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# Effect of intracuff alkalinised lidocaine alone and combined with dexamethasone on post-extubation emergence in smokers undergoing elective surgeries under general anaesthesia

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## ABSTRACT

**Background:** Emergence phenomena (EP) following general anaesthesia (GA), such as cough, sore throat, and hoarseness, are common yet often overlooked. This study aimed to evaluate the effects of intracuff alkalinized lidocaine and dexamethasone in attenuating endotracheal tube (ETT)-induced EP. **Aims and Objectives:** The study aimed to assess the effect of intracuff alkalinized lidocaine, alkalinized lidocaine with dexamethasone, and saline on the occurrence and severity of post-operative cough, sore throat, and hoarseness in smokers for 24 h after surgery. In addition, it aimed to evaluate their efficacy in maintaining intracuff pressure and to assess hemodynamic changes during emergence from GA. **Materials and Methods:** This prospective, observational study included 90 American Standards Association II and III male patients aged 20–50 years with a 5-year smoking history. Patients were divided into three groups of 30 to receive either alkalinized lidocaine, alkalinized lidocaine with dexamethasone, or saline as the cuff inflation agent. **Results:** Cuff pressure increased in all groups ($P > 0.05$). The cough was more severe and frequent in the saline group ($P < 0.05$). Sore throat and hoarseness occurred less frequently in the alkalinized lidocaine and lidocaine-dexamethasone groups compared to the saline group, with less severity observed at 3 h- and 24-h post-extubation. **Conclusion:** Alkalinized lidocaine with dexamethasone for ETT cuff inflation was as effective as alkalinized lidocaine in reducing post-extubation symptoms and more effective than saline.

**Key words:** Emergence phenomena; Endotracheal tube; Alkalinized lidocaine; Dexamethasone; Post-operative symptoms

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## INTRODUCTION

General anesthesia (GA) is widely used for various surgical procedures requiring airway management through cuffed endotracheal tubes (ETTs).[1] While ETTs provide effective ventilation, they are associated with adverse effects such as sore throat, hoarseness, and dysphagia post-extubation, affecting up to 50% of patients.[2] More severe complications, including tracheal stenosis and tracheoesophageal fistula, may occur with prolonged use.[1] ETT-induced emergence phenomena (EP) encompass sore throat, cough, and dysphonia, primarily caused by mechanical and chemical irritation during intubation and ventilation.[3-6] These responses can result in hypertension, tachycardia, increased intracranial and intraocular pressure, laryngospasm, bronchospasm, and even pulmonary edema.[7,8] Factors contributing to EP include patient demographics, type of surgery, cuff pressure, ETT size, and

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mucosal trauma.[9,10] The primary cause remains the direct irritation from the ETT cuff.[11] ETT cuffs maintain a seal between the tube and tracheal wall, preventing aspiration and air leaks. However, excessive cuff pressure (>48 cm $H_2O$) can compromise tracheal capillary perfusion, while insufficient pressure (<18 cm $H_2O$) risks aspiration.[12] Monitoring intracuff pressure intraoperatively is crucial to minimize tracheal damage.[13]

Smokers are particularly susceptible to perioperative complications due to chronic airway inflammation and heightened airway sensitivity, leading to increased risks of laryngospasm and airway obstruction.[14-16] Strategies to mitigate EP include low-pressure cuffs, steroid-coated ETTs, topical lidocaine, dexamethasone, and extubation in a deeper anesthesia plane.[17-19] However, these methods have limitations, including delayed emergence and aspiration risks.[9,7] Using lidocaine as an ETT cuff inflation medium may provide continuous anaesthetic effects while preventing nitrous oxide-induced pressure increases.[20] Alkalinized lidocaine, prepared with sodium bicarbonate, enhances diffusion and prolongs anaesthetic action.[21] Dexamethasone, with its potent anti-inflammatory properties, can further reduce postextubation airway complaints.[22] Given the multifactorial nature of post-extubation respiratory symptoms,[3] we hypothesized that intracuff alkalinized lidocaine and dexamethasone would be effective in minimizing post-operative airway complications. This observational study aimed to compare the clinical effects of these agents in smokers undergoing elective surgeries under GA.

