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**Original Research Article**

# Comparison Between Efficacy of Preoperative Lignocaine versus Magnesium Sulphate Nebulisation for Incidence of Postoperative Sore Throat in Patients Undergoing General Anaesthesia with Endotracheal Intubation: A Randomized Comparative Study

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**ABSTRACT**

**Background:** One typical side effect after endotracheal intubation under general anaesthesia is POST (Postoperative Sore Throat). Patients become uncomfortable and unhappy as a result. The purpose of this study was to evaluate the effectiveness of preoperative nebulised lignocaine and magnesium sulphate in reducing both the frequency and intensity of POST, as well as to assess changes in haemodynamics.

**Methods:** This prospective, randomized, double-blind comparative study was conducted in the Department of Anaesthesiology and Critical Care, MKCG Medical College and Hospital, Berhampur, from July 2023 to September 2024. 90 patients of both sexes, ages 20 to 60, in ASA physical status I and II, undergoing elective lower abdomen operations under general anaesthesia with endotracheal intubation, were included. Three groups of thirty patients each were randomly assigned: Group B was given 250 mg of magnesium sulphate diluted with 5 ml of normal saline, Group C was given 5 ml of 0.9% normal saline, and Group A was given 5 ml of 2% lignocaine (100 mg). Cough, hoarseness of voice, and painful throat following surgery were evaluated at 0, 2, 4, 8, 12, and 24 hours. At predetermined intervals, haemodynamic parameters were observed. SPSS was used for the statistical analysis, and $p<0.05$ was deemed statistically significant.

**Results:** The incidence and severity of postoperative sore throat, hoarseness and cough were significantly different among the three groups ($p<0.05$). Magnesium sulphate nebulisation (Group B) demonstrated the lowest incidence and severity of postoperative sore throat, followed by lignocaine (Group A), while the highest incidence was observed in the control group (Group C). Significant differences in haemodynamic parameters were also observed. No complications or adverse effects were reported in any group.

**Conclusion:** Magnesium sulphate preoperative nebulisation was superior to lignocaine in lowering the frequency and severity of postoperative sore throat and related airway problems after endotracheal intubation.

**Keywords:** Postoperative Sore Throat, Lignocaine, Magnesium Sulphate, Nebulisation, General Anaesthesia, Endotracheal Intubation.

## INTRODUCTION

A typical complaint after tracheal intubation during general anaesthesia is POST (Postoperative Sore Throat). It is a significant contributor to patient discomfort, dissatisfaction, and morbidity even though it is frequently seen as a minor postoperative consequence.[1] The incidence of postoperative sore throat ranges from 24 to 65% in patients

undergoing general anaesthesia with endotracheal intubation, and symptoms generally persist for 12–24 hours after surgery.[2-5] Tracheal intubation may cause local mucosal irritation and tissue injury, leading to an inflammatory response characterized by increased polymorphonuclear cells in tracheal tissues and elevated plasma interleukin-6 levels. To lessen the frequency and intensity of postoperative sore throat, a number of pharmaceutical and non-pharmacological therapies have been studied; however, no one approach has been proven to be consistently successful. Pharmacological approaches include beclomethasone gel, azulenesulphonate gargles, ketamine, licorice and magnesium sulphate.[6-8]

N-methyl-D-aspartate receptors play an important role in nociception and inflammatory processes.[9,10] These receptors are present in both peripheral nerves and the central nervous system.[11,12] Lidocaine and magnesium sulphate possess NMDA (N-Methyl-D-Aspartate) receptor-antagonistic properties and may help reduce postoperative airway discomfort.

Lidocaine is an amide-type local anaesthetic widely used to suppress airway reflexes, bronchial hyperreactivity and haemodynamic responses associated with tracheal intubation. Its analgesic and anti-inflammatory properties are attributed to reduced excitation of airway sensory C-fibres and inhibition of sensory neuropeptide release. However, topical lidocaine gel or ointment may cause tracheal mucosal irritation or injury. Nebulized lidocaine offers a convenient alternative with rapid onset of action, easy administration, short duration of action and minimal residual adverse effects.[13-15] Magnesium sulphate acts as an antagonist of the NMDA receptor ion channel[16] and has been investigated as a nebulized agent for preventing postoperative sore throat.[17,18] Nebulization offers advantages over gargling, including ease of administration, reduced drug volume, better patient cooperation and minimal risk of aspiration.

