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Comparison of Preoperative Nebulized Magnesium Sulfate and Lidocaine for the Prevention of Post-Intubation Sore Throat

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KEYWORDS

Post-intubation sore throat, Magnesium sulfate, Lidocaine, Nebulization, Hemodynamic response etc.

ABSTRACT:

Background:

Post-intubation sore throat (POST) is a common complication following general anaesthesia, often leading to patient discomfort in the immediate postoperative period. Magnesium sulfate and lidocaine, when administered via nebulization, have been studied individually for their potential to reduce POST and blunt hemodynamic responses during laryngoscopy. The aim is to compare the effectiveness of preoperative nebulized magnesium sulfate and lidocaine in preventing POST and in attenuating the hemodynamic response to intubation.

Methods:

This randomized clinical trial included 52 adult patients undergoing elective surgery under general anaesthesia with endotracheal intubation. Patients were randomly assigned to two groups: Group A received 250 mg magnesium sulfate nebulization; Group B received 100 mg of 2% lidocaine nebulization, both administered 15 minutes prior to induction. POST severity was assessed using a 4-point Likert scale (LPM score) at 0, 2, 4, 8, 12, and 24 hours post-extubation. Hemodynamic parameters including heart rate and blood pressure were recorded at baseline, post-intubation, and at 2, 4, and 10 minutes.

Results:

At 24 hours, the magnesium group showed significantly lower POST scores compared to the lidocaine group (mean LPM score: 1.00 ± 0.20 vs. 1.88 ± 0.78, $p = 0.0001$). In contrast, the lidocaine group demonstrated better attenuation of heart rate and blood pressure rise during and after intubation ($p < 0.001$ at key time points). No significant difference in oxygen saturation was observed between groups.

Conclusion:

Preoperative nebulized magnesium sulfate is more effective in reducing the incidence and severity of POST, whereas lidocaine offers superior control of the hemodynamic response to intubation. Agent selection should be guided by the primary clinical objective—airway comfort versus cardiovascular stability.

Introduction

Post-intubation sore throat (POST) is a common and distressing complication following endotracheal intubation, affecting 18–65% of patients in the immediate postoperative period, often lasting up to 24 hours after surgery [1,2]. Although self-limiting, it can significantly impact patient satisfaction and postoperative recovery.

Various pharmacological interventions have been investigated to reduce the incidence and severity of POST. Among these, magnesium sulfate has garnered attention due to its N-Methyl-D-Aspartate (NMDA) receptor antagonistic, analgesic, and anti-inflammatory

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properties [3]. When administered as a preoperative nebulization, magnesium sulfate achieves uniform distribution across the oropharyngeal mucosa, avoiding issues of palatability and operator variability seen with gargling or lozenges [4].

Lidocaine, a widely used local anesthetic, is known to attenuate airway reflexes and suppress hemodynamic responses to intubation [5]. Nebulized lidocaine has demonstrated efficacy in reducing mucosal irritation and inflammation, with a rapid onset and minimal systemic absorption [6,7]. However, concerns about mucosal irritation with topical gels and inconsistent efficacy have limited its widespread use in some contexts [8].

Recent studies have explored the prophylactic use of nebulized agents like ketamine, dexamethasone, magnesium sulfate, and lidocaine, either alone or in combination, with varying results [9,10]. Despite several trials comparing individual agents with placebo, comparative data between nebulized magnesium sulfate and lidocaine remain limited. Hence, identifying the superior agent in terms of efficacy, safety, and hemodynamic stability remains a clinical necessity.

This study aims to compare the effectiveness of preoperative nebulized magnesium sulfate versus lidocaine in preventing POST in adult patients undergoing general anaesthesia with endotracheal intubation, and to assess associated hemodynamic responses. The findings are expected to guide optimal airway management strategies and enhance patient outcomes. This is one of the few studies directly comparing nebulized magnesium sulfate and lidocaine in a controlled, randomized setting.

