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Original Research Article

A Hospital-Based, Double Blind, Randomized, Controlled Assessment of the Effect of Dexmedetomidine on Hemodynamic Responses during Tracheal Extubation

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Abstract

Aim: To assess the efficacy of dexmedetomidine in attenuating hemodynamic responses and airway reflexes encountered during extubation.

Material & Methods: A hospital-based, double blind, randomized, controlled study was carried out to study the efficacy of dexmedetomidine in attenuation of hemodynamic response during tracheal extubation. Applying consecutive sampling technique, 80 patients of either sex, belonging to ASA physical grades I & II, 18-50 years old, posted to undergo surgery under general anesthesia, were enrolled for the study. The patients were then randomly assigned to two groups (40 in each group) using computer generated random numbers to receive injection dexmedetomidine or Normal saline (NS).

Results:80 patients posted for surgery under general anesthesia were randomly assigned to two groups (n=40) as follows and were observed to study the effect of IV dexmedetomidine for attenuation of hemodynamic responses and airway reflexes associated with extubation. Mean arterial pressure in Group 1 remained below baseline value (5%-6%) throughout the study period, whereas in Group 2 mean blood pressure remained above the baseline value (6%-18%), and this difference was statistically significant (p value <0.05). Group 1 patients had a smoother extubation as indicated by a lower score on the 'Extubation quality 5-point scale' compared to Group 2.

Conclusion: Dexmedetomidine 0.5 mcg/kg infusion given over 10 minutes prior to extubation, decreases hemodynamic responses and results in smooth extubation.

Keywords: Dexmedetomidine, extubation, hemodynamics

Introduction

Tracheal extubation is performed at the end of surgical procedure when the patient is fully awake and is able to protect his airway. Extubation may be associated with upper airway obstruction, laryngospasm, bronchospasm, tachycardia, hypertension and dysrrhythmias [1-3]. This may lead to complications like hypoventilation, pulmonary aspiration, wound disruption, pulmonary edema, increase in plasma concentrations of catecholamines, rise in intracranial and intraocular pressures and

myocardial ischemia in susceptible individuals [3-7].

A smooth extubation without straining, movement, laryngospasm or coughing helps in avoiding these complications. Another problem upon emergence from general anesthesia is emergence delirium which is significantly related to the anesthetic agents used and the duration of the procedure. This may lead to injuries, pain, hemorrhage, self extubation and removal of catheters [9, 10].

Dexmedetomidine, a comparatively newer drug, shows a high ratio of selective α-2 receptor activity (α2/α1 1600:1), making it a complete α-2 agonist. It possesses sedative, anxiolytic and analgesic actions, but does not significantly affect patient arousability and respiratory function. Studies suggest that it can attenuate stress response to intubation in a dose-dependent manner. [11] However very few studies are available with regard to attenuation of hemodynamic response to extubation using dexmeditomidine.

This study was conducted to assess the efficacy of dexmedetomidine infusion, 0.5µg/ kg body weight, administered prior to extubation, in attenuating the hemodynamic responses and airway reflexes associated with reversal and extubation. Side effects of the drug, if any, were recorded.

Material & Methods:

A hospital-based, double blind, randomized, controlled study was carried out to study the efficacy of dexmedetomidine in attenuation of hemodynamic response during tracheal extubation. Applying consecutive sampling technique, 80 patients of either sex, belonging to ASA physical grades I & II, 18-50 years old, posted to undergo surgery under general anesthesia, were enrolled for the study. Patients with co-morbidities like cardiovascular or respiratory diseases, diabetes, obesity, hypertension, and those taking medications that have an effect on the cardiovascular system were not included in the study. Pregnant patients and currently lactating women were also excluded from the study. Other exclusion criteria included difficult airway, history of sleep apnea and patients taken up for emergency procedures.

The patients were then randomly assigned to two groups (40 in each group) using computer generated random numbers to receive injection dexmedetomidine or Normal saline (NS).

This was a double blinded study i.e. the patient as well as the investigator (anesthesiologist recording the data) were blinded and hence, were unaware of the group the patient belonged to. Patients were interviewed and examined one day before surgery. Thorough preoperative assessment and relevant investigations as per case record form (complete blood count, liver function tests, renal function tests, blood sugar, ECG and X-ray chest) were done. No hypnotic medications were given to the patients on the night before surgery.