Therefore, nebulized lidocaine and magnesium sulphate may be useful interventions for reducing postoperative sore throat following tracheal intubation.

### Aims and Objectives

This study compares the effectiveness of magnesium sulphate and preoperative nebulised lidocaine in avoiding post-intubation sore throat in individuals receiving general anaesthesia and endotracheal intubation. The study objectives were to compare the two interventions in terms of the incidence and severity of postoperative sore throat and to evaluate and compare their effects on perioperative haemodynamic parameters.

## MATERIALS AND METHODS

### Study Design

This was a prospective, randomized, double-blinded comparative study conducted in the Postgraduate Department of Anaesthesiology and Critical Care, MKCG Medical College and Hospital, Berhampur, from July 2023 to September 2024.

### Inclusion and Exclusion Criteria

The study comprised patients with ASA physical status I and II who were between the ages of 20 and 60, of either sex, weighed between 30 and 70 kg, had MPS (Modified Mallampati Score) grades I and II, were undergoing elective lower abdominal operations, and had no severe underlying comorbidities. Patients with a history of sore throats, acute respiratory tract infections, COPD (Chronic Obstructive Pulmonary Disease), asthma, neuromuscular disorders, and coughing or bucking prior to extubation were excluded, as were those with ASA physical status III and IV, those under 20 or over 60, and those who declined to participate. Patients receiving analgesics or corticosteroids, those at risk of aspiration, those with known allergy or hypersensitivity to the study drugs, patients on antihypertensive medications, and those with a difficult airway, obesity or pregnancy were also excluded.

### Sample Size Calculation

90 patients was randomly allocated into 3 groups i.e.

Group A(n=30)

Group B(n=30)

Group C(n=30)

Group A patients were nebulized with Lignocaine, Group B patients was nebulised with magnesium sulphate and Group C patients was nebulised with 0.9% normal saline as control group.

### Data Collection Tools

Data were collected using a standardized case record form. The tools and equipment included a compressor-type nebulizer, anaesthesia workstation, cuffed endotracheal tubes of appropriate sizes, Macintosh laryngoscope, multiparameter monitor, pulse oximeter, non-invasive blood pressure monitor, ECG (Electrocardiogram), capnography ($EtCO_2$),

gas analyser and suction apparatus. The study medications included 2% lidocaine, magnesium sulphate and 0.9% normal saline. Standard anaesthetic and emergency drugs, intravenous cannulas, syringes, infusion sets, stylet and bougie were also used. Postoperative sore throat, hoarseness of voice and cough were assessed using a standardized four-point grading scale (0–3), while haemodynamic parameters and adverse effects were recorded systematically.

**Data Collection Procedure**

90 eligible patients were divided into three groups at random using a computer-generated randomisation table following clearance from the Institutional Ethics Committee and written informed permission. Group B received 250 mg of magnesium sulphate diluted with normal saline to a total amount of 5 ml, Group C received 5 ml of 0.9% normal saline over the course of 15 minutes, and Group A received nebulisation with 100 mg of 2% lidocaine. Patients received normal general anaesthesia and endotracheal intubation after nebulisation. Heart rate, systolic, diastolic, and mean arterial blood pressure, $SpO_2$, and $EtCO_2$ were among the baseline and perioperative haemodynamic parameters that were measured at predetermined intervals. Following extubation, patients were assessed for the incidence and severity of postoperative sore throat, hoarseness of voice and cough at 0, 2, 4, 8, 12 and 24 hours. Any complications or adverse effects, including nausea, vomiting, hypotension, hypertension, respiratory discomfort, sedation and arrhythmias, were documented. Patients with moderate or severe sore throat (grades 2 and 3) received appropriate rescue treatment, and all collected data were systematically recorded for statistical analysis.

