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EFFECTS OF DIFFERENT DEXMEDETOMIDINE DOSES ON HAEMODYNAMIC VARIABILITY DURING LARYNGOSCOPY AND INTUBATION: A RANDOMIZED DOUBLE-BLIND STUDY

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ABSTRACT

Background: Effective airway management is vital in anesthesiology for preserving patient lives. Laryngoscopy and endotracheal intubation, commonly used procedures, can lead to undesirable outcomes due to vagal activation and sympathoadrenal reaction. This double-blind, randomized interventional study aimed to assess the impact of two different doses of dexmedetomidine on heart rate and blood pressure during laryngoscopy and intubation, which often induce tachycardia and hypertension, particularly risky for patients with hypertension, myocardial insufficiency, and cerebrovascular disease.

Methods: Seventy-six participants, aged 20-60 years and classified as American Society of Anesthesiologists (ASA) Grade I & II, were enrolled after Institutional Ethics Committee approval. Random allocation assigned them to two groups: Group A (0.5 µg/kg dexmedetomidine) and Group B (1.0 µg/kg dexmedetomidine) before anesthesia induction. Hemodynamic measurements were recorded at various time points: pre- and post-drug administration, before intubation, and at intervals thereafter.

Results: Both groups exhibited similar age, weight, and gender distribution. Group B consistently demonstrated lower hemodynamic variables compared to Group A after laryngoscopy and intubation. Additionally, Group B required a smaller induction dose of propofol than Group A. No significant adverse effects were reported in either group during the study.

Conclusion: The study suggests that intravenous administration of dexmedetomidine at a rate of 1 µg/kg is more effective than 0.5 µg/kg in attenuating the physiological response to laryngoscopy and intubation. Moreover, it reduces the required propofol dose for anesthesia induction. These findings highlight the potential benefits of higher dexmedetomidine doses in mitigating adverse physiological effects during airway management procedures

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INTRODUCTION

Anaesthesiologists must carry out airway management as it is a crucial element in ensuring the patient can be ventilated [1]. Anaesthesiologists commonly use laryngoscopy & endotracheal intubation as their primary methods of airway management [2]. Even though these methods are regularly utilized, they can cause undesirable results due to afferent vagal stimulation and efferent sympathoadrenal response [3].

The stimuli generated by the process of intubation leading to a period of extreme hemodynamic stress which is accompanied by intense sympathetic activity [4]. Factors that may lead to hemodynamic changes during laryngoscopy and intubation include inadequate anesthesia, prolonged duration of the procedure, and elevation of the epiglottis due to the laryngoscope blade [5]. The physiological effects of laryngoscopy and intubation, such as tachycardia and hypertension, can have a lasting, yet varied, effect on individuals.

Generally, these effects cause minimal issues for healthy people, but for those with heart, circulatory, or cerebrovascular conditions, they can be dangerous. This response to laryngoscopy & intubation increases the risk to development of cerebrovascular accident, pulmonary edema and myocardial insufficiency [6,7]. The use of alpha-2 adrenergic agonists is becoming increasingly popular in clinical practice due to their ability to reduce the hemodynamic response to laryngoscopy and endotracheal intubation. These sympatholytic agents are known to be antihypertensive and negative chronotropic, which make them an effective option in managing the pressor response associated with these procedures.

Despite this, no single drug or combination of drugs has yet been proven to completely blunt the haemodynamic response [8]. Clinically available α2 adrenergic agonists, such as Clonidine and Dexmedetomidine, provide a range of additional benefits in addition to their agonist effects. These drugs are known to have sedative, anxiolytic and analgesic effects [9].

Clonidine and Dexmedetomidine are both known to act on α1 and α2 receptors, but Dexmedetomidine is more specific and selective as an α2 adrenoreceptor agonist, with a binding selectivity ratio of 1620:1 as compared to 220:1 for Clonidine [10].

