EFFECT OF INTRAVENOUS DEXMEDETOMIDINE ON HAEMODYNAMIC AND RECOVERY RESPONSE DURING TRACHEAL EXTUBATION

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ABSTRACT

BACKGROUND

Dexmedetomidine, a highly selective alpha-2 agonist, has various beneficial effects like sedation, analgesia, attenuation of stress response with minimal cardiovascular instability or respiratory depression and may be a useful agent to facilitate smooth tracheal extubation.

The aim of this study is to observe the effects of intravenous infusion of Dexmedetomidine in attenuating adverse haemodynamic and recovery response associated with tracheal extubation in patients operated under General Anaesthesia.

METHODS AND MATERIALS

120 patients were divided into two groups with 60 cases in each group by matching patient's age, sex, Mallampati and ASA grading and randomised with a sealed envelope and divided into two equal groups of 60 each namely group D and group C. Group D and C received an intravenous infusion of dexmedetomidine 0.75 mcg/kg or placebo respectively, over 15 minutes before anticipated time of end of surgery, Anaesthesia techniques were standardised. Heart rate, systolic, diastolic, mean arterial pressures were recorded while starting injection; at 1, 3, 5, 10, 15 minutes after starting injection; at the time of giving reversal; during extubation; at 1, 3, 5 minutes after extubation; and thereafter every 5 minutes for 15 minutes. Quality of extubation was evaluated on a 5-point scale and postoperative sedation on a 6-point scale. Any event of laryngospasm, bronchospasm, desaturation, respiratory depression, vomiting, hypotension, undue sedation was noted.

Statistical Analysis- Descriptive data presented as Mean ± SD and in percentage. Pair wise comparison between the groups was done by Student's unpaired t-test. For Qualitative data, Chi-square test was used. Fisher's exact test was used to determine p-value of frequency of complication. P-value<0.05 is considered significant.

RESULTS

Heart rate, systolic, diastolic, mean arterial pressures were significantly higher in group C (P <0.05). Extubation quality score of majority of patients was 2 in group D and 3 in group C. Sedation score of most patients was 3 in group D and 2 in group C. Bradycardia was higher in group D. One patient in group D, two patients in group C had vomiting.

CONCLUSION

Dexmedetomidine 0.75 mcg/kg administered 15 minutes before extubation stabilises haemodynamics and facilitates smooth extubation.

KEYWORDS

Alpha-2-agonist, Dexmedetomidine, Extubation, Haemodynamics.

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BACKGROUND

Management of the airway is central to the practice of anaesthesia.[1] The tracheal tube is removed (extubation) when it is no longer needed for airway protection. Timing and technique are influenced by balance between the residual effect of anaesthetic drugs and recovery of airway and other reflexes.[2]

Tracheal extubation is almost always associated with haemodynamic changes due to reflex sympathetic discharge caused by epipharyngeal and laryngopharyngeal stimulation.

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This increase in sympatho-adrenal activity may result in hypertension, tachycardia and arrhythmias.[3,4] This increase in blood pressure and heart rate are usually transitory, variable and unpredictable. It is more hazardous to the patient with hypertension, myocardial insufficiency or cerebrovascular diseases.[5] Respiratory complications at extubation include pulmonary aspiration, upper airway obstruction or hypoventilation leading to hypoxaemia, bronchospasm and laryngospasm.[6] At the same time, airway irritation appearing during tracheal extubation may cause cough or difficulties in breathing and may contribute to an increase in blood pressure.[7,8]

Various techniques and antihypertensive drugs are available to attenuate airway and circulatory reflexes during extubation, but none have been completely successful.[9,10,11] Attempts have been made to attenuate the pressor response by the use of drugs such as narcotic analgesics, deep anaesthesia induced by inhalational anaesthetics, local anaesthetics, adrenoceptor blockers and vasodilator agents.[12]

Alpha-2 agonists are used in modern anaesthesia practice due to their various beneficial effects like sedation, analgesia, attenuation of stress response and reduction in anaesthetic drug requirement.[13] Alpha-2 agonist decreases the sympathetic outflow and noradrenergic activity, thereby counteracting the haemodynamic fluctuations occurring at the time of extubation due to increase in sympathetic stimulation.[14]

To attenuate airway and pressor response during tracheal extubation, dexmedetomidine, a highly selective alpha‑2 adrenoceptor agonist, has been studied as single dose,[15,16] at the time of extubation and as an anaesthetic adjuvant.[16,17,18,19,20,21]

MATERIALS AND METHODS

Place of study

The present study was conducted in the Department of Anaesthesiology, Assam Medical College and Hospital, Dibrugarh for a period of one year.