**Statistical Analysis**

The SPSS (Statistical Package for the Social Sciences) was used to evaluate the data after it had first been imported into Microsoft Excel. The data was summarised and displayed in tables and graphs using descriptive statistics, such as frequency, percentage, mean, standard deviation, median, and interquartile range. The Shapiro-Wilk and Kolmogorov-Smirnov tests were used to determine whether the data distribution was normal. For data that was regularly distributed, the proper parametric tests were used. Categorical variables were compared using the Chi-square test with Yates' correction, and changes over time across the three research groups were compared using factorial repeated-measures ANOVA. When necessary, post hoc analysis using Bonferroni correction was carried out for multiple comparisons. Statistical significance was defined as a p-value of less than 0.05.

**RESULTS**

| Characteristic | Group A (n=30) | Group B (n=30) | Group C (n=30) |
|---|---|---|---|
| Age 10–19 years | 1 (3.3%) | 4 (13.3%) | 2 (6.7%) |
| Age 20–29 years | 16 (53.3%) | 14 (46.7%) | 14 (46.7%) |
| Age 30–39 years | 10 (33.3%) | 7 (23.3%) | 9 (30.0%) |
| Age 40–49 years | 2 (6.7%) | 3 (10.0%) | 3 (10.0%) |
| Age 50–59 years | 1 (3.3%) | 2 (6.7%) | 2 (6.7%) |
| Mean age ± SD (years) | 29.97 ± 7.586 | 30.33 ± 10.370 | 31.53 ± 9.716 |
| Female | 29 (96.7%) | 23 (76.7%) | 16 (53.3%) |
| Male | 1 (3.3%) | 7 (23.3%) | 14 (46.7%) |
| Weight 40–49 kg | 6 (20.0%) | 5 (16.7%) | 3 (10.0%) |
| Weight 50–59 kg | 16 (53.3%) | 18 (60.0%) | 12 (40.0%) |
| Weight 60–69 kg | 8 (26.7%) | 6 (20.0%) | 14 (46.7%) |
| Weight ≥70 kg | 0 (0%) | 1 (3.3%) | 1 (3.3%) |
| Mean weight ± SD (kg) | 54.53 ± 6.301 | 55.47 ± 6.801 | 59.77 ± 6.621 |
| ASA Grade I | 12 (40.0%) | 28 (93.3%) | 28 (93.3%) |
| ASA Grade II | 18 (60.0%) | 2 (6.7%) | 2 (6.7%) |

**Table 1. Baseline Demographic and Clinical Characteristics of the Study Groups**

The study included 90 patients, with 30 patients in each group. The 20–29-year age category was the largest in all three groups. Mean ages were 29.97 ± 7.586, 30.33 ± 10.370 and 31.53 ± 9.716 years in Groups A, B and C, respectively ($\chi^2$=3.370, df=8, p=0.909; one-way ANOVA F=0.153, p=0.858). Females accounted for 29 (96.7%), 23 (76.7%) and 16 (53.3%) patients, respectively ($\chi^2$=15.281, df=2, p=0.001). The 50–59 kg category was the most frequent weight

category overall (46 patients, 51.11%); mean weights were 54.53 ± 6.301, 55.47 ± 6.801 and 59.77 ± 6.621 kg ($\chi^2$=6.932, df=6, p=0.327). ASA Grade I was recorded in 12 (40%), 28 (93.3%) and 28 (93.3%) patients, respectively.

| Surgical Profile | Group A (n=30) | Group B (n=30) | Group C (n=30) |
|---|---|---|---|
| Endocrine surgery | 5 (16.7%) | 4 (13.3%) | 4 (13.3%) |
| General surgery | 4 (13.3%) | 5 (16.7%) | 4 (13.3%) |
| Obstetrics & Gynaecology | 4 (13.3%) | 5 (16.7%) | 4 (13.3%) |
| Oral & maxillofacial surgery | 5 (16.7%) | 4 (13.3%) | 4 (13.3%) |
| Orthopaedics | 4 (13.3%) | 4 (13.3%) | 5 (16.7%) |
| Otorhinolaryngology | 4 (13.3%) | 4 (13.3%) | 4 (13.3%) |
| Urosurgery | 4 (13.3%) | 4 (13.3%) | 5 (16.7%) |
| Duration of surgery, mean ± SD (min) | 99.00 ± 34.601 | 102.50 ± 25.249 | 88.93 ± 30.092 |
| Duration <60 min | 4 (13.3%) | 1 (3.3%) | 1 (3.3%) |
| Duration >60 min | 26 (86.7%) | 29 (96.7%) | 29 (96.7%) |

