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Comparative study between magnesium sulphate and dexmedetomidine for attenuation of vasopressor stress response during laryngoscopy and endotracheal intubation

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Abstract

Direct laryngoscopy & endotracheal intubation mostly produces vasopressor stress response characterized by tachycardia & increased blood pressure, which is transient starting from 30 seconds after intubation and lasting upto 10 minutes. It is tolerated well by healthy people, but harmful in patients with hypertension, ischaemic heart disease, cerebrovascular disease.

Aim: To compare effectiveness of intravenous MgSO₄ 30mg/kg & Dexmedetomidine(DEX) 1mcg/kg in attenuating vasopressor stress response during laryngoscopy and endotracheal intubation to study effect on heart rate, blood pressure & record complication if any.

Methodology: Sixty patient aged between 18-65years scheduled for elective surgical procedures belonging to ASA class I and II and Mallampatti grade I and II were included in study group and randomly allocated in two groups. GroupD received DEX 1mcg/kg diluted to 10ml normal saline, iv over 10 minutes, 10 minutes before intubation. GroupM received 30mg/kg of MgSO₄ diluted to 10ml with normal saline, iv over 10minutes, 10 minutes before intubation. Both groups were observed for changes in haemodynamic parameters i.e.heart rate, systolic, diastolic & mean arterial pressure at 0, 2, 5, 10 minutes post intubation.

Results: Statistical analysis was performed using SPSS VERSION 20(USA). We observed that the changes in laryngoscopy & intubation were comparable in both groups ($p>0.005$). However heart rate was more controlled in groupD as compared to groupM ($p<0.005$).

Conclusion: MgSO₄ is as effective as Dexmedetomidine to attenuate vasopressor stress response to laryngoscopy and ETI.

Keywords: Laryngoscopy, Intubation, Vasopressor Stress Response, Magnesium Sulphate, Dexmedetomidine.

Introduction

- Since the time of general anaesthesia in the last quarter of 19th century endotracheal intubation has become one of frequently performed procedures in practice of anaesthesia.
- It includes direct laryngoscopy and intubation, this produces vasopressor stress response characterized by tachycardia and increased blood pressure.
- **Vasopressor stress response**
 - Transient, variable and unpredictable starting from 30 seconds after intubation and lasting upto 10 Minutes ^[1].
 - Reflex phenomenon mediated by Vagus (X) and Glossopharyngeal (IX) cranial nerves.
 - Afferent stimulus from epiglottis and infraglottic region and activate vasomotor centre to cause peripheral sympathetic adrenal response to release adrenaline and noradrenaline.
 - Harmful in patients with hypertension, ischaemic heart disease, cerebrovascular disease and can evoke life threatening conditions.
 - Various non pharmacological and pharmacological methods have been used to attenuate the vasopressor stress response to laryngoscopy and endotracheal intubation.
 - Non pharmacological methods like smooth and gentle intubation with a shorter duration of laryngoscopy, insertion of LMA.

- Pharmacological methods like inhalational anaesthetics, topical and intravenous lidocaine, narcotics, calcium channel blocker, vasodilators and β -blockers [2].
- None of above approaches or agents have proved to be ideal.
- Hence the search for an ideal agent to attenuate the vasopressor stress response is still continuing [1].
- Magnesium sulphate blocks release of catecholamines from adrenergic nerve terminals and adrenal gland [3].
- Increased serum magnesium levels also inhibit release of catecholamines [3].
- Dexmedetomidine, an alpha 2 receptor agonist is known to produce sympatholysis, anxiolysis, hypnosis, sedation and analgesia.

Aim and Objective

- To compare the effectiveness of intravenous Magnesium sulphate 30mg/kg and Dexmedetomidine 1mcg/kg in attenuating vasopressor stress response during laryngoscopy and endotracheal intubation.
- To study effect on heart rate.
- To study effect on systolic, diastolic and mean arterial pressure.
- To record complications if any.

Materials and Methods

- Study design: Hospital based prospective, randomized, single blinded (Patient Blinded) study.
- Total 60 cases undergoing elective surgical procedure under GA.
- Patients were divided into two groups of 30 each.
- Randomization of patients was done opaque envelop method.
- Data analysis: Power analysis permitted a type-1 error rate of 0.05 with type-2 error rate of 0.02, a sample size of 27 patients was calculated in each group. We totalled the sample size to 60 patients, predicting a dropout of 10%. Statistical analysis was conducted with Statistical Package for Social Sciences, version 20.0 (SPSS, USA). Parametric variables such as age, sex and weight were analyzed with Student's *t*-test. While for nonparametric data, Chi-square test was used. *P* < 0.005 was considered statistically significant and *P* < 0.001 as highly significant.
- This study was conducted in department of Anaesthesiology at tertiary care hospital for the period of 24 months.
- Inclusion and exclusion criteria were as follows

Inclusion Criteria:

- Patients of either sex, aged between 18-65 years.
- Patients belonging to American Society of Anesthesiologists Class I & II and Mallampatti grade I & II.
- All patients posted for surgery under GA.