This study aimed to explore the influence of two doses of intravenous dexmedetomidine (0.5µg/kg and 1µg/kg) on hemodynamic variables (HR, SBP, DBP, MAP, and SPO2) at the time of laryngoscopy and endotracheal intubation in a randomized, double-blind manner. The primary goal was to compare the two doses of dexmedetomidine, while the secondary objectives included analysing the effects of the induction dose of propofol and any related side effects.

METHODOLOGY

This research was conducted at a tertiary care teaching hospital and was approved by the Institutional Ethics Committee. It took place over a nine-month period from March 2022 to November 2022, and adhered to the Consolidated Standards of Reporting Trials (CONSORT) Guidelines as well as the ethical standards of the Indian Council of Medical Research (ICMR, 2017).

The study was a randomized, double-blind interventional one. Standard operating procedures (SOPs) of the Institutional Ethics Committee of Jhalawar Medical College (I.E.C.J.M.C) were strictly observed throughout the duration of the study. After obtaining written and informed consent, 76 patients aged 20-60 years with ASA Grade I & II were recruited for surgery and divided into two groups randomly. Group A (38 patients) received an infusion of 0.5 µg/kg of Inj Dex in 20 ml of normal saline over 10 minutes, while Group B (38 patients) was administered 1 µg/kg of Inj Dex in 20 ml of normal saline. Patients with anticipated difficult airway, cardiovascular disease, known drug allergy and any co morbidities were excluded from study. A pre-operative assessment was conducted the day before the surgery. The multi-parameter monitor was used to measure the patient's heart rate, SP02, NIBP, and ECG recording. Standard monitoring techniques were applied.

Group A received an intravenous infusion of 0.5µg/kg of Dexmedetomidine in 20mL of normal saline administered slowly over 10 minutes. In contrast, Group B had an intravenous infusion of 1µg/kg of Dexmedetomidine in 20mL of normal saline that was also delivered slowly over 10 minutes. The participants of the study were given the drug via infusion 10 minutes prior to the administration of anesthesia. Subsequently, the heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation were measured at both five and ten minutes after the infusion of the drug. Prior to the onset of the procedure, the patients were administered the

following medications intravenously: Glycopyrrolate (0.004mg/kg), Ondansetron (0.15 mg/kg), Midazolam (0.02 mg/kg), and Fentanyl (2 µg/kg). After preoxygenation with 100% oxygen for 3 minutes, induction was done using Propofol (1%) intravenously at the rate of 0.5ml/sec until the patient's eyelash reflex was eliminated. Succinylcholine (2mg/kg) was then injected intravenously, and positive pressure ventilation (IPPV) was initiated.

Finally, direct laryngoscopy and endotracheal intubation were performed. The presence of bilateral air entry was confirmed and the endotracheal tube was securely placed. During the procedure, oxygen and a mixture of 2-4% sevoflurane was administered. Intraoperatively, a loading dose of 0.5mg/kg of Atracurium and a maintenance dose of 0.1mg/kg was given. To ensure that the end-tidal carbon dioxide (EtCO2) was maintained between 35 to 45 mm of Hg, mechanical ventilation was employed. Upon completion of the surgery, neostigmine 0.05 mg/kg and glycopyrrolate 0.01mg/kg were administered intravenously as a reversal agent.

Vital signs were monitored regularly throughout the operation. Patients were carefully observed for one hour following surgery in the recovery room before being moved to the post-operative ward. During this time, any perioperative complications or side effects were noted and handled appropriately. For this study, the chi-square test and student t-test were used to compare categorical and quantitative data (mean and SD), respectively, between the two groups.

RESULT

Both the groups were comparable in view of demographical data (age, weight, & gender) in our study. Both groups were comparable in view of spo2 also.