### Aims and objectives

1. To determine the effect of intracuff alkalinized lidocaine, alkalinized lidocaine plus dexamethasone and saline on the occurrence and severity of post-operative cough, sore throat and hoarseness in smokers for 24 h after surgery
2. To evaluate the efficacy of intracuff alkalinized lidocaine, alkalinized lidocaine plus dexamethasone and saline in maintaining intracuff pressure
3. To evaluate hemodynamic changes that occurs during emergence from GA.

## MATERIALS AND METHODS

The study was conducted as a prospective observational, in the Department of Anaesthesiology and Critical Care, Sher-I-Kashmir Institute of Medical Sciences, Soura, Srinagar, Jammu and Kashmir. Patients fulfilling the selection criteria were enrolled. Participants eligible for this study included individuals who met predefined conditions. The Institutional Ethics Committee approved this study and written informed consents were obtained from all the patients. A total number of 90 male patients, 20–50 years of age, with history of smoking for a period longer than 5 years, of American Standards Association (ASA) status II and III, Mallampati score of 1 and 2, posted for elective surgeries lasting for more than 1 h were enrolled for this study. Patients were excluded from the study if they were younger than 20 years or older than 50 years. Individuals with a history of respiratory tract infection within the last 2 weeks or those diagnosed with bronchial asthma were not included in the study. Patients with documented hypersensitivity to lidocaine were also excluded. Furthermore, those anticipated to have difficult intubation, classified as Mallampati Grade III or IV, were not considered for the study. Participants who could not be successfully intubated on the first attempt were also excluded. Patients with risk factors for postoperative aspiration of gastric contents, including those requiring post-operative nasogastric tube placement, were not included in the study. In addition, individuals undergoing oropharyngeal or laryngeal surgeries were excluded, as were those with contraindications to the use of nitrous oxide. Patients were randomly allocated into three groups, each consisting of 30 participants, based on the agent used for inflating the ETT cuff. Group L received 10 mL of alkalinized lidocaine (9 mL of 2% lidocaine+1 mL of 7.5% $NaHCO_3$), Group LD received 10 mL of alkalinized lidocaine with dexamethasone (7 mL of 2% lidocaine+1 mL of 7.5% $NaHCO_3$+2 mL of dexamethasone), and Group NS received 10 mL of normal saline. Pre-operative assessments included history-taking, physical examination, airway evaluation, and relevant baseline investigations. Patients fasted for at least 8 h before surgery. Standard intraoperative monitoring was initiated, and intravenous access was secured. Anesthesia induction included propofol (2 mg/kg), fentanyl (2 mcg/kg), and atracurium (0.5 mg/kg) for muscle relaxation. Tracheal intubation was performed by an experienced anaesthetist using an 8 mm ID cuffed ETT. Correct placement was confirmed by chest auscultation and capnography. Anesthesia was maintained with nitrous oxide (50%), oxygen (50%), isoflurane (1%), and atracurium as a muscle relaxant. Mechanical ventilation was adjusted to maintain normocapnia. Analgesia was provided using fentanyl boluses and paracetamol (15 mg/kg). Crystalloid fluids were administered as required. Cuff pressure was measured immediately after intubation and every 30 min thereafter using a RUSCH endotest cuff pressure manometer. At the end of surgery, nitrous oxide and isoflurane were discontinued, and 100% oxygen was administered. Residual neuromuscular blockade was reversed with neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg). Hemodynamic parameters, including heart rate, systolic and diastolic blood pressure (DBP), and mean arterial pressure (MAP), were recorded at extubation. Cough

reflexes were evaluated at extubation and at 1-, 3-, and 24-h post-extubation. The presence of coughing was assessed as absent (no cough or cough only during ETT cuff removal) or present (coughing during regular or irregular breathing with the ETT in place). Sore throat and cough severity were graded on a 4-point scale; 0-None, 1-Mild, 2-Moderate, 3-Severe. Hoarseness was also graded on a 4-point scale: 0-None, 1-Noted only by the patient, 2-Mild but apparent, 3-Severe and readily apparent.[23] Data were compiled in Microsoft Excel and analyzed using SPSS v20.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as Mean±SD, and categorical variables as percentages. Analysis of Variance was used for intergroup comparisons, with least significant difference for multiple comparisons. Chi-square or Fisher's exact test was applied for categorical data. A P<0.05 was considered statistically significant.