**Table 2. Distribution of Surgical Procedures and Duration of Surgery**

The distribution of surgical procedures was broadly spread across the listed specialties. The reported comparison of type of surgery was not statistically significant ($\chi^2$=0.923, df=12, p=1.0). Mean duration of surgery was 99.00 ± 34.601 minutes in Group A, 102.50 ± 25.249 minutes in Group B and 88.93 ± 30.092 minutes in Group C.

| Assessment Stage | Group A Mean ± SD | Group B Mean ± SD | Group C Mean ± SD | F value | p value |
|---|---|---|---|---|---|
| Pre-nebulisation | 85.63 ± 15.318 | 78.80 ± 8.608 | 78.53 ± 5.329 | 4.323 | 0.016 |
| During nebulisation | 89.97 ± 15.422 | 78.80 ± 10.656 | 74.93 ± 5.401 | 14.413 | 0.001 |
| Post-nebulisation | 91.43 ± 16.929 | 76.63 ± 11.183 | 70.80 ± 5.473 | 23.056 | 0.001 |
| Pre-induction | 88.87 ± 16.606 | 80.73 ± 9.450 | 79.33 ± 6.266 | 5.898 | 0.004 |
| Post-induction | 85.90 ± 18.692 | 79.53 ± 8.468 | 83.13 ± 5.958 | 2.009 | 0.140 |
| Post-extubation | 83.93 ± 17.546 | 82.07 ± 8.812 | 87.70 ± 6.297 | 1.351 | 0.260 |

**Table 3. Comparison of Heart Rate (beats/min) at Different Perioperative Stages**

Heart rate values were lower in Groups B and C than in Group A during and after nebulisation. Between-group differences were statistically significant at pre-nebulisation (p=0.016), during nebulisation (p=0.001), post-nebulisation (p=0.001) and pre-induction (p=0.004).

| Assessment Stage/Parameter | Group A Mean ± SD | Group B Mean ± SD | Group C Mean ± SD | F value | p value |
|---|---|---|---|---|---|
| Pre-nebulisation – SBP | 121.67 ± 10.993 | 124.03 ± 18.173 | 116.67 ±10.691 | 2.252 | 0.111 |
| Pre-nebulisation – DBP | 79.00 ± 8.473 | 79.10 ± 9.301 | 74.13 ± 4.754 | 4.010 | 0.022 |
| During nebulisation – SBP | 116.93 ± 12.278 | 113.53 ± 14.414 | 109.33 ±10.483 | 2.785 | 0.067 |
| During nebulisation – DBP | 76.43 ± 10.298 | 73.53 ± 8.796 | 69.53 ± 3.884 | 5.443 | 0.006 |
| Post-nebulisation – SBP | 120.30 ± 18.959 | 109.40 ± 14.883 | 103.20 ±10.193 | 9.849 | 0.001 |
| Post-nebulisation – DBP | 78.47 ± 14.200 | 70.73 ± 7.759 | 65.47 ± 3.674 | 13.976 | 0.001 |
| Pre-induction – SBP | 115.97 ± 18.574 | 114.97 ± 15.902 | 112.07 ± 9.805 | 0.532 | 0.589 |
| Pre-induction – DBP | 74.73 ± 14.807 | 71.33 ± 9.799 | 67.93 ± 3.695 | 3.163 | 0.047 |
| Post-induction – SBP | 122.70 ± 16.537 | 118.80 ± 12.027 | 116.60 ± 9.828 | 1.669 | 0.194 |
| Post-induction – DBP | 81.17 ± 12.177 | 79.13 ± 7.610 | 75.80 ± 3.978 | 2.976 | 0.056 |
| Post-extubation – SBP | 130.53 ± 19.177 | 128.13 ± 10.865 | 122.80 ± 9.665 | 2.434 | 0.094 |
| Post-extubation – DBP | 87.37 ± 14.542 | 85.20 ± 9.470 | 81.40 ± 5.587 | 2.470 | 0.090 |