Material and Methods

This study was designed as a prospective, randomized clinical trial and was conducted at KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi, over a period of three months, from May 2022 to July 2022. Ethical clearance was obtained from the Institutional Ethics Committee prior to initiation, and informed written consent was taken from all participants.

Fifty-two adult patients between 18 and 60 years of age, belonging to either gender, and classified as ASA physical status I or II were included in the study. All patients were scheduled for elective surgeries requiring general anaesthesia with endotracheal intubation. Patients with known allergy to magnesium sulfate or lidocaine, those with pre-existing respiratory, cardiovascular, renal, or neurological disorders, and individuals with a history of alcohol or drug abuse were excluded.

Participants were randomly assigned into two groups of 26 each using a computer-generated random number table. Patients in Group A received a nebulization of 250 mg magnesium sulfate (0.5 ml) diluted with 4.5 ml of normal saline, while Group B received 5 ml of 2% lidocaine solution. Nebulization was administered approximately 15 minutes before induction using a standard ultrasonic nebulizer.

Standard premedication was given to all patients, followed by induction and intubation using an appropriately sized endotracheal tube. Anaesthesia was maintained using standard institutional protocols. Post-intubation sore throat (POST) was assessed using a 4-point scale—ranging from 0 (no sore throat) to 3 (severe)—at six time points: immediately after extubation, and at 2, 4, 8, 12, and 24 hours postoperatively.

In addition to assessing POST, hemodynamic parameters such as heart rate, systolic and diastolic blood pressure, mean arterial pressure, and oxygen saturation (SpO_2) were recorded at multiple intervals: before nebulization, after shifting to the operating theatre, after induction, and at 2, 4, and 10 minutes following intubation.

Data were compiled and analyzed using appropriate statistical tests. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as percentages. Comparisons between groups were made using Student's t-test, Chi-square test, or Mann-Whitney U test, depending on the nature of the data. A p-value of less than 0.05 was considered statistically significant.

Results:

A total of 52 patients were enrolled and randomized into two groups of 26 each: Group A (Magnesium sulfate) and Group B (Lidocaine).

The demographic characteristics are shown in Table 1. The mean age of patients in the magnesium sulfate group was significantly higher than that in the lidocaine group (46.10 ± 11.40 vs. 38.17 ± 16.52 years, $p = 0.015$). While more male patients were included in both groups, the gender distribution did not differ significantly ($p = 0.083$).

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Table 1: Comparison of Demographic Characteristics between Groups

Parameter	Magnesium sulfate Group (n=26)	Lidocaine Group (n=26)	p-value
Mean Age (years)	46.10 ± 11.40	38.17 ± 16.52	0.015 *
Gender Male	17	20	0.083
Female	9	6	

*Statistically significant

The LPM scores were recorded at 0, 2, 4, 8, 12, and 24 hours post-extubation (Table 2). No sore throat was reported in either group at the first three time points. From 8 hours onward, POST scores began to rise in both groups, with a greater increase in the lidocaine group. At 24 hours, the difference was statistically significant (p = 0.0001).

Table 2: Comparison of LPM Sore Throat Scores at Different Time Points

Time Point	Magnesium sulfate (Mean ± SD)	Lidocaine (Mean ± SD)	p-value
0 hr	0.00 ± 0.00	0.00 ± 0.00	1.000
2 hr	0.00 ± 0.00	0.00 ± 0.00	1.000
4 hr	0.00 ± 0.00	0.00 ± 0.00	1.000
8 hr	0.02 ± 0.14	0.17 ± 0.38	0.177
12 hr	1.02 ± 0.14	1.21 ± 0.41	0.0916
24 hr	1.00 ± 0.20	1.88 ± 0.78	0.0001 *

*Statistically significant

As shown in Figure 1, both groups exhibited minimal or no sore throat in the initial postoperative hours. However, a noticeable increase in sore throat was observed by 12 and 24 hours, with the lidocaine group reporting significantly more discomfort.