Exclusion Criteria:

- Patient refusal for the procedure.
- Patients with history of allergy or contraindications to either Dexmedetomidine or Magnesium sulfate.
- Those with predicted difficulty in intubation, pregnancy, nursing women and morbid obesity, Coronary artery disease, ischemic heart disease, heart blocks, Diabetes mellitus and Patients with heart rate <

60 bpm and systolic blood pressure < 100 mmHg were excluded.

Anaesthesia Procedure

- Written informed consent was taken.
- Detailed history and complete preanaesthetic checkup was done for every patient.
- After 5 minutes of stabilisation of patient in operation theatre baseline heart rate (HR), systolic (SBP), diastolic (DBP), mean arterial pressure (MAP) were recorded.
- GROUP M received Inj Magnesium sulphate 30mg/kg diluted to 10 ml normal saline intravenously over 10 minutes.
- GROUP D received Inj Dexmedetomidine 1mcg/kg diluted to 10 ml normal saline intravenously over 10 minutes.
- Preoxygenation done and premedication given.
- Standard procedure of general anaesthesia performed with
 - Inj Fentanyl 2mcg/kg iv
 - Inj Propofol 2 mg/kg iv
 - Inj Vecuronium 0.1mg/kg iv
 - Maintained on O₂, N₂O and sevoflurane/isoflurane on IPPV.
 - Haemodynamic parameters of patients including HR, SBP, DBP and MAP were recorded immediately after endotracheal intubation and at 2,5,10 minutes after ETI.
 - Tachycardia was defined as HR>25% of baseline value.
 - Bradycardia was defined as HR<20% of baseline value.
 - Hypotension was defined as SBP<20% of baseline value.

Observations and Results

- Both groups were comparable in terms of age, weight, baseline HR, SBP, DBP and MAP.

Table 1: Comparison of mean heart rate (bpm) changes in response to laryngoscopy and intubation between Group M and Group D

Time Interval	Group (N=30) (Mean ± SD)	Group (N=30) (Mean ± SD)	P value
Baseline	84.23 ± 11.87	80.4 ± 11.18	0.20(ns)
0 min	95.2 ± 10.18	80.73 ± 11.87	0.0001(hs)
2 min	92.8 ± 10.6	78.93 ± 9.40	0.0001(hs)
5 min	87.13 ± 8.58	78.16 ± 10.39	0.005(hs)
10 min	81.33 ± 8.34	74.9 ± 8.90	0.005(hs)

Hs- Highly sigificant, SD- standard deviation, Ns-not significant

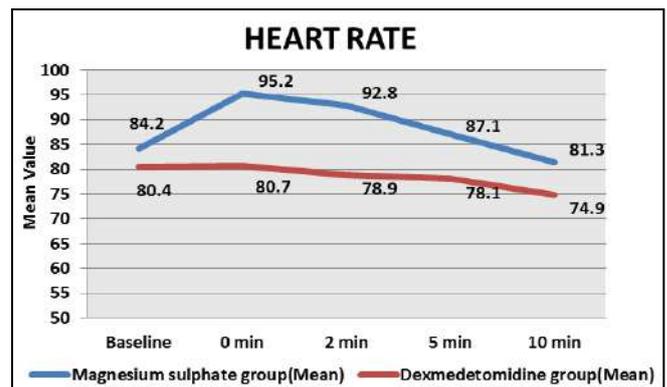


Fig 1: Comparison of mean heart rate (bpm) changes in response to laryngoscopy and intubation between Group M and Group D

Table 2: Comparison of mean systolic blood pressure (mmHg) changes in response to laryngoscopy and intubation between Group M and Group D

Time Interval	Group (N=30)	Group (N=30)	P value
	(Mean ± SD)	(Mean ± SD)	
Baseline	123.78 ± 12.67	126.06 ± 11.41	0.46(ns)
0 min	122.46 ± 16.22	123.5 ± 17.61	0.81(ns)
2 min	118.03 ± 13.71	122.43 ± 17.13	0.27(ns)
5 min	112.2 ± 11.00	115.56 ± 13.96	0.30(ns)
10 min	108.66 ± 10.87	110.73 ± 12.03	0.48(ns)

