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Original Article

Anaesthesia Section

Comparative Efficacy of Nebulised Magnesium Sulphate and Lignocaine in Attenuating the Haemodynamic Response to Laryngoscopy and Intubation: A Randomised Controlled Study

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ABSTRACT

Introduction: The haemodynamic alterations occurring during laryngoscopy and intubation presents a significant challenge for Anaesthesiologists. It causes a transient but marked rise in Heart Rate (HR) and blood pressure which is highly undesirable.

Aim: To analyse the comparative role of nebulised magnesium sulphate and nebulised lignocaine in managing the pressor response triggered by laryngoscopy and endotracheal intubation under anaesthesia.

Materials and Methods: The present randomised controlled was carried out in the Department of Anaesthesia and critical care at PGIMS, Rohtak,India from September 2023 to August 2024 .The study included 80 patients scheduled for elective surgery requiring general anaesthesia. Group M (n=40) received nebulisation with 5 mL of a solution containing 1 mL of 50% (500 mg) magnesium sulphate diluted in 4 mL of saline. Group L (n=40) was nebulised with 5 mL of a 2% lignocaine hydrochloride solution. Baseline haemodynamic parameters (V_0) were recorded, and subsequent parameters were measured after nebulisation (V_1), prior to laryngoscopy (V_2), and at intervals following endotracheal intubation: one minute (V_3), three minutes (V_4), and 5 minutes (V_5). Data was expressed as frequency(n) or mean with standard deviation and appropriate statistical tests were applied for intragroup and intergroup comparison. Results were considered significant if the p-value was less than 0.05.

Results: The demographic and clinical profiles of patients (age, sex, Body Mass Index (BMI), American Society of Anaesthesiologists (ASA) and Mallampatti Grading (MPG) were statistically similar across both groups. Baseline measurements for haemodynamic parameters were comparable between the groups. Group M had higher SBP values just before laryngoscopy (p=0.004) while Group L demonstrated significantly higher mean Systolic Blood Pressure (SBP) values than Group M at multiple time points: 1st minute (p=0.003), 3rd minute (p=0.001), and 5th minute (p=0.001) after laryngoscopy and endotracheal intubation. Similarly, Group L exhibited higher mean Diastolic Blood Pressure (DBP) values at comparable time intervals (p=0.03, p=0.001, p=0.001 and p=0.003). A more pronounced rise in mean MAP was observed in Group L compared to Group M at 1st min (p=0.001) and 3rd min post-intubation (p=0.001). Group L also had higher HR values than Group M after nebulisation (p=0.03), before laryngoscopy (p=0.04), and at 1st minute (p=0.006) and 3rd minute (p=0.001) postintubation.

Conclusion: The present study revealed that Group L exhibited significantly greater haemodynamic responses to laryngoscopy and endotracheal intubation than Group M at multiple time points in patient receiving general anaesthesia when compared with nebulised lignocaine. So The authors concluded that nebulised magnesium sulphate provided more persistent and effective attenuation for the pressor response.

Keywords: Endotracheal, Nebulisation, Pressor response

INTRODUCTION

Laryngoscopy and intubation are routinely done procedure in patient requiring general anaesthesia. It triggers activation of sympathetic nervous system and adrenal medulla [1]. Catecholamine surge occurring because of these stimulus causes systemic hypertension and tachycardia [2]. Typically, the associated circulatory response begins within seconds, peaks within a few minutes, and returns to baseline by the fifth minute [3]. This pressor response is well tolerated by healthy individuals but can be fatal in patients with haemodynamic compromise.

