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Original Research Article

COMPARATIVE STUDY OF INTRACUFF 1% KETAMINE, 2% LIGNOCAINE, AND AIR IN REDUCING POSTOPERATIVE SORE THROAT IN ELECTIVE LAPAROSCOPIC SURGERIES: A RANDOMIZED CONTROLLED STUDY

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ABSTRACT

Background: Postoperative sore throat (POST) is a common complication after general anaesthesia with endotracheal intubation, occurring in 20–70% of patients. Though often considered minor, it causes significant dissatisfaction and can overshadow otherwise smooth anaesthetic care. POST arises from mucosal trauma, high cuff pressures causing ischemia, airway dryness, and inflammation. Even when transient, it may delay oral intake, hinder early ambulation, and prolong recovery. Various pharmacological and non-pharmacological measures have been studied to prevent POST, such as smaller tubes, cuff pressure monitoring, humidified gases, corticosteroids, and local anaesthetics. Intracuff drug administration is particularly promising, as the cuff acts as a reservoir, enabling diffusion onto the tracheal mucosa for sustained local effect without systemic absorption. Lignocaine, a commonly used local anaesthetic, stabilizes membranes, attenuates airway reflexes, and reduces emergence phenomena. Ketamine, an NMDA receptor antagonist with analgesic and anti-inflammatory effects, has shown benefit in reducing POST through local use. However, direct comparisons of intracuff ketamine and lignocaine are limited. **Materials and Methods:** This study included ASA I–II patients aged 16–60 years undergoing elective laparoscopic surgeries under general anaesthesia with intubation at JSS Hospital, Mysuru. Participants were randomized into three groups: Group K (1% ketamine), Group L (2% lignocaine), and Group A (air). Standardized anaesthesia was used with cuff pressure maintained at 25 cm H_2O. POST was assessed at 0, 1, and 4 hours post-extubation using a 0–10 NRS, along with hemodynamic parameters and rescue analgesia needs. Data were analyzed with SPSS v25.0 using Chi-square and ANOVA, with $p<0.05$ considered significant. **Result:** Demographic characteristics parameters were comparable across groups. The incidence and severity of POST were significantly lower in Groups K and L when compared to Group A at all time intervals ($p<0.05$). The difference in hemodynamic fluctuation was also significantly higher in Group A when compared to Groups K and L ($p<0.05$). No significant difference was observed between ketamine and lignocaine groups in all parameters tested. No significant difference was observed among the three groups when comparing their need for rescue analgesia and incidence of swallowing difficulty. **Conclusion:** Both intracuff ketamine and lignocaine are effective in reducing the incidence and severity of POST compared to air, with stable hemodynamic profiles. Either drug may be safely used for this purpose.

INTRODUCTION

Postoperative sore throat (POST) is a frequently encountered complication following general anesthesia involving endotracheal intubation. Its reported incidence ranges widely from 20% to 70%, depending on patient characteristics, surgical factors, and airway management techniques.[1] Although often categorized as a minor postoperative issue, POST significantly contributes to patient discomfort and dissatisfaction, particularly in ambulatory and outpatient surgeries.[2]

POST is a complex symptom arising from multiple physiological causes. Mechanical irritation during laryngoscopy and intubation, high cuff pressures, mucosal drying, and inflammatory changes are key contributors.[3,4] The endotracheal tube causes direct mucosal compression, leading to ischemia and subsequent inflammation, resulting in symptoms like pain, hoarseness, or cough. The tracheal mucosa is highly sensitive and richly innervated by branches of the vagus and glossopharyngeal nerves.[5] Even minor injuries can trigger significant sensory feedback, making POST a clinically relevant concern.

Patient-specific risk factors for POST include younger age, female sex, higher BMI, and prior history of sore throat post-surgery.[6] Procedure-specific factors such as the duration of intubation, use of larger ETT sizes, lack of lubrication, and movement of the tube during surgery further increase the incidence.[7] Moreover, surgeries involving steep Trendelenburg position or pneumoperitoneum, such as laparoscopic procedures, place additional mechanical stress on the airway.[8]

Numerous methods have been explored to prevent POST. Pharmacological strategies range from intravenous to topical applications of various agents, including magnesium sulfate, corticosteroids, NSAIDs, and local anesthetics.[9] Lignocaine has been widely used either as a spray or gel on the endotracheal tube, or even within the cuff, and has been shown to reduce mucosal irritation.[10]

An innovative approach gaining traction is the intracuff administration of medications. By placing lignocaine or ketamine inside the ETT cuff instead of air, the drug can diffuse through the semipermeable cuff membrane and directly contact the tracheal mucosa.[11] This continuous topical delivery avoids systemic side effects while ensuring prolonged anesthetic or anti-inflammatory effect.