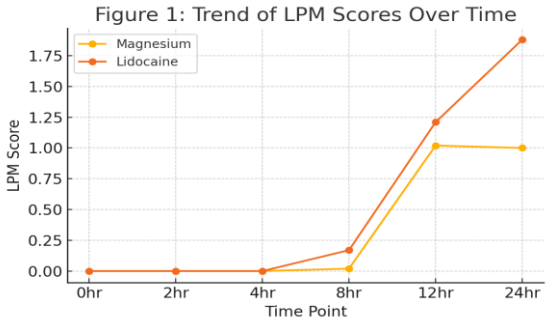

Table 3 presents heart rate comparisons between the magnesium sulfate and lidocaine groups at different peri-intubation intervals. Baseline heart rates were similar in both groups, with no significant difference (p = 0.277). Following intubation, the magnesium group showed a significantly higher rise in heart rate compared to the lidocaine group (124.12 ± 18.94 vs. 100.31 ± 15.99 bpm, p = 0.0001). This elevated trend persisted at 2 and 4 minutes post-intubation, with statistically significant differences (p = 0.0009 and p = 0.0010, respectively). By 10 minutes, heart rates in both groups had stabilized, and the difference was no longer significant (p = 0.697), indicating a return to near-baseline levels.

Table 3: Comparison of Heart Rate at Various Time Points

Time Point	Magnesium sulfate (Mean ± SD)	Lidocaine (Mean ± SD)	p-value
Baseline	78.52 ± 11.76	80.60 ± 7.05	0.277

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Post-Intubation	124.12 ± 18.94	100.31 ± 15.99	0.0001 *
2 min	104.35 ± 15.04	95.35 ± 11.56	0.0009 *
4 min	95.65 ± 10.77	89.10 ± 8.77	0.0010 *
10 min	83.42 ± 9.93	82.75 ± 7.47	0.697

*Statistically significant

Figure 2 shows that the magnesium group demonstrated a sharper rise in heart rate during and immediately after intubation, suggesting a higher sympathetic response compared to the lidocaine group.

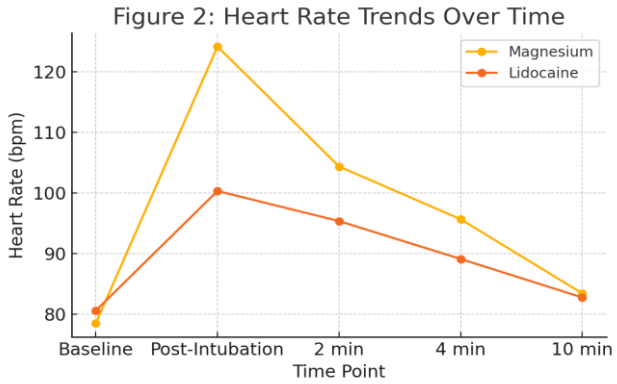


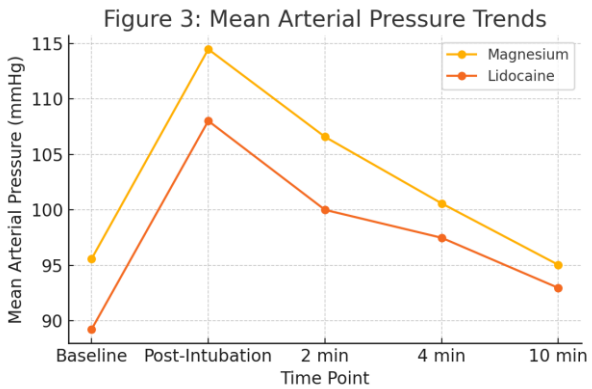
Table 4 summarizes key hemodynamic parameters recorded immediately after intubation. Systolic blood pressure (SBP) and mean arterial pressure (MAP) were significantly higher in the magnesium group compared to the lidocaine group ($p = 0.0003$ and $p = 0.0002$, respectively). Diastolic blood pressure (DBP), however, did not differ significantly between the groups ($p = 0.0721$). These findings suggest that lidocaine provided more stable hemodynamic control during the post-intubation period.

