ATTENUATION OF CARDIOVASCULAR RESPONSES TO LARYNGOSCOPY AND INTUBATION- DEXMEDETOMIDINE VS. MAGNESIUM SULFATE

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ABSTRACT

BACKGROUND

Laryngoscopy and intubation are associated with cardiovascular changes like tachycardia, increase in blood pressure and pulmonary artery pressure and arrhythmias and ever since several methods have been suggested to alleviate such complications including the administration of dexmedetomidine and magnesium sulfate. This study compares the effects of intravenous administration of dexmedetomidine and magnesium sulfate on unwanted haemodynamic responses following laryngoscopy and intubation in elective surgery cases.

MATERIALS AND METHODS

This prospective randomised clinical trial was conducted on 100 ASA-I and ASA-II candidates who received dexmedetomidine and magnesium sulfate randomly before intubation. Heart rate, systolic blood pressure and diastolic blood pressure were noted at 0, 3, 5 and 10 minutes after intubation.

RESULTS

Systolic and diastolic blood pressure in both groups when compared to the preoperative values showed that after giving the study drug there was significant fall in SBP and DBP. Both magnesium sulfate and dexmedetomidine controlled the systolic and diastolic blood pressure to laryngoscopy and endotracheal intubation effectively. Heart rate values were statistically and significantly lower in dexmedetomidine group. The increase in heart rate was highly significant in magnesium sulfate group when compared to dexmedetomidine group during laryngoscopy and intubation.

CONCLUSION

Our study concludes that dexmedetomidine and magnesium sulfate were equally effective in attenuating the stress response to laryngoscopy and intubation when administered 10 minutes prior to intubation.

KEYWORDS

Cardiovascular response, Laryngoscopy, Intubation, Dexmedetomidine, Magnesium Sulfate.

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BACKGROUND

Hypertension and tachycardia during intubation under general anaesthesia have been reported since 1950.[1,2] Increase in blood pressure and heart rate occurs most commonly from reflex sympathetic discharge in response to laryngotracheal stimulation, which in turn leads to increased plasma norepinephrine concentration.[3] These changes may be associated with increased morbidity and mortality in patients with pre-existing cardiac and cerebral conditions and increasing risk of complications like bleeding, ischaemic heart disease and stroke.

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Many prophylactic drugs have been used to alleviate the cardiovascular response to laryngoscopy and intubation including the topical and intravenous use of lignocaine, providing deep anaesthesia, use of ganglionic blockers and antihypertensive agents like beta blockers,[4] phentolamine,[5] sodium nitroprusside, nitroglycerine[6] and calcium channel blockers.[7,8]

Intravenous magnesium sulfate inhibits catecholamine release associated with tracheal intubation and produces vasodilation by directly acting on blood vessels.[9]

Alpha-2 adrenergic agonist stimulate alpha-2 receptors in the lateral reticular nucleus resulting in reduced central sympathetic outflow and blunting of the haemodynamic responses to unpleasant stimulation and hence preventing the overall haemodynamic variability. Alpha-2 agonist also induce sedation and a reduction of up to 50% in the MAC of volatile agents.

Dexmedetomidine is a more specific and selective alpha-2 adrenergic agonist than clonidine and has a shorter duration of action.[10]

MATERIALS AND METHODS

After approval of the study protocol by the Institutional Ethical Committee, written informed consent was obtained from each patient. 100 patients were selected in this study and randomly divided in two groups of 50 each.

Inclusion Criteria

Patients belonging to ASA physical status of I and II of either sex aged 20-60 years with Mallampati class I or II scheduled for elective noncardiac surgery under general anaesthesia with endotracheal intubation.

Exclusion Criteria

Patients who have a pre-existing cardiac, cerebral, respiratory, endocrine, renal and hepatic disease, heart rate of less than 60 bpm undergoing emergency surgeries, pregnant females and having a history of drug allergies were excluded from the study. Also, the cases in which the attempt for intubation took longer than 20 seconds were excluded from the study.

Routine investigations were carried out and all patients were examined thoroughly.

All vital parameters (systolic and diastolic blood pressure, SpO_2 and heart rate) were recorded before the patient was shifted to the operation theatre and IV access was established using an 18-G venous cannula.

In the operation theatre, all monitors were connected to patient including noninvasive blood pressure monitoring, pulse oximetry and ECG and Ringer lactate infusion (6 mL/kg) was started.

All patients were premedicated with Inj. Glycopyrrolate 0.04 mg/kg IV and Inj. Ondansetron 0.15 mg/kg IV.

The patients were randomly divided into two equal groups of 50 each.

