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Original Research Article

A Hospital Based Analytical Assessment of the Efficacy of Intravenous Esmolol and Intravenous Magnesium Sulphate in Attenuating Haemodynamic Response to Laryngoscopy and Endotracheal Intubation

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Abstract

Aim: To compare the effects of intravenous administration of esmolol and magnesium sulfate on the hemodynamic changes due to LETI.

Methodology: This study was a prospective study done on 50 patients in Department of Anesthesiology, AIIMS, Patna, Bihar for six months. Sixty patients posted for elective surgeries were randomly selected and were divided in two groups of thirty each i.e. Group E and group M. Patients were thoroughly evaluated pre-operatively, kept NPO from previous midnight, and were administered Alprazolam 0.5mg orally. Group E patients were administered Esmolol hydrochloride 1.5 mg/kg diluted to 10 ml with Normal saline over 1 min. Group M patients received Magnesium Sulfate 50 mg/kg diluted to 10 ml with Normal Saline over 1 min Endo-tracheal intubation was facilitated by Inj. Succinylcholine 1.5 mg/kg. Laryngoscopy and tracheal intubation were performed in less than 15 seconds. Heart rate and Blood pressure recording were done pre-intubation, immediately after intubation and at 2 minutes and 5 minutes after intubation.

Results: In group E patients, mean heart rate before intubation was 84.85 $\pm$ 14.22 which was increased to 83.85 $\pm$ 14.22 but reduced to 79.8 $\pm$ 9.84 after 5 minutes. In group M patients, mean heart rate before intubation was 85.6 $\pm$ 12.50 which was increased to 94.52 $\pm$ 13.62 but reduced to 86.10 $\pm$ 11.90 after 5 minutes but still was increased than pre-intubation mean heart rate. In group E patients, mean arterial pressure before intubation was 99.5 $\pm$ 10.15 which was increased to 116.86 $\pm$ 18.68 but reduced to 98.26 $\pm$ 16.54 after 5 minutes. In group M patients, MAP before intubation was 94.88 $\pm$ 9.66 which was increased to 119.98 $\pm$ 13.75 but reduced to 100.32 $\pm$ 14.78 after 5 minutes but still was much more than pre-intubation MAP.

Conclusion: HR and MAP was controlled 5 minutes after intubation in patients who were given esmolol in comparison to magnesium sulfate. The mean heart rate in group E was significantly lower than in group M immediately after intubation showing that esmolol had a greater control over heart rate than magnesium sulfate. In conclusion, Esmolol is a better agent to attenuate intubation response than Magnesium sulfate as it attenuates the rise in both heart rate and blood pressure.

Keywords: Esmolol, Magnesium Sulfate, Mean Arterial Pressure, Heart Rate.

Introduction:

Airway manipulation with laryngoscopy and endotracheal Intubation (LETI) results in reflex sympathetic activity, characterized primarily by systemic arterial hypertension and tachycardia. This response is justified by the mechanical stimulation of the pharynx and larynx, leading to an increase in plasma levels of epinephrine and norepinephrine [1-3]. Such response is usually transient and varies in presentation, being unpredictable most of the time [1,4]. It is well tolerated by healthy individuals, but may be responsible for adverse events in others, such as: arrhythmias, myocardial ischemia, acute myocardial infarction and cerebral hemorrhage [3,4]. Patients with diabetes mellitus, cerebrovascular diseases, coronary artery disease, systemic arterial hypertension, heart failure and previous arrhythmias, in addition to the geriatric population, are at greater risk for these events [4,5].

Recent clinical interest and research has encouraged the investigation of various drugs and techniques that modify the hemodynamic response to laryngoscopy and endotracheal intubation (LETI). Prior to the introduction of muscle relaxants, such as curare, the circulatory response to LET1 was not considered to be a problem because at the time of intubation, patients were well anesthetized with inhalation drugs such as cyclopropane or ether [6]. The hemodynamic response to LETI does not present a problem for most patients. However, a subgroup of patients, which includes those with coronary artery disease (CAD), recent myocardial infarction (MI), hypertension, preeclampsia, and cerebrovascular pathology such as tumors, aneurysms, or increased intracranial pressure (ICP), are at increased risk of morbidity and mortality [7,8].

The period during which intubation is performed is particularly a high-risk interval [9-11]. Known or suspected heart disease is one of the most common indications to modify the hemodynamic response [9,12]. Studies [9-11,13,14] support the hypothesis that controlling perioperative stress, including that of LETI, improves outcome in high-risk patients. Patients who require careful hemodynamic control include those with a symptomatic aortic aneurysm, ischemic heart disease, recent MI, cerebral aneurysm, and intracranial hypertension. Slog off and Keats [10] reported that most ischemic episodes during anesthesia were associated with intubation and surgical stimulation, especially if tachycardia occurred. Similarly, Kleinman et al [11] reported that the tachycardia and increased afterload of LET1 can be associated with myocardial ischemia secondary to coronary artery vasoconstriction.

