Original Research

EFFECT OF MAGNESIUM SULPHATE NEBULIZATION ON THE INCIDENCE OF POSTOPERATIVE SORE THROAT IN PATIENTS REQUIRING ENDOTRACHEAL INTUBATION FOR GENERAL ANESTHESIA

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ABSTRACT

Background: Postoperative sore throat (POST) is a common and distressing complication following endotracheal intubation under general anesthesia. Airway mucosal irritation and inflammation play a significant role in its pathogenesis. Magnesium sulphate, owing to its anti-inflammatory and antinociceptive properties, may reduce the incidence and severity of POST when administered as nebulization prior to induction of anesthesia.

Aim: To evaluate the effect of preoperative magnesium sulphate nebulization on the incidence and severity of postoperative sore throat in patients undergoing surgery under general anesthesia with endotracheal intubation.

Materials and Methods: This prospective randomized controlled study was conducted at Dhanalakshmi Srinivasan Institute of Medical Sciences and Hospital over a period of six months from July 2025 to December 2025. A total of 100 patients aged 20–65 years, belonging to ASA physical status I and II, scheduled for elective surgery under general anesthesia with endotracheal intubation were enrolled. Patients were randomly allocated into two groups of 50 each. The control group received nebulization with normal saline, while the study group received nebulization with magnesium sulphate prior to induction of anesthesia. The incidence and severity of postoperative sore throat were assessed at 0, 2, 4, 12, and 24 hours post-extubation.

Results: The incidence and severity of postoperative sore throat were significantly lower in the magnesium sulphate group compared to the control group, particularly at 4, 12, and 24 hours postoperatively. No significant adverse effects related to magnesium sulphate nebulization were observed.

Conclusion: Preoperative nebulization with magnesium sulphate is a safe, simple, and effective method for reducing the incidence and severity of postoperative sore throat in patients undergoing general anesthesia with endotracheal intubation.

Keywords: Postoperative Sore Throat, Magnesium Sulphate, Nebulization, Endotracheal Intubation, General Anesthesia.

INTRODUCTION

Postoperative sore throat (POST) is one of the most common complaints following general anesthesia with endotracheal intubation, with an incidence reported to range between 30% and 70% [1,2]. Although considered a minor complication, POST contributes significantly to postoperative discomfort, patient dissatisfaction, and delayed Recovery, especially in ambulatory and short-stay surgical procedures [3].

The etiology of POST is multifactorial. Mechanical trauma to the airway mucosa during laryngoscopy and intubation, friction caused by the endotracheal tube, excessive cuff pressure, repeated intubation attempts, and local inflammatory responses are important contributing factors [4,5]. Despite adherence to careful airway management techniques, the occurrence of POST remains frequent, highlighting the need for effective preventive strategies.

Various pharmacological and non-pharmacological measures have been evaluated to reduce the incidence of POST. These include the use of smaller endotracheal tubes, cuff pressure monitoring, topical

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lignocaine, ketamine gargles or nebulization, corticosteroids, and alpha-2 agonists [6]. However, these interventions have shown variable efficacy and may be associated with undesirable side effects or limited availability.

Magnesium sulphate has gained interest as a potential agent for preventing POST due to its anti-inflammatory, membrane-stabilizing, and analgesic properties. It acts as a non-competitive N-methyl-D-aspartate (NMDA) receptor antagonist, thereby reducing nociceptive transmission and attenuating inflammatory responses [7]. When administered via nebulization, magnesium sulphate delivers a high local concentration to the airway mucosa with minimal systemic absorption and adverse effects.

Previous studies have suggested that preoperative nebulization of magnesium sulphate may reduce the incidence and severity of postoperative sore throat [8]. However, evidence remains limited, and further randomized controlled trials are required to establish its efficacy and safety in routine clinical practice. Hence, this prospective randomized controlled study was undertaken to evaluate the effect of preoperative magnesium sulphate nebulization on the incidence and severity of postoperative sore throat in patients undergoing general anesthesia with endotracheal intubation.

MATERIALS AND METHODS

Study Design

This was a single-center, prospective, randomized controlled trial conducted to compare the effect of preoperative magnesium sulphate nebulization with normal saline nebulization on the incidence and severity of postoperative sore throat following endotracheal intubation under general anesthesia.

Study Setting

The study was conducted at Dhanalakshmi Srinivasan Institute of Medical Sciences and Hospital, a tertiary care teaching hospital in Tamil Nadu, India.

Study Period

The study was conducted over a period of six months, from July 2025 to December 2025.