Group D received dexmedetomidine 1.0 µg/kg as slow IV infusion over a period of 10 minutes, 10 minutes before induction of anaesthesia and Group M received 60 mg/kg of 50% magnesium sulfate, 10 minutes before induction of anaesthesia.

Haemodynamic variables were recorded again at the end of 5 mins. after giving the study drug infusion.

Patients were induced with Inj. Pentothal (4-7 mg/kg) IV, Inj. Suxamethonium (2 mg/kg) IV and fentanyl (2 mcg/kg) followed by laryngoscopy and intubation. All intubations were accomplished within 15-20 seconds by an expert anaesthesiologist. Only, one attempt of intubation lasting for not more than 20 seconds was accepted in the study.

Heart rate, systolic blood pressure and diastolic blood pressure were noted at 0, 3, 5 and 10 minutes after intubation.

Anaesthesia was maintained with O_2, N_2O, isoflurane and Inj. Vecuronium. At the end of the surgery, patients were reversed with neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg.

Statistical Analysis

Statistical analysis was performed using SPSS version 20 (USA). Categorical variables were expressed as actual numbers and percentages. Continuous variables were expressed as mean and standard deviations. Between groups, analysis was done using unpaired t-test. A probability of less than 0.05 was considered statistically significant.

RESULTS

Demographic profile of patients.

Parameters	Group D	Group M	P value
Age (in years)	34.4	36.5	>0.05
Weight (in kg)	51.5	52.1	>0.05
Male: Female	14:36	12:38	
ASA status (I/II)	13/37	15/35	
MP grade (I/II)	19/31	23/27	

Table 1. Demographic Profile of Patients

Demographic profile of patients were comparable and there were no significant differences among the two groups (P >0.05).

Heart Rate

The heart rate was measured at baseline, 5 mins. after administration of drug, during laryngoscopy and intubation and after 1, 3 and 5 minutes.

Group	Baseline	After Drug	0	1	3	5
Group D	88.78±9.18	68.88±9.68	76.23±11.88	78.65±11.91	78.22±13.45	73.38±10.70
Group M	90.76±9.85	92.45±3.65	106.40±8.98	105.04±6.89	103.20±9.20	103.00±9.80
P value	0.3010*	0.0001†	0.0001†	0.0001†	0.0001†	0.0001†

Table 2. Changes in Heart Rate

* Baseline heart rate of all patients of both groups are comparable to each other and there is no statistical difference between them (p value >0.05).

† By conventional criteria, this difference is considered to be extremely statistically significant.

Blood Pressure

The blood pressure (systolic and diastolic) was measured at baseline, 5 mins. after administration of drug during laryngoscopy and intubation and after 1, 3 and 5 minutes.

Group	Baseline	After Drug	0	1	3	5
Group D	129.28±8.52	112.96±10.86	119.80±9.01	120.08±9.44	120.92±8.52	118.04±14.21
Group M	130.44±6.69	116.20±8.22	122.96±14.47	125.04±15.19	122.32±15.40	121.16±8.52
P value	0.450*	0.095*	0.193*	0.052*	0.574*	0.186*

Table 3. Changes in Systolic Blood Pressure

* By conventional criteria, this difference is considered to be not statistically significant.

Group	Baseline	After Drug	0	1	3	5
Group D	78.32±5.64	69.02±8.09	76.6±8.76	77.12±10.74	76.79±10.13	75.79±9.50
Group M	80.48±6.91	69.44±6.41	79.1±5.87	80.20±6.02	79.32±6.36	77.32±5.56
P value	0.090*	0.774*	0.096*	0.080*	0.138*	0.328*

Table 4. Changes in Diastolic Blood Pressure

* By conventional criteria, this difference is considered to be not statistically significant.

DISCUSSION

Direct laryngoscopy and endotracheal intubation are the most stressful events during induction of anaesthesia. These lead to a transient, but marked stimulation of the sympathetic system leading to tachycardia and hypertension and arrhythmias. In healthy individuals, transient hypertension and tachycardia are probably of not much significance, but the same may not hold true for patients with hypertension, coronary artery and cerebrovascular disease[11] and even a temporary increase in blood pressure and heart rate maybe hazardous.

Prophylaxis includes the topical and intravenous use of lignocaine, providing deep anaesthesia, use of ganglionic blockers, antihypertensive agents[12] and narcotics.