Two dynamic predictors for perioperative cardiac morbidity include tachycardia and hypertension [13]. The hemodynamic responses to intubation resulting from sympathetic nervous stimulation that predispose patients to ischemia include increases in HR, BP, pulmonary capillary wedge pressure (PCWP), and decreased ejection fraction (EF) [14]. Increases in HR deleteriously affect myocardial oxygen (0_2) supply (decreased diastolic filling time) and 02 demand (increased cardiac work). Blood pressure is directly related to cardiac output (CO) and systemic vascular resistance (SVR). Acute hypertension affects both myocardial 0_2 supply and demand. During systemic hypertension, peak systolic ventricular pressure increases, producing commensurate increases in ventricular wall demand, which increases myocardial 0_2 consumption [13,14].

Esmolol is a cardio selective beta-blocker with the potential to prevent possible clinical sequelae related to increased

hemodynamic parameters during OTI. Its use for this purpose is well established [4, 15,16]. Magnesium sulfate inhibits release of catecholamines by the adrenal medulla and has a systemic and coronary vasodilator effect by antagonizing the calcium ion in vascular smooth muscle. It has a modulating effect on sodium and potassium channels, influencing cell membrane potential, and it also has a depressant effect on the central nervous system by antagonizing N-methyl-D-aspartate (NMDA) receptors [17,18]. The main objective of this study was to compare the effects of intravenous administration of esmolol, magnesium sulfate and placebo on the hemodynamic changes due to LETI.

Materials and Methods

This study was a prospective study done on 50 patients in Department of Anesthesiology, AIIMS, Patna, Bihar for six months. Sixty patients posted for elective surgeries were randomly selected and were divided in two groups of thirty each i.e. Group E and group M.

Inclusion & exclusion criteria

The Inclusion criteria for patient selection were age group between 20-60 years, ASA grade I and II and with no contraindications to the study drugs.

Exclusion criteria were patients undergoing emergency surgeries, patients with pre-existing cardiac, renal, hepatic, respiratory, neurological, endocrine and coagulation disorders, morbidly obese and difficult-to-intubate patients.

Methodology

Patients were screened for routine laboratory investigations like complete blood picture, complete urine examination, blood sugars, serum electrolytes, blood urea and serum creatinine. The procedure was explained to patients and informed consent was taken from all the patients on the day of surgery.

Patients were thoroughly evaluated pre-operatively, kept NPO from previous mid-night, and were administered Alprazolam 0.5mg orally. On arrival in the operation theatre, a suitable peripheral vein was cannulated with 18G catheter and continuous monitoring of ECG, non-invasive arterial pressure and pulse-oximetry were started and baseline vitals recorded.

Pre-medication with glycopyrrolate 0.2 mg intravenously was given. After pre-oxygenation with 100% O_2 for 3 min, induction was done with thiopentone sodium 3-5 mg/kg till loss of eyelash reflex. After this, patients were administered the study drug - Group E patients received. Esmolol hydrochloride 1.5 mg/kg diluted to 10 ml with Normal saline over 1 min. Group M patients received Magnesium Sulfate 50 mg/kg diluted to 10 ml with Normal Saline over 1 min [19] Endo-tracheal intubation was facilitated by Inj. Succinylcholine 1.5 mg/kg.

Laryngoscopy and tracheal intubation were performed in less than 15 seconds [20,21]. Heart rate and Blood pressure recording were done pre-intubation, immediately after intubation and at 2 minutes and 5 minutes after intubation [22]. Maintenance of anaesthesia was done with oxygen and nitrous oxide with a closed circuit and positive pressure ventilation. Muscle relaxation was achieved with vecuronium 0.1 mg/kg loading and 0.02 mg/kg maintenance doses repeated as necessary. Reversal of residual neuromuscular blockade was done with neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg I.V. and extubation done after full clinical recovery.

Results:

A total of 50 patients were enrolled in the study which were divided into two gorpus i.e. group E and M including 25 patients in each group. Mean age of patients of group

E was 35.63±10.37 years and group M was 37.66±9.48 years. In group E, 12 were males and 13 were females, while in group M, 13 were males and 12 were females.

Table 1: Demogaphic details

	Group E (25 patients)	Group M (25 patients)	P-value
Age (in years)	35.63±10.37	37.66±9.48	>0.05
Sex (Male: Female)	12:13	13:12	

In group E patients, mean heart rate before intubation was 84.85 ± 14.22 which was increased to 83.85 ± 14.22 but reduced to 79.8 ± 9.84 after 5 minutes. In group M patients, mean heart rate before intubation was 85.6 ± 12.50 which was increased to 94.52 ± 13.62 but reduced to 86.10 ± 11.90after 5 minutes but still was increased than pre-intubation mean heart rate. Pre-intubation heart rates were approximate similar in both the groups but patients in Group E had a significantly lower heart rate as compared to Group M as recorded at various intervals after intubation till 5 minutes. Difference in heart rates at the time of intubation, after 2 minutes and after 5 minutes in the both groups were statistically significant.