Ketamine, known primarily as a dissociative anesthetic and NMDA receptor antagonist, has shown benefits in reducing POST when administered intra-cuff. Its mechanism is attributed not only to peripheral receptor blockade but also to anti-inflammatory actions and the reduction of cytokine-mediated irritation.[12] It acts locally on nociceptors in the tracheal mucosa, providing prolonged analgesia.[13]

Lignocaine, on the other hand, stabilizes neuronal membranes and inhibits sodium channel conduction, effectively numbing the tracheal mucosa. Alkalinized lignocaine has shown better diffusion through the cuff membrane and superior efficacy compared to plain lignocaine.[14] However, results across studies vary depending on drug concentrations, cuff pressures, and surgical duration.

Non-pharmacological approaches like pre-warming of the ETT, use of supraglottic airway devices, humidified gases, and careful laryngoscopy techniques also contribute to reducing POST but may not always be feasible.[15]

Despite the availability of these options, no single intervention provides complete prevention of POST. The use of intra-cuff medication remains one of the most effective, cost-efficient, and easily implementable techniques in the perioperative period.

Laparoscopic surgeries, being minimally invasive, the extent of POST can be assessed better as compared to open surgeries which may mask the severity of POST as explained by the gate control theory.[16]

This study was therefore undertaken to evaluate and compare the efficacy of intra-cuff ketamine (1%), 2% lignocaine, and air in reducing the incidence and severity of POST in patients undergoing elective laparoscopic surgeries under general anesthesia.

MATERIALS AND METHODS

The study population comprised patients with ASA physical status I and II, undergoing laparoscopic procedures under general anaesthesia at JSS Hospital, Mysuru. Patients of either sex aged between 16 and 60 years, scheduled for elective laparoscopic surgeries requiring general anaesthesia with endotracheal intubation, and who provided informed written consent were included in the study. Patients were excluded if they refused participation, had known allergies to ketamine or lignocaine, pre-existing sore throat, hoarseness, or laryngeal disease, anticipated difficult airway, recent respiratory tract infection, pre-existing respiratory or cardiovascular comorbidities, ASA physical status III or above, or were pregnant or breastfeeding.

Eligible patients were randomly assigned into three groups: Group K (1% ketamine), Group L (2% lignocaine), and Group A (air).

Endotracheal tubes of appropriate size were used, with an internal diameter of 7mm for women and 8mm for men. Cuff pressure was maintained at 25 cm H_2O using a cuff pressure manometer. Anaesthesia technique was standardized across groups. POST was assessed at 0, 1, and 4 hours post-extubation using a 0–10 Numerical Rating Scale (NRS). Hemodynamic parameters (HR, SBP, DBP, MAP) were recorded perioperatively and at the time of extubation, along with difficulty

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swallowing and need for rescue analgesia post operatively.

Statistical analysis:

Data were analyzed using SPSS v25.0 (IBM, NY). Continuous variables were expressed as mean ± SD and categorical variables as frequencies/percentages. Chi-square test compared categorical data (e.g., incidence of POST), and one-way ANOVA compared continuous variables across groups. Effect sizes were calculated using Cohen's d with 95% CIs. Statistical significance was set at $p<0.05$. Graphs (bar and line diagrams) were prepared in Microsoft Excel/Word.

RESULTS

Immediately after extubation, NRS scores for postoperative sore throat were significantly higher in the air group compared to both the lignocaine and ketamine groups. Post hoc analysis confirmed significant differences between air vs. lignocaine and air vs. ketamine ($p<0.001$), while scores between lignocaine and ketamine did not differ significantly.

Table 1: NRS Score post extubation comparison between the three groups

	GROUP						
	AIR		LIGNOCAINE		KETAMINE		
	Median	Mean Rank	Median	Mean Rank	Median	Mean Rank	
NRS Score Post Extubation	5	67.12	3.5	39.1	3	30.28	P value 0.001*

$\chi^2 = 34.68$, df 2, P = 0.001* [Chi-square test]

Table 2: NRS Score 1 hour post extubation comparison between the three groups

	GROUP						
	AIR		LIGNOCAINE		KETAMINE		
	Median	Mean Rank	Median	Mean Rank	Median	Mean Rank	
NRS Score 1 hour Post Extubation	4	68.3	2	33.6	2	34.6	P value 0.001*

$\chi^2 = 38.7$, df 2, P = 0.001* [Chi-square test]

At 1 hour post-extubation, the air group had higher NRS scores compared to the lignocaine and ketamine groups. The difference was statistically significant for air versus lignocaine and air versus ketamine, while no significant difference was observed between lignocaine and ketamine.

