Section: Anesthesiology

Original Research Article

COMPARISON OF VARYING DOSES OF DEXMEDETOMIDINE TO ATTENUATE EXTUBATION RESPONSE IN ADULT PATIENTS UNDERGOING GENERAL ANAESTHESIA

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Abstract

Background: Extubation of the trachea is the process of discontinuing an artificial airway when the necessities for its use, such as protection and maintenance of the airway and ventilation, are corrected. This study aimed to compare the effects of varying doses of dexmedetomidine on airway reflexes and haemodynamic responses during tracheal extubation in patients undergoing surgery under general anaesthesia. **Materials and Methods:** This prospective randomized double-blinded study was conducted on 60 patients at K.A.P.V Government Medical College & Mahatma Gandhi Memorial Government Hospital, Trichy from January 2020 to September 2021. Two groups received dexmedetomidine infusions 15 minutes before the expected last surgical suture: Group D1 with 0.5 mcg/kg and Group D2 with 0.75 mcg/kg, both administered over 10 minutes in 100 ml of 0.9% normal saline. The initial parameters were recorded during drug administration and after extubation. Postoperative sedation was assessed using a 3.0 scale, and adverse effects were recorded. **Result:** In groups D1 and D2, statistical significance was observed in mean heart rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, and extubation quality after 1 min, 5 min, 10 min, 15 min, and after extubation ($p>0.05$). There were no statistically significant differences between the two groups in terms of age, weight, SPO2, and respiratory rate ($p<0.05$). Incidence of bradycardia was common in both groups. **Conclusion:** Dexmedetomidine 0.75 µ/kg administered before tracheal extubation was more effective in maintaining hemodynamic stability, facilitated smooth tracheal extubation and had a better quality of recovery as compared to dexmedetomidine 0.5 µ/kg administration.

INTRODUCTION

Extubation of the trachea is the process of discontinuing the artificial airway when the necessities for its use, such as the protection and maintenance of the airway and ventilation, are corrected. Endotracheal extubation involves the translaryngeal removal of a tube from the trachea via the nose or mouth. It is one of the most uncomfortable states during general anaesthesia. It is well known that after tracheal extubation, there is an increase in arterial blood pressure and heart rate associated with an increase in the plasma concentrations of both noradrenaline and adrenaline. Tracheal extubation during lighter planes of anaesthesia or sedation can stimulate reflexes by laryngeal and tracheal irritation. Laryngopharyngeal stimulation is associated with a reflex increase in sympathetic activity, leading to changes in the haemodynamic profile.

These haemodynamic changes are reflected as an increase in heart rate and arterial blood pressure, and are usually variable, transitory, and unpredictable. It is more dangerous in patients with systemic hypertension, heart disease, intracranial aneurysms, cerebrovascular disease, and other comorbidities. Transient changes in arterial blood pressure and heart rate can result in potentially deleterious effects, such as cerebral haemorrhage, cardiac arrhythmias, myocardial ischaemia, left ventricular failure, pulmonary oedema, and rupture of intracranial aneurysms. For smooth endotracheal extubation, the patient should not have any straining, coughing, bucking, breath-holding, laryngospasm, or bronchospasm.

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Different techniques and drugs have been tried to attenuate stress responses and airway responses during tracheal extubation. However, none of these methods have been completely successful. Many trials have been conducted to attenuate haemodynamic and airway responses during tracheal extubation using various drugs, such as inhalational agents, opioids, local anaesthetics, vasodilators, alpha-blockers, beta-blockers, and calcium channel blockers. Studies have been carried out using fentanyl, sevoflurane, lignocaine, propofol, magnesium sulphate, nitroglycerine, clonidine, esmolol, labetalol, metoprolol, verapamil, nicardipine, diltiazem, etc., either as a sole agent or in combination with each other with this background.

Aim

This study aimed to compare the effects of varying doses of dexmedetomidine on airway reflexes and haemodynamic responses during tracheal extubation in patients undergoing surgery under general anaesthesia.

MATERIALS AND METHODS

This prospective randomized double-blinded study was conducted on 60 patients undergoing surgery under GA at K.A.P.V Government Medical College & Mahatma Gandhi Memorial Government Hospital, Trichy from January 2020 to September 2021. The study was approved by the institutional ethics committee before initiation, and informed consent was obtained from all patients.