Study Population

The study population comprised 100 patients aged 20 to 65 years, belonging to American Society of Anaesthesiologists (ASA) physical status I and II, who were scheduled to undergo elective surgical procedures under general anesthesia requiring endotracheal intubation at Dhanalakshmi Srinivasan Institute of Medical Sciences and Hospital.

Inclusion Criteria

1. Patients aged between 20 and 65 years
2. Patients of either gender
3. Patients belonging to ASA physical status I and II
4. Patients scheduled for elective surgical procedures
5. Patients undergoing surgery under general anesthesia with endotracheal intubation
6. Patients who provided written informed consent

Exclusion Criteria

1. Patients with anticipated difficult airway
2. Patients requiring more than one attempt at endotracheal intubation
3. Patients with recent upper respiratory tract infection
4. Patients with a history of bronchial asthma or chronic obstructive pulmonary disease
5. Smokers and patients with chronic throat irritation
6. Patients with known hypersensitivity or allergy to magnesium sulphate

Sample Size and Group Allocation

A total of 100 patients were enrolled in the study. Using a randomization method, patients were allocated into two equal groups of 50 patients each:

- Group A (Control Group): $n = 50$ — received nebulization with 3 mL normal saline prior to induction of anesthesia.
- Group B (Magnesium Sulphate Group): $n = 50$ — received nebulization with magnesium sulphate (250 mg) diluted in 3 mL normal saline prior to induction of anesthesia.

Randomization

Randomization was carried out using a computer-generated randomization sequence. Group allocation was concealed using sealed opaque envelopes, which were opened just before administration of the nebulization.

Intervention

All patients received nebulization approximately 15 minutes prior to induction of anesthesia. Nebulization was administered using a standard jet nebulizer with oxygen as the driving gas.

- Group A (Control Group): Patients received nebulization with 3 mL of normal saline.
- Group B (Magnesium Sulphate Group): Patients received nebulization with magnesium sulphate 250 mg diluted in 3 mL of normal saline.

Anesthesia Technique

All patients were managed using a standardized anesthesia protocol. On arrival in the operating room, standard monitoring including electrocardiography, non-invasive blood pressure, pulse oximetry, and capnography was instituted. Baseline vital parameters were recorded.

After adequate preoxygenation, general anesthesia was induced with intravenous induction agents and neuromuscular blockade was achieved using a muscle relaxant to facilitate endotracheal intubation. Direct laryngoscopy was performed by an experienced anesthesiologist, and endotracheal intubation was achieved using appropriately sized cuffed endotracheal tubes (7.0–7.5 mm internal diameter for females and 8.0–8.5 mm for males).

Endotracheal tube cuff pressure was maintained within recommended limits throughout the procedure. Anesthesia was maintained using inhalational anesthetic agents with oxygen and air, along with intermittent doses of muscle relaxants as required. Analgesia was provided as per institutional protocol.

At the end of the surgical procedure, neuromuscular blockade was reversed, and patients were extubated after ensuring adequate recovery, spontaneous breathing, and protective airway reflexes.

Outcome Measures

The outcomes of the study were categorized as primary and secondary outcome measures.

Primary Outcome Measure

- Incidence of postoperative sore throat (POST) following endotracheal intubation in patients undergoing general anesthesia.

Secondary Outcome Measures

- Severity of postoperative sore throat, assessed using a standardized grading scale
- Time of onset of postoperative sore throat following extubation
- Duration of postoperative sore throat within the first 24 hours postoperatively
- Comparison of severity of postoperative sore throat between the magnesium sulphate group and control group at different postoperative time intervals
- Incidence of associated symptoms such as hoarseness of voice or throat discomfort
- Occurrence of any adverse effects related to magnesium sulphate nebulization

Assessment / Grading Scale

Postoperative sore throat (POST) was assessed at 0, 2, 4, 12, and 24 hours after extubation using the following grading scale:

1. Grade 0: No sore throat
2. Grade 1: Mild sore throat – patient complains of sore throat only on questioning
3. Grade 2: Moderate sore throat – patient complains of sore throat spontaneously
4. Grade 3: Severe sore throat – severe pain associated with hoarseness of voice or voice changes

Statistical Analysis

Data were collected, tabulated, and analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were expressed as frequency and percentages.

Baseline demographic variables between the two groups were compared using the Student's independent *t*-test for continuous variables and the Chi-square test for categorical variables. The incidence and severity of postoperative sore throat at various postoperative time intervals were compared between the two groups using the Chi-square test or Fisher's exact test, as appropriate.

A *p*-value of less than 0.05 was considered statistically significant.

