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Original Research Article

The effectiveness of intravenous dexmedetomidine on haemodynamic responses during tracheal extubation in patients undergoing craniotomies

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ABSTRACT

Background: Dexmedetomidine an α_2 agonist reduces heart rate and blood pressure due to sympatholytic activity. The aim of this study was to evaluate the effect of dexmedetomidine on haemodynamic response during endotracheal extubation in patients undergoing craniotomies for intracranial space occupying lesion (ICSOL).
Methods: Sixty patients of ASA grade I and II, age 18-50 years scheduled for craniotomy for nonvascular ICSOL were selected after randomization into 2 groups with 30 patients in each group. Group D and C received an IV infusion of dexmedetomidine 0.5 µg/kg and normal saline 100 ml respectively over 10 min at the time of skin closure in a double-blind manner. Heart rate, systolic and diastolic blood pressure were recorded just before drug administration, 3 and 5 minutes after drug administration, during extubation and at 3, 5, 10 and 15 minutes after extubation. Respiratory rate and oxygen saturation were analyzed at 3, 5, 10 and15 minutes after extubation. Any laryngospasm, bronchospasm, desaturation, respiratory depression, vomiting, hypotension and bradycardia was noted.
Results: Heart rate, systolic and diastolic blood pressure increased during emergence time in both groups ($p<0.05$) but this increase was more significant in control group than group D. SBP and heart rate were significantly lower in group D from 3 minutes after drug administration to 15 minutes after extubation. DBP was lower in group D during extubation till 15 minutes after extubation ($p<0.01$). No significant differences were observed in the respect of adverse events between the groups.
Conclusions: Intravenous dexmedetomidine 0.5 µg/kg before extubation is attenuates haemodynamic response during endotracheal extubation in craniotomies.

Keywords: Craniotomies, Dexmedetomidine, Extubation, Haemodynamic response

INTRODUCTION

Tracheal extubation should be devoid of cardiovascular changes like hypertension and tachycardia and adverse events such as coughing, breath holding or laryngospasm. Intubation and extubation both lead to increase plasma concentration of epinephrine and norepinephrine causing increased heart rate and blood pressure.[1,2] These changes may lead to life threatening complications in patients with cerebrovascular disease.[3]

It is an important goal of neuro anaesthesia to achieve stable cerebral haemodynamics perioperatively to prevent cerebral edema and haemorrhage. After intracranial

surgery, acute hypertension may also increase morbidity and mortality by raising intracranial pressure, or disrupting the delicate postoperative haemostatic state.[4]

Different drugs and methods have been used to prevent haemodynamic response during extubation such as local anaesthetics, calcium channel blockers and vasodilators.[5-7]

Dexmedetomidine hydrochloride is a highly selective, specific and potent α_2 adrenergic agonist (1620:1 α_2 to α_1) drug which is S-enantiomer of medetomidine.[8] It decreases the sympathetic outflow and noradrenergic activity thereby decreasing blood pressure and heart rate. It also has sedative, analgesic and anaesthetic sparing properties without producing respiratory depression.[9]

This study was undertaken to evaluate the beneficial effects of intravenous dexmedetomidine in attenuation of haemodynamic responses during extubation in craniotomies for ICSOL under general anaesthesia.

METHODS

The present study was approved by the Ethics Committee of the Institution. This study was conducted as prospective, randomized, placebo controlled, double blind study.

Sixty patients of ASA grade I and II, age group 18 to 50 years of either sex admitted for craniotomies for nonvascular ICSOL under general anaesthesia were included for study. Patients with cardiopulmonary diseases, hepatic dysfunction, renal dysfunction, psychiatric illness, pregnant and lactating patients and any patient who required postoperative ventilation were excluded from study.

After taking written informed consent from patients, preanesthetic assessment of all the selected patients were done with complete history and physical examination. Routine investigations like complete blood count, blood sugar, blood urea, serum creatinine, chest X-ray and ECG were done.

Patients were randomized into 2 groups of 30 patients each via sealed envelope technique. Group C (control): 100 ml normal saline IV infusion over a period of 10 minutes. Group D: 0.5 µg/kg inj. dexmedetomidine in 100 ml normal saline slow IV infusion over 10 minutes. Study drugs were given at the time of skin closure.

Patients were kept nil orally for 6 hours before procedure. All patients were uniformly premeditated with inj. glycopyrrolate 0.2 mg IM 30 minutes before shifting to operation theatre.

Upon arrival of the patient in the operation theatre, intravenous access with 18 G cannula was established. Patients were monitored by heart rate (bpm), systolic and diastolic blood pressure (mmHg), respiratory rate and oxygen saturation (SpO_2).