Recent studies with alpha-2 adrenoceptor agonists have demonstrated beneficial effects in anaesthetised patients. Alpha-2 adrenoceptor agonists attenuates cardiovascular responses to laryngoscopy and endotracheal intubation. It also reduces MAC of inhaled anaesthetics by up to 50% and potentiates effects of opioids by stimulating alpha-2 receptors in the spinal cord where they augment endogenous opiate release and modulate the descending noradrenergic pathways involved in spinal nociceptive processing. Alpha-2 adrenoceptor agonists are also anxiolytic at low doses. Dexmedetomidine is a highly potent and selective alpha-2 adrenoceptor agonist. Dexmedetomidine causes a dose-dependent decrease in blood pressure and heart rate, dexmedetomidine decreases the plasma catecholamine concentrations and reduces the sympathetic nervous activity. A single intravenous dose of dexmedetomidine 1.0 µg/kg as slow IV infusion over a period of 10 minutes, 10 minutes before induction of anaesthesia attenuated the haemodynamic response to laryngoscopy and endotracheal intubation and decreased the requirement of thiopentone and isoflurane requirements.[13,14]

Keniya et al concluded that at DEX infusion of 1 µg/kg for 10 mins. followed by 0.2-0.4 µg/kg/h. till skin closure, the need for thiopentone and isoflurane decreased by 30% and 32% respectively and fentanyl requirement was 100±10 µg and 60±10 µg in DEX group as compared to the isoflurane-opioid group. After tracheal intubation, maximal increase in HR, systolic and diastolic blood pressure was 7%, 8% and 11% for DEX and 21%, 40% and 25% for isoflurane-opioid group.[15,16]

Several studies have shown calcium to play a major role in the release of catecholamines from the adrenal medulla and adrenergic nerve terminals after stimulation by the sympathetic nervous system. Magnesium acts as a calcium antagonist competitively binding to membrane channels and can modify the responses that are mediated by calcium, hence blocking the release of catecholamine stores and decreasing responses to adrenergic stimulations.[17,18]

Magnesium also induces smooth muscle relaxation by reducing availability of calcium in the smooth muscles cytoplasm reducing its responsiveness to noradrenaline stimulation.[17,19]

It has been demonstrated that magnesium acts as a N-methyl-D-aspartate (NMDA) receptor blocker in neurons and can be used as a neuroprotective agent in neurological injuries or in premature foetus for neuronal protection.[20]

Several studies have shown the importance of magnesium in pain management.[21] It doesn't have a primary analgesic activity per se, but may act by enhancing the actions of other established pain medications as shown by some studies in which intravenous use of magnesium reduced the opioid dose requirement and it also improved pain control when added to epidural or spinal infusions.

In our study, we compared dexmedetomidine with magnesium sulfate to attenuate the stress response to laryngoscopy and endotracheal intubation.

Heart rate values (Table 1) were statistically significantly lower in group D after completion of drug and statistically significantly lower at 0, 1, 3 and 5 minutes.

The increase in heart rate was highly significant in group M as compared to group D during laryngoscopy and after intubation. MgSO4 in group M on comparison with its preoperative values (Table 2) showed significant rise in heart rate during intubation and till 5 minutes after intubation. The heart rate started to return to normal values at the end of 10 minutes post intubation.

In this study, effects of magnesium sulfate on minimising haemodynamic changes during laryngoscopy, it is seen that despite a drop in SVR and naturally diminishing changes in

mean arterial pressure, heart rate rises at first, but gradually returns to the baseline value. These findings are in agreement with that of Michael FM (1989),[9] systolic and diastolic blood pressure in dexmedetomidine group when compared to the preoperative values shows that after giving the study drug, there is significant fall in SBP and DBP.

Systolic and diastolic blood pressure in MgSO4 group when compared to the preoperative values shows that after giving the study drug there is significant fall in SBP and DBP.

In our study, both dexmedetomidine and magnesium sulfate have shown to effectively control the increase in systolic and diastolic blood pressure in response to laryngoscopy and intubation. There was no statistically significant difference between both the drugs when compared at 0, 1, 3 and 5 minutes for blood pressure ($p>0.05$).

Patients were haemodynamically stable throughout the perioperative period and recovery was smooth in both the groups. The drugs also reduced the use of opioids, muscle relaxants and volatile anaesthetics in both the groups.

The advantages of using dexmedetomidine or magnesium sulfate premedication for attenuation of cardiovascular responses to the laryngoscopy are easy administration, no significant side effects and availability. Also, both drugs have antinociceptive effects that maybe beneficial for controlling postoperative pain.

CONCLUSION

Our study concludes that dexmedetomidine and magnesium sulfate are equally effective in attenuating the hypertensive response to laryngoscopy and intubation when administered 10 minutes prior to intubation. But, dexmedetomidine is more effective in controlling the heart rate.

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