In past, various studies have been done to find out measures to mitigate cardiovascular fluctuations during laryngoscopy and intubation. Commonly used techniques include intravenous drugs like beta blockers, calcium channel blockers, local anaesthetic and alpha 2 agonist etc., [4-11]. Recently, nebulised form of drugs has been used to attenuate this haemodynamic response. Nebulisation facilitates uniform and efficient delivery of the drug across the pharynx and up to the entry of the upper respiratory tract. The role of nebulised local anaesthetic drug like lignocaine has been extensively studied and found to be effective [12-15]. Nebulised magnesium sulphate, on the other hand, has been more commonly used for preventing postoperative sore throat [16]. While preliminary findings suggest it may attenuate circulatory responses to intubation, robust evidence is still lacking. The present study aimed to compare the effectiveness of nebulised magnesium sulfate to nebulised lignocaine in mitigating the circulatory response during laryngoscopy and endotracheal intubation in patients under anaesthesia. The primary objective was to assess efficacy of nebulised magnesium sulphate in comparison to nebulised lignocaine on hypertensive response to laryngoscopy and intubation during general anaesthesia. Secondary objectives was to compare of efficacy of nebulised magnesium sulphate and nebulised lignocaine on tachycardiac response to laryngoscopy and intubation and evaluation of side effects associated with use of these drugs, if any including 1) Hypotension; 2) Bradycardia; 3) Fall in saturation; 4) Any other.

MATERIALS AND METHODS

The present double-blinded, randomised controlled trial was carried out in the Department of Anaesthesia and critical care at PGIMS, Rohtak, Haryana, India, following clearance from the Institutional Ethics Committee from September 2023 to August 2024 (BREC/22/TH/Anaesth-13). The study protocol was registered with the Clinical Trials Registry of India (CTRI/2023/09/057750). All the participants were explained about the study procedure in detail and their written informed consent for participation was obtained prior to study.

Sample size calculation: The sample size estimate was calculated by comparing the mean blood pressure between the two groups. A mean difference of 0.04 and a standard deviation of 0.5 were used for the calculation. The sample size calculation, following a 95% confidence level, with statistical power of 80% and 0.05 significance level, was adapted from the study by Misganaw A et al., [17]. The result of above calculations led to an estimated sample size of 40 per group.

Inclusion criteria: A total of 80 patients, aged 18 to 60 years, classified as ASA physical status I or II, and scheduled for elective surgeries requiring endotracheal intubation under anaesthesia were enrolled in the study.

Exclusion criteria: Patients were excluded if they met any of the following conditions: refusal to provide informed consent, pre-existing significant cardiovascular or respiratory diseases, or other contraindications to usage of study drugs.

Study Procedure

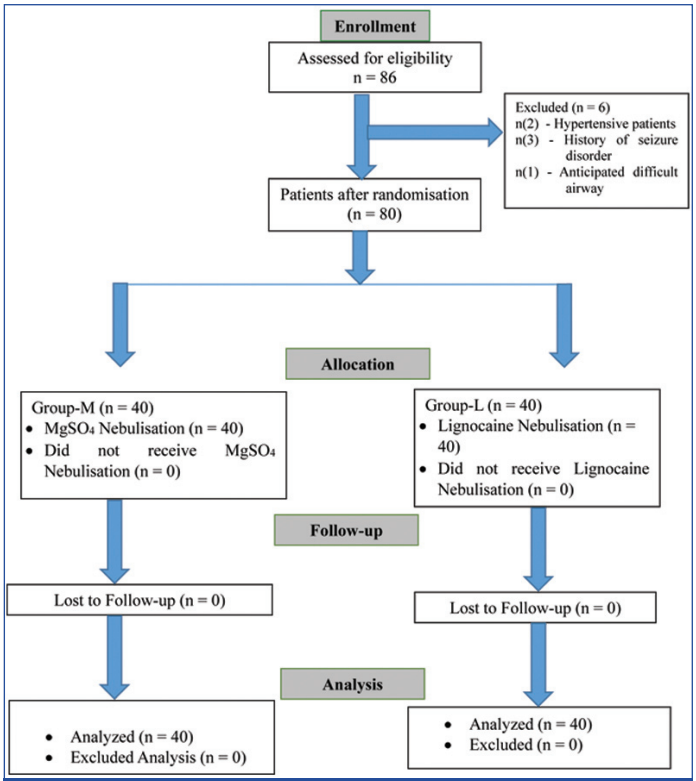
In this study, all patients were evaluated during a preoperative visit conducted by the attending Anaesthesiologist one day prior to surgery. A comprehensive explanation of general anaesthesia, including its risks and benefits was provided. Patients underwent a thorough clinical assessment, including a detailed medical history, airway evaluation, and a comprehensive physical and systemic evaluation, including routine investigations.