Inclusion criteria:

Patients with ASA physical status 1 and 2 and men and women aged between 20 and 60 years who underwent surgery under GA were included.

Exclusion criteria:

Patients aged < 20 years and > 60 years, those who were haemodynamically unstable, those with cardiorespiratory disorders (medications that affect heart rate), and those with a history of sleep apnoea were excluded.

The preanesthetic assessment of the patient was performed with a complete history, physical examination, and routine investigations. The age, weight, height, and body mass index of the patients were recorded. All patients were premedicated with Inj glycopyrrolate 0.2 mg IV, Inj midazolam (1 mg), IV Inj ranitidine (50 mg), and IV Inj metoclopramide (10 mg). Monitoring in the operating theatre included pulse oximetry, non-invasive blood pressure, five-lead electrocardiogram, and capnography. Preoxygenation was performed with 100% oxygen for three minutes.

The patient was induced with Inj fentanyl 2mcg/kg, Inj propofol 2 mg/kg, Inj rocuronium 1 mg/kg and endotracheal intubation was performed. Anaesthesia was maintained with nitrous oxide and oxygen at a ratio of 2:1, along with sevoflurane 2–2.5%. Intravenous rocuronium was repeated at a dose of 10 mg to maintain muscle relaxation, and end-tidal carbon dioxide was maintained between 35-40 mmHg. Normal saline and Ringer's lactate were used for volume replacement and maintenance. The patients were categorised into two groups using the sealed envelope method. Sevoflurane was removed from both groups before drug administration.

Group D1 - dexmedetomidine (0.5 mcg/kg)- received dexmedetomidine infusion of 0.5 mcg/kg in 100 ml of 0.9% normal saline administered 15 minutes before the expected last surgical suture over 10 minutes. Group D2 - dexmedetomidine (0.75 mcg/kg)- received dexmedetomidine infusion of 0.75 mcg/kg in 100 ml of 0.9% normal saline administered 15 minutes before the expected last surgical suture over 10 minutes.

Reversal from neuromuscular blockade was performed using Inj. glycopyrrolate at 20 mcg/kg and Inj. neostigmine 50 mcg/kg. The trachea was extubated when spontaneous breathing efforts were adequate and the patient obeyed commands. Initial parameters, such as heart rate, systolic arterial blood pressure, diastolic arterial blood pressure, and mean arterial pressure, were documented in both groups during the time of drug administration and at 1, 5, 10, and 15 min after extubation. The extubation response was analysed on a five-point scale (extubation quality score) based on the patient's comfort and response.

The extubation quality score evaluated the smoothness of extubation as follows: 1, no cough, 2 signifies smooth extubation with minimal coughing (1 or 2 times), 3 represents moderate coughing (3 or 4 times), 4 denotes severe coughing (5-10 times with straining); and 5, poor extubation with significant discomfort, including laryngospasm and more than ten instances of coughing.

The postoperative sedation level was analysed using a 3.0 scale: 1 indicates the patient is awake and alert, 2 signifies the patient responds to voice, and 3 denotes that the patient is not aroused. Any adverse effects such as respiratory depression, delayed arousal, and bradycardia were recorded.

Statistical analysis:

All data analyses were performed using the computer software SPSS for Windows. All data collected were compared using an independent t-test, and a p-value < 0.05 was considered statistically significant.

RESULTS

In group D1, 50% were male and 50% were female, whereas in group D2, 46.7% were male and 53.3% were female. There was no statistically significant difference in gender distribution between study groups D1 and D2 (p=0.796). The mean age in group D1 was 40.17±9.72 and the mean age in group D2 was 41.50±8.84 and was not statistically significant (p=0.580). The mean weight of group D1 was 59.64±5.44, and that of group D2 was 61.93±6.44 and is not statistically significant (p=0.142). The mean height in group D1 was 154.21±6.08, and the mean height in group D2 was 156.73±7.08, which was not statistically significant (p=0.144) [Table 1].

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Anthropological growth was observed in two patients (50%), with an equal distribution between the two groups (2 patients, 50%). Appendicitis was present in 1 patient (50%) in each group. Bilateral polyposis was noted in one patient (50%) per group. Calculous cholelithiasis was found in 9 patients (50%) in group D1 and 6 patients (50%) in group D2. The diagnoses in both groups were compared and found to be insignificant (p=1) [Table 2].

