using high bolus doses of intravenous agents such as opioids in anesthetic induction. The plasma concentration of an intravenous anesthetic should be titrated to match the need of individual patient.<sup>40</sup>

The conveyance of a spray under direct vision permits focused on the inclusion of key laryngeal structures, as well as subglottic applications. The use of an atomizer seems to be important when compared to the administration via trachea. It seems to be a more effective option to nonatomized conveyance because atomized particles are little, spread a huge surface zone, and may better hold fast to endotracheal layer bringing about progressively powerful medication assimilation. Therefore, the electrical charge of the atomized particle contributes to increased spread throughout the respiratory tract.<sup>8,24,41</sup>

There are other described ways of topicalization for an application that includes the blind instillation of lidocaine to the back of the mouth, administration directly down the tracheal tube and nebulization. Lidocaine applied indiscriminately into the rear of the mouth has appeared to convey answer to key laryngeal structures in youngsters, yet it is probably going to be less solid than application under direct vision and far-fetched to anesthetize the subglottic district.<sup>3,8,41</sup>

The use of nebulization is probably going to be less aggravated to the airway than an application with a splash and might be of advantage in methodology requiring a wide dispersion of local anesthesia (e.g., flexible bronchoscopy or fiberoptic intubation), as nebulization enhances the spread of much smaller droplets to the peripheral airways, but nebulization cannot target the local anesthetic to a particular area, delay the time to administer and the dose delivered is still unknown (because part of it could escape exhales).<sup>8,39</sup>

The use of topical airway anesthesia had a little influence on extubation time. This keeps the developing patient's tidal volumes well without troublesome rise airway reflexes, which allows employing a ventilator pressure support mode or handbag assisted ventilation.<sup>4,31,33,42</sup> On the other hand, another meta-analysis<sup>43</sup> confirmed that both alkalinised and non-alkalinised intracuff fundamentally delayed spontaneous ventilation time. To what extent intracuff lidocaine expanded the extubation time was not analysed, yet in the event that the objective was productive turnover of the working room, at that point intracuff lidocaine would not be a suggested decision.<sup>43</sup>

Besides the reduction in perioperative cough,<sup>1-3,14,15,28-31,33,39,42</sup> sore throat<sup>1,15,19</sup> and laryngospasm,<sup>1</sup> oropharyngeal instillation of local anesthetic attenuates the cardiovascular responses to intubation<sup>7,16,31-34,44,45</sup> and postoperative throat pain without influence patients recovery.<sup>3,4,14,39</sup> D'Aragon et al.,<sup>14</sup> in a multivariate analysis, watched the use of lidocaine spray diminished the rate of cough at extubation (odds ratio = 0.256;  $p < 0.001$ ). In the same study, the utilisation of intracuff alkalinized lidocaine did not affect the event of cough ( $p = 0.471$ ). They found a number need to treat (NNT) with lidocaine spray of 3.05 patients.<sup>14</sup>

Considering the efficacy of airway topical anesthesia against an important nociceptive stimulus of the endotracheal tube, we can consider it as regional anesthesia. The use of local anesthesia is a generally common part of any perioperative multimodal analgesia or improved recuperation after medical procedure (ERAS) pathway.<sup>45</sup> With the assortment of local strategies accessible and the adaptability of these methods in regards to various surgeries, regional anesthesia/analgesia particularly positions the anesthesiologist to have a noteworthy effect in the decrease of narcotics in the perioperative period.<sup>46,47</sup>

The length of action of topical laryngeal local anesthetic may depend on the type and concentration used. Most of the studies included in this meta-analysis used lidocaine. Lidocaine has a fast onset of action when injected into tissue



at normal physiological pH. Lidocaine has a term of activity of 1–2 hours when used for different regional anesthesia strategies. Other options with longer effect should be considered to reduce the incidence of cough/bucking and others perioperative respiratory adverse events, especially in surgeries with longer anesthesia times.<sup>1,4,8,39,48,49</sup>

An infusion of the local anesthetic lidocaine is ordinarily utilised as an aid to control intraoperative nociception and postoperative pain. When used in nerve blocks or regional anesthesia, local anesthetics produce antinociception by either repressing excitation of nerve endings or by blocking conduction of activity possibilities in peripheral nerves. A balanced technique of multimodal general anesthesia predicated on picking a mix of specialists, including regional anesthesia, that demonstrated at various focuses in the nociceptive framework to control nociception intraoperatively and pain postoperatively. Since these specialists additionally decline excitement, the portions of hypnotics inhaled ethers needed to control unconsciousness are diminished.<sup>50,51</sup>

Anesthesiologists adopt a few techniques to diminish pointless narcotic use, narcotic opioid-related adverse events, and reactions in the perioperative period. Multimodal analgesia, upgraded recuperation pathways, and regional anesthesia are key apparatuses as we move in the direction of ideal narcotic stewardship and the perfect of compelling absence of pain without unwanted sequelae.<sup>47</sup>

While the multimodal approach seems to raise the advantage to symptom proportion, a rational strategy for include the topical airway anesthesia is proposed. With the assortment of local methods accessible and the adaptability of these strategies in regard to various surgeries, regional anesthesia/analgesia of pain remarkably positions the anesthesiologist to have a noteworthy effect in the decrease of anesthetic consumption and narcotics in the perioperative period.<sup>46,50</sup>

The main limitation of this study is that cough/bucking and coughing severity may be a subjective interpretation, raising the issue of between inter-observer variability and bias. Even though contrasting and “nothing”, or no medicine may bring up issues of result appraisal inclination with regards to surveying a subjective outcome, most of the studies utilised blinded assessors apart from the primary anesthesiology group. Another restriction is the enormous level of heterogeneity in medication dosage. This heterogeneity may change the watched impact, particularly whenever included examinations used subtherapeutic doses. We endeavored to outline this impact by leading a subgroup investigation using low, middle, and high doses, however it was not possible due to the sparsity of information.

Considering the choice of local anesthetic, it can interfere with the outcome of cough and postoperative sore throat. There is a need for more studies to show the difference between the different local anesthetics and drugs, and if there are worse adverse events or outcomes to evaluate better interventions. Magnesium sulphate, liquorice, and steroids seem most effectively prevented postoperative sore throat at 24 hours.<sup>1</sup> Also, there are others confounding factors such as total intravenous anesthetic (TIVA) versus volatile, the cumulative rank of opioids effects, tracheal tube size and cuff type, all of which we couldn't evaluate because of lack of information. Several reasons may exist for the distinction in consequences of various researches,

including diverse statistical methods and models for study consideration and avoidance.<sup>4,10,17</sup>

All study medications exhibited superior to placebo or no medication in diminishing peri-extubation cough, but further studies could have this objective to combine the different ways to perform this kind of anesthesia, such as opioid use, other adjuvant anesthetics, hemodynamics data, and other local anesthetics.

## Conclusion

This systematic review showed that the local anesthetics used as topical application would be advised to reduce the frequency of immediate post-extubation cough/bucking in comparison to either placebo or no medication. It also demonstrated that the local anesthetics used as topical tracheal application had better odds to reduce the extubation time as well. The NNT found was 4.61.

## Conflicts of interest

The authors declare no conflicts of interest.

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