Patients were instructed to fast for a minimum of two hours for clear liquids and six hours for solids before their scheduled surgery. They received premedication the night before surgery, consisting of antianxiety and antacid drugs orally (alprazolam 0.25 mg & pantoprazole 40 mg). Upon arrival in the operating room, standard anaesthesia monitoring (pulse oximetry, electrocardiography and non-invasive blood pressure) was initiated. An intravenous line of proper size was secured and baseline haemodynamic parameters (V_0) were recorded.

The patients were randomised into the groups using computer generated randomisation [Table/Fig-1]. The opaque sealed envelope approach was used to randomly assign eligible patients into two groups of 40 each, Group M (study group) and Group L (control group). Slips were drawn by an independent observer who then prepared the nebulising solutions corresponding to the assigned group.

- Group M (n=40): Patients received nebulisation with 5 mL of a solution consisting of 1 mL of 50% (500 mg) magnesium sulphate in 4 mL of normal saline [18].
- Group L (n=40): Patients were nebulised with 5 mL of a 2% preservative-free lignocaine hydrochloride solution [15].

All participants received the assigned medication in aerosol form through a nebuliser, with oxygen provided at a flow rate of 10 L/min from an auxiliary oxygen source connected to the nebuliser. Patients were seated upright and instructed to breathe at their normal tidal volume. The nebulisation process continued until the entire solution was fully aerosolised, lasting approximately 10-12 minutes. Haemodynamic parameters were measured immediately following nebulisation (V_1).



[Table/Fig-1]: CONSORT flow diagram.

Preoxygenation was performed for three minutes with 100% oxygen. Induction of anaesthesia was achieved with intravenous fentanyl (2 mcg/kg) and thiopentone sodium (5 mg/kg). After confirming ventilation adequacy, neuromuscular paralysis was induced using vecuronium (0.1 mg/kg). Maintenance of anaesthesia was done using a 50:50 combination of nitrous oxide and oxygen along with sevoflurane.

Airway management was conducted at three minutes using an endotracheal tube (8 mm ID for males and 7 mm ID for females) under direct laryngoscopy. Intubation was performed by an Anaesthetist with a minimum experience of 50 successful intubations who was unaware of study group. Prior to laryngoscopy (V_2), at one minute after intubation (V_3), three minutes after intubation (V_4), and five minutes after intubation (V_5) haemodynamic parameters were recorded.

From the time the laryngoscope was picked up until the endotracheal tube was successfully established, as verified by capnography, the duration of the endotracheal intubation was documented. The study eliminated patients who required more than 18 seconds for intubation or who required several attempts. Additionally, patients with unanticipated airway difficulties were also not included. The remaining anaesthesia procedure followed standard protocols.

The following parameters were observed by an Anaesthetist who was not involved in the study:

1. Demographic parameters like age, sex, BMI, ASA and MPG.
2. Haemodynamic parameters like HR in beats per minute (bpm), SBP in mmHg, DBP in mmHg and Mean Arterial Pressure (MAP) in mmHg at above mentioned intervals were recorded.
3. Events occurring during intubation like bucking were noted.
4. Number of attempts and time required for intubation were recorded.
5. Any adverse effect like.
   a. Desaturation
   b. Hypotension
   c. Bradycardia
   d. Dysrhythmia

STATISTICAL ANALYSIS

The data collected was processed using Statistical Package for Social Sciences (SPSS) software version 22.0. Descriptive statistics included the calculation of frequency (n) and percentages for categorical variables, alongside means and standard deviations for numerical data. Comparisons between groups were carried out using the Chi-square test. To assess whether numerical data followed a normal distribution, the Shapiro-Wilk test or the Kolmogorov-Smirnov test was applied. Based on these results, appropriate statistical methods were chosen. The t-tests were used for normally distributed data to compare groups, while non-normally distributed data were analysed with non parametric tests such as the Mann-Whitney U test. Paired t-tests were employed for within-group comparisons. The threshold for statistical significance was set at an alpha value of 0.05, with a beta error of 20% ensuring a statistical power of 80%. Results were considered significant if the p-value was less than 0.05.

RESULTS

Key demographic parameters, such as age, gender, and BMI, along with clinical factors like ASA classification and MPG score, were analysed. No statistical significant differences were observed between the groups, as detailed in [Table/Fig-2].

