ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 16, Issue 8, 2023

Online - 2455-3891
Print - 0974-2441

Research Article

DEXMEDETOMIDINE 1 MG/KG VERSUS MAGNISIUM SULPHATE 30 MG/KG IN ATTENUATING STRESS RESPONSE DURING DIRECT LARYNGOSCOPY AND INTUBATION – A COMPARATIVE STUDY

UPPUTURI VIJAYA SEKHAR[1], CHIRANJEEVI SARASWATH I[2], VENKATESWARA PRADEEP M[2], PHANEENDRA REDDY T[2]*

[1]Department of Anaesthesiology, Katuri Medical College and Hospital, Guntur, Andhra Pradesh, India. [2]Department of Anaesthesiology, Santhiram Medical College and General Hospital, Nandyala, Andhra Pradesh, India.
*Corresponding author: Phaneendra Reddy T; Email: drphanicap7@gmail.com

Received: 05 June 2023, Revised and Accepted: 18 July 2023

ABSTRACT

Objective: In patients who undergo general anesthesia, the need for intubation and laryngoscopy is paramount. There will be hemodynamic changes in the body which occur due to intubation ultimately leading to stress.

The aim of the study was to compare the efficacy of dexmedetomidine 1 μg/kg and magnesium sulfate 30 mg/kg in reducing the stress response occurring due to intubation and laryngoscopy.

Methods: A randomized and double-blinded study was carried out in 60 participants who were divided into two groups. Group D were given dexmedetomidine 1 μg/kg while Group M were given magnesium sulfate 30 mg/kg. The baseline vitals were monitored at 0, 1, 3, 5, and 10 minutes after intubation.

Results: The heart rate and blood pressure showed an increase in both the groups after intubation. However, the pre-induction values were reached earlier in the Group D when compared to the Group M patients.

Conclusion: The patients who were pre-induced with dexmedetomidine 1 μg/kg showed a better hemodynamic stability when compared to those given magnesium sulfate 30 mg/kg.

Keywords: Laryngoscopy, intubation, dexmedetomide, magnesium sulfate.

 DOI: http://dx.doi.org/10.22159/ajpcr.2023v16i8.49002. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Laryngoscopy and tracheal intubation in adult patients frequently result in an elevation of arterial blood pressure and pulse rate [1]. The observed hemodynamic alterations may rely on several parameters, including prior airway manipulation measures, the choice of anesthetic agent, the level and depth of anesthesia, and the duration of intubation. Intravenous anesthetic induction drugs fail to sufficiently inhibit the circulatory reactions elicited by endotracheal intubation [2]. Several studies have also demonstrated that dexmedetomidine has the ability to reduce the hemodynamic response associated with laryngoscopy and intubation [3-8]. The utilization of intravenous dexmedetomidine as a premedicant for anesthesia has several benefits, such as sedation, analgesia, anxiolysis, and enhanced hemodynamic stability. Magnesium sulfate inhibits the secretion of catecholamines from both adrenergic nerve terminals and adrenal glands. It is implicated in various physiological processes, including the regulation of vasomotor tone, cardiac excitability, and neurotransmitter release. A prospective, double-blind, randomized, and controlled study was done in 30 patients with mild-to-moderate cardiovascular disease by Kunisawa *et al*. [7], evaluated the effect of dexmedetomidine with fentanyl on hemodynamics and found that use of the dexmedetomidine administration during anesthetic induction was helpful in blunting the cardiovascular responses to tracheal intubation. In a study conducted by Elsharnouby and Elsharnouby [9] the use of magnesium sulfate as a method for inducing hypotensive anesthesia was investigated. The study involved a total of 60 patients, of which 25 were female, who were undergoing functional endoscopic sinus surgery. The patients were divided into two parallel groups for the purpose of the study. The magnesium group was administered a bolus of magnesium sulfate at a dosage of 40 mg/kg intravenously before the initiation of anesthesia. In addition, a continuous intravenous infusion of 15 mg/kg/h was administered during the course of the operation. It was observed that the administration of magnesium sulfate resulted in a decrease of arterial pressure, heart rate (HR), blood loss, and surgical length. There is only a small amount of research that has investigated the comparative efficacy of magnesium sulfate and dexmedetomidine in suppressing the stress response associated with endotracheal intubation during general anesthesia. The present study examines the efficacy of intravenous magnesium sulfate and dexmedetomidine in decreasing the hemodynamic response to laryngoscopy and intubation in adult patients undergoing general anesthesia for various operations. The intravenous doses were 1 μg/kg and 30 mg/kg, respectively, given over 10 min through infusion before induction of anaesthesia.