Cholecystectomy was performed in one patient (50%) in each group. Diagnostic laparoscopy was performed in 2 patients (50%) per group. Excision biopsy was performed in 1 patient (50%) in each group. Functional endoscopic sinus surgery (FESS) was also performed in one patient (50%) per group. Hemi-thyroidectomy was performed in two patients (50%) in each group. The procedures in both groups were compared and found to be insignificant (p=1) [Table 3].

The mean heart rates at baseline, at the time of drug administration, and 1, 5, and 10 min after drug administration in group D1 were 84.37±2.86, 83.80±10.11, 79.40±5.69, 77.93±8.60 and 76.70±5.86, respectively, and those in group D2 were 84.50±2.13, 82.27±5.11, 79.13±4.56, 74.97±4.87 and 74.80±6.85, respectively. The heart rate before extubation in both groups was statistically insignificant (p>0.05). Heart rates after reversal and extubation in both groups were statistically significant (p<0.05) [Figure 1]. The mean systolic blood pressure at baseline, at the time of giving drugs, 1 minute, 5 minutes, and 10 minutes after giving drugs in the group-D1 was 123.47 ± 5.14, 120.27 ± 1.08, 115.97 ± 9.91, 114.90 ± 6.11 and 112.85 ± 5.04 in the group-D2 it was 121.53 ± 8.92, 120.00 ± 6.73, 114.73±3.28, 113.00±8.13 and 111.03±4.25 respectively. Statistical analysis showed that the p-values for systolic blood pressure before extubation were 0.308, 0.831, 0.520, 0.816, and 0.978, respectively, which were statistically insignificant. The p-values for systolic blood pressure after reversal and extubation were 0.007, 0.012, 0.006, 0.011, and 0.006, respectively, which were statistically significant [Figure 2].

The mean diastolic blood pressure at baseline and at the time of drug administration in group D1 was 77.10±4.96, 77.00±7.16 and in group D2 it was 78.13±5.91, 76.70±7.28, respectively. The p-values for diastolic blood pressure before extubation were 0.466, and 0.068 which were statistically insignificant among the groups. Diastolic blood pressure after reversal and extubation was statistically significant in both groups (p <0.05) [Figure 3].

The mean arterial pressure at baseline, at the time of drug administration, and 1 min after drug administration in group D1 was 92.23±3.54, 92.90±4.72, 87.10±7.20 in group D2 was 92.27±5.93, 90.83±6.03, 84.43±2.67, respectively. The p-values of the mean arterial pressure before extubation were 0.979, 0.066, and 0.062, respectively, which were statistically insignificant. Mean arterial pressures after reversal and extubation were statistically significant among the groups (p<0.05) [Figure 4].

At baseline, the mean SPO2 values for group D1 was 99.37±0.49 and group D2 was 99.47±0.51. The mean SPO2 values, at the time of drug administration, remained the same as the baseline for both groups, with group D1 at 99.37±0.49 and group D2 at 99.47±0.51. The SPO2 of both groups was not significantly different (p =0.441) [Figure 5].

After the administration of the reversal agent, the mean SPO2 values were similar in both groups. One minute after extubation, the mean SPO2 for group D1 was 16.5±0.51, while group D2 had a mean SPO2 of 16.47±0.51. Five minutes after extubation, the mean SPO2 for group D1 remained at 16.5±0.51, and group D2's mean SPO2 was 16.47±0.51. Ten minutes after extubation, group D1 maintained a mean SPO2 of 16.5±0.51. In all comparisons, there were no significant differences between the groups (p=0.8) [Figure 6].

None of the patients had respiratory depression and delayed arousal. Two patients had bradycardia (heart rate < 60/min) in group D1 whereas seven patients had bradycardia in group D2. But none of them required intervention. The adverse effect was statistically significant among the groups (p=0.006). The sedation scores of both groups were compared and were found to be insignificant (p=1). The mean time to emergence and extubation in both groups was not significant (p=0.077 and p=0.359, respectively) [Table 4].