Variables		Group M	Group L	p-value
Age (years)		33.15±13.45	34.87±11.96	0.55*
BMI(kg/m^2)		23.96±2.35	25.10±5.83	0.25*
Gender	Female	19 (47.5%)	25 (62.5%)	0.17**
	Male	21 (52.5%)	15 (37.5%)	
ASA grade	I	24 (60%)	16 (40%)	0.07**
	II	16 (40%)	24 (60%)	
MPG	I	14 (35%)	10 (25%)	0.29**
	II	26 (65%)	30 (75%)	

[Table/Fig-2]: Demographic parameters.
Age and BMI represented as Mean±SD. Gender, ASA grade and MPG represented as "n" (frequency%). BMI: Body Mass Index, ASA: American Society of Anaesthesiologists, MPG: Mallampati grading.*unpaired t-test,**Chi-square test

Systolic Blood Pressure (SBP): At baseline (V_0), there was no significant difference statistically in the groups' mean SBP (mmHg). However, with p-values of 0.004, 0.003, 0.001, and 0.001, respectively, Group L showed a noticeably higher increase in SBP than Group M during the time intervals immediately before to laryngoscopy and at 1st, 3rd, and 5th min post-endotracheal intubation [Table/Fig-3].

Parameters	Group M	Group L	p-value*
Baseline (V_0)	129.75±13.566	125.93±10.19	0.15
After nebulisation (V_1)	130.58±14.415	125.40±13.085	0.09
Before laryngoscopy (V_2)	120.03±20.080	109.50±9.452	0.004 (S)
1 min (V_3)	129.83±24.219	144.28±16.407	0.003 (S)
3 min (V_4)	117.45±19.956	131.75±12.144	0.001 (S)
5 min (V_5)	107.58±13.403	120.85±14.858	0.001 (S)

[Table/Fig-3]: Comparison of Systolic Blood Pressure (SBP) (mmHg) between two groups.
Data expressed as Mean±SD in mm Hg. *unpaired t-test.

Intragroup analysis revealed that mean SBP in Group M decreased before laryngoscopy, followed by a transient rise that subsided at 3rd min post-intubation. In contrast, in Group L, the transient rise subsided at 5th minute post-intubation [Table/Fig-4,5].

Diastolic Blood Pressure (DBP): At baseline (V_0), there was no significant difference statistically in the groups' mean DBP (mmHg). However, with p-values of 0.03, 0.001, 0.001, and 0.003 respectively, Group L had a substantially higher increase in DBP than Group M at the following intervals: following nebulisation and at 1st, 3rd and 5th minute post-endotracheal intubation [Table/Fig-6].

Parameters	Mean±SD	Mean difference from baseline	p-value vs baseline*
Baseline (V_0)	129.75±13.566		
After nebulisation (V_1)	130.58±14.415	-0.83	0.65
Before laryngoscopy (V_2)	120.03±20.080	9.72	0.001 (S)
1 min (V_3)	129.83±24.219	-0.08	0.98
3 min (V_4)	117.45±19.956	12.3	0.001 (S)
5 min (V_5)	107.58±13.403	22.17	0.001 (S)

[Table/Fig-4]: Comparison of difference of Systolic Blood Pressure (SBP) from baseline within Group M.
Data expressed in mm Hg. SD: standard deviation. *paired t-test

Parameters	Mean±SD	Mean difference from baseline	p-value vs baseline*
Baseline (V_0)	125.93±10.19		
After nebulisation (V_1)	125.40±13.085	0.53	0.77
Before laryngoscopy (V_2)	109.50±9.452	16.43	0.001 (S)
1 min (V_3)	144.28±16.407	-18.35	0.001 (S)
3 min (V_4)	131.75±12.144	-5.82	0.008 (S)
5 min (V_5)	120.85±14.858	5.08	0.09

[Table/Fig-5]: Comparison of difference of Systolic Blood Pressure (SBP) from baseline within Group L.
Data expressed in mm Hg. SD: standard deviation. *paired t-test.