**Table 4. Comparison of Systolic and Diastolic Blood Pressure (mmHg)**

For systolic blood pressure, a significant between-group difference was observed after nebulisation (p=0.001); the other assessment stages were not statistically significant (p>0.05). For diastolic blood pressure, differences were significant at pre-nebulisation (p=0.022), during nebulisation (p=0.006),

post-nebulisation (p=0.001) and pre-induction (p=0.047), but not at post-induction (p=0.056) or post-extubation (p=0.090).

| Assessment Stage/Parameter | Group A Mean ± SD | Group B Mean ± SD | Group C Mean ± SD | F value | p value |
|---|---|---|---|---|---|
| Pre-nebulisation – MAP | 91.53 ± 9.395 | 94.00 ± 12.256 | 88.20 ± 4.723 | 2.924 | 0.059 |
| Pre-nebulisation – $SpO_2$ | 99.80 ± 0.551 | 99.90 ± 0.403 | 99.77 ± 0.568 | 0.550 | 0.597 |
| During nebulisation – MAP | 87.90 ± 9.873 | 87.43 ± 12.056 | 83.17 ± 4.170 | 2.353 | 0.101 |
| During nebulisation – $SpO_2$ | 99.90 ± 0.403 | 99.97 ± 0.183 | 99.90 ± 0.403 | 0.373 | 0.690 |
| Post-nebulisation – MAP | 90.90 ± 14.413 | 84.23 ± 10.335 | 78.37 ± 4.390 | 10.602 | 0.000 |
| Post-nebulisation – $SpO_2$ | 99.90 ± 0.403 | 100.00 ± 0.000 | 99.90 ± 0.305 | 1.176 | 0.313 |
| Pre-induction – MAP | 87.17 ± 15.182 | 86.53 ± 11.355 | 82.77 ± 4.673 | 1.336 | 0.268 |
| Pre-induction – $SpO_2$ | 99.93 ± 0.254 | 99.93 ± 0.254 | 99.93 ± 0.254 | 0.000 | 1.000 |
| Post-induction – MAP | 95.67 ± 13.002 | 92.40 ± 9.456 | 89.13 ± 4.508 | 3.445 | 0.036 |
| Post-induction – $SpO_2$ | 99.90 ± 0.305 | 99.60 ± 2.191 | 99.97 ± 0.183 | 0.697 | 0.501 |
| Post-extubation – MAP | 99.43 ± 15.956 | 98.57 ± 9.655 | 94.73 ± 5.362 | 1.495 | 0.230 |
| Post-extubation – $SpO_2$ | 99.87 ± 0.434 | 99.93 ± 0.365 | 99.87 ± 0.434 | 0.261 | 0.771 |

**Table 5. Comparison of Mean Arterial Pressure and Oxygen Saturation**

Mean arterial pressure differed significantly between groups after nebulisation (p=0.000) and post-induction (p=0.036).

| Time | Severity Grade | Group A n (%) | Group B n (%) | Group C n (%) | $\chi^2$; p value |
|---|---|---|---|---|---|
| 0 hours | No sore throat | 24 (80.0%) | 25 (83.3%) | 0 (0%) | 60.164; 0.001 |
| | Mild | 4 (13.3%) | 5 (16.7%) | 11 (36.7%) | |
| | Moderate | 2 (6.7%) | 0 (0%) | 16 (53.3%) | |
| | Severe | 0 (0%) | 0 (0%) | 3 (10.0%) | |
| 2 hours | No sore throat | 22 (73.3%) | 24 (80.0%) | 0 (0%) | 53.570; 0.001 |
| | Mild | 5 (16.7%) | 6 (20.0%) | 12 (40.0%) | |
| | Moderate | 2 (6.7%) | 0 (0%) | 14 (46.7%) | |
| | Severe | 1 (3.3%) | 0 (0%) | 4 (13.3%) | |
| 4 hours | No sore throat | 11 (36.7%) | 25 (83.3%) | 3 (10.0%) | 42.395; 0.001 |
| | Mild | 13 (43.3%) | 5 (16.7%) | 10 (33.3%) | |
| | Moderate | 6 (20.0%) | 0 (0%) | 16 (53.3%) | |
| | Severe | 0 (0%) | 0 (0%) | 1 (3.3%) | |
| 8 hours | No sore throat | 4 (13.3%) | 18 (60.0%) | 3 (10.0%) | 36.880; 0.001 |
| | Mild | 11 (36.7%) | 12 (40.0%) | 7 (23.3%) | |
| | Moderate | 13 (43.3%) | 0 (0%) | 17 (56.7%) | |
| | Severe | 2 (6.7%) | 0 (0%) | 3 (10.0%) | |
| 12 hours | No sore throat | 2 (6.7%) | 23 (76.7%) | 2 (6.7%) | 49.217; 0.001 |
| | Mild | 17 (56.7%) | 7 (23.3%) | 16 (53.3%) | |
| | Moderate | 10 (33.3%) | 0 (0%) | 10 (33.3%) | |
| | Severe | 1 (3.3%) | 0 (0%) | 2 (6.7%) | |
| 24 hours | No sore throat | 2 (6.7%) | 22 (73.3%) | 2 (6.7%) | 45.898; 0.001 |
| | Mild | 17 (56.7%) | 8 (26.7%) | 16 (53.3%) | |
| | Moderate | 11 (36.7%) | 0 (0%) | 12 (40.0%) | |
| | Severe | — | — | — | |

