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Attenuating stress response of extubation in craniotomy: Dexmedetomidine vs magnesium sulphate

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Abstract
Context: Similar to intubation, Extubation is also associated with stressful airway response. Through not of same degree, it needs to be attenuated especially in neurosurgical patients, due to undesired haemodynamic instability.
Aims: To compare beneficial effects of dexmedetomidine and magnesium sulphate in terms of quality of extubation and hemodynamic changes during extubation in craniotomy patients.
Methods and Material: Sixty patients of ASA grade I and II, 18 -60 years scheduled for craniotomy were randomly allocated in two groups with 30 each. Group D and M received an infusion of dexmedetomidine 0.5µg/kg and magnesium sulphate 30 mg/kg respectively over ten min at the time of skin closure. HR, SBP and DBP were recorded just before drug administration, 3 and 5 min after drug administration, during extubation and at 3, 5, 10 and 15 minutes after extubation. Extubation quality was rated on five point scale and postoperative sedation on Ramsay sedation scale.
Results: Haemodynamic values i.e HR, SBP, DBP and MAP were found to be significantly more acceptable in Group D then in group M ($P<0.05$). Majority of the patients (76.7%) of group D had an extubation quality score of one, whereas it was three in most of patients of group M (50%) ($p<0.01$). Sixty percent of patients in group D had a sedation score of 2 (calm) and 70% of group M had a score of 1 (anxious & agitated) ($p<0.01$).
Conclusions: Dexmedetomidine provides a better attenuation of circulatory and airway responses during extubation as compared to magnesium.

Keywords: Haemodynamics, dexmedetomidine, magnesium sulphate, craniotomy

Introduction

Emergence from anaesthesia refers to the process of moving away from deliberate unconsciousness level to awakening of the patient following surgery as well as cessation of the effect of anaesthetic drugs [1]. The complications after tracheal extubation are three times more common than complications occurring during intubation and induction of anaesthesia (12.6% vs. 4.6%) [2].

Tracheal extubation is an important event in general anaesthesia which causes a modest (10% to 30%) and transient (lasting approximately 5 to 15 min) increase in blood pressure and heart rate. A smooth emergence is preferable for all patients but is especially desired for those patients who would not tolerate any alteration in physiologic changes e.g. severe aortic stenosis, coronary artery disease, cerebral aneurysm clipping, carotid endarterectomy, thyroidectomy, craniotomies.

After uncomplicated surgery, early extubation and rapid recovery in the operating room is preferred in neurosurgery for the early assessment of neurological functions [3]. Different kinds of methods and drugs are available to reduce airway and circulatory stress responses during extubation, but none have been completely successful [4, 5, 6].

Dexmedetomidine acts as sedative, anxiolytic, analgesic and amnesic agent [7]. It also has a sympatholytic effect causing decrease in the concentration of norepinephrine. This, in turn, decreases BP and HR. Thus, it may be theoretically appropriate for reducing airway and haemodynamic reflexes during emergence from anesthesia.

Magnesium in anaesthetic practice has been always highlighted for its major and multipotential action. Magnesium produces effects similar to calcium antagonist and non-competitive antagonist of N-methyl D-aspartate (NMDA) receptor. It inhibits many calcium-mediated responses like the release of catecholamine from both adrenal glands and adrenergic nerve terminals in response to sympathetic stimulation. So intravenous

magnesium sulphate is capable of attenuating the adverse haemodynamic response associated with extubation [8].
As both the drugs – Dexmedetomidine and magnesium sulphate seem to be reasonably effective in attenuating stress response during extubation, the present study is being carried out to evaluate and compare the beneficial effects of dexmedetomidine and magnesium sulphate as assessed in terms of quality of extubation and hemodynamic changes (HR and mean arterial pressure [MAP]) during extubation.