On the morning of surgery, after taking written informed consent, patients were shifted to the operation theatre. Standard ASA (American Society of Anaesthesiologist's) monitors were attached to record vital parameters like Electrocardiography (ECG), Oxygen saturation (SpO_2), Non-invasive blood pressure (NIBP) and End-tidal carbon-dioxide ($EtCO_2$). Baseline parameters were recorded. Intravenous (IV) access was secured with a

20G cannula and an infusion of Ringer's lactate, at the rate 10-15ml/kg, was started.

Patients were preoxygenated with 100% oxygen for 3min and premedicated with injection glycopyrolate 0.2mg, injection ondansetron 4mg, injection midazolam 1mg and injection fentanyl 2µg/kg intravenously.

They were induced with injection thiopentone sodium 4-5mg/kg or injection propofol 2mg/kg IV and neuromuscular blockade was achieved with injection atracurium besylate 0.75mg/kg or injection vecuronium bromide 0.1mg/kg IV. Laryngoscopy was done after 3mins of giving muscle relaxant and intubation achieved with 8.0 - 8.5mmID cuffed endotracheal tube for males and 7.0 - 7.5mmID for females. Correct placement of the tube was confirmed by auscultation and square wave capnography.

Anesthesia was maintained with a mixture of nitrous oxide: oxygen (50:50) with isoflurane (0.8- 1.2%) and incremental doses of inj. atracurium/ inj. vecuronium, using closed circuit with mechanical ventilation while maintaining the $EtCO_2$ within normal limits.

Twenty minutes prior to the expected time of extubation, isoflurane was discontinued, and patients were randomly allocated to one of the following two groups in a double-blind manner. The study drugs, either dexmedetomidine or Normal saline were given according to the group allocation.

Group 1(n = 40): received a bolus of IV dexmedetomidine, 0.5µg /kg body weight, diluted to 20 ml with NS, over 10 minutes with the help of a syringe pump and Group **2 (n = 40):** received IV Normal Saline 20 ml, over 10 minutes with a syringe pump.

The time of starting the study drug was recorded. Heart rate, systolic, diastolic and mean arterial blood pressure, and oxygen saturation (SpO_2) were noted prior to infusion and at 1min, 3min, 5min, 7min and 10 minutes after starting infusion of the study drug / normal saline.

At the termination of the study drug infusion, nitrous oxide was discontinued. When patients regained adequate spontaneous respiratory efforts, the remaining neuromuscular blockade was reversed with inj. neostigmine 0.05mg/kg and inj. glycopyrrolate 8µg/kg IV. Oropharyngeal secretions were cleared by gentle suction. Above mentioned hemodynamic parameters and SpO_2 were again recorded at the time of reversal.

Patients were extubated, on fulfilling the extubation criteria, which are, as follows. [12]

1. Sustained head lift for more than 5 seconds.
2. Sustained hand grip for more than 5 seconds.
3. Adequate level of consciousness.
4. Maximum inspiratory pressure ≥ 40 to 50 cm H_2O.

A 5-point scale was used to rate quality of extubation, as follows:

1. No coughing
2. Smooth extubation, minimal coughing
3. Moderate coughing (3 or 4 times)
4. Severe coughing (5 to 10 times) and straining
5. Poor extubation, very uncomfortable (laryngospasm and coughing >10 times)

Other criteria noted were:

Time to eye opening i.e. interval between cut-off of nitrous oxide to eye opening.

Time to extubation i.e. the interval between cut-off of nitrous oxide to extubation.

Occurrence of number of coughs per patient was recorded for 15mins post-extubation. Any untoward effects like laryngospasm, bronchospasm or desaturation over a period of 15mins following extubation were noted.

Above monitoring parameters HR, SBP, DBP, MAP and SpO_2 were recorded again after extubation, and at 1min, 3mins, 5mins, 7mins, 10mins, 13mins and 15mins after extubation.

After extubation, quality of sedation was assessed by Ramsay Sedation Scale, as given below: [13]

1. Anxious and agitated, restless.
2. Co-operative, oriented, tranquil.

3. Responsive to verbal commands, drowsy.
4. Asleep, responsive to light stimulation.
5. Asleep, slow response to stimulation.
6. No response to stimulation

Possible adverse effects such as bradycardia, tachycardia, arrhythmias, hypotension, hypertension, vomiting and dry mouth during the administration of dexmedetomidine infusion and in the postoperative period, were recorded and treated as follows:

Bradycardia (HR<45/min): inj. atropine (0.5mg IV) Tachycardia (HR ≥ 160/min, lasting longer than 3min): Beta (β) blockers –inj. metoprolol IV, in titrated dose.