## RESULTS

As shown in Table 1, the patient characteristics, mainly age, weight, height, and ASA status were similar between the groups, ensuring comparability.

Furthermore, there were no significant differences between the groups in pre-operative vital signs, surgery duration, or intra-cuff pressure measurements during surgery.

Table 2 depicts that the heart rate at extubation was significantly higher in the NS group (92.2±7.6 bpm) compared to the L group (85.1±7.9 bpm) and the LD group (85.5±8.4 bpm) (P<0.05). Likewise, the systolic blood pressure (SBP) at extubation was significantly higher in the NS group (144.6±18.2 mmHg) than in the L group (132.3±12.9 mmHg) and the LD group (133.1±13.5 mmHg) (P<0.05). The DBP was also significantly higher in the NS group (85.7±10.5 mmHg) compared to both the L group (76.4±7.5 mmHg) and the LD group (77.9±8.4 mmHg) (P<0.05). The MAP was significantly higher in the NS group (106.6±12.4 mmHg) compared to the L group (98.4±9.4 mmHg) and the LD group (99.2±10.5 mmHg) (P<0.05).

As shown in Tables 3 and 4, the severity of cough was highest in the NS group at all-time points, followed by the L group with moderate severity, and the LD group, which reported the least severity. Regarding sore throat, the NS group had a significantly higher incidence of sore throat at extubation (83.3%, 25/30) compared to the L group (53.3%, 16/30) and the LD group (30%, 9/30) (P<0.05). At 1 h, the incidence remained higher in the NS group

**Table 1: Patient characteristics**

| Parameter | Group L (n=30) | Group LD (n=30) | Group NS (n=30) | P-value |
|---|---|---|---|---|
| Age (years) | 34.5±7.11 | 36.1±7.39 | 35.8±7.43 | 0.663 (NS) |
| Weight (kg) | 59.7±7.40 | 61.2±9.14 | 59.4±8.00 | 0.684 (NS) |
| Height (cm) | 165.3±4.29 | 165.5±4.59 | 167.2±6.17 | 0.251 (NS) |
| ASA status (%) | ASA II: 86.7% (26)<br>ASA III: 13.3% (4) | ASA II: 80.0% (24)<br>ASA III: 20.0% (6) | ASA II: 83.3% (25)<br>ASA III: 16.7% (5) | 0.787 (NS) |

ASA: American society of anesthesiologists

**Table 2: Hemodynamic parameters at extubation**

| Group | Heart rate (bpm) | SBP (mmHg) | DBP (mmHg) | MAP (mmHg) |
|---|---|---|---|---|
| NS | 92.2±7.6 | 144.6±18.2 | 85.7±10.5 | 106.6±12.4 |
| L | 85.1±7.9 | 132.3±12.9 | 76.4±7.5 | 98.4±9.4 |
| LD | 85.5±8.4 | 133.1±13.5 | 77.9±8.4 | 99.2±10.5 |

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, MAP: Mean arterial pressure