Materials and Methods

The present study is a prospective, randomized, comparative study which was conducted in a tertiary care medical college, after approval from the institutional ethics committee (approval no – EC / MGM / July- 18/40). The study included 60 patients aged 18 – 60 years with ASA grade I – II undergoing elective craniotomies under general anaesthesia. The patients requiring post-op ventilation, Severe cardiac disease, 2nd or 3rd-degree heart block, chronic obstructive lung disease, renal and hepatic insufficiencies, endocrine, metabolic disorders, Pregnant and lactating females and those with any drug allergy were excluded from the study.
A careful preoperative assessment of all the selected patients was done with a complete history and physical examination. An informed and written consent was taken from all the patients included in the study. They were kept nil orally for six hours before the procedure. Patients were randomized into two groups with 30 patients in each group using sealed envelope technique. Patients in group D (n = 30) received Inj. dexmedetomidine 0.5 µg/kg in 100 ml normal saline intravenous infusion over ten minutes and those in group M (n =30) received Inj. magnesium sulphate 30 mg/kg in 100 ml normal saline intravenous infusion over ten minutes. Study drugs were given at the time of skin closure.
Patients were explained and counseled about general anaesthesia. All patients were uniformly pre-medicated with inj. glycopyrrolate 0.2 mg im 30 min before shifting to the operation theatre. Upon the arrival of the patient in the operation theatre, inj.midazolam 50 µg/kg was given intravenously. Patients were monitored for heart rate (bpm), systolic, diastolic and mean blood pressure (mmHg), respiratory rate and oxygen saturation (SpO2).
Patients were preoxygenated with 100% oxygen for three minutes. The induction of general anaesthesia was done with inj. fentanyl 2 mcg/kg followed by inj. thiopentone sodium 3 - 5 mg/kg. Endotracheal intubation was facilitated with intravenous succinylcholine 1.5 mg/kg. After ensuring the correct position of the endotracheal tube, it was fixed and a loading dose of non-depolarizing muscle relaxant inj. vecuronium 0.1mg /kg was given. After induction, intraarterial line was secured and invasive blood pressure monitoring was started. A central venous line was also secured and Central venous pressure monitoring was done if needed. Continuous neuromuscular monitoring was also done.
General anaesthesia was maintained with nitrous oxide and oxygen (50:50) and isoflurane in titrated concentration with an infusion of vecuronium (1mcg/kg/min) throughout the surgical procedure. At the time of skin closure, isoflurane and vecuronium were discontinued and the study drug was given in 100ml saline over a period of ten minutes.
After completion of the surgery, residual neuromuscular blockade was reversed with inj. neostigmine (0.07mg/kg) and inj. glycopyrrolate (0.01 mg/kg). Once patients met the signs of adequate reversal (train of four ratio >0.7), extubation was performed and all the patients were administered oxygen by face mask at the rate of 4 l / min during the recovery period.
Values for HR, MAP, SBP and DBP were recorded just before the study drug administration(A0) taken as baseline value for comparison and 3, 5 min after the study drug administration(A3 and A5) and at extubation (E), 3, 5, 10 and 15 min after extubation (E, E3, E5, E10, E15). Respiratory rate and oxygen saturation were also recorded at the similar time intervals.
At the end of extubation, quality of extubation was recorded with extubation quality score [10] (Grade 1: No Coughing; Grade 2: Minimal Coughing [1 -2 times]; Grade 3: Moderate coughing [3-4 times]; Grade 4: Severe coughing [5 or more times]), Grade 5: Poor extubation, very uncomfortable (Laryngospasm and coughing > 10 times). Patients were also observed for sedation by Ramsay sedation score [10] as: Grade 1: Anxious and agitated or restless or both; Grade 2: Co-operative, oriented and calm; Grade 3: Responsive to command only; Grade 4: Exhibiting brisk response to light tap/auditory stimulus; Grade 5: Exhibiting sluggish response to light tap/auditory stimulus; Grade 6: Unresponsive
Emergence time was defined as the time interval from discontinuation of anesthetic agents to the time patient follows verbal commands. Extubation time was measured as the time interval from the cessation of anesthetic agents to the moment patient was extubated.
Any occurrence of adverse events like laryngospasm, bronchospasm, desaturation (<85%), respiratory depression, vomiting, hypotension (below 20% of basal value or MAP less than 60 mm hg whichever was less), bradycardia (below 20% of basal value or HR less than 60/minutes, whichever is less) or undue sedation were noted.
The data was initially entered into the customized proforma designed for the purpose of the study. Then this data was transferred to Microsoft Excel for analysis. Statistical Software Minitab Version 17.0 was used for calculating the P values. A comparison of means between the two groups was done using the Unpaired 't' test, association between two non-parametric variables was done using Pearson Chi-square test and comparison of proportions was done using Fisher's Exact Test. A p-value of < 0.05 was taken as statistically significant.

Results

A total of 60 patients were included in the study. The data such as age, weight, sex, ASA grade, duration of surgery, duration of anaesthesia were comparable between the two groups (TABLE 1).