METHODS

Following the endorsement of the research protocol by the Institutional Ethics Committee, a total of 60 patients with ASA physical status I and II, regardless of gender, between the ages of 20 and 40 years, who were scheduled to have elective non-cardiac surgery under general anesthetic with Mallampatti Grading I and II and < 15 s duration of laryngoscopy were selected for participation in this study. While the patients with ASA-III and ASA IV, with HR and Systolic blood pressure (SBP) of <70 beats per minute and 100 mm Hg, respectively, with Mallampatti Grading III and IV signifying a difficult intubation and more than 20 s duration of laryngoscopy and with history of asthma, cardiac disease, systemic hypertension and presence of heart block were excluded from the study.

Out of the 60 patients, 30 were randomly assigned to Group D (dexmedetomidine group) and the remaining 30 were assigned to Group M (magnesium sulfate) using sealed envelopes that contained the group names. The package was opened by a senior anesthesiologist who was responsible for preparing the solutions and was not participating in the study. The pre-anesthetic examination was conducted on the evening before the surgical procedure. Before the surgery, all patients were instructed to fast overnight and were given premedication in the form of a 0.5 mg tablet of alprazolam and a 150 mg tablet of ranitidine, both administered orally at bedtime. In the operating room, an intravenous line, pulse oximeter, non-invasive blood pressure cuff, and ECG monitor were connected. Before drug administration, baseline recordings of HR, SBP, and diastolic blood pressure (DBP) were noted. Group M received 30 mg/kg magnesium sulfate (50%) in 100 mL of NS through infusion 10 min before induction. Group D received dexmedetomidine 1 μg/kg in 100 mL of NS through infusion 10 min before induction. Three minutes after pre-oxygenation, to ease intubation, all patients were induced with intravenous thiopentone sodium 5 mg/kg, succinylcholine 1.5 mg/kg, and fentanyl 2 mics/kg. For the purpose of intubation Macintosh no.3 blade was used and duration of laryngoscopy was noted. HR, SBP, DBP, and mean arterial blood pressure were measured at 0, 1, 3, 5, and 10 min after intubation.

Statistical methods

SPSS version 20 was used for performing statistical analysis with groups; analysis was done using unpaired t-test. Mean and standard deviations were used to express the continuous variables. Intergroup comparison was done using independent sample "t" test. $p<0.01$ is considered to be statistically very significant, indicating a strong level of confidence in the result. $p<0.05$ is considered statistically significant, suggesting a moderate level of confidence in the result.

RESULTS

Pre-induction mean HRs for Groups M and D were 79.63±6.47 bpm and 79.33±6.47 bpm, respectively. After induction and by the time of intubation, the mean HR between two groups 70.97±5.15 bpm and 75.90±5.665 bpm ($p<0.05$) which was statistically significant. The HR recorded immediately following intubation was 75.20±5.56 beats per minute (bpm) in Group D and 85.40±5.944 bpm in Group M. This indicated an increase in the HR of 5 bpm in the D group and 10 bpm in the M group. However, this difference in the HR between the two groups was statistically significant. The Group D demonstrated a return to the pre-induction HR mean within 1 min after intubation, while the Group M took 3 min to reach the same level. At intervals of 1, 3, 5, and 10-min following intubation, there was a statistically significant difference between the mean HR values for the groups receiving dexmedetomidine and magnesium sulfate, respectively. Statistically, the mean HR values before intubation were extremely significant (p=0.01). The mean SBP levels at pre-induction and pre-intubation were similar in both groups (p=0.264; p=0.786). There was a significant increase in the mean SBP of 10mmHg observed at 0 minutes after intubation in Group M, compared to the pre-induction value. In contrast, Group D only experienced a 3 mmHg raise in SBP, which was statistically significant ($p<0.01$). At 1 min following intubation in patients belonging to Group D, and at three minutes following intubation in Group M, the mean SBP measurements returned to pre-induction levels.