Table 4: Summary of Hemodynamic Comparison (Post-Intubation Values)

Parameter	**Magnesium sulfate Group**	**Lidocaine Group**	**p-value**
SBP (mmHg)	167.62 ± 9.82	157.04 ± 17.71	0.0003 *
DBP (mmHg)	87.88 ± 4.93	90.15 ± 7.53	0.0721
MAP (mmHg)	114.48 ± 4.91	108.02 ± 10.84	0.0002 *

*Statistically significant

As per figure 3, magnesium sulfate, despite its known vasodilatory effect, resulted in greater pressure responses during intubation compared to lidocaine, likely due to reduced suppression of airway reflexes.



Oxygen saturation remained above 99% in both groups throughout the perioperative period, with no intergroup difference noted.

Discussion:

Post-intubation sore throat (POST) remains a frequent postoperative complaint despite being considered minor. It can impact patient satisfaction and recovery, especially after short-stay or day-care procedures. In this study, we compared nebulized magnesium sulfate and lidocaine for the prevention of POST and to assess their effect on hemodynamic responses during intubation.

Our results showed that nebulized magnesium sulfate significantly reduced the severity of POST, particularly at 24 hours postoperatively. This aligns with earlier

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findings by Yadav et al. [3] and Kamel et al. [4], who highlighted the anti-inflammatory properties of magnesium sulfate delivered via the nebulized route. Its mechanism involves NMDA receptor antagonism and suppression of substance P release, contributing to its prolonged analgesic action [11].

Lidocaine, although effective in suppressing airway reflexes, appeared to offer shorter-lasting relief from POST in our study. Similar observations were made in a trial by Nishiyama et al., where lidocaine reduced early but not delayed sore throat symptoms [12]. Moreover, studies by Estebe et al. and Gupta et al. emphasized that lidocaine's effectiveness is technique- and dose-dependent, and repeated doses or alkalinization may enhance its efficacy [13,14].

In terms of hemodynamic parameters, lidocaine outperformed magnesium sulfate in attenuating the sympathetic surge associated with laryngoscopy and intubation. Our findings are consistent with earlier work by Cho et al. [2] and corroborated by Harless and DeWitt, who noted lidocaine's role in blunting heart rate and blood pressure elevations during airway manipulation [15].

Magnesium sulfate, while less effective in blunting the hemodynamic response, demonstrated superior control over POST symptoms without respiratory compromise. This is in agreement with Bagchi et al. [16], who reported similar results in a randomized trial comparing ketamine, magnesium sulfate, and placebo.

Importantly, oxygen saturation remained stable in both groups throughout the perioperative period, consistent with the safety profiles noted in previous studies [17,18]. These results reinforce that both agents are safe for nebulization prior to induction.

The limitations of our study include the relatively small sample size and short follow-up duration. Additionally, the use of a single dose for each agent may not fully represent their optimal effectiveness. Further studies with larger populations, varying dosages, and combined use may offer more comprehensive insights.

In conclusion, nebulized magnesium sulfate appears to be more effective than lidocaine in preventing POST, especially in the later postoperative period, while lidocaine remains preferable for blunting the immediate hemodynamic response to intubation. Selection should be guided by the primary clinical objective—whether to minimize airway discomfort or manage cardiovascular stability.

Conclusion:

This study demonstrates that preoperative nebulization with magnesium sulfate is more effective than lidocaine in reducing the incidence and severity of post-intubation sore throat, particularly in the late postoperative period. On the other hand, lidocaine provided better control over the hemodynamic responses associated with laryngoscopy and endotracheal intubation. Both agents were well-tolerated, with no adverse effects on oxygen saturation observed in either group. Based on these findings, magnesium sulfate may be preferred when the primary goal is to minimize postoperative throat discomfort, whereas lidocaine is more suitable when hemodynamic stability during intubation is a priority. Further studies with larger sample sizes and extended follow-up are recommended to validate these results and explore potential benefits of combining both agents.

Conflict o interest: None

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