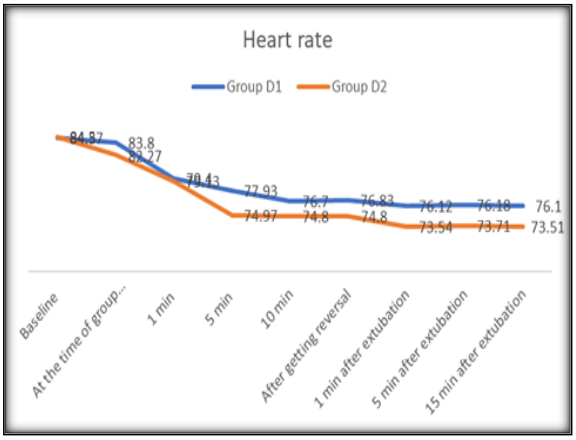

Figure 1: Comparison of heart rate at various times among groups

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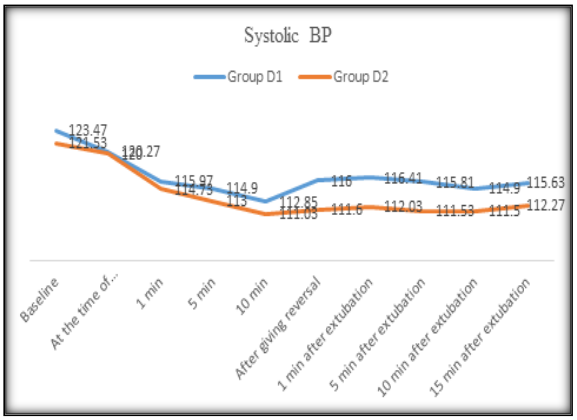