All the drugs administered by a person who not involved in study to avoid bias. Patients were medicated with inj. pentazocine IV 0.5 mg/kg followed by preoxygenation with 100% oxygen for 3 minutes. Induction of general anaesthesia was done with inj. thiopentone sodium 5 mg/kg. Endotracheal intubation was facilitated with intravenous succinylcholine 1.5 mg/kg and ventilation with 100% oxygen for 1 minute. General anaesthesia was maintained with nitrous oxide and oxygen (66:33) and isoflurane (0.5-1%) given by Bain's circuit with intermittent dosage of non-depolarizing muscle relaxant IV vecuronium loading dose- 0.04 mg/kg and intermittent dose - 0.01 mg/kg throughout surgical procedure. At the time of skin closure, isoflurane was discontinued and study drug was given in 100 ml saline over a period of 10 minutes. Residual neuromuscular blockage was reversed with inj. neostigmine (0.05 mg/kg) and inj. glycopyrrolate (0.01 mg/kg) IV. Once patient met the signs of adequate reversal extubation was performed and all patients were given O2 by face mask during recovery period. Values for HR, SBP and DBP were recorded just before the study drug administration(A_0) which taken as baseline value for comparison and 3, 5 minutes after the study drug administration (A_3 and A_5) and at extubation (E), 3, 5, 10 and 15 minutes after extubation (E_3, E_5, E_{10}, E_{15}). Respiratory rate and SpO_2 were recorded at 3, 5, 10 and 15 minutes after extubation.

Patients were closely observed for bradycardia (below 20% of basal value), hypotension (below 20% of basal value) and desaturation (<85%) during intra and postoperative period. During postoperative period along with above nausea, vomiting, respiratory depression and shivering were also recorded if occurred. Any complication if occurred was treated with appropriate medications.

The observations were recorded and subjected to statistical analysis using statistics calculator SPSS 17.00 version. Student's t test was used for analysis of quantitative and χ^2 (chi square) test was used to analyze qualitative data. p-value <0.05 was taken statistically significant.

RESULTS

The patients in 2 groups were comparable for age, sex, weight, duration of anaesthesia (Table 1). The difference between 2 groups was insignificant (p>0.05).

Baseline values such as heart rate, SBP and DBP were comparable in both groups (p>0.05). Compared to baseline values, there was increase in heart rate at A_3 which keep on increasing up to extubation after that heart rate slightly decreased but remained higher to baseline value in group C. In group D, heart rate decreased below the baseline value at 3 and 5 minutes after study drug

administration. During extubation heart rate increased above the baseline value which came to baseline value at E_3 after that it decreased again and remain below the baseline value. On comparing group C with group D, heart rate was significantly higher in group C ($p<0.01$) at all study time interval.

Table 1: Demographic profile of two groups (Mean±SD).

Variables	Group C	Group D
Age (years)	38.26±10.65*	35.83±10.88
Sex	14:16	18:12
Weight (Kg)	60.63±9.74	63.33±8.98
Duration of anaesthesia (minute)	176.66±38.10	175.66±43.12

Table 2: Comparison of changes in mean heart rate in 2 groups at various time intervals.

Time in minutes	Group-C (mean±SD)	Group-D (mean±SD)	P-value
A_0	80.83±11.45	83.13±12.21	0.45
A_3	81.63±10.98	72.80±10.11	0.002
A_5	83.10±11.17	74.76±10.47	0.004
E	104.03±17.65	87.46±13.24	0.000
E_3	100.03±17.02	83.10±12.26	0.000
E_5	96.63±16.08	79.80±11.35	0.000
E_{10}	92.20±14.39	77.23±11.37	0.000
E_{15}	90.50±11.24	74.63±11.07	0.000

Measurement points; A_0: during study drug administration, A_3: 3 minutes after drug administration, A_5: 5 minutes after drug administration, E: at the time of extubation, E_3: 3 minutes after extubation, E_5: 5 minutes after extubation, E_{10}: 10 minutes after extubation, E_{15}: 15 minutes after extubation. D = dexmedetomidine, C = control.

In group C as compared to baseline value (A_0), there was increase in SBP at 3 minutes after the study drug administration (A_3) which continuously increased up to extubation, after that SBP slightly decreased but it remains higher to baseline value. In group D, as compared to baseline value SBP decreased at 3 and 5 minutes after study drug administration. During extubation SBP increased above the baseline value and reach to baseline value at E_3. After that it was decreasing below the baseline value. During comparison of group D and C, SBP was significantly higher in group C ($p<0.01$) at all time interval.

Compared to baseline values, in group C there was increase in DBP at A_3 which keep on increasing up to extubation. After that DBP slightly decrease but remain higher to baseline value. In group D, mean DBP was decrease at A_3 and A_5 after study drug administration while it increased during extubation. At 3 minutes after extubation DBP reached near to baseline value. After that it keep on decreasing and reached below the baseline value. As compared to group C DBP was lower in group D during extubation and 3, 5, 10 and 15 minutes after extubation ($p<0.01$).