Parameters	Group M	Group L	p-value*
Baseline (V_0)	80.30±11.474	76.90±9.350	0.15
After nebulisation (V_1)	76.80±9.977	81.73±9.941	0.03 (S)
Before laryngoscopy (V_2)	71.83±16.800	71.63±9.800	0.94
1 min (V_3)	79.15±17.271	99.60±15.718	0.001 (S)
3 min (V_4)	69.60±13.109	85.58±12.222	0.001 (S)
5 min (V_5)	65.90±9.097	74.85±16.079	0.003 (S)

[Table/Fig-6]: Comparison of Diastolic Blood Pressure (DBP) between two groups.
Data expressed as Mean±SD in mm Hg. SD: standard deviation; *unpaired t-test

Intragroup analysis for Group M demonstrated a significant decline in DBP from baseline at all time intervals, except for a transient rise 1st minute after intubation [Table/Fig-7]. In Group L, intragroup analysis revealed a significant rise in DBP after intubation, which subsided by 5th minute post-endotracheal intubation [Table/Fig-8].

Parameters	Mean±SD	Mean difference from baseline	p-value vs baseline*
Baseline (V_0)	80.30±11.474		
After nebulisation (V_1)	76.80±9.977	3.5	0.04 (S)
Before laryngoscopy (V_2)	71.83±16.800	8.47	0.005 (S)
1 min (V_3)	79.15±17.271	1.15	0.71
3 min (V_4)	69.60±13.109	10.7	0.001 (S)
5 min (V_5)	65.90±9.097	14.4	0.001 (S)

[Table/Fig-7]: Comparison of Diastolic Blood Pressure (DBP) (mmHg) from baseline within Group M.
Data expressed in mm Hg. SD: Standard deviation. *paired t-test

Parameters	Mean±SD	Mean difference from baseline	p-value vs baseline*
Baseline (V_0)	76.90±9.350		
After nebulisation (V_1)	81.73±9.941	-4.83	0.04 (S)
Before laryngoscopy (V_2)	71.63±9.800	5.27	0.01 (S)
1 min (V_3)	99.60±15.718	-22.7	0.001 (S)
3 min (V_4)	85.58±12.222	-8.68	0.001 (S)
5 min (V_5)	74.85±16.079	2.05	0.53

[Table/Fig-8]: Comparison of Diastolic Blood Pressure (DBP) from baseline within Group L.
Data expressed in mm Hg. SD: standard deviation. *paired t-test

Mean Arterial Pressure (MAP): At baseline (V_0), there was no significant difference in MAP (mmHg) between the two groups. However, Group L experienced a substantially greater increase in MAP compared to Group M at 1st and 3rd minute post-endotracheal intubation, with p-values of 0.001 and 0.001, respectively [Table/Fig-9].

Parameters	Group M	Group L	p-value*
Baseline (V_0)	97.90±11.370	94.85±9.06	0.18
After nebulisation (V_1)	95.75±10.846	96.80±9.140	0.64
Before laryngoscopy (V_2)	88.58±16.486	84.55±8.941	0.17
1 min (V_3)	97.63±18.884	116.03±14.845	0.001 (S)
3 min (V_4)	86.40±13.937	101.48±11.523	0.001 (S)
5 min (V_5)	80.28±10.238	110.80±12.687	0.13

[Table/Fig-9]: Comparison of Mean Arterial Pressure (mmHg) between two groups.
Data expressed as Mean±SD in mm Hg. *unpaired t-test.

In Group M, MAP showed a temporary increase at 1st min, which returned to baseline by 3rd minute post-intubation. In Group L, the increase in MAP lasted longer but normalised by 5th minute post-intubation [Table/Fig-10,11].

Parameters	Mean±SD	Mean difference from baseline	p-value vs baseline*
Baseline (V_0)	97.90±11.370		
After nebulisation (V_1)	95.75±10.846	2.15	0.15
Before laryngoscopy (V_2)	88.58±16.486	9.32	0.001 (S)
1 min (V_3)	97.63±18.884	0.27	0.93
3 min (V_4)	86.40±13.937	11.5	0.001 (S)
5 min (V_5)	80.28±10.238	17.62	0.001 (S)

[Table/Fig-10]: Comparison of Mean Arterial Pressure (MAP) from baseline within Group M.
Data expressed in mm Hg. Mean±SD: Standard deviation. *paired t-test