Table 3: NRS score 4 hours post extubation comparison between the three groups

	GROUP						
	AIR		LIGNOCAINE		KETAMINE		
	Median	Mean Rank	Median	Mean Rank	Median	Mean Rank	
NRS Score 4 hours Post Extubation	3	65.67	1	34.97	1	35.87	P value 0.001*

$\chi^2 = 30.84$, df 2, P = 0.001* [Chi-square test]

At 4 hours post-extubation, the air group had higher NRS scores compared to both the lignocaine and ketamine groups. The differences were statistically significant for air versus lignocaine and air versus ketamine, while no significant difference was noted between lignocaine and ketamine.

Table 4: Change in the hemodynamic values post extubation comparison between the three groups

	GROUP						
	AIR		LIGNOCAINE		KETAMINE		
	Present	Absent	Present	Absent	Present	Absent	
Change in HR/BP post extubation	21	9	10	20	20	10	P value 0.004*

$\chi^2 = 10.84$, df = 2, P = 0.004* [Chi-square test]

A greater proportion of patients in the air group experienced >20% changes in heart rate or blood pressure post-extubation compared to the lignocaine and ketamine groups. This difference was statistically significant.

DISCUSSION

Post-operative sore throat (POST) is defined as pain, discomfort, or irritation of the throat following general anesthesia with endotracheal intubation. It is one of the most frequently reported complications in the immediate post-operative period, with an incidence ranging from 20% to 70%, depending on patient factors, surgical type, and airway management technique.[17] Although often considered a minor complication, POST can cause significant patient discomfort and dissatisfaction, especially in ambulatory and outpatient surgeries. It may lead to additional consequences such as hoarseness of voice, cough, dysphagia, and

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increased analgesic requirement, thereby prolonging recovery time and impairing overall patient experience.[18] Various pharmacological and non-pharmacological methods have been explored to reduce the incidence and severity of POST, with intracuff drug administration emerging as a promising and simple intervention.[19]

In our pilot study of 10 healthy patients undergoing elective laparoscopic surgery, the air group showed higher median NRS scores, with several reporting ≥6 immediately after extubation. Scores remained elevated at 1 and 4 hours, and many experienced swallowing difficulty at 1 hour; about half required rescue analgesia. Over 20% changes in heart rate or blood pressure were also common, indicating sympathetic response to airway irritation. The incidence of POST was 57% in the air group versus 22.8% in the ketamine group.

Air as a cuff inflation medium is linked to higher POST, hemodynamic instability, and analgesic needs. These pilot findings highlighted the need to compare ketamine with air and lignocaine in a larger study to reduce airway morbidity.

Laparoscopic surgeries were chosen as they cause minimal incisional pain limited to port sites, enabling patients to better distinguish throat discomfort from surgical pain. This reduces confounding factors and makes POST assessment more reliable, strengthening the study's internal validity.

Our study was designed to compare the efficacy of intracuff ketamine and lignocaine, both known for their local anaesthetic and anti-inflammatory properties, with air as control in reducing the incidence and severity of POST following laparoscopic surgeries under general anaesthesia.

Ketamine and lignocaine were selected for their potential to reduce postoperative sore throat through complementary mechanisms. Lignocaine, by blocking sodium channels, decreases mucosal irritation and suppresses airway reflexes, while ketamine, as an NMDA antagonist, provides analgesic and anti-inflammatory effects. Intracuff use may limit mucosal inflammation and nociceptive signaling, thereby reducing the incidence and severity of POST.

Demographic details: In our study, 90 healthy adult patients graded ASA I or II, undergoing elective laparoscopic surgeries such as laparoscopic cholecystectomy, laparoscopic appendicectomy, and total laparoscopic hysterectomy, each with a total duration of less than three hours, were selected. The patients were randomly allocated into three groups of 30 each.

- Group K - 1% KETAMINE as an endotracheal tube cuff inflation agent.
- Group L - 2% LIGNOCAINE as an endotracheal tube cuff inflation agent.
- Group A - AIR as an endotracheal tube cuff inflation agent.
- In the AIR group, the mean age was 44.63 ± 11.96 years. In the LIGNOCAINE group, the mean age was 43.23 ± 16.63 years. In the KETAMINE group, the mean age was 42.63 ± 13.75 years. There was no statistical significance in age distribution comparison between the three groups.
- In the AIR group, 36.7% were male and 63.3% were female. In the LIGNOCAINE group, 33.3% were male and 66.7% were female. In the KETAMINE group, 23.3% were male and 76.7% were female. There was no statistical significance in gender distribution comparison between the three groups.

Mallampatti grading: In the AIR group, 33.3% of patients had a Mallampati grade of 1, while 66.7% had a grade of 2. In the LIGNOCAINE group, 23.3% of patients had a grade 1 and 76.7% had a grade 2. Similarly, in the KETAMINE group, 26.7% had a grade 1 and 73.3% had a grade 2. The distribution of Mallampati scores was comparable among the three groups, and no statistically significant difference was observed.