Sample Size Calculation

The sample size was calculated based on comparison of two proportions using the following formula:

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times [p_1(1-p_1) + p_2(1-p_2)]}{(p_1 - p_2)^2}$$

Where:

- n = sample size required per group
- $Z_{\alpha/2}$= standard normal variate corresponding to 95% confidence level (1.96)
- Z_{β}= standard normal variate corresponding to 80% power (0.84)
- p_1= anticipated incidence of postoperative sore throat in the control group
- p_2= anticipated incidence of postoperative sore throat in the magnesium sulphate group

Based on previous studies and allowing for possible dropouts, a total sample size of 100 patients, with 50 patients in each group, was included in the study.

Ethical Approval

The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrolment in the study.

RESULTS

A total of 100 patients were enrolled and completed the study. All patients were successfully analyzed, with 50 patients in each group. There were no protocol deviations or dropouts.

Demographic Data

The demographic variables and perioperative characteristics were comparable between the two groups. There was no statistically significant difference with respect to age, gender distribution, ASA physical status, or duration of surgery ($p > 0.05$).

Table 1: Demographic and Perioperative Characteristics

Parameter	Group A (n = 50)	Group B (n = 50)	*p*-value
Age (years) (Mean ± SD)	42.6 ± 11.2	41.9 ± 10.8	0.74
Gender (M/F)	28 / 22	26 / 24	0.68
ASA I / II	32 / 18	34 / 16	0.67

Duration of surgery (min) (Mean ± SD)	94.2 ± 21.5	92.8 ± 20.9	0.71

Table Note: Values are expressed as mean ± standard deviation (SD) or number (percentage). There was no statistically significant difference between the two groups with respect to demographic variables and perioperative characteristics ($p > 0.05$). ASA – American Society of Anaesthesiologist

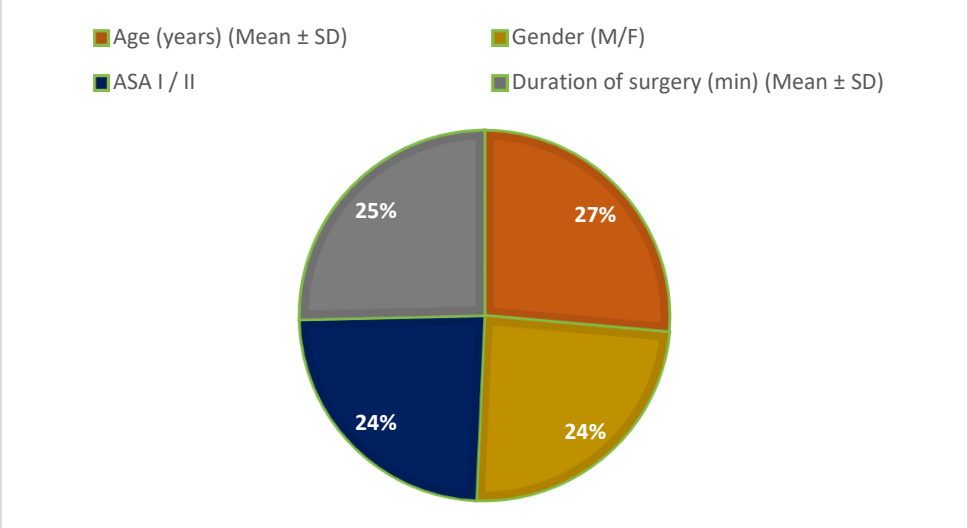
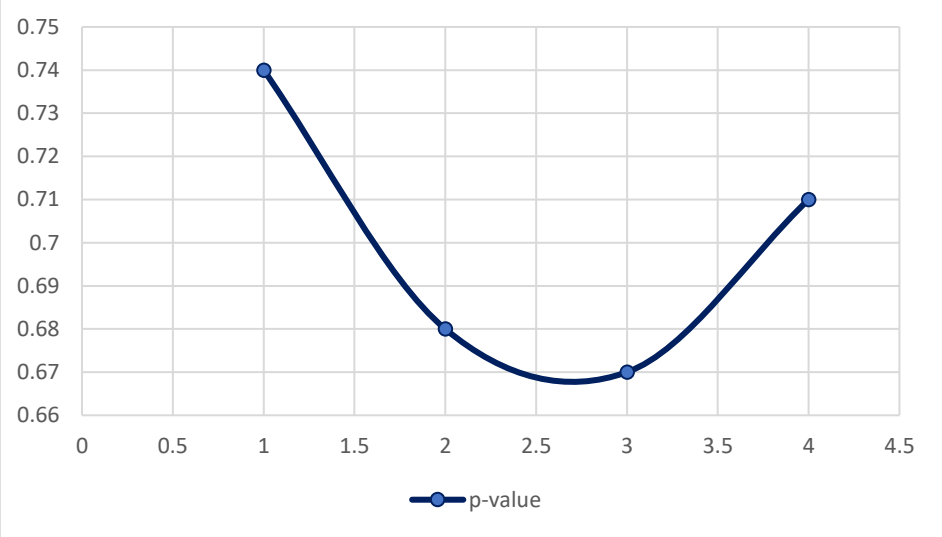