Design of study

Randomised controlled trial.

Source of Data

Patients undergoing elective surgery under general anaesthesia at different operation theatres of Assam Medical College and Hospital, Dibrugarh.

Study Period

One year from July, 2014 to June, 2015.

Following Criteria were adopted for Selecting Patients

Inclusion Criteria

- Patients aged between 20-50 years of both the sexes.
- Patients scheduled for elective surgeries under general anaesthesia.

Patients with ASA Grade I or II. (ASA Grade I- normal healthy patient, ASA Grade II- patient with mild systemic disease).

Exclusion Criteria

- Patients with neurological and other endocrine abnormalities.
- Patients with renal impairment and hepatic disease.
- Patients with congestive heart failure, Valvular heart disease, Hypertension, Diabetes Mellitus, and IHD.
- Patients on psychotropic drugs or history of drug allergies.
- Anticipated difficult intubation.
- Previous records of failed intubation.

Patients were selected after thorough pre-anaesthetic assessment and investigations. 120 patients were divided into two groups with 60 cases in each group by matching patient's age, sex, Mallampati and ASA grading and randomised with a sealed envelope and divided into two equal groups of 60 each namely group D and group C.

Group D

Dexmedetomidine group. Here dexmedetomidine 0.75 mcg/kg body weight in 100 mL normal saline was infused for 15 minutes before anticipated time of end of surgery.

Group C

Control group. Here 100 mL normal saline was infused for 15 minutes before anticipated time of end of surgery.

Procedure

The patient was pre-oxygenated with 100% oxygen for 3 minutes before induction with a tight fitting facemask. Anaesthesia was induced with Inj. Propofol (2 mg/kg) and administered slowly till the loss of eyelash reflex. Inj. Succinylcholine was administered at a dose of 1-1.5 mg/kg IV and maintained on N_2O (66%), oxygen (33%), isoflurane (0.5 – 1%) and atracurium (0.5 mg as loading dose and one-fifth as maintenance).

Patients in group D received Dexmedetomidine 0.75 mcg/kg body weight in 100 mL normal saline (NS) infusion for 15 minutes, while in group C patients received 100 mL NS infusion for 15 minutes before the end of surgery. HR, systolic BP and diastolic BP were recorded at the start of bolus drug injection and also consecutively at 1, 3, 5,10 and 15 minutes. Residual neuromuscular blockades were reversed with Inj. Neostigmine 0.05 mg/kg and Inj. Glycopyrrolate 0.01 mg/kg IV. HR, systolic BP, diastolic BP were recorded at the time of giving reversal. When patients' respirations were spontaneous and regular and patients were able to obey simple commands, suctioning and extubation was done. HR, systolic BP and diastolic BP were recorded at the time of extubation and thereafter at 1, 5, 10, 15 minutes after extubation. Occurrence of any event like laryngospasm, bronchospasm, desaturation, respiratory depression, vomiting, hypotension, bradycardia or undue sedation was noted.

Quality of extubation was evaluated based on coughing immediately after extubation, using a 5-point rating scale (Extubation Quality Score). 1 = no coughing, 2 = smooth extubation, minimal coughing (1 or 2 times), 3 = moderate coughing (3 or 4 times), 4 = severe coughing (5-10 times) and straining, 5 = poor extubation, very uncomfortable (laryngospasm and coughing>10 times). Postoperative sedation was evaluated on a 6-point scale.

An observation was made related to adverse effects of drugs and anaesthesia related problems and were attended appropriately. Bradycardia was defined as heart rate less than 60 per minute and was corrected with IV atropine 0.6 mg IV when heart rate went below 50 per minute. Hypotension was defined as a decrease in mean arterial pressure of less than 60 mmHg and was corrected with IV fluids and if required, with small dose of mephentermine 3 mg IV.