Surgeries performed: In the AIR group, the majority underwent laparoscopic cholecystectomy 80%, followed by laparoscopic appendicectomy 6.7%, totally extraperitoneal repair 6.7%, diagnostic laparoscopy 3.3%, and a combined laparoscopic appendicectomy with meshplasty 3.3%.

In the LIGNOCAINE group, laparoscopic cholecystectomy accounted for 73.3% of the procedures, laparoscopic appendicectomy 10%, total laparoscopic hysterectomy (6.7%), diagnostic laparoscopy 6.7%, and TEP 3.3%.

The KETAMINE group had a similar distribution, with 66.7% undergoing laparoscopic cholecystectomy, followed by laparoscopic appendicectomy 16.7%, total laparoscopic hysterectomy 10%, and diagnostic laparoscopy 6.7%. There was no significant difference in Surgery distribution comparison between two groups.

Incidence of post operative sore throat (post): Postoperative sore throat (POST) was assessed using a Numerical Rating Scale (NRS) ranging from 0 to 10 at extubation, 1 hour, and 4 hours postoperatively.

Immediately after extubation, the median NRS was 5 in the AIR group (mean rank 67.12), 3.5 in the LIGNOCAINE group (39.1), and 3 in the KETAMINE group (30.28). This difference was significant ($p < 0.001$); post hoc Dunn-Bonferroni showed significance between AIR and both LIGNOCAINE and KETAMINE, but not between LIGNOCAINE and KETAMINE ($p = 0.531$). These results align with Canbay et al., who found intracuff lignocaine reduced POST compared to air, and with Estebe et al., who showed alkalinized lignocaine was superior to air in lowering tracheal morbidity.[4]

At 1 hour post-extubation, the median NRS was 4 in the AIR group versus 2 in both LIGNOCAINE and KETAMINE groups, with significant differences between AIR and the drug groups. This is consistent with Nadeem et al., who found lower POST scores

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at 1 hour with intracuff ketamine and lignocaine compared to air, attributing the effect to ketamine's NMDA antagonism and lignocaine's local anesthetic and anti-inflammatory actions.

At 4 hours post-extubation, the median NRS was 3 in the AIR group and 1 in both LIGNOCAINE and KETAMINE groups, with significant differences between AIR and the drug groups but not between LIGNOCAINE and KETAMINE. A similar prolonged effect of ketamine was reported by Puri et al., where ketamine gargle provided symptom relief up to 6 hours, attributed to its anti-nociceptive and anti-inflammatory actions.[20]

Incidence of hemodynamic fluctuation post extubation: Hemodynamic changes >20% from baseline (HR or BP) post-extubation were seen in 70% of the AIR group, but only in 33.3% of both the LIGNOCAINE and KETAMINE groups, a statistically significant difference ($p < 0.05$). These findings align with Estebe et al., who showed intracuff lignocaine blunts cardiovascular responses by anesthetizing the tracheal mucosa,[4] and with Nadeem et al., who reported intracuff ketamine reduces extubation-induced surges via its analgesic and NMDA-antagonist effects.[21] Our results suggest drug-filled cuffs not only reduce sore throat but also enhance cardiovascular stability during emergence.

Need for rescue analgesia: The requirement for rescue analgesia was assessed as an indirect marker of airway-related discomfort. In the AIR group, 43.3% of patients required rescue analgesia, compared to 20% in the LIGNOCAINE group and 23.3% in the KETAMINE group. Although the intervention groups showed a reduced need for additional analgesics relative to AIR, the difference was not statistically significant ($p > 0.05$). Similar findings were reported by Nadeem et al., who demonstrated lower analgesic requirements with intracuff lignocaine, attributed to attenuation of tracheal irritation and inflammation that contribute to postoperative discomfort.[21] Estebe et al. also observed a reduction in airway morbidity and associated analgesic use with intracuff lignocaine, owing to its prolonged local anesthetic action on the tracheal mucosa.[4] While statistical significance was not achieved in our study, the observed trend supports the role of intracuff agents in improving postoperative comfort.

CONCLUSION

Based on the results of our study, we conclude that both intracuff ketamine (1%) and intracuff lignocaine (2%) are effective in reducing the incidence and severity of postoperative sore throat (POST) in adult patients undergoing elective laparoscopic surgeries under general anesthesia when compared to air.

Although both ketamine and lignocaine demonstrated comparable efficacy, ketamine showed a slightly greater reduction in POST scores at all time intervals though not statistically significant. Ketamine's marginally better performance maybe due to its dual action—NMDA receptor antagonism and anti-inflammatory properties, while lignocaine has only local anesthetic effect.

Given their safety, ease of availability administration, and clinical benefit, both ketamine and lignocaine offer valuable, cost-effective alternatives to air for ETT cuff inflation. Their use can be recommended as part of routine anesthetic practice, particularly in cases where postoperative sore throat is anticipated.

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