Hypotension (decrease in diastolic pressure >25% of the baseline, or an absolute systolic value <90mmHg): IV. Pain was assessed every 3min for 15mins, according to Visual Analogue Scale (VAS). Rescue analgesia was provided with inj. paracetamol.

Ethical Justification and Statistical Analysis

Ethical clearance for conducting the study was obtained from the Ethics Review Committee of the institute. This study was ethically justified as all the drugs used in management of patients for general anesthesia are described in the available literature and universally dispensed to such patients.

Data was analyzed using SPSS 20.0 (SPSS Inc., Chicago, IL, USA). We used the Chi square test or Fisher's exact probability test for categorical data and Student's t test. A p-value < 0.05 was considered to be statistically significant.

Results:

80 patients posted for surgery under general anesthesia were randomly assigned to two groups (n=40) as follows and were observed to study the effect of IV dexmedetomidine for attenuation of hemodynamic responses and airway reflexes associated with extubation.

Group 1 received 0.5µg /kg body weight bolus of dexmedetomidine, diluted to 20 ml in Normal saline, intravenously over a period of 10 minutes with the aid of a syringe pump whereas Group 2 received Normal saline, 20 ml, over 10 minutes with syringe pump.

All the patients in both the groups were matched in terms of age, sex, ASA physical grade and weight of the patients.

The patients were comparable in terms of ASA grade (p=1.00). [Table 1]

All the patients in both the groups were in the age group of 18 - 50 years. The mean age of patients in Group 1 was 32.72 ± 8.02 years; in Group 2, it was 31.55 ± 8.77 (p =0.7921). [Table 2]

Mean arterial pressure in Group 1 remained below baseline value (5%-6%) throughout the study period, whereas in Group 2 mean blood pressure remained above the baseline value (6%-18%), and this difference was statistically significant (p value <0.05). [Graph 1]

Group 1 patients had a smoother extubation as indicated by a lower score on the 'Extubation quality 5-point scale' compared to Group 2 [Table 3].

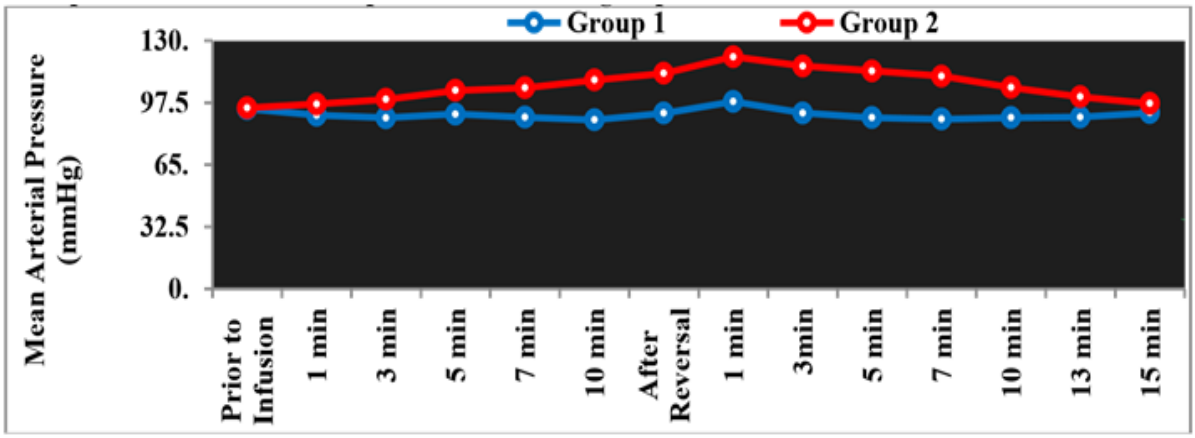
On assessment of the patients in the two groups by Ramsay Sedation Scale, patients receiving dexmedetomidine were found to be calm, peaceful, sedated but rousable at extubation and also post-extubation at 3,5,7,10,13 and 15 minutes [Table 4]. In comparison, patients in the control group were cooperative and oriented but restless.