Statistical Analysis

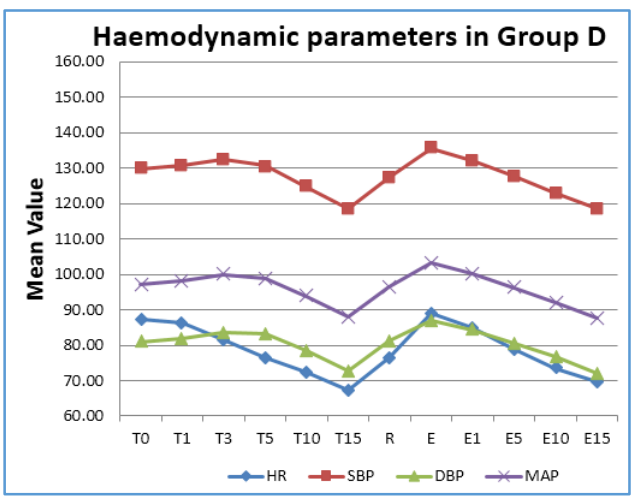
Descriptive data presented as Mean ± SD and in percentage. Pair wise comparison between the groups was done by Student's unpaired t-test. For Qualitative Data Chi-Square test was used. Fisher's exact test was used to determine p value of frequency of complications. For all tests p value of less than 0.05 was considered significant. Microsoft Excel and Microsoft Word have been used to generate graphs and tables.

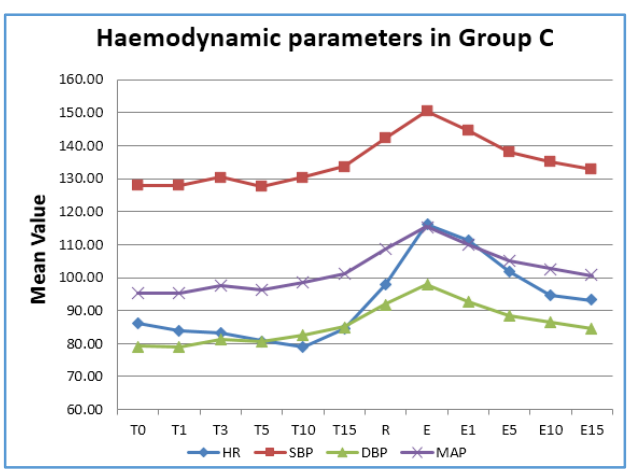
RESULTS

1. Demographic Profile of the Two Groups-

	Study	Control
Age	34.98 ± 8.77	34.22 ± 10.07
Weight	58.08 ± 6.00	58.08 ± 6.00
Sex	Male =35%, Female=65%	Male=33.33%, Female=66.67%
ASA I and II		I and II

2. Graphs Showing Haemodynamic Parameters





Extubation Quality Score	Group D		Group C	
	n	% in Group	n	% in Group
1	0	0	0	0
2	44	73.33	23	38.33
3	16	26.67	37	61.67
4	0	0	0	0
5	0	0	0	0
Total	60	100	60	100

3. Table Showing Extubation Quality Score

In this study, 73.33% patients in group D could be extubated smoothly with minimal coughing (Extubation quality score 2), whereas 26.67% patients showed moderate coughing, (Extubation quality score 3). 38.33% patients in group C could be extubated smoothly (Extubation quality score 2) whereas 61.67% showed moderate coughing, (Extubation quality score 3) in group C. So, Dexmedetomidine facilitates a smooth extubation compared with the control group.

Ramsey Sedation Score	Group D		Group C	
	Number	% in Group	Number	% in Group
1	0	0	4	6.66
2	9	15.00	46	76.67
3	51	85.00	10	16.67
4	0	0	0	0
Total	60	100.00	60	100.00

4. Table Showing Ramsey Sedation Score

Adverse Effect	Group D		Group C		P Value	Significance
	n	% in Group	n	% in Group		
Bradycardia	6	10.00	2	3.33	0.2790	NS
Nausea	2	3.33	2	3.33	1.000	NS
Vomiting	1	1.67	2	3.33	1.000	NS

5. Table Showing Adverse Effects

In group D, 6 patients developed bradycardia as compared to 2 patients in the control group, which is statistically not significant. 2 patients in group D and group C developed nausea. Two patients in group C had vomiting and one patient in group D had vomiting. It is not statistically significant.