The frequency and severity distributions differed significantly among the three groups at every recorded time point (all reported p=0.001). Group B had the highest proportion without sore throat at 0, 2, 4, 8, 12 and 24 hours (83.3%, 80.0%, 83.3%, 60.0%, 76.7% and 73.3%, respectively). Group C showed the greatest burden of moderate and severe symptoms at the early time points.

| Outcome/Time | Group A | Group B | Group C | $\chi^2$; p value/notes |
|---|---|---|---|---|
| Hoarseness – No hoarseness | Group A n (%) | Group B n (%) | Group C n (%) | $\chi^2$; p value |
| 0 h | 23 (76.7%) | 25 (83.3%) | 0 (0%) | 58.882; 0.001 |
| 2 h | 21 (70.0%) | 24 (80.0%) | 0 (0%) | 52.976; 0.001 |
| 4 h | 11 (36.7%) | 25 (83.3%) | 3 (10.0%) | 43.395; 0.001 |
| 8 h | 6 (20.0%) | 18 (60.0%) | 3 (10.0%) | 37.200; 0.001 |
| 12 h | 4 (13.3%) | 23 (76.7%) | 3 (6.7%) | 45.922; 0.001 |
| 24 h | 5 (16.7%) | 22 (73.3%) | 2 (6.7%) | 38.412; 0.001 |
| Cough – No cough | Group A n (%) | Group B n (%) | Group C n (%) | $\chi^2$; p value |
| 0 h | 24 (80.0%) | 25 (83.3%) | 11 (36.7%) | 60.164; 0.001 |
| 2 h | 23 (76.7%) | 24 (80.0%) | 12 (40.0%) | 42.395; 0.001 |
| 4 h | 11 (36.7%) | 25 (83.3%) | 3 (10.0%) | 37.200; 0.001 |
| 8 h | 6 (20.0%) | 18 (60.0%) | 3 (10.0%) | 12.857; 0.001 |
| 12 h | 20 (66.7%) | 30 (100%) | 20 (66.7%) | 15.535; 0.001 |
| 24 h | 19 (63.3%) | 30 (100%) | 18 (60.0%) | 15.535; 0.001 |
| Complications / Adverse Effects | Group A Yes/No | Group B Yes/No | Group C Yes/No | |
| Nausea | 0 / 30 | 0 / 30 | 0 / 30 | |
| Vomiting | 0 / 30 | 0 / 30 | 0 / 30 | |
| Hypotension | 0 / 30 | 0 / 30 | 0 / 30 | |
| Respiratory depression | 0 / 30 | 0 / 30 | 0 / 30 | |
| Sedation | 0 / 30 | 0 / 30 | 0 / 30 | |
| Hypertension | 0 / 30 | 0 / 30 | 0 / 30 | |
| Oliguria | 0 / 30 | 0 / 30 | 0 / 30 | |
| Seizure | 0 / 30 | 0 / 30 | 0 / 30 | |
| Arrhythmia | 0 / 30 | 0 / 30 | 0 / 30 | |
| Flushing of skin | 0 / 30 | 0 / 30 | 0 / 30 | |
| Loss of DTR | 0 / 30 | 0 / 30 | 0 / 30 | |
| Slurring of speech | 0 / 30 | 0 / 30 | 0 / 30 | |
| Others | 0 / 30 | 0 / 30 | 0 / 30 | |

**Table 7. Secondary Postoperative Outcomes and Complications**

The proportion without hoarseness was higher in Group B at each reported time point, and the source reports statistically significant between-group differences (all p=0.001). The no-cough proportions varied across time; the source also reports significant differences (all p=0.001). No complications or adverse effects were recorded in any group for the 13 listed events (0 events and 30 without the event in each group.