Figure Notes The figure shows the comparison of demographic and perioperative characteristics between Group A and Group B there was no statistically significant difference between the two groups ($p > 0.05$).



Graph Notes: Data are expressed as mean ± SD or number (percentage) as appropriate. Statistical analysis was performed using the student's *t*-test and Chi-square test.

Incidence of Postoperative Sore Throat

The incidence of postoperative sore throat was lower in the magnesium sulphate group compared to the control group at all postoperative time intervals. The difference was statistically significant at **4, 12, and 24 hours** ($p < 0.05$).

Table 2: Incidence of Postoperative Sore Throat

A	Group A (n = 50)	Group B (n = 50)	*p*-value
0 hours	18 (36%)	14 (28%)	0.38
2 hours	22 (44%)	15 (30%)	0.14
4 hours	26 (52%)	12 (24%)	**0.004**

12 hours	20 (40%)	8 (16%)	**0.006**
24 hours	14 (28%)	4 (8%)	**0.01**

Table Note: Values are expressed as **number (percentage)**. Comparison between groups was done using the **Chi-square test**. A *p*-value < 0.05 was considered statistically significant.

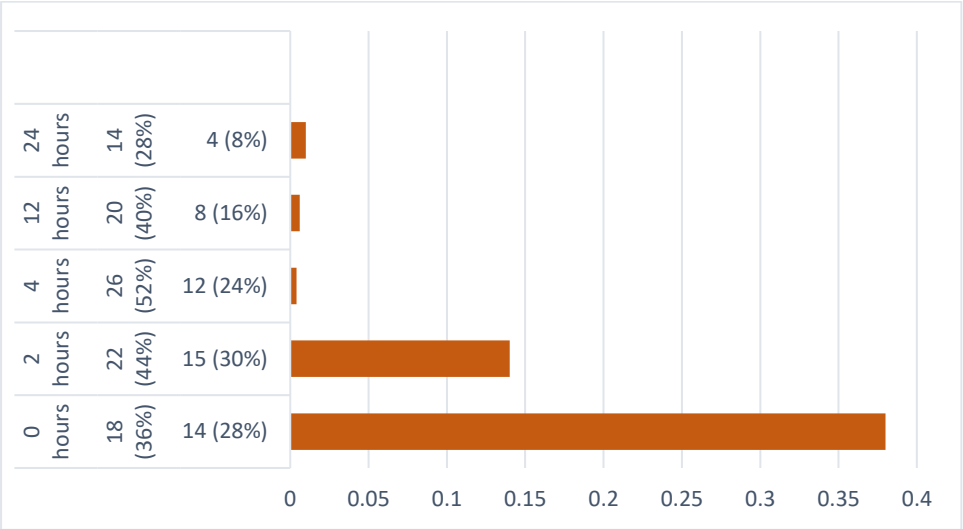


Figure Notes The figure depicts the comparison of the incidence of postoperative sore throat between Group A and Group B at different postoperative time intervals. A statistically significant reduction in incidence was observed in the magnesium sulphate group ($p < 0.05$).

Severity of Postoperative Sore Throat

The severity of POST was significantly reduced in the magnesium sulphate group compared to the control group, particularly at 4, 12, and 24 hours postoperatively.

Table 3: Severity of Postoperative Sore Throat at 4 Hours

Severity Grade	Group A (n = 50)	Group B (n = 50)	*p*-value
Grade 0	24 (48%)	38 (76%)	
Grade 1	14 (28%)	10 (20%)	
Grade 2	10 (20%)	2 (4%)	
Grade 3	2 (4%)	0 (0%)	**0.01**

Table Note: Severity of postoperative sore throat was graded using a standardized sore throat scoring scale. Values are expressed as number (percentage). Comparison between groups was performed using the Chi-square test.
Grade 0 – No sore throat; Grade 1 – Mild; Grade 2 – Moderate; Grade 3 – Severe.

Associated Symptoms

The incidence of associated symptoms such as hoarseness of voice was lower in the magnesium sulphate group, though the difference was not statistically significant.