DISCUSSION

There are many adverse changes of haemodynamic and airway following tracheal extubation. Numerous strategies have been used to prevent haemodynamic responses caused by emergence from anaesthesia including extubation under deep anaesthesia, administration of local anaesthetics, vasodilators and short-acting opioids.[22] Administering vasodilators such as sodium nitroprusside, nitroglycerin, and hydralazine could be associated with complications like reflexive tachycardia and increase in the plasma renin activity.[23]

Dexmedetomidine may be useful as an effective agent for blunting the adverse haemodynamic and recovery response to tracheal extubation.

Dexmedetomidine has been used in different doses in different studies for blunting the adverse haemodynamic and recovery response to tracheal extubation. The dose varied over a wide range in different studies. Most workers used intravenous dexmedetomidine in the range of 0.5-1 mcg/kg body weight. However, Bindu b et al[21] used a dose 0.75 mcg/kg, same as our study.

Dexmedetomidine is an alpha-2 agonist. It is the dextro–stereoisomer and active ingredient of medetomidine. It has seven to eight-fold higher affinities for alpha-2 receptors than clonidine.[24] Like other alpha-2-adrenergic agonists, it exerts sympatholytic effects by activating inhibitory alpha-2 receptors in both the central nervous system and the peripheral sympathetic nerve endings, inhibiting noradrenaline release.[25] The inhibition of sympathetic transmitter release can be measured in humans as a decline in the plasma concentration of noradrenaline.[26] Activation of the receptors in the brain and spinal cord inhibits neuronal firing, causing hypotension, bradycardia, sedation, and analgesia.[27]

IV bolus dexmedetomidine was very effective in attenuating these airway and haemodynamic reflexes without causing any untoward side effect or any other specific

complication.[28] Without interfering in recovery time, dexmedetomidine 0.5 mcg/kg administered 5 min. before the end of surgery stabilises haemodynamics, allows easy extubation, provides a more comfortable recovery and early neurological examination following intracranial operations.[15] Single-dose bolus injection of dexmedetomidine before tracheal extubation attenuates airway-circulatory reflexes during extubation.[16] DEX 1 mcg/kg over 10 minutes, prior to administration of reversal provided haemodynamic stability associated with extubation.[14] Dexmedetomidine 0.5 mcg/kg in 100 mL, administered 5 minutes before extubation, and was more effective in attenuating airway reflex responses to tracheal extubation and maintaining haemodynamic stability without prolonging recovery compared with fentanyl 1 mcg/kg IV in these patients undergoing rhinoplasty.[29]

In another study, dexmedetomidine was compared with lignocaine and normal saline in extubation and concluded that the use of dexmedetomidine was associated with less increase in HR as compared to lignocaine group, MAP was better controlled in the dexmedetomidine group than in lignocaine group and airway response was better controlled with the use of dexmedetomidine providing a smooth and easy tracheal extubation, thereby a more comfortable recovery and early neurological examination.[30] In another study, there was a significant decrease in MAP and HR in Dexmedetomidine group as compared to group Lignocaine and group Placebo ($p<0.05$) at all-time interval after extubation. Extubation quality score of the majority of patients was 1 in group DEX, 2 in group Lignocaine and 3 in group Placebo.[31]

In our study, most of the patients could be extubated smoothly with minimal coughing (Extubation quality score 2), whereas in control group most of the patients showed moderate coughing, (Extubation quality score 3). Dexmedetomidine facilitates a smooth extubation compared with the control group. This finding is similar to most of the above studies where they found dexmedetomidine facilitates a smooth extubation.

We compared the sedation profile of patients of both the groups on the basis of Ramsay Sedation Score. We found that most patients in dexmedetomidine group were drowsy but responding to verbal commands (Ramsay Sedation Scale 3) after extubation when compared to control group, where most patients belonged to Ramsay Sedation Scale 2. It is due to sedative and anxiolytic properties of dexmedetomidine.

The incidence of bradycardia was higher in group D compared to group C. 6 patients in group D developed bradycardia as compared to only 2 patients in the control group, but their p-value was insignificant. None required treatment as no patient had heart rate below 50 beats per minute. 2 patients in group D and group C developed nausea. Two patients in group C had vomiting and one patient in group D had vomiting. The incidence of PONV was almost similar in both the groups. None of the patients in either group had any of the other side effects like hypotension, respiratory depression, laryngospasm, bronchospasm or undue sedation.

CONCLUSION

Dexmedetomidine 0.75 mcg/kg administered 15 minutes before extubation stabilises haemodynamics and facilitates smooth extubation.

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