Parameters	Mean±SD	Mean difference from baseline	p-value vs baseline*
Baseline (V_0)	94.85±9.06		
After nebulisation (V_1)	96.80±9.140	-1.95	0.25
Before laryngoscopy (V_2)	84.55±8.941	10.3	0.001 (S)
1 min (V_3)	116.03±14.845	-21.18	0.001 (S)
3 min (V_4)	101.48±11.523	-6.63	0.002 (S)
5 min (V_5)	110.80±12.687	-15.95	0.35

[Table/Fig-11]: Comparison of Mean Arterial Pressure (MAP) from baseline within Group L.
Data expressed in mm Hg. SD: Standard deviation. *paired t-test

Heart Rate (HR): At baseline (V_o), no statistically significant difference in HR was observed between the two groups. However, laryngoscopy caused a much larger increase in HR in Group L compared to Group M, with p-values of 0.006, 0.001, and 0.05 at 1st, 3rd and 5th min post-laryngoscopy, respectively [Table/Fig-12].

A significant increase in HR was observed in both groups when compared to baseline. However, HRs returned to normal levels within five minutes after laryngoscopy for both Group M and Group L [Table/Fig-13,14].

Parameters	Group M	Group L	p-value*
Baseline (V_0)	80.78±11.472	85.95±13.420	0.06
After nebulisation (V_1)	81.68±13.246	88.35±14.278	0.03 (S)
Before laryngoscopy (V_2)	81.78±11.792	87.58±13.581	0.04 (S)
1 min (V_3)	92.88±11.887	99.98±10.477	0.006 (S)
3 min (V_4)	85.93±16.029	97.05±12.872	0.001 (S)
5 min (V_5)	81.93±9.942	87.43±15.052	0.05

[Table/Fig-12]: Comparison of Heart Rate (HR) between two groups.
Data expressed as Mean±SD in bpm. *unpaired t-test

Parameters	Mean±SD	Mean difference from baseline	p-value vs baseline*
Baseline (V_0)	80.78±11.472		
After nebulisation (V_1)	81.68±13.246	-0.9	0.45
Before laryngoscopy (V_2)	81.78±11.792	-1	0.52
1 min (V_3)	92.88±11.887	-12.1	0.001 (S)
3 min (V_4)	85.93±16.029	-5.15	0.05
5 min (V_5)	81.93±9.942	-1.15	0.68

[Table/Fig-13]: Comparison of Heart Rate (HR) from baseline within Group M.
Data expressed as Mean±SD in bpm. SD: standard deviation. *paired t-test.

Parameters	Mean±SD	Mean difference from baseline	p-value vs baseline*
Baseline (V_0)	85.95±13.420		
After nebulisation (V_1)	88.35±14.278	-2.4	0.03 (S)
Before laryngoscopy (V_2)	87.58±13.581	-1.63	0.37
1 min (V_3)	99.98±10.477	-14.03	0.001 (S)
3 min (V_4)	97.05±12.872	-11.1	0.001 (S)
5 min (V_5)	87.43±15.052	-1.48	0.37

[Table/Fig-14]: Comparison of Heart Rate (HR) from baseline within Group L.
Data expressed as Mean±SD in bpm. SD: Standard deviation; *paired t-test.

The average time required for laryngoscopy and endotracheal intubation was 11.2±3.12 seconds in Group M and 10.68±2.63 seconds in Group L. Upon statistical analysis no significant difference was found for duration of endotracheal intubation (p=0.41). The number of attempts required for intubation were similar between the two groups. The incidence of bucking during laryngoscopy and intubation were also comparable between the groups. No adverse effects, such as hypotension, bradycardia, arrhythmias, or oxygen desaturation, were observed in either group.

DISCUSSION

Laryngoscopy and endotracheal intubation activate mechanoreceptors located around oropharyngeal wall and glottic opening, leading to a stress response characterised by sudden spike in HR and blood pressure [19]. This increases cardiac workload disrupts the balance between oxygen demand and supply. The resulting strain can potentially lead to arrhythmias, intracranial bleeding, and organ dysfunction, particularly in organs such as the brain, kidneys, and heart. These risks are especially significant for patients with underlying conditions, including diabetes, high blood pressure, coronary artery disease, renal disorders, or cerebrovascular conditions [20].