Figure 2: Comparison of systolic BP at various times among the groups

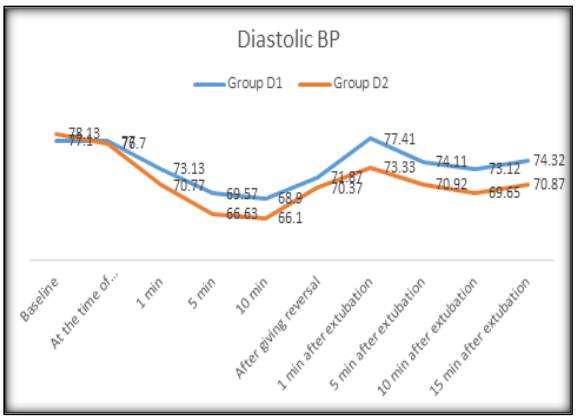

Figure 3: Comparison of diastolic BP at various times among the groups

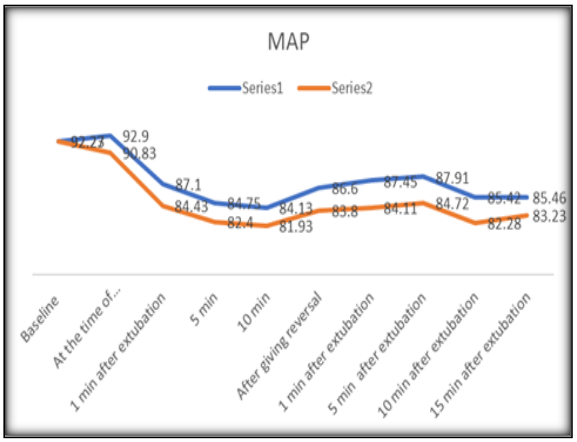

Figure 4: Comparison of MAP at various times among the groups

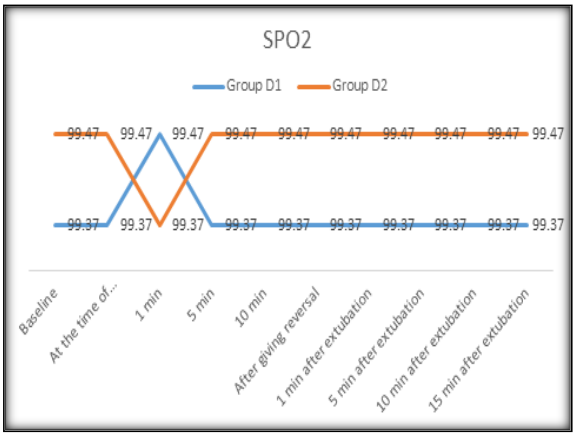

Figure 5: Comparison of SPO2 at various times among the groups

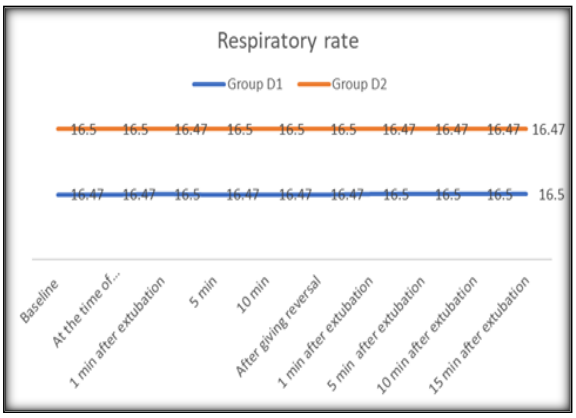

Figure 6: Comparison of respiratory rate at various times among the groups

Table 1: Demographic details of the study

		Group D1	Group D2	P-value
Gender	Male	15 (50%)	14 (46.7%)	0.796
	Female	15 (50%)	16 (53.3%)	
Age (mean)		40.17±9.72	41.5±8.84	0.58
Weight (mean)		59.64±5.44	61.93±6.44	0.142
Height (mean)		154.21±6.08	156.73±7.08	0.144
ASA	I	15 (50%)	14 (46.7%)	0.796
	II	15 (50%)	16 (53.3%)	

Table 2: Diagnosis details of the study

Diagnosis	Group D1	Group D2	P-value
Anthropologic growth	2 (50%)	2 (50%)	

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Appendicitis	1 (50%)	1 (50%)	1
Bilateral polyposis	1 (50%)	1 (50%)	
Calculous cholelithiasis	9 (50%)	6 (50%)	
Carcinoma breast	1 (60%)	1 (40%)	
Cholelithiasis	3 (50%)	3 (50%)	
Chronic suppurative otitis media	1 (50%)	1 (50%)	
Fibroadenoma	1 (50%)	1 (50%)	
Gynecomastia	3 (50%)	4 (50%)	
Multi nodular goitre	1 (49.90%)	1 (57.10%)	
Nonhodgkin lymphoma	1 (50%)	1 (50%)	
Phyllodes tumour	1 (50%)	1 (50%)	
Recurrent appendicitis	2 (50%)	4 (50%)	
Right inguinal hernia	1 (33.30%)	1 (66.70%)	
Solitary nodular goitre	30 (50%)	30 (50%)	

Table 3: Various procedures of the study

Procedure	Group 1	Group2	P-value
Cholecystectomy	1 (50%)	1 (50%)	1
Diagnostic laparoscopy	2 (50%)	2 (50%)	
Excision biopsy	1 (50%)	1 (50%)	
FESS	1 (50%)	1 (50%)	
Hemi thyroidectomy	2 (50%)	2 (50%)	
Laparotomy	2 (50%)	2 (50%)	
Laparoscopic appendicectomy	1 (50%)	1 (50%)	
Laparoscopic cholecystectomy	2 (50%)	4 (50%)	
Laparoscopic hernioplasty	3 (33.30%)	3 (66.70%)	
Mastoidectomy	9 (50%)	6 (50%)	
Total thyroidectomy	1 (42.90%)	1 (57.10%)	
websters procedure	1 (50%)	1 (50%)	
Wild local excision	30 (50%)	30 (50%)	

Table 4: Smoothness of extubation, sedation score, adverse effects, mean time to emergence and extubate of both groups

		Group D1	Group D2	P-value
Smoothness of Extubation	No coughing	4 (13.3%)	13 (43.3%)	0.003
	Minimal coughing	17 (56.7%)	17 (56.7%)	
	Moderate coughing	7 (23.3%)	0 (0%)	
	Severe coughing	2 (6.7%)	0 (0%)	
Sedation score	Awake and alert	27 (90%)	3 (10%)	1
	Response to voice	27 (90%)	3 (10%)	
Adverse effects	bradycardia	2 (6.7%)	7 (23.3%)	0.006
	Nil	28 (93.3%)	23 (76.7%)	
Mean time to emergence		3.06±1.79	3.97±2.06	0.077
Mean time to extubate		4.56±1.56	5.13±2.96	0.359