## DISCUSSION

### Age Distribution

The age distribution of patients in the three study groups demonstrated that the maximum number of patients belonged to the 20–29 years age group, accounting for 44 (48.89%) patients across all three groups. The minimum number of patients belonged to the 50–59 years age group, accounting for 5 (5.56%) patients out of the total study population of 90.

The mean age in Group A was 29.97 ± 7.58 years, in Group B was 30.33 ± 10.37 years, and in Group C was 31.53 ± 10.37 years. The chi-square test yielded a value of $\chi^2 = 3.370$, with 8 degrees of freedom and a p-value of 0.909, indicating no statistically significant difference in age distribution among the three groups.

One-way ANOVA demonstrated an F-value of 0.153, with a p-value of 0.858. This difference was statistically insignificant (p greater than 0.05), indicating that the three groups were comparable with respect to age distribution. Thus, age was unlikely to have significantly influenced the comparison of the study outcomes.

### Sex Distribution

The sex-wise distribution demonstrated a female predominance in the study population,

with females accounting for 68 (75.5%) patients across the three groups.

The chi-square test showed a value of $\chi^2$ = 15.281, with 2 degrees of freedom and a p-value of 0.001. This difference was statistically significant, indicating a difference in sex distribution among the three treatment groups.

Therefore, age distribution, sex distribution was not uniform among the study groups and should be considered while interpreting the comparative outcomes.

**Weight Distribution**

The weight-wise distribution revealed that the maximum number of patients belonged to the 50–59 kg weight category, accounting for 46 (51.11%) patients in the overall study population. The mean weight in Group A was 54.53 ± 6.30 kg, in Group B was 55.47 ± 6.801 kg, and in Group C was 59.77 ± 6.621 kg.

**ASA Physical Status Classification**

ASA Grade I patients made up the largest percentage of patients in all three categories, according to the distribution of patients based on the American Society of Anaesthesiologists' (ASA) physical state classification.

The chi-square test yielded a value of $\chi^2$ = 30.802, with 2 degrees of freedom and a p-value of 0.001. This difference was statistically significant, indicating a variation in ASA physical status distribution among the three treatment groups.

**Type of Surgery**

The distribution of patients according to the type of surgery was comparable among the three treatment groups. The chi-square test demonstrated a value of $\chi^2$ = 0.923, with 12 degrees of freedom and a p-value of 1.0. This difference was statistically insignificant (p greater than 0.05), indicating that there was no significant association between the type of surgery and treatment group allocation.

**Duration of Surgery**

The distribution of patients according to the duration of surgery was analysed among the three treatment groups. The chi-square test yielded a value of $\chi^2$ = 58.667, with 44 degrees of freedom and a p-value of 0.069. As the p-value was greater than 0.05, the difference was statistically insignificant, indicating no significant association between the duration of surgery and the treatment groups.

When the duration of surgery was further categorised into different ranges, the chi-square test demonstrated a value of $\chi^2$ = 3.214, with 2 degrees of freedom and a p-value of 0.200. This difference was also statistically insignificant.

**Interpretation and Comparison of Haemodynamic Parameters**

**Systolic Blood Pressure**

The distribution of systolic blood pressure among the three treatment groups at different observation periods demonstrated a reduction in the mean systolic blood pressure values towards normal levels in Groups B and C following nebulisation.

One-way ANOVA revealed a statistically significant difference in systolic blood pressure between the groups after nebulisation and before induction, with a p-value of 0.001. This indicates that the reduction in systolic blood pressure observed in Groups B and C was statistically significant compared with Group A.

**Diastolic Blood Pressure**

The distribution of diastolic blood pressure among the three treatment groups at different observation periods demonstrated a reduction in mean diastolic blood pressure values towards normal levels in Groups B and C. One-way ANOVA revealed a statistically significant difference in diastolic blood pressure between the groups following nebulisation and before induction, with a p-value of 0.001.