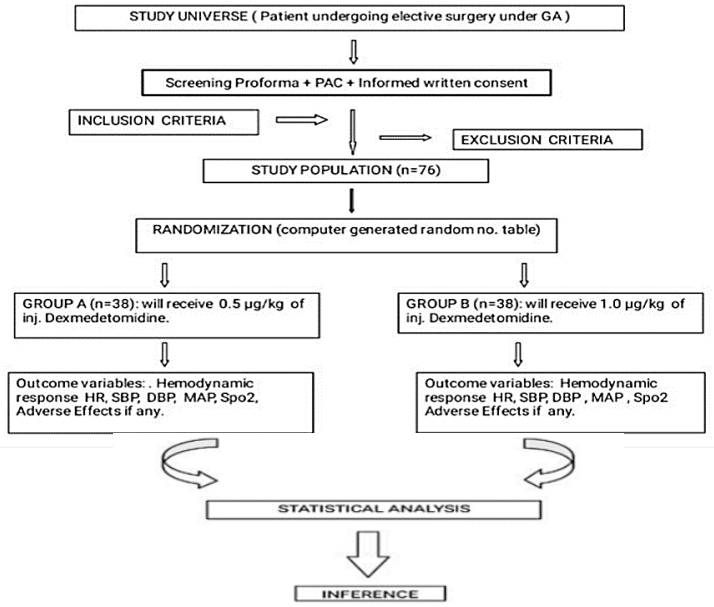

Table 1: Baseline parameters

Parameters	Group A	Group B	p value
Age	40.13±10.11	42.76±10.67	0.251 (NS)
Gender (M/F)	19/19	22/16	0.489 (NS)
Weight	64.05 ± 4.64	65.68 ± 4.72	0.133 (NS)

n=38, Mean ± SD

Baseline parameters in both groups (Age, weight and gender) were comparable in our study. No statistically significant difference was seen.