The mean value before intubation of the Mean arterial pressure (MAP) in the Group D was 82.87±4.167, while in Group M, the value was 85.43±4.066. These values exhibited statistical significance with p=0.0192. The mean values for MAP attained the pre-induction value 1 min after intubation in Group D, while the pre-induction value in Group M was attained 3 min after intubation.

Table 1: Presents the intergroup comparison of mean HR variations in bpm (beats per minute) in response to laryngoscopy and intubation

Parameters	Group N	Mean	SD	p-value
HR Pre-induction	Dex 30	79.63	6.473	0.8582
	$MgSO_4$ 30	79.33	6.472	
HR pre-intubation	Dex 30	70.97	5.156	0.0008
	$MgSO_4$ 30	75.90	5.665	
HR 0 min after intubation	Dex 30	75.20	5.565	0.0001
	$MgSO_4$ 30	85.40	5.944	
HR 1 min after intubation	Dex 30	77.47	6.078	0.0139
	$MgSO_4$ 30	85.37	5.828	
HR 3 min after intubation	Dex 30	74.20	5.869	0.0220
	$MgSO_4$ 30	77.70	5.652	
HR 5 min after intubation	Dex 30	70.10	5.610	0.0186
	$MgSO_4$ 30	73.77	6.118	
HR 10 min after intubation	Dex 30	67.23	5.500	0.0415
	$MgSO_4$ 30	70.30	5.902	

HR: Heart rate

Table 2: The intergroup comparison of the mean systolic blood pressure in response to laryngoscopy and intubation

Parameter	Group N	Mean	SD	p-value
SBP Pre-induction	Dex 30	126.17	5.421	0.2643
	$MgSO_4$ 30	124.73	4.425	
SBP Pre-intubation	Dex 30	116.33	5.108	0.7867
	$MgSO_4$ 30	116.70	5.428	
SBP 0 min after intubation	Dex 30	129.97	5.189	0.0009
	$MgSO_4$ 30	134.13	3.884	
SBP 1 min after intubation	Dex 30	123.47	5.316	0.0001
	$MgSO_4$ 30	128.73	4.354	
SBP 3 min after intubation	Dex 30	118.47	5.270	0.0004
	$MgSO_4$ 30	123.37	4.738	
SBP 5 min after intubation	Dex 30	113.67	6.860	0.0045
	$MgSO_4$ 30	118.23	4.918	
SBP 10 min after intubation	Dex 30	108.20	6.738	0.0014
	$MgSO_4$ 30	113.60	5.685	

SBP: Systolic blood pressure

Table 3: Intergroup comparison of MAP in mmHg changes in response to laryngoscopy and intubation

Parameter	Group N	Mean	SD	p-value
MAP Pre-induction	Dex 30	88.33	4.751	0.1726
	$MgSO_4$ 30	90.00	4.616	
MAP Pre-intubation	Dex 30	82.87	4.167	0.0192
	$MgSO_4$ 30	85.43	4.066	
MAP 0 min AI	Dex 30	93.17	5.193	0.0001
	$MgSO_4$ 30	98.37	4.429	
MAP 1 min AI	Dex 30	85.97	5.869	0.0001
	$MgSO_4$ 30	93.73	4.093	
MAP 3 min AI	Dex 30	81.27	4.675	0.0001
	$MgSO_4$ 30	89.13	4.142	
MAP 5 min AI	Dex 30	77.03	4.367	0.0001
	$MgSO_4$ 30	85.43	4.305	
MAP 10 min AI	Dex 30	72.27	4.299	0.0001
	$MgSO_4$ 30	82.23	4.207	

MAP: Mean arterial pressure

DISCUSSION

Endotracheal intubation and laryngoscopy are widely recognized as pivotal occurrences in the process of administering general anesthesia, as they elicit a temporary yet significant rise in the sympathoadrenal response, characterized by the manifestation of increased blood pressure and HR. In recent studies, α-2 agonists such as clonidine [10] and dexmedetomidine [11] have been investigated for their potential