Table 1: Demographic data

S. No	Parameter	Group M (Mean ± SD)	Group D (Mean ± SD)	P-value
1.	Age (years)	33.37 ± 12.81	36.57 ±13.35	0.347, NS
2.	Weight (kg)	64.37 ± 9.95	62.12 ± 8.10	0.452, NS
3.	Sex (male / female)	13/17	14/16	1.0, NS
4.	ASA (grade I / II)	14/16	17/13	0.147,NS
5.	Duration of Surgery (hrs)	3.95 ± 0.66	3.91 ± 0.76	0.834, NS
6.	Duration of Anaesthesia (hrs)	4.71 ± 0.69	4.74 ± 0.81	0.880, NS

There was a significant difference in the extubation score between both the groups. Around seventy six (76.7) % of patients in dexmedetomidine group had no coughing (grade 1) against 3.3 % in magnesium group, which is statistically significant (p-value < 0.01). Minimal coughing (grade 2) was found in 23.3 % of patients in dexmedetomidine group and 43.3% in magnesium group, which is statistically insignificant (p-value = 0.170). No patient in the dexmedetomidine group had moderate coughing (grade 3) as compared to 50 % of patients in group M, which is again statistically significant (p-value < 0.01). Only one patient (3.3%) in the magnesium group had a severe cough (TABLE 2).

Table 2: Quality of Extubation

Grades	Group M	Group D	Fisher's Exact Test
Grade 1	3.3%	76.7%	0.001*
Grade 2	43.3%	23.3%	0.170, NS
Grade 3	50.0%	0.0%	0.001*
Grade 4	3.3%	0.0%	1.000, NS

There was a statistically significant difference in heart rate, mean arterial pressure, systolic and diastolic blood pressure at A5, E, E3, E5, E10 and E15 between two groups (*p*-value < 0.05) (Fig 1 & 2). In our study, the difference in respiratory rate was found to be statistically significant between the two groups at and after the extubation (E, E3, E5, E10, and E15) and no with difference in Sp02 between both the groups.

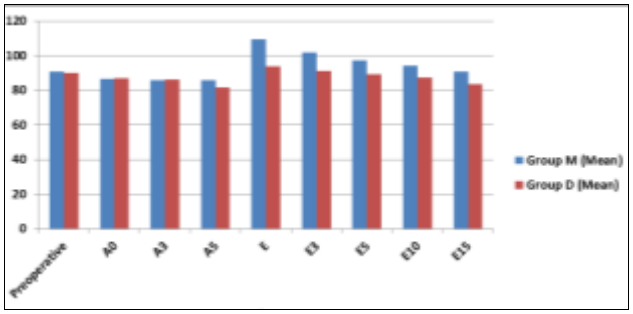

Fig 1: Comparison of mean Heart rate between two groups

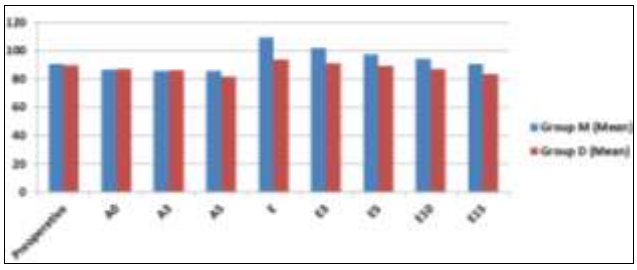

Fig 2: Comparison of mean blood pressure between the two groups at different time intervals

No patient in group D was anxious and agitated (sedation score 1) as compared to 70% in group M, which is statistically significant (p-value < 0.05). In group D, 60 % of patients were co-operative and oriented (sedation score 2) as compared to 30% of patients in group M, which is also statistically significant (p-value < 0.05). Forty percent (40%) of patients in dexmedetomidine group were drowsy but responded to verbal commands (sedation score 3) as against no patients (0%) in magnesium group (p-value < 0.05). (Table 3)

Table 3: Sedation score

Grade	Group M	Group D	Fisher's Exact Test
Grade 1	70.0%	0.0%	0.001*
Grade 2	30.0%	60.0%	0.037*
Grade 3	0.0%	40.0%	0.001*

There was no statistically significant difference between mean emergence and extubation times between the two groups. (P = 0.148 and P = 0.130) respectively.