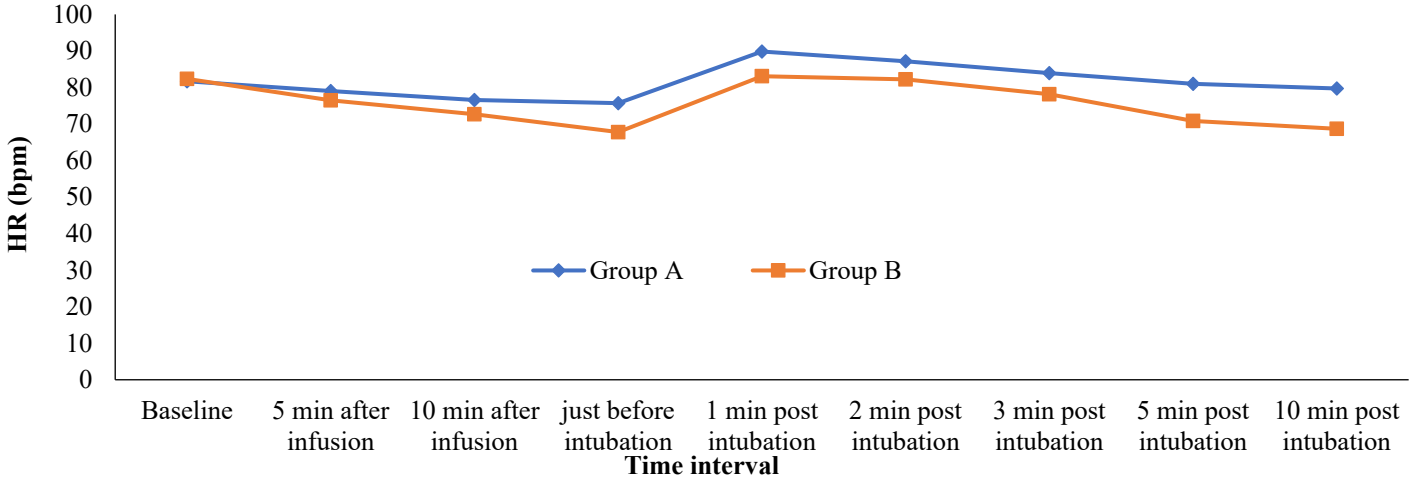

Fig 1: Mean Heart Rate (bpm) comparison in between Group A & Group B. Comparing Group A and Group B, the difference in Mean HR at baseline and 5 minutes after study drug infusion was found statistically non- significant (p value >0.05) while comparing Mean HR at10 mins after study drug infusion, & before intubation, 1 minute, 2 minutes, 3 minutes, 5 minutes and 10 minutes after intubation were found to be statistically significant (p<0.05).

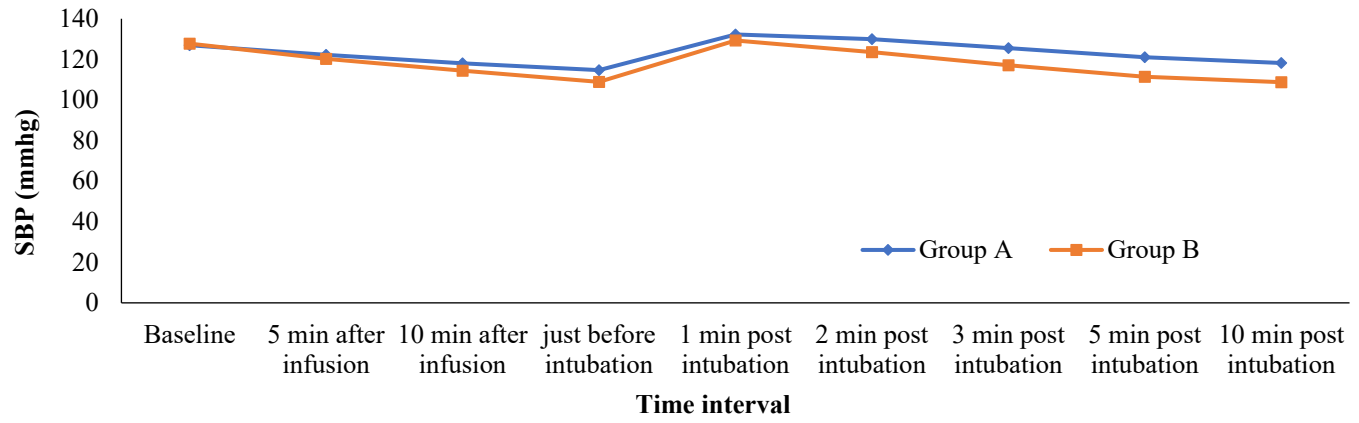

Fig 2: Systolic blood pressure (mm Hg) comparison in between Group A & Group B

Fig 2: shows that while comparing Group A & Group B, the difference in between Mean SBP at baseline and 5min after study drug infusion was found statistically non- significant (p value>0.05) while the difference in Mean SBP at 10 mins after study drug infusion, & before intubation, 1min, 2min, 3min, 5min & 10min after intubation were found statistically significant (p<0.05).