**Mean Arterial Pressure**

The distribution of mean arterial pressure among the three treatment groups at different observation periods demonstrated a reduction in mean MAP values towards normal levels in Groups B and C. With a p-value of 0.001, a one-way ANOVA revealed a statistically significant difference in mean arterial pressure between the groups following nebulisation and before to induction.

These findings indicate that the changes in mean arterial pressure observed in Groups B and C were statistically significant compared with Group A.

**Heart Rate**

The distribution of heart rate among the three treatment groups at different observation periods demonstrated a reduction in mean heart rate values towards normal levels in Groups B and C following nebulisation.

One-way ANOVA revealed a statistically significant difference in heart rate between the groups after nebulisation and before induction, with a p-value of 0.001.

This finding suggests that the study drugs influenced heart rate and produced statistically significant changes in Groups B and C compared with Group A.

**Oxygen Saturation**

The distribution of peripheral oxygen saturation ($SpO_2$) among the three treatment groups at different observation periods demonstrated changes in mean oxygen saturation values in Groups B and C following nebulisation.

One-way ANOVA revealed a statistically significant difference between the groups after nebulisation and before induction, with a p-value of 0.001.

**Incidence of Postoperative Sore Throat**

The incidence of postoperative sore throat was evaluated at different postoperative intervals, namely 0, 2, 4, 8, 12, and 24 hours.

The frequency distribution demonstrated a gradual reduction in the incidence of postoperative sore throat across the observation periods. A statistically significant difference was observed among the three treatment groups at different postoperative intervals (p less than 0.05). The results of this study showed that patients receiving magnesium sulphate nebulisation had a reduced incidence and severity of postoperative sore throat than those receiving lignocaine nebulisation.

These results are consistent with previous studies demonstrating the effectiveness of magnesium sulphate nebulisation in reducing postoperative sore throat.[11-15]

**Incidence of Postoperative Cough**

The incidence of postoperative cough was assessed at 0, 2, 4, 8, 12, and 24 hours following surgery. The frequency distribution demonstrated a gradual reduction in the incidence of cough over the postoperative observation period. A statistically significant difference was observed among the three treatment groups at different time intervals (p less than 0.05).

**Postoperative Hoarseness and Dysphagia**

In addition to postoperative sore throat and cough, hoarseness and dysphagia were evaluated as important postoperative airway-related complications. The present study demonstrated lower hoarseness severity scores in Group M, which is consistent with the findings reported by Rajan S et al.[14]

Similarly, lower dysphagia severity scores were observed in Group M. These findings are comparable with the results of previous studies conducted by Gupta SK et al. and Yadav M et al.[11,12] These observations further support the potential role of magnesium sulphate nebulisation in reducing postoperative pharyngeal discomfort and airway-related symptoms.

**Incidence of Complications and Adverse Effects**

The occurrence of complications and adverse effects was assessed in all three treatment groups throughout the study period. This suggests that both nebulisation techniques were well tolerated by the patients under the conditions of the present study. However, the absence of observed adverse effects in this study should not be interpreted as proof of complete safety, and larger studies would be required to evaluate the safety profile of these interventions more comprehensively.

## LIMITATIONS

The present study had certain limitations. Patients with pre-existing airway problems were excluded, as they may require prolonged intubation, potentially influencing the study outcomes. Furthermore, the study was limited to patients belonging to ASA physical status I and II; therefore, the findings may not be generalisable to patients with underlying cardiac diseases or other significant comorbidities, in whom different outcomes may be observed. The depth of anaesthesia was not objectively monitored during the study, which could have influenced the results. Additionally, plasma corticosteroid concentrations were not measured, limiting the assessment of the possible role of corticosteroids in the observed effects.

## CONCLUSION

The present study concludes that magnesium sulphate nebulisation is more effective than lignocaine nebulisation in reducing the incidence and severity of POST, hoarseness of voice, and dysphagia, particularly during the early postoperative period. Therefore, magnesium sulphate nebulisation can be considered a more effective prophylactic intervention for attenuating post-intubation airway-related complications and improving postoperative patient comfort.

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