Discussion

1. The Emergence airway response was better attenuated with dexmedetomidine than with magnesium sulphate assessed in terms of quality of extubation.
2. Dexmedetomidine infusion resulted in a steady and smooth reduction in heat rate and mean blood pressure with better hemodynamic control during extubation.
3. Acceptable level of sedation was found in the patients of dexmedetomidine group without side effects like respiratory depression, laryngospasm, bronchospasm, undue sedation, and desaturation.
4. There was no difference in extubation and emergence time between the two groups.

Coughing during emergence from anesthesia results from irritation of stretch stimuli caused by the endotracheal tube which leads to undesired sympathomimetic responses. In our study, we observed a significant difference in the quality of extubation between group D and group M. Patients in group D had better extubation scores (No coughing - 76.7%, minimal coughing - 23.3%) than the patients in group M (minimal coughing - 43.3%, moderate coughing - 50 %, severe coughing – 3.3%). Tandon N. *et al.* [10] states that dexmedetomidine is more effective in attenuating the haemodynamic response during extubation in craniotomies in comparison with magnesium sulphate. Devi S. *et al.* [9] concludes that same dose of dexmedetomidine administered before extubation attenuates the haemodynamic and airway reflexes during emergence from anaesthesia. Our study is in accordance with the above studies.

Suppression of cough in group D is attributed to its sympatholytic effect, analgesic & sedative properties. α 2 agonistic agents have shown their smooth muscle relaxant effect *in vitro*, therefore, dexmedetomidine may also have this property. This has been supported by several studies where dexmedetomidine reduced the incidence of a post-operative cough or any other airway complications [12].

There was a statistically significant difference in heart rate, mean arterial pressure, systolic and diastolic blood pressure at A5, E, E3, E5, E10 and E15 between two groups (p value < 0.05).

The attenuation of the stress response and hemodynamic stability provided by dexmedetomidine is due to activation of α2 A receptors in the brain stem vasomotor center which results in suppression of norepinephrine release leading to hypotension and bradycardia and stimulation of α2 A and α2 C in locus ceruleus results in sedation. Magnesium sulphate blocks catecholamine release from the adrenal medulla and its calcium antagonistic effects on vascular smooth muscle cells also contribute to the vasodilatation directly and also indirectly decrease in arterial blood pressure. But in our study after extubation, patients receiving dexmedetomidine were haemodynamically more stable as compared to group M. This is also in conjunction with the study carried by Tandon N. *et al.* [10] and Arar C. *et al.* [13].

But, Nooraei N *et al*. [17] supported the fact that use of magnesium sulphate provides better arterial pressure control than lignocaine during intubation. Panda NB *et al*. [18] studied similar dose as used in our study and found significant reduction in BP during intubation. Arar C. *et al*. [13] found that using esmolol before extubation following coronary artery bypass graft surgery prevents undesirable haemodynamic responses while magnesium reduces undesirable haemodynamic responses but does not prevent them which goes in response with our study.

The difference in respiratory rate was found to be statistically significant between the two groups at and after the extubation (E, E3, E5, E10, and E15). The lower respiratory rate in group D is not due to respiratory depression but may be due to decreased stress response, sedation and analgesia produced by infusion of dexmedetomidine. This statement is favored by the fact that the respiratory rate in group D is within the normal range with no associated changes in arterial oxygen saturation.

The sedative and anxiolytic effects of dexmedetomidine result primarily from its activity in the locus ceruleus of the brain. Decreased noradrenergic output from the locus ceruleus allows for increased firing of inhibitory neurons including the g-aminobutyric acid system resulting in anxiolysis and sedation [12].

We found that the difference in extubation time and emergence time between both the groups were statistically insignificant. Although patients in Group D were sedated more than those receiving magnesium sulphate at the time of extubation, we didn't find any undue sedation and prolonged action of muscle relaxants in our patients.

Although this study has tried to meet its aims and objectives in all aspects, there are few limitations to it as we compared only fixed doses of both the drugs, the desired effect may have been attained in lesser doses which we can't comment, lack of control group, which would have been used for better comparison. There is also a contradiction between single and bolus infusion of drugs as effect and complications vary with both the methods, We didn't measure the level of norepinephrine in the blood, which would have given the surest idea about attenuation of stress response.

Conclusion

We conclude that dexmedetomidine, an α 2 agonist is more effective in attenuating the stress response of extubation in comparison to magnesium sulphate in patients undergoing craniotomies.