Table 2: Heart rate of group E and M patients before intubation, at the time of intubation, 2 minutes and 5 minutes after intubation.

Heart rate	Group E (25 patients)	Group M (25 patients)	P-value
HR (pre-intubn)	84.85 ± 14.22	85.6 ± 12.50	>0.05
HR (0 min)	83.85 ± 14.22	94.52 ± 13.62	<0.05
HR (2 min)	81.9 ± 10.56	90.95 ± 13.05	<0.05
HR (5 min)	79.8 ± 9.84	86.10 ± 11.90	<0.05

In group E patients, mean arterial pressure before intubation was 99.5 ± 10.15 which was increased to 116.86 ± 18.68 but reduced to 98.26 ± 16.54 after 5 minutes. In group M patients, MAP before intubation was 94.88 ± 9.66 which was increased to 119.98 ± 13.75 but reduced to 100.32 ± 14.78 after 5 minutes but still was much more than pre-intubation MAP. On comparison of mean arterial pressures, there was no significant difference between both the groups both before and after intubation during the study duration. No significant side effects were observed during the study.

Table 3: Mean Arterial Pressure (MAP) of group E and M patients before intubation, at the time of intubation, 2 minutes and 5 minutes after intubation.

MAP (mm Hg)	Group E (30 patients)	Group M (30 patients)	P-value
MAP (pre-intubn)	99.5 ± 10.15	97.88 ± 9.66	>0.05
MAP (0 min)	116.86 ± 18.68	119.98 ± 13.75	>0.05
MAP (2 min)	106.54 ± 17.86	105.86 ± 14.87	>0.05
MAP (5 min)	98.26 ± 16.54	100.32 ± 14.78	>0.05

Discussion

Haemodynamic response to laryngoscopy and intubation is well established. Various methods have been tried to attenuate the hemodynamic response to laryngoscopy and intubation. In this study, authors have compared the efficacy of a single preintubation intravenous bolus dose of esmolol in attenuating these cardiovascular responses to that of a similarly administered dose of magnesium sulphate

which has previously been reported to blunt these responses.

Mendonça et al. [17] used magnesium sulfate at a dose of 30 mg/kg and had an increase in SBP and DBP with statistical significance after intubation when compared to baseline values, different from what was observed in the present study. Hypertension and tachycardia were recorded, but no hypotension was reported. A similar study was conducted by Borah et al. [23], which were also observed a significant increase in SBP and DBP when compared to baseline values, in addition to an increase in HR and MAP in the first two minutes after OTI in patients who used magnesium sulfate. Kumar et al. [24] compared magnesium sulphate and esmolol, in which esmolol was superior controlling HR, a difference not observed in the present study. Both for Kumar [24] and our study, esmolol was superior to magnesium sulfate in the control of MAP increase after OTI.

Bhalerao et al. [25] infused 50 mg/kg of magnesium sulfate for half an hour before induction in hypertensive patients, without a significant increase in SBP and HR after intubation, but they needed to intervene in the management of hypotension, which was already suggested by Panda et al. [26]. Khan et al. [27] achieved good results with the use of 60 mg/kg of magnesium sulfate. For Honarmand et al. [28], who compared different doses of magnesium sulfate in normotensive patients, 30mg/kg would be comparable to higher doses in preventing the increase of SBP, DBP and MAP up to five minutes after intubation.

The mean heart rate in group E (83.85 $\pm$ 14.22 immediately after intubation) was significantly lower than in group M (94.52 $\pm$ 13.62) during the study duration ($P<0.05$) showing that esmolol had a greater control over heart rate than magnesium sulfate. Our results were in correlation to the study done by Dr. Santosh kumar et al [20] who observed similar response in the study groups receiving 2 mg/kg of esmolol and 60 mg/kg of magnesium sulfate respectively. The heart rate returned to pre- intubation levels by 2 minutes in esmolol group as compared to 5 minutes in magnesium sulfate group. The mean arterial pressures were comparable in both the groups before and after intubation ($P>0.05$) and the results were in fair correlation to Juhi Sharma et al [29] who observed that both magnesium sulfate (40 mg/kg) and esmolol (1.5 mg/kg) had similar control over systolic and diastolic pressures during tracheal intubation in controlled hypertensive patients ($P>0.05$). [30] However, they observed an increase in heart rate after intubation by 18 bpm in magnesium sulfate group, which is higher when compared to our study. Lesser dose of magnesium sulfate used by them could be the reason.

Conclusion

HR and MAP was controlled 5 minutes after intubation in patients who were given esmolol in comparison to magnesium sulfate. The mean heart rate in group E was significantly lower than in group M immediately after intubation showing that esmolol had a greater control over heart rate than magnesium sulfate In conclusion, Esmolol is a better agent to attenuate intubation response than Magnesium sulfate as it attenuates the rise in both heart rate and blood pressure.

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