The use of nebulised drugs targets nerve endings in the upper airway, reducing the reflex responsible for the release of catecholamines. This method allows for effective distribution of the drug along the airway mucosa, minimising systemic side effects. Magnesium facilitates vasodilation by directly acting on blood vessels and inhibiting the activity of vasoconstrictive agents. When serum magnesium levels rises, there is a noticeable reduction in the surge of catecholamines. This mechanism contributes to the suppression of sympathetic nervous system activity and the inhibition of catecholamine release [21].

SBP and DBP: In the present study, Mean SBP and DBP exhibited higher value in Group L compared to Group M just before laryngoscopy, one minute, three minutes and five minutes after endotracheal intubation [Table/Fig-3,6]. These findings suggest that $MgSO_4$ nebulisation offers improved control over SBP and DBP during and after laryngoscopy compared to lignocaine nebulisation. Misganaw A et al., reported that SBP and DBP values were higher in Group L than Group M immediately after intubation, at 2nd, and at 7th min post-intubation (p<0.001) [17]. Kamel AAF et al., found that SBP and DBP were less in Group L following nebulisation and before anaesthesia induction when compared statistically with Group

M. However, the results of the current study differ, likely because of increased dose of $MgSO_4$ (500 mg) used in the present study compared to the dose of 250 mg administered in their study [22]. Grover N et al., observed a sustained reduction in SBP and DBP in patients treated with $MgSO_4$ nebulisation at 2nd and 5th minutes post-endotracheal intubation, compared to baseline haemodynamic readings (p<0.001). These results closely align with the outcomes of our study [23]. Elmeligy MSM and Elmeliegy MFM showed that $MgSO_4$ nebulisation resulted in a significant decrease in SBP and DBP at 3rd and 6th min post-intubation, with statistical significance (p<0.001) [24].

MAP: In the present study, MAP values were consistently elevated in Group L at one and three minutes post-endotracheal intubation [Table/Fig-9]. In another study, MAP was markedly less in Group M than in Group L at immediate, 2nd, and 5th minutes post-endotracheal intubation, with p-values of 0.002, 0.001, and 0.023, respectively [17]. Grover N et al., also found sustained reduction in MAP after $MgSO_4$ nebulisation post intubation (p<0.001) [23].

HR: In this study, mean HR was markedly elevated statistically in Group L compared to Group M after nebulisation, before laryngoscopy, and at one and three minutes post-endotracheal intubation [Table/Fig-12]. HR in Group L increased from baseline after nebulisation and peaked at one minute post-endotracheal intubation [Table/Fig-14]. Similarly, Group M exhibited a rise in HR at one minute post-intubation, with the highest peak occurring at that interval [Table/Fig-13]. The findings from Grover N et al., indicated a sustained reduction in HR following $MgSO_4$ nebulisation, which contrasts with our results. This discrepancy may be attributed to the increased dose of $MgSO_4$ used in our study [23]. Kamel AAF et al., observed a statistically significant reduction in mean HR values in lignocaine group, after nebulisation and before induction compared to $MgSO_4$ group. These findings differ from the present study, likely due to the difference in $MgSO_4$ dosage. The present study used a higher dose (500 mg) compared to the 250 mg used by Kamel AAF et al., [22].

Limitation(s)

This study was subjected to several limitations. The present study included only ASA physical status I and II patients and patients with MPG grade I and II. So the study result cannot be extrapolated to patients with difficult airway and co-morbidities. The authors did not use Bispectral Index (BIS) to assess the depth of anaesthesia at the time of laryngoscopy and intubation. The authors did not measure plasma concentration of the catecholamines which could have provided direct evidence for alteration in haemodynamic parameters during intubation.

CONCLUSION(S)

The study concluded that both $MgSO_4$ and lignocaine are effective and safe for mitigating the pressor response to laryngoscopy and intubation via nebulisation. Patients in the $MgSO_4$ group showed significantly lower SBP and DBP, MAP, and HR at key time intervals compared to lignocaine. These findings suggest that magnesium's sympatholytic and vasodilatory effects offer better haemodynamic stability during airway manipulation. However, further multicentric trials may help in establishing the role of nebulised $MgSO_4$ as standard premedication for this purpose.

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