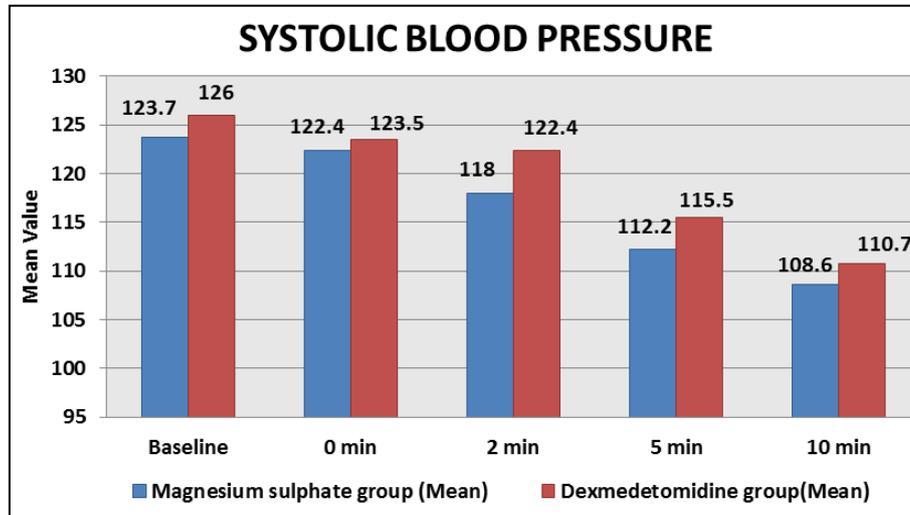


Fig 2: Comparison of mean systolic blood pressure (mmHg) changes in response to laryngoscopy and intubation between Group M and Group D

Table 3: Comparison of mean diastolic blood pressure (mmHg) changes in response to laryngoscopy and intubation between Group M and Group D

Time Interval	Magnesium sulphate Group (N=30)	Dexmedetomidine Group (N=30)	P value
	(Mean ± SD)	(Mean ± SD)	
Baseline	78.6 ± 8.46	78.83 ± 9.53	0.92(ns)
0 min	78.53 ± 14.07	74.73 ± 10.09	0.23(ns)
2 min	78.83 ± 10.29	72.26 ± 10.19	0.55(ns)
5 min	70.2 ± 9.61	69.36 ± 9.83	0.74(ns)
10 min	66.16 ± 8.78	66.36 ± 8.96	0.93(ns)

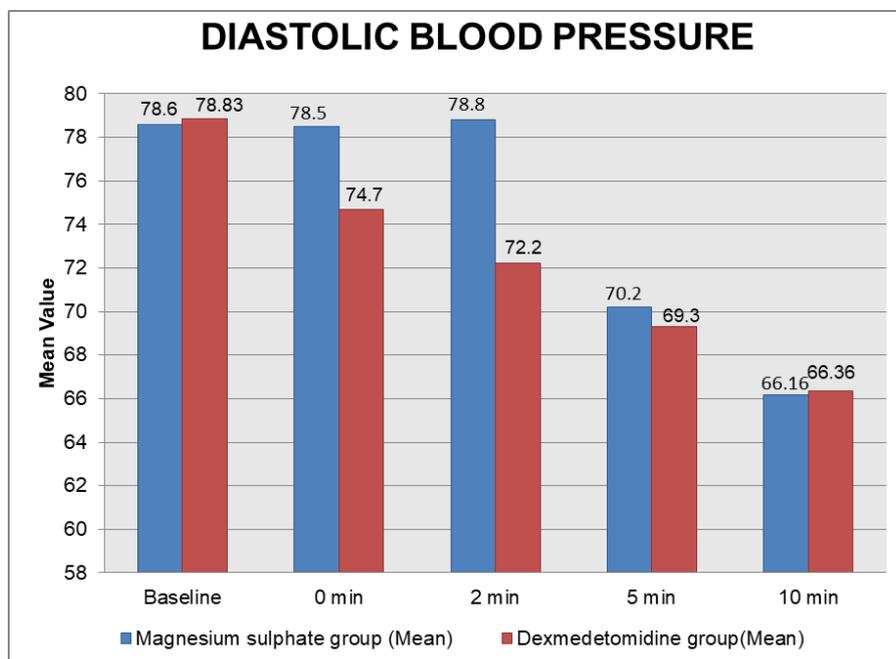
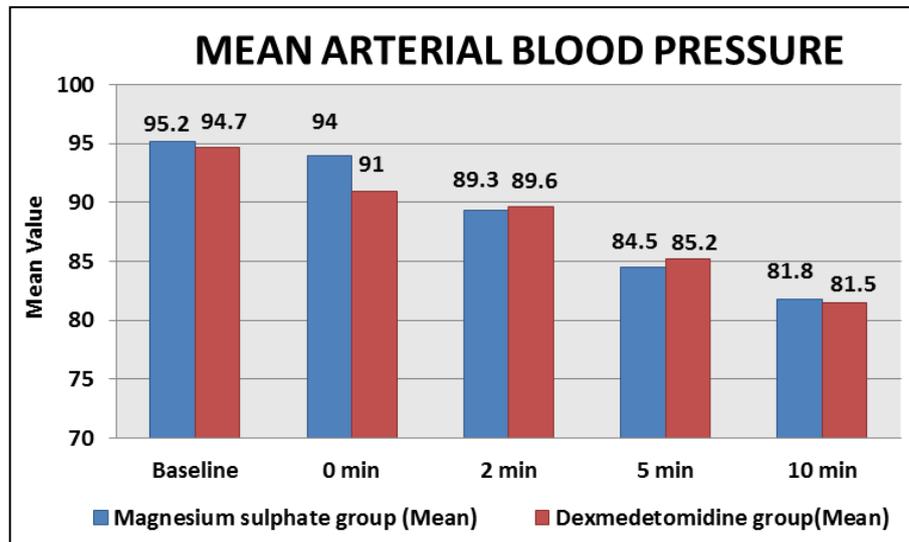