Table 3: Comparison of changes in mean systolic blood pressure in 2 groups at various time intervals.

Time in minutes	Group-C (mean±SD)	Group-D (mean±SD)	P-value
A_0	123.83±9.40	120.96±9.49	0.245
A_3	124.86±9.53	114.40±8.89	0.000
A_5	126.60±11.42	116.03±11.93	0.001
E	145.93±8.25	126.26±13.13	0.000
E_3	141.13±7.41	121.83±12.06	0.000
E_5	136.73±6.95	118.66±12.93	0.000
E_{10}	132.70±6.75	115.83±12.00	0.000
E_{15}	128.96±8.05	113.56±11.49	0.000

Measurement points; A_0: during study drug administration, A_3: 3 minutes after drug administration, A_5: 5 minutes after drug administration, E: at the time of extubation, E_3: 3 minutes after extubation, E_5: 5 minutes after extubation, E_{10}: 10 minutes after extubation, E_{15}: 15 minutes after extubation. D = dexmedetomidine, C = control.

Table4: Comparison of changes in mean diastolic blood pressure in 2 groups at various time intervals.

Time in minutes	Group-C (mean±SD)	Group-D (mean±SD)	P-value
A_0	76.86±8.90	78.73±7.66	0.388
A_3	77.96±8.37	74.36±9.48	0.125
A_5	78.70±8.22	75.23±10.95	0.171
E	95.73±9.36	83.30±9.78	0.000
E_3	92.26±9.02	79.36±8.20	0.000
E_5	89.63±7.71	76.76±8.28	0.000
E_{10}	86.03±6.77	74.33±8.02	0.000
E_{15}	82.50±6.80	72.33±7.62	0.000

Measurement points; A_0: during study drug administration, A_3: 3 minutes after drug administration, A_5: 5 minutes after drug administration, E: at the time of extubation, E_3: 3 minutes after extubation, E_5: 5 minutes after extubation, E_{10}: 10 minutes after extubation, E_{15}: 15 minutes after extubation. D = dexmedetomidine, C = control.

No significant difference was observed in respiratory rate and SpO_2 after extubation until end of study among 3 groups.

One and 2 patients had nausea (3.33%) and shivering (6.66%) respectively in control group. Beside these, no untoward side effects like laryngospasm, bronchospasm, respiratory depression, breath holding, desaturation occurred in any group. None of the patients had bradycardia and hypotension in patients of both groups.

DISCUSSION

Tracheal extubation is associated with similar problems as occur during intubation. During extubation increased heart rate and blood pressure may result in complications such as cardiac failure, pulmonary edema and cerebral

vascular haemerage.[10] Proposed mechanism behind these haemodynamic changes is increased sympathetic activity and release of catecholamines. Dexmedetomidine, active D isomer of medetomidine (4-{1-(2,3-dimethylphenyl) -ethyl}-1H-imidazole) is a highly specific and selective α_2 adrenoceptor agonist.[11,12] It has sympatholytic properties, produce sedation and analgesia and frequently used in monitored anaesthesia care unit.[13] It effectively prevents circulatory response to tracheal intubation.[14]

This study was planned with aim to evaluate the effects of dexmedetomidine on heart rate, systolic and diastolic blood pressure (SBP and DBP) during extubation. We observed in this study that during extubation there was significant increase in heart rate and blood pressure in both groups but dexmedetomidine infusion at the time of skin closure led to a decrease in pressure response following extubation. The mean heart rate, SBP and DBP were lower in dexmedetomidine as compared to control group but none of patients suffered from bradycardia and did not required dose reduction.

Aksu R et al used 0.5 µg/kg dexmedetomidine and 1 µg/kg fentanyl for attenuation of stress response during extubation in patients undergoing rhinoplasty and found that dexmedetomidine was superior than fentanyl for blunting haemodynamic response.[15] Guler G et al used same dose of dexmedetomidine as was used in present study and found similar results which correlate with our findings.[16] Dexmedetomidine produces dose dependent decrease in heart rate and blood pressure associated with a decrease in serum norepinephrine concentration. In CNS, activation of α-2 receptor leads to decrease in sympathetic outflow and an increase in vagal activity.[9]

Turan G et al done their study with 0.5 µg/kg dexmedetomidine before extubation in intracranial surgery and concluded that there was significant decrease in heart rate, SBP and DBP in dexmedetomidine group.[17]

In study by Jain D et al, it has been shown a significant reduction in heart rate and blood pressure during extubation with use of dexmedetomidine.[18] Lawerence et al used single dose dexmedetomidine before study and observed reduced the need for anaesthetic and postoperative analgesia and attenuates cardiovascular response to intubation and extubation.[19] Our findings are well supported by Bindu B et al.[20]