Table 4: Comparison of change in mean MAP between magnesium and dexmedetomidine groups following intubation

	Mean change in mean arterial blood Pressure following intubation at various intervals (in mm Hg)				
	0 min	1 min	3 min	5 min	10 min
Magnesium sulphate	+ 8.37	+ 3.73	−1	−4.57	−7.77
Dexmedetomidine	+ 4.87	+ 2.36	−7.06	−11.3	−16.06
P Value	0.0001	0.0001	0.0001	0.0001	0.0001

The sign (-) denotes decrease and (+) denotes increase in mean MAP

in suppressing the response to intubation. These agonists have demonstrated superior effects compared to other drugs, while also exhibiting a notable absence of side effects such as respiratory depression or an increased incidence of postoperative nausea and vomiting.

Magnesium sulfate group

In Group M, the pre-induction mean HR was 79.63±6.47 bpm. The mean HR returned to baseline pre-induction values by the 3rd minute following intubation. The results from the group injected with magnesium sulfate indicate a negligible rise in HR following the administration of the study drug. However, there was a statistically significant increase in HR immediately after intubation, as well as at 1- and 3-min post-intubation. The study done by Allen *et al*. [12] yielded several significant findings. The HR exhibited a significant increase of 19 bpm from the baseline value following the induction and administration of magnesium. Similarly, after intubation, the HR shows a notable increase of 16 bpm from the baseline value. The results indicated that there was a decline in the HR following intubation in the group that received magnesium, as compared to their post-induction values. In a separate study conducted by Puri *et al*. [13], it was observed that the HR exhibited an increase from the baseline of 65.2±12.7 bpm–70.5±15.6 bpm following the administration of magnesium. However, this increase was not found to be statistically significant. The MAP exhibited a significant drop following the administration of magnesium, with a value of 76.2±15.6 mmHg compared to the baseline value of 91.7±14.5 mmHg ($p<0.001$). This decrease was observed in isolation, since it was significantly different from the control group ($p<0.05$) during the pre-induction period.

In the present study, the researchers observed a maximum increase of 10.12 mmHg in SBP, 8.10 mmHg in DBP, and 8.50 mmHg in MAP immediately following intubation.

Dexmedetomidine group

In Group D (dexmedetomidine), the average HR before induction was 79.63±6.47 bpm, while the mean HR after induction was 70.97±5.156 bpm. Following the administration of anesthesia, a comparison between the pre-induction values revealed a decrease of 4 bpm in the M group, whereas the Group D experienced a decrease of 9 bpm. This observed difference in HR reduction between the two groups was considered statistically significant. The observed alterations in HR within the current investigation exhibited similarities to the outcomes reported in the study done by Kunisawa *et al*. [7] The average HR during intubation was 84.20±6.55 beats per minute (bpm), indicating an increase of 4 bpm. One minute following intubation, the HR decreased to 78.47±6.07 bpm, returning to pre-induction levels. Following the induction, a decrease of 10 mmHg in SBP was observed in Group D, in comparison to the pre-induction measurement. Kunisawa *et al*. [7] reported comparable findings, noting a significant rise of 14 mmHg in SBP immediately on intubation at 0 min, in comparison to the pre-intubation measurement. The recordings obtained immediately following intubation exhibited similar results to those observed in a study conducted by Scheinin *et al*. [3] In their investigation, an immediate increase of 18 mmHg in SBP was observed after intubation, as opposed to the values measured after induction.

Strengths and limitations

1. The present study is a randomized, double-blinded, and prospective study.
2. The study compared the efficacy of $MgSO_4$ and dexmedetomidine in blunting the response to intubation.
3. This is one of the few studies which have compared the two drugs defining their doses.
4. As this study is a randomized and control study, chances of selection bias and dropouts will be there.
5. As dexmedetomidine is expensive compared to $MgSO_4$, financial burden might be more in Group D patients

CONCLUSION

Based on the examination of the data acquired from the present study, it can be inferred that:

1. In patients belonging to the magnesium group, there was a notable increase in the average HR, SBP, DBP, and MAP immediately after intubation (0 min), as well as at 1 min and 3 min after laryngoscopy and intubation. After lasting for 5 min, the HR and blood pressure restored to their pre-induction pre-baseline levels.
2. In the group of patients receiving dexmedetomidine, a dose of 1 μg/kg intravenously was administered 10 min before induction through a 100 mL drip. This intervention successfully reduced the HR and arterial pressure responses to laryngoscopy and intubation.