Fig 3: Comparison of mean diastolic blood pressure (mmHg) changes in response to laryngoscopy and intubation between Group M and Group D

Table 4: Comparison of mean of MAP (mmHg) changes in response to laryngoscopy and intubation between Group M and Group D

Time Interval	Group (N=30)	Group (N=30)	P value
	(Mean \pm SD)	(Mean \pm SD)	
Baseline	95.2 \pm 11.32	94.73 \pm 10.28	0.86(ns)
0 min	94.06 \pm 14.96	91.08 \pm 12.27	0.52(ns)
2 min	89.3 \pm 11.21	89.63 \pm 12.07	0.91(ns)
5 min	84.53 \pm 9.17	85.26 \pm 10.65	0.77(ns)
10 min	81.83 \pm 8.56	81.56 \pm 9.20	0.90(ns)

**Fig 4:** Comparison of mean of MAP (mmHg) changes in response to laryngoscopy and intubation between Group M and Group D

Side Effects

Our patients did not face any adverse effects like hypotension requiring interventions because of proper precautions like preloading the patient and adequate dose selection of both the drugs for the study.

Discussion

- From our study it can be observed that the stress response to laryngoscopy and intubation was effectively attenuated in both the groups, heart rate being better controlled in Group D.
- Our results are consistent with Krishna chaithanya *et al* who showed that magnesium sulphate is efficient in attenuating the stress response to laryngoscopy and intubation. It also reduces the requirements of anaesthetic drugs intraoperatively^[1].
- The ability of magnesium ions to inhibit the release of catecholamines from both the adrenal gland and peripheral adrenergic nerve terminals has been known for over 25 years and is now well established^[3].
- Magnesium has been described as the physiological calcium antagonist^[4] because it competes with calcium for membrane channels and can modify many calcium-mediated responses
- Study by Naveed Nurai *et al.*, Magnesium sulfate is more effective than lidocaine in controlling hemodynamics, although it may increase the heart rate^[8].
- Dexmedetomidine, an alpha 2 agonist, increases the hemodynamic stability by altering the stress induced sympatho-adrenal responses to intubation during surgery and emergence from anesthesia.
- Dexmedetomidine by activating pre and post -synaptic α_2 -receptors of sympathetic system produces

vasodilatation; also by acting on post-synaptic α_2 -receptors of vascular smooth muscle cells it produces vasoconstriction.

- It there by shows a biphasic, dose dependent response on blood pressure and heart rate, characterized by an initial short-term increase in BP followed by a longer lasting reduction in BP and HR^[10, 11, 12].
- Chhaya Joshi *et al*^[9]. found that fall in HR in dexmedetomidine group was highly significant compared to magnesium sulphate. Our result is consistent with her study.
- Bidyut Borah *et al*^[13]. found that Dexmedetomidine is far more effective in blunting the hemodynamic response to laryngoscopy.
- This observation will prove beneficial in patients with comorbidities like IHD, diabetes mellitus, cerebrovascular diseases, hyperthyroidism and patients prone to congestive cardiac failure.

Conclusion

- Magnesium sulphate is as effective as Dexmedetomidine to attenuate vasopressor stress response to laryngoscopy and endotracheal intubation.
- However in patients in whom heart rate control is deemed necessary (IHD, CAD, HT etc), dexmedetomidine may be a better choice.

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