Respiratory rate and SpO_2 were comparable among all the 3 groups. Our findings are consistent with the study done by Aksu R et al.[15]

Present study observed insignificant difference in incidence of adverse effect between 2 groups. This correlate with study done by Guler G et al and Turan G et al as they found no significant difference between the dexmedetomidine group and control group in respect to complications. [16,17]

CONCLUSION

Intravenous dexmedetomidine attenuates the haemodynamic response during extubation in craniotomies without increasing the recovery period.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Paulissian R, Salem MR, Joseph NJ, Braverman B, Cohen HC, Crystal GJ, et al. Hemodynamic responses to endotracheal extubation after coronary artery bypass grafting. Anesth Analg. 1991;73(1):10-5.
2. Lowrie A, Johnson PL, Fell D, Robinson SL. Cardiovascular and plasma catecholamine responses at tracheal extubation. Br J Anaesthesia. 1992;68(3):261-3.
3. Parida S, Badhe A. Emergence hypertension in patients undergoing intracranial surgery. Int J Anesthesiol. 2008;22:1.
4. Basali A, Mascha EJ, Kalfas I, Schubert A. Relation between perioperative hypertension and intracranial hemorrhage after craniotomy. Anesthesiol. 2000;93(1):48-54.
5. Sharma VB, Prabhakar H, Rath GP, Bithal PK. Comparison of dexmedetomidine and lignocaine on attenuation of airway and pressor responses during tracheal extubation. J Neuroanaesthesiol Crit Care. 2014;1:50-5.
6. Mikawa K, Nishina K, Maekawa N, Obara H. Attenuation of cardiovascular responses to tracheal extubation; Verapamil versus Diltiazem. Anaesthesia and Analgesia 1996;82(6):1205-10.
7. Nagatani A, Shibata O, Haseba S, Fukuzaki M, Tomiyasu S, Tsuzaki K, et al. The effect of nitroglycerin ointment on cardiovascular functions in hypertensive patients during emergence from anesthesia. Masui. Japanese J Anesthesiol. 1989;38(10):1312-6.
8. Bhana N, Goa KL, McClellan KJ. Dexmedetomidine. Drugs. 2000;59(2):263-8.
9. Gertler R, Brown HC, Donald H. Mitchell DH, Silvius EN. Dexmedetomidine: a novel sedative-analgesic agent. Proceedings. 2001;14(1):13-21.
10. Alkaya MA, Saraçoglu KT, Pehlivan G, Eti Z, Goguş FY. Effects of esmolol on the prevention of haemodynamic responses to tracheal extubation after craniotomy operations. Turk J Anaesth Reanim. 2014;42(2):86-90.
11. Virtanen R, Savola JM, Saano V, Nyman L. Characterization of selectivity, specificity and potency of medetomidine as an α_2-adrenoceptor agonist. Eu J Pharmacol. 1988;150(1-2):9-14.
12. Scheinin M, Kallio A, Koulu M, Viikari J, Scheinin H. Sedative and cardiovascular effects of

medetomidine, a novel selective alpha 2-adrenoceptor agonist, in healthy volunteers. Br J Clin Pharmacol. 1987;24(4):443-51.
13. Candiotti KA, Bergese SD, Bokesch PM, Feldman MA, Wisemandle W, Bekker AY. Monitored anaesthesia care with dexmedetomidine: a prospective, randomized, double-blind, multicentre trial. Anaesthesia Analgesia. 2010;110(1):47-56.
14. Keniya VM, Ladi S, Naphade R. Dexmedetomidine attenuates sympathoadrenal response to tracheal intubation and reduces perioperative anaesthetic requirement. Indian J Anaesth. 2011;55(4):352-7.
15. Aksu R, Akın A, Bicer 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. 2009;70 (3):209-20.
16. Guler G, Akin A, Tosun Z, Eskitascoglu E, Mizrak A, Boyaci A. Single-dose dexmedetomidine attenuates airway and circulatory reflexes during extubation. Acta Anesthesiol Scand. 2005;49(8):1088-91.
17. Turan G, Ozgultekin A, Turan C, Dincer E, Yuksel G. Advantageous effects of dexmedetomidine on haemodynamic and recovery responses during extubation for intracranial surgery. Eu J Anaesthesiol. 2008;25(10):816-20.
18. Jain D, Khan R, Maroof M. "Effect of dexmedetomidine on stress response to extubation." Internet J Anesthesiol. 2008;21:1.
19. Lawrence CJ, De Lange S. Effects of a single pre-operative dexmedetomidine dose on isoflurane requirements and peri-operative haemodynamic stability. Anaesthesia. 1997; 52(8):736-44.
20. 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(2):162-7.

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