References

1. Bhagat H, Luthra A. The art of waking up a neurosurgical patient: It is time to hone our skills. Neurol India 2017;65:1059-60.
2. Asai T, Koga K, Vaughan R. Respiratory complications associated with tracheal intubation and extubation. BJA 1998;80:767-75.
3. Bruder N, Ravussin P. Recovery from anesthesia and post-operative extubation of neurosurgical patients: A Review. Journal of neurosurgical Anaesthesiology 11(4):282-293.
4. Miller KA, Harkin CP, Bailey PL. Postoperative tracheal extubation. Anesth Analg 1995;80:149-72.
5. Nishina K, Mikawa K, Shiga M, Maekawa N, Obara H. Prostaglandin E1 attenuates the hypertensive response to tracheal extubation. Can J Anaesth 1996;43:678-83.
6. Bidwai AV, Bidwai VA, Rogers CR, Stanley TH. Blood-pressure and pulse-rate responses to endotracheal extubation with and without prior injection of lidocaine. Anesthesiology 1979;51:1713.
7. Isik B, Arslan M, Özsoylar O, Akçabay M. The effects of α2 adrenergic receptor agonist dexmedetomidine on hemodynamic response indirect laryngoscopy. Open Otorhinolaryngol J 2007;1:5-11.
8. James MF. Clinical use of magnesium infusions in anaesthesia. Anaesthesia& Analgesia 1992;74(1):129-36.
9. Devi Sarada V, Manjula Suguna, Surender. Effect of dexmedetomidine on haemodynamic and recovery responses during tracheal extubation: a randomized comparative study. Journal of Evolution of Medical and Dental Sciences 2016;5:10. 14260/jemds/2016/ 671.
10. Tandon N, Goyal S. Comparison of dexmedetomidine and magnesium sulphate in attenuation of airway and pressor responses during extubation in patients undergoing craniotomies. International Journal of Contemporary Medical Research 2017;4(5):1033-1037.
11. Aksu R, Akin A, Biçer C, Esmaoglu A, Tosun Z, Boyaci A. Comparison of the effects of dexmedetomidine versus fentanyl on airway reflexes and hemodynamic responses to tracheal extubation during rhinoplasty: A double-blind, randomized, controlled study. Curr Ther Res Clin Exp 2009;70:209-2030.
12. Bindu B, Pasupuleti S, Gowd UP, Gorre V, Murthy RR, Laxmi MB. A double-blind, randomized, controlled trial to study the effect of dexmedetomidine on hemodynamic and recovery responses during tracheal extubation. J Anaesthesiol Clin Pharmacol 2013;29:162-7.
13. Arar C, Colak Alkin, Alagol A, Uzer S, Ege T *et al*. The use of esmolol and magnesium to prevent haemodynamic responses to extubation after coronary artery grafting. European journal of anaesthesiology 24:826-31. 10.1017/S0265021507000865.
14. Dutta Debojyoti, Godara Mukesh, Purohit Shobha, Kalra Poonam, Sharma Satya P, Gill Nitesh. Comparison of the effect of intravenous dexmedetomidine and lignocaine spray instilled into the endotracheal tube on extubation response in patients undergoing spine surgery. Journal of Neuro anaesthesiology and Critical Care 3:239. 10.4103/2348-0548.190070.
15. Mistry Tuhin, Purohit Shobha, Arora Gunjan, Gill Nitesh, Sharma Jaya. Attenuation of extubation responses: Comparison of prior treatment with verapamil and dexmedetomidine. Journal of Neuro anaesthesiology and Critical Care. 3. 33. 10.4103/2348-0548.173234.
16. Sharma VB, Prabhakar H, Rath GP, Bithal PK. Comparison of dexmedetomidine and lignocaine on attenuation of airway and pressor responses during tracheal extubation. JNeuroanaesth Crit Care 2014;1:50-5.
17. Nooraei N, Dehkordi ME, Radpay B, Teimoorian H, Mohajerani SA. Effects of Intravenous Magnesium Sulfate and Lidocaine on Hemodynamic Variables Following Direct Laryngoscopy and Intubation in Elective Surgery Patients. Tanaffos 2013;12:57-63. 28.
18. Panda NB, Bharti N, Prasad S. Minimal effective dose of magnesium sulfate for attenuation of intubation response in hypertensive patients. Journal of Clinical Anaesthesia 2013;25:92-7.