Table 1: Distribution of ASA grading in the two groups studied

ASA Grade	Group 1 (Dexmeditomidine)		Group 2 (Normal Saline)	
	No. of patients	Percentage (%)	No. of patients	Percentage (%)
Grade I	32	80	30	75
Grade II	08	20	10	25
Total	40	100	40	100

Table 2: Distribution of age in two groups

Age (years)	Group 1(Dexmeditomidine)		Group 2 (Normal Saline)	
	No. of patients	Percentage (%)	No. of patients	Percentage (%)
18-20	03	7.5	04	10
21-30	19	47.5	18	45
31-40	10	25	08	20
41-50	08	20	10	25
Total	40	100	40	100
Mean ± S.D.	32.72 ± 8.02		31.55 ± 8.77	



Graph 1: Comparison of Mean Arterial Pressure in two groups

Table 3: Comparison of extubation parameters of two groups

	Group 1 (Dexmeditomidine)	Group 2 (Normal Saline)	*p*-value
Time to extubation (in mins)	17.33 ± 3.48	15.62 ± 1.90	<0.0001
Time to eye opening (in mins)	15.40 ± 2.71	12.81 ± 1.86	<0.0001
Extubation quality 5-point scale	1.21 ± 0.39	1.63 ± 0.84	<0.0006
No. of bouts of cough/patient	0.54 ± 0.13	1.77 ± 1.18	<0.0001

Table 4: Comparison of Ramsay sedation scale in two groups studied.

	Ramsay Sedation Scale	Group 1 (Dexmedetomidine)	Group 2 (Normal saline)	*p* value
P1	Post-extubation at 1min	2.12 ± 0.30	1.00 ± 0.00	<0.0001
P2	Post-extubation at 3min	2.15 ± 0.33	1.09 ± 0.23	<0.0001
P3	Post-extubation at 5 min	2.24 ± 0.32	1.04 ± 0.16	<0.0001
P4	Post-extubation at 7 min	2.02 ± 0.00	1.02 ± 0.17	<0.0001
P5	Post-extubation at 10 min	2.01 ± 0.00	1.00 ± 0.00	<0.0001
P6	Post-extubation at 13 min	2.13 ± 0.32	1.02 ± 0.18	<0.0001
P7	Post-extubation at 15 min	2.00 ± 0.00	2.05 ± 0.18	0.5290

Discussion:

Tracheal extubation may be followed by several respiratory complications (e.g., laryngospasm, airway obstruction, and desaturation). [14] Because the nose is newly reconstructed in rhinoplasty, ventilation using a face mask can be difficult and might change the shape of the nose, requiring ventilation via tracheal intubation. Therefore, coughing, straining, and laryngospasm are especially undesirable with this surgery. Subcutaneous emphysema has been reported after rhinoplasty when air was pumped through the lateral osteotomy incision during ventilation using a face mask. [15] If the trachea can be extubated while the patient is still deeply anesthetized, these prevalences can be alleviated. [16] In nonfasting patients or patients who have gastroesophageal reflux disease, this technique may not be applicable because of the risk for aspiration. [17]

In a study by Guler et al [18], 3.33% of patient had bradycardia and 10% of patient had hypotension in dexmedetomidine group compared to none in placebo group. In their study, all the patients were premedicated with atropine. Increased incidence of bradycardia (52%) in the study by Bindu B. et al [19] could be due to increased dose of dexmedetomidine (0.75 mcg/kg). Dexmedetomidine induced reduction of heart rate and blood pressure is mainly dose dependent. Dutta D. et al [20] observed no incidence of bradycardia and hypotension in their study with the use of dexmedetomidine 0.3 mcg/kg. In their study they have premedicated all the patients with Glycopyrrolate 0.2mg.

Jain D et al in their study, where the blood pressure did not change significantly throughout the study period in the patient group receiving dexmedetomidine in a dose of 1µg/kg; on the other hand, significant rise in systolic blood pressure was noted ($p<0.05$) following extubation in the control group. [21] In the study by Guler G et al, diastolic blood pressure increased significantly in both dexmedetomidine and control groups during extubation, [22] but it was significantly lower in dexmedetomidine group than in control group at all times starting from 5 min after the drug administration. [18]

Conclusion:

Dexmedetomidine 0.5 mcg/kg infusion given over 10 minutes prior to extubation,

decreases hemodynamic responses and results in smooth extubation. It provides adequate sedation while maintaining patient's arousability and also delays the need for analgesia in the post-operative period.

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