Table 4: Incidence of Hoarseness of Voice

Symptom	Group A (n = 50)	Group B (n = 50)	*p*-value
Hoarseness present	6 (12%)	2 (4%)	0.14
Hoarseness absent	44 (88%)	48 (96%)	

Table Note: Values are expressed as **number (percentage)**. Comparison between groups was done using the **Chi-square test**. A *p*-value < 0.05 was considered statistically significant.

DISCUSSION

Postoperative sore throat (POST) remains one of the most common and distressing complications following endotracheal intubation under general anesthesia [1,2]. Although not life-threatening, it significantly affects patient comfort and postoperative satisfaction [3]. The present prospective randomized controlled study evaluated

the effect of preoperative magnesium sulphate nebulization on the incidence and severity of POST and demonstrated a significant reduction when compared with normal saline nebulization.

In the present study, the incidence of postoperative sore throat was significantly lower in the magnesium sulphate group at 4, 12, and 24 hours postoperatively. This finding suggests that magnesium sulphate provides sustained protection against airway mucosal irritation beyond the immediate postoperative period. Similar temporal reductions in POST have been reported in earlier studies evaluating topical magnesium administration [4,5]. The reduced incidence observed during the early postoperative hours may be attributed to the local anti-inflammatory effect of nebulized magnesium on the airway mucosa [6].

Magnesium sulphate acts as a non-competitive N-methyl-D-aspartate (NMDA) receptor antagonist and possesses membrane-stabilizing and anti-inflammatory properties [7]. When administered via nebulization, it delivers a high local concentration to the airway epithelium, thereby attenuating nociceptive transmission and reducing inflammatory responses without significant systemic absorption [8]. This pharmacological profile makes magnesium sulphate particularly suitable for the prevention of POST.

The findings of the present study are consistent with those reported by **Borazan et al.**, who demonstrated a significant reduction in both the incidence and severity of POST with magnesium sulphate when compared with placebo [9]. Similarly, **Agarwal et al.** reported that preoperative magnesium sulphate nebulization effectively reduced POST with minimal side effects [10]. These observations further support the results of the present study and reinforce the role of magnesium sulphate as an effective preventive strategy.

Several comparative studies evaluating different agents for POST prevention have shown variable efficacy. Ketamine nebulization has been shown to reduce POST effectively; however, it may be associated with adverse effects such as unpleasant taste and hallucinations [11]. Lignocaine and corticosteroids, though effective, may carry risks related to systemic absorption or delayed wound healing [12]. In contrast, magnesium sulphate nebulization is simple to administer, cost-effective, and associated with minimal adverse effects, making it a favorable alternative [13].

In the present study, the severity of postoperative sore throat was also significantly lower in the magnesium sulphate group, with fewer patients experiencing moderate to severe symptoms. This reduction in severity further highlights the analgesic benefit of magnesium sulphate and its role in improving postoperative comfort. Additionally, the incidence of associated symptoms such as hoarseness of voice was lower in the magnesium sulphate group, although the difference was not statistically significant. Similar findings have been reported in previous randomized trials [14].

No significant adverse effects related to magnesium sulphate nebulization were observed in this study. This finding is consistent with previous studies that have reported good tolerability and safety of nebulized magnesium sulphate [4,9]. The absence of systemic side effects further supports its routine use in clinical practice.

The standardized anesthesia protocol, controlled endotracheal tube size, maintenance of cuff pressure, and observer-blinded assessment strengthen the internal validity of this study. However, certain limitations such as the single-center design and the subjective nature of sore throat assessment may affect the generalizability of the results.

Limitations

- This was a single-center study, which may the limit generalizability of the results.
- The sample size was relatively small.
- Assessment of postoperative sore throat was subjective and based on patient reporting.

CONCLUSION

Preoperative nebulization with magnesium sulphate was found to be an effective method in reducing the incidence and severity of postoperative sore throat in patients undergoing general anesthesia with endotracheal intubation. The beneficial effect was more evident during the early postoperative period, particularly between 4 and 24 hours after extubation. Magnesium sulphate exerts its effect through local anti-inflammatory and antinociceptive mechanisms on the airway mucosa. The intervention was well tolerated, with no significant adverse effects observed in the study population. Standardization of anesthesia technique and endotracheal tube management further supported the validity of the findings. Given its ease of administration and low cost, magnesium sulphate nebulization can be safely incorporated into routine anesthetic practice. Its use may improve postoperative patient comfort and satisfaction. Further multicenter studies with larger sample sizes are recommended to validate these findings.

Conflict of Interest: The authors declare no conflicts of interest for this study.

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