**Table 3: Incidence of cough, sore throat, hoarseness at various time points**

| Parameter | Group | Extubation (%) | 1 h (%) | 3 h (%) | 24 h (%) |
|---|---|---|---|---|---|
| Incidence of cough | NS | 93.3 (28/30) | 86.7 (26/30) | 73.3 (22/30) | 23.3 (7/30) |
| | L | 60 (18/30) | 50 (15/30) | 40 (12/30) | 0 (0/30) |
| | LD | 33.3 (10/30) | 26.7 (8/30) | 23.3 (7/30) | 0 (0/30) |
| Incidence of sore throat | NS | 83.3 (25/30) | 76.7 (23/30) | 56.7 (17/30) | 16.7 (5/30) |
| | L | 53.3 (16/30) | 43.3 (13/30) | 30 (9/30) | 0 (0/30) |
| | LD | 30 (9/30) | 16.7 (5/30) | 6.7 (2/30) | 0 (0/30) |
| Incidence of hoarseness | NS | 90 (27/30) | 86.7 (26/30) | 66.7 (20/30) | 36.7 (11/30) |
| | L | 63.3 (19/30) | 46.7 (14/30) | 30 (9/30) | 3.3 (1/30) |
| | LD | 33.3 (10/30) | 20 (6/30) | 10 (3/30) | 0 (0/30) |

**Table 4: Mean severity (scale 1–10) of cough, sore throat, and hoarseness at various time points**

| Group | Cough severity (scale 1–10) | Sore throat severity (scale 1–10) | Hoarseness severity (scale 1–10) |
|---|---|---|---|
| NS | 7.8±2.5 | 7.6±2.3 | 8.2±2.1 |
| L | 4.5±1.9 | 4.2±1.7 | 5.1±1.9 |
| LD | 2.3±1.4 | 1.9±1.2 | 2.1±1.5 |

(76.7%, 23/30), compared to the L group (43.3%, 13/30) and the LD group (16.7%, 5/30) (P<0.05). Similarly, at 3 h, 56.7% (17/30) of the NS group had sore throat, compared to 30% (9/30) in the L group and 6.7% (2/30) in the LD group (P<0.05). By 24 h, the NS group had 16.7% (5/30) of patients still reporting sore throat, while the L and LD groups reported no sore throat (0% in both groups) (P<0.05). The severity of sore throat was highest in the NS group at all-time points, followed by moderate severity in the L group, with the LD group reporting the least severity. The incidence of hoarseness at extubation was 90% (27/30) in the NS group, 63.3% (19/30) in the L group, and 33.3% (10/30) in the LD group, with the NS group having the highest incidence (P<0.05). At 1 h, 86.7% (26/30) of patients in the NS group experienced hoarseness, compared to 46.7% (14/30) in the L group and 20% (6/30) in the LD group (P<0.05). At 3 h, 66.7% (20/30) of the NS group reported hoarseness, compared to 30% (9/30) in the L group and 10% (3/30) in the LD group (P<0.05). By 24 h, 36.7% (11/30) of the NS group still had hoarseness, while only 3.3% (1/30) of the L group and no patients in the LD group (0%) experienced hoarseness (P<0.05). The severity of hoarseness followed a similar pattern, with the NS group reporting the highest severity at all-time points, the L group reporting moderate severity, and the LD group reporting the least severity.

### Post-operative complications

Overall, the incidence of sore throat and hoarseness was significantly higher in the NS group compared to the L and LD groups at all-time points post-extubation. The LD group demonstrated the least incidence of both sore throat and hoarseness, followed by the L group. These findings suggest that the use of L and LD treatments significantly reduces the occurrence of these common post-operative complications.