DISCUSSION

Tracheal extubation is associated with wide fluctuations in haemodynamics, which can lead to tachycardia, hypertension, and arrhythmia. It is also associated with a reflex increase in airway reactivity, leading to airway irritation. Dexmedetomidine is associated with control of these hemodynamic changes and stressful airway responses. **Rao and Haritha** compared the effects of dexmedetomidine with fentanyl in 60 patients of 30 in each group.[1] They found a statistically significant difference in heart rate beginning at 1 min, 5 min, 10 min, 15 min, and after extubation. In this study, the heart rate increased in both groups compared with the baseline values. However, the use of dexmedetomidine 0.75 µ/kg was associated with a lesser increase in heart rate compared to that of dexmedetomidine 0.5 µ/kg. The heart rate variations between dexmedetomidine 0.75 µ/kg and dexmedetomidine (0.5 µg/kg) were statistically significant from the time of extubation and continued after extubation until observations were recorded.

Rao and Haritha observed that the systolic blood pressure varied significantly between dexmedetomidine and fentanyl starting from 1 min after drug administration and continued until the observations were made.[1] In our study, the systolic blood pressure variations between dexmedetomidine D1 and D2 were statistically significant from the time of extubation and continued until the observations were recorded. So, dexmedetomidine 0.75 µ/kg controlled the systolic blood pressure better than dexmedetomidine 0.5 µ/kg. These findings are similar to those of the aforementioned studies.

Rao and Haritha observed that the diastolic blood pressure showed a statistically significant difference between dexmedetomidine and fentanyl starting from 1 min after drug administration which continued until the observations were made.[1] In this study, the diastolic blood pressure variations between dexmedetomidine D1 and dexmedetomidine D2 were statistically significant from the time of extubation and continued after extubation until the time of observation. Therefore, the findings are concurrent with those of the aforementioned study.

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Rao and Haritha observed that the mean arterial blood pressure varied significantly between dexmedetomidine and fentanyl groups starting from ten minutes after drug administration and continued until the observations were made.[1] In this study, the mean arterial pressure was elevated in both groups. It was observed that dexmedetomidine 0.75 µ/kg had a better control over mean arterial pressure as compared to that of dexmedetomidine 0.5 µ/kg and it remained statistically significant from the time of extubation till the observations were made. Therefore, these findings are similar to those of the aforementioned studies.

Rao and Haritha observed in their study that extubation quality was better in the Dexmedetomidine group.[1] 33% of patients in the group dexmedetomidine, had minimal cough, whereas 60% of patients had a moderate cough during extubation. In the fentanyl group, 50% of patients had a severe cough during extubation, whereas only 10% of patients had a minimal cough. In this study, 43.3% of the patients were extubated smoothly in the dexmedetomidine 0.75 µ/kg group with minimal cough, whereas only 13.3% of the patients were extubated smoothly in the 0.5 µ/kg group. Moreover, none of the patients in the dexmedetomidine 0.75 µ/kg group had a moderate cough, whereas 23.3% of the patients in the dexmedetomidine 0.5/kg group had a moderate cough during extubation. Hence, in this study, the quality of extubation is better with dexmedetomidine 0.75 µ/kg when compared with dexmedetomidine 0.5 µ/kg which is in concurrence with the study of **Bindu et al.**[2]

Rao and Haritha observed in their study that 93.3% of the patients in the dexmedetomidine group were awake and alert, whereas in the fentanyl group, 90% of the patients were oriented, cooperative and tranquil.[1] This study showed that the sedation score during extubation and the quality of sedation in the postoperative period were the same in both groups.

In the study conducted by **Rao and Haritha**, bradycardia occurred more frequently in the dexmedetomidine group than in the fentanyl group.[1] 3.3% of the patients in the dexmedetomidine group had bradycardia, whereas, in the fentanyl group, 0% had bradycardia, but treatment was not required in any of the patients. In this study, 6.7% of the patients in the dexmedetomidine 0.5 µ/kg group and 23.3% of the patients in the dexmedetomidine 0.75 µ/kg group developed bradycardia respectively, However, none of the patients required any intervention.

CONCLUSION

In conclusion, dexmedetomidine 0.75 µ/kg administered before tracheal extubation was more effective in maintaining hemodynamic stability, facilitated smooth tracheal extubation and had a better quality of recovery as compared to dexmedetomidine 0.5 µ/kg administration.

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