Intravenous dexmedetomidine 1 μg/kg was more effective at reducing the hemodynamic stress response to tracheal intubation than intravenous magnesium sulfate 30 mg/kg. Therefore, it can be concluded that pre-treatment with dexmedetomidine at a dose of 1 μg/kg administered as a 10-min infusion before induction of anesthesia is a safe and effective method for attenuating the hemodynamic response to laryngoscopy and intubation when compared to magnesium sulfate 30 mg/kg. Considering cost-effectiveness and availability, magnesium sulfate is a more affordable and easily accessible option compared to dexmedetomidine, which is a costly medicine and not widely accessible.

REFERENCES

1. Reid LC, Brace DE. Irritation of respiratory tract and its reflex effect on heart. Surg Gynaecol Obstet 1940;70:157.
2. Preys-Roberts C. Anaesthesia and hypertension. Br J Anaesth 1984;56:711-24.
3. Scheinin B, Lindgren L, Randell T, Scheinin H, Scheinin M. Dexmedetomidine attenuates sympathoadrenal responses to tracheal intubation and reduces the need for thiopentone and peroperative fentanyl. Br J Anaesth 1992;68:126-31.
4. Aho M, Lehtnen AM, Erkola O, Scheinin H, Lehtinen A, Kallio A, *et al*. The effect of intravenously administered dexmedetomidine on perioperative hemodynamics and isoflurane requirements in patients undergoing abdominal hysterectomy. Anesthesiology 1991;74:997-1002.
5. Yildiz M, Tavlan A, Tuncer S, Reisli R, Yosunkaya A, Otelcioglu S. Effect of dexmedetomidine on hemodynamic responses to laryngoscopy and intubation: Perioperative hemodynamics and anesthetic requirements. Drugs RD 2006;7:43-52.
6. Basar H, Akpinar S, Doganci N, Buyukkocak U, Kaymak C, Sert O, *et al*. The effect of preanesthetic, single-dose dexmedetomidine on induction, hemodynamic, and cardiovascular parameters. J Clin Anaesth 2008;20:431-6.
7. Kunisawa T, Nagata O, Nagashima M. Dexmedetomidine suppresses the decrease in blood pressure during anesthetic induction and blunts the cardiovascular response to tracheal intubation. J Clin Anaesth 2009;21:194-9.
8. Menda F, Koner O, Sayin M, Ture H, Imer P, Aykac B. Dexmedetomidine as an adjunct to anesthetic induction to attenuate hemodynamic

response to endotracheal intubation in patients undergoing fast-track CABG. Ann Card Anaesth 2010;13:16-21.
9. Elsharnouby NM, Elsharnouby MM. Magnesium sulphate as a technique of hypotensive anesthesia. Br J Anaesth 2006;96:727-31.
10. Boerner TF, Ramanathan S. Functional anatomy of the airway. In: Benumof JL, editor. Airway Management-Principles and Practice. New York: Mosby Inc.; 1996.
11. Russell WJ, Morris RG, Frewin DB, Drew SE. Changes in plasma catecholamine concentrations during endotracheal intubation. Br J Anaesth 1981;53:837-9.
12. Allen RW, James MF, Uys PC. Attenuation of the pressor response to tracheal intubation in hypertensive proteinuric pregnant patients by lignocaine, alfentanil and magnesium sulphate. Br J Anaesth 1991;66:216-23.
13. Puri GD, Marudhachalam KS, Chari P, Suri RK. The effect of magnesium sulphate on hemodynamics and its efficacy in attenuating the response to endotracheal intubation in patients with coronary artery disease. Anesth Analg 1998;87:808-11.