## DISCUSSION

The prevention of EP, such as coughing during extubation, is crucial for patient safety, as it can lead to complications in the post-operative period.[24] Smooth extubation is a key clinical skill, and post-operative sore throat and hoarseness are common concerns following GA.[1] These complications are influenced by factors like tube size, design, intracuff pressure, and intubation duration.[9] In our study, the baseline demographic parameters such as age, weight, height, ASA status, and duration of surgery were comparable across all three groups (L, LD, and NS). No statistically significant differences were observed in these parameters, which is consistent with previous studies by Dollo et al.,[25] and Fagan et al.[7] In addition, there were no significant differences in pre-operative heart rate, blood pressure, or MAP, which aligns with the findings of Rafiei et al.[23] During extubation, heart rate increased in all groups, with the increase being most pronounced and statistically significant in the NS group (P<0.001), while no significant difference was found between group L and LD (P=0.195). This observation is similar to the study by Estebe et al.[21] Likewise, SBP, DBP, and MAP showed higher increases in the NS group, with statistically significant differences between groups NS and L (P<0.001) and NS and LD (P<0.001), but no significant differences between groups L and LD. Cough occurrence was highest in the NS group at extubation (93.3%), with significant decreases in incidence over time. At 1-h post-extubation, 86.7% of subjects in the NS group had a cough, compared to 43.3% in group L and 16.7% in group LD. This was statistically significant and is in line with the study by Shroff and Patil[26] who found that air-filled cuffs induced more cough than saline-filled cuffs. Our study also supports findings by Pandey et al.,[27] and Fagan et al.,[7] who observed that using lidocaine in ETT cuffs reduced the incidence of postextubation cough.

Regarding severity, the NS group had the highest cough severity scores at all-time intervals, followed by group L and group LD, with significant differences between groups.

Dexamethasone in group LD provided a stronger preventive effect on cough severity, corroborating the study by Yu et al.,[28] who found that dexamethasone is effective in stabilizing mast cells and reducing airway reactivity. Sore throat occurrence was also highest in the NS group, with significant differences compared to groups L and LD at 1 h, 3 h, and 24 h post-extubation. At 1-h post-extubation, 83.3% of subjects in the NS group had sore throats, while only 50% and 40% of subjects in groups L and LD experienced sore throats, respectively. Our results align with Soltani et al.,[3] who showed that lidocaine reduced post-operative sore throat. Similarly, the severity of sore throat was greatest in the NS group, with a gradual decrease over time. This result is consistent with Soltani and Aghadavoudi, findings on the use of lidocaine to reduce post-operative discomfort.

Hoarseness was most common in the NS group, with 90% of patients experiencing it at 1-h post-extubation, compared to 56.7% in group L and 43.3% in group LD.

Statistically significant differences were found between groups NS and L ($P<0.05$) and NS and LD ($P<0.001$). The severity of hoarseness was highest in the NS group at 1 h, 3 h, and 24 h, which supports the findings of Navarro et al.,[29] who demonstrated that lidocaine in ETT cuffs decreased emergence symptoms such as hoarseness. Intracuff pressure, measured throughout the procedure, remained stable across all groups, which was consistent with the study by Liu et al.,[30] who found that saline-filled cuffs maintained more stable pressures than air-filled cuffs. Moreover, our data aligns with Combes et al.,[31] who showed that saline-filled cuffs resulted in stable pressures, even in the presence of nitrous oxide. This is important as nitrous oxide is known to increase cuff volume when air is used, potentially leading to more irritation. Overall, our study demonstrates that the use of lidocaine and dexamethasone to inflate ETT cuffs is an effective method to reduce post-operative cough, sore throat, and hoarseness, with stable intracuff pressures, particularly in the presence of nitrous oxide. These findings are consistent with previous studies by Patel et al.,[32] and Estebe et al.,[33] who also observed the benefits of using lidocaine and saline for cuff inflation, providing smoother extubation and reduced airway irritability.

### Implications

Using these agents for cuff inflation can improve patient tolerance to anesthesia, especially in those with reactive airways.

### Limitations of the study

The sample was taken only from one hospital; hence, the results cannot represent the enitre Jammu and Kashmir. To validate this study multicenter study needs to be done with a larger sample size.

## CONCLUSION

Filling the ETT cuff with alkalinized lidocaine and dexamethasone effectively reduces post-extubation cough and discomfort. This combination is ideal for improving patient tolerance, especially in smokers and those with reactive airways.

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**Authors' Contributions:**
**SF**- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation; **RJ**- Concept, design, clinical protocol, manuscript preparation, preparation of figures, and manuscript revision; **RSS**- Design of study, statistical analysis, interpretation, coordination, submission of article; **MJ**- Editing and review manuscript; **AR and AHM**- Manuscript preparation, and revision; **SAG**- Literature survey and manuscript revision

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