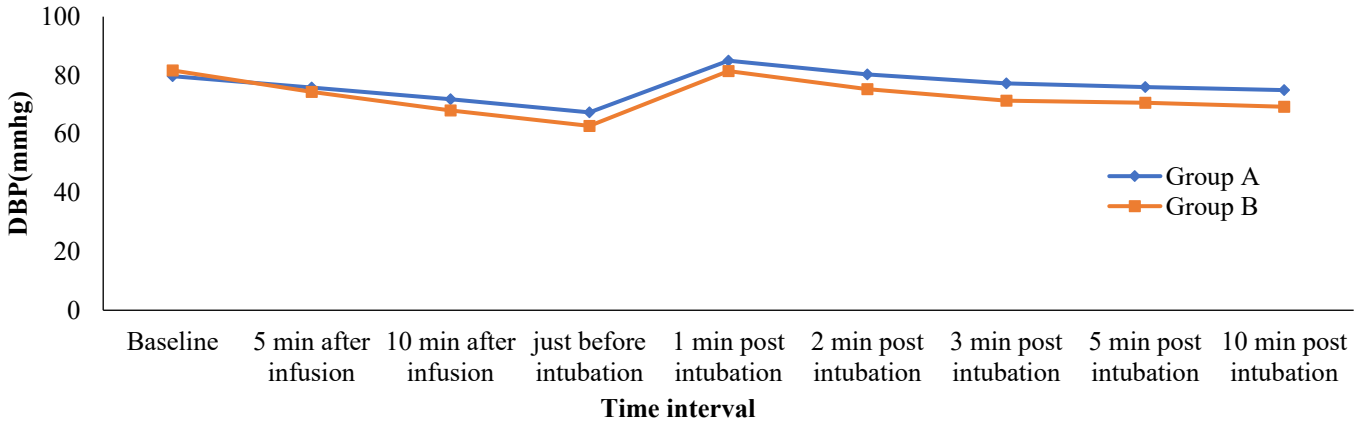

Fig 3: Diastolic blood pressure (mm Hg) comparison in between Group A & Group B

Fig 3 shows that while comparison of Group A & Group B the difference in Mean DBP at baseline and 5min after study drug infusion was found non- significant (p value>0.05) while the difference in Mean DBP at 10mins after study drug infusion, & before intubation, 1min, 2min, 3min, 5min & 10min after intubation were found statistically significant (p<0.05)

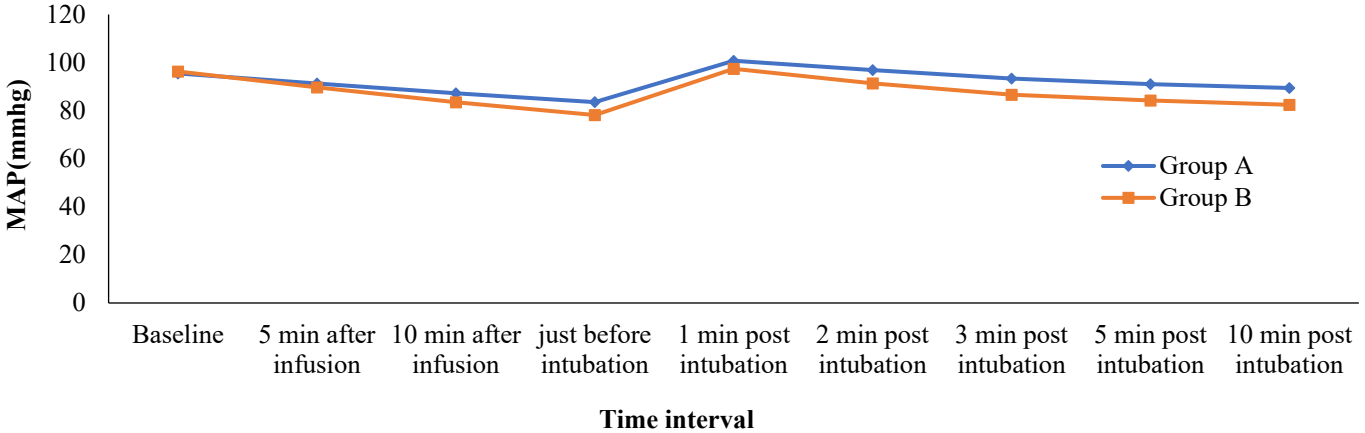

Fig 4: Mean arterial pressure (mm of Hg) comparison in between Group A & Group B

Fig 4: shows that while comparison of Group A & Group B. The difference in MAP at baseline and 5min after study drug infusion was found statistically non- significant (p value >0.05) while the difference in MAP at 10 mins after study drug infusion & before intubation, 1min, 2min, 3min, 5min & 10min after intubation were found statistically significant (p<0.05)

Table 2: IV Propofol (induction dose) comparison in between Group A & Group B

	Study Group		P value
	Group A (n=38)	Group B (n=38)	
Mean propofol ± SD	1.40 ± 0.08	1.32 ± 0.08	0.02(S)
Range	1.15-1.58	1.14-1.55	

Mean induction dose of iv propofol was lower in group B compare to group A ($p<0.05$)

Table 3: Comparison of side effects between the study groups

Parameters	Group A (n=38)	Group B (n=38)	P value
Bradycardia	0	1(2.63%)	1(NS)
Hypotension	1(2.63)	2(5.26%)	1(NS)
Nausea	0	0	0(NS)
Vomiting	1(2.63%)	1(2.63%)	1(NS)

Any of the side effects such as bradycardia, hypotension, nausea and vomiting were not significantly seen in both the groups

DISCUSSION

This research project aimed to evaluate the influence of different doses of dexmedetomidine on hemodynamic variables during laryngoscopy and endotracheal intubation. A total of 76 patients with ASA Grade I and II were enrolled and divided into two groups: Group A was administered 0.5 µg/kg of dexmedetomidine, and Group B was given 1.0 µg/kg of the medication before receiving anaesthesia. To assess the hemodynamic parameters, measurements were taken one, two, three, five and ten minutes after the direct laryngoscopy and intubation.

Baseline parameters: Our research demonstrated that age, weight, and gender were comparable among participants ($p>0.05$). Drug distribution, metabolism, excretion, action and dose of drug is changed according to patient's age weight and gender. Nevertheless, any slight changes in age, weight, and gender had no significant effect on the results.

Mean Heart Rate: Our study revealed no statistically significant difference between the baseline mean heart rates of Groups A and B ($P>0.05$). Group A's mean heart rate after laryngoscopy at 1,2,3,5 & 10 min were 85.74±4.09, 85.05±3.79, 83.32±3.73, 80.82±3.80, and 78.89±3.94, respectively. Meanwhile, Group B showed mean heart rates after laryngoscopy of 83.08±5.00, 82.18±4.78, 79.82±4.66, 77.42±4.69, 75.84±4.56 at the same time intervals. The analysis of the mean heart rates at different points of time after intubation revealed a lower rate among those in Group B when compared to Group A. This difference was determined to be statistically significant (p-value<0.05) for all points of time observed, which included 1 min, 2min, 3 min, 5min, and 10 min post-intubation. Smitha et al. (2014) [11], Silpa et al. (2020) [12], and Jatin et al. (2021) [13] reported similar results to what was observed in our study.

Mean Systolic Blood pressure: In this research, the mean systolic blood pressure was comparable between the two groups at baseline ($p>0.05$). The results of the study showed that after administering the drug, the mean SBP decreased for both groups. This difference was not statistically significant five minutes after the infusion, yet was significant ten minutes later and just prior to intubation. After laryngoscopy and intubation, the mean SBP increased in both groups with the mean SBP in Group B being lower than that of Group A, and statistically significant ($p<0.05$). Our study revealed comparable mean systolic blood pressure changes intraoperatively in the two groups in line with the research conducted by Bon Sebastian et al (2017) [14], Silpa et al (2020) [12], Smitha K et al (2014) [11], and Jatin B et al (2021) [13]. Moreover, Dhanchandra L et al (2019) [15] found that both doses of Dexmedetomidine (0.5µg/kg &0.75µg/kg) had the potential to reduce hemodynamic responses to laryngoscopy and intubation, with 0.75µg/kg being more effective than 0.5µg/kg, suggesting a dose-dependent effect of Dexmedetomidine.

Mean Diastolic Blood Pressure: The current study found no significant difference in the Baseline Mean diastolic blood pressure (DBP) between both groups ($p>0.05$). Five minutes post-infusion, the Mean DBP values were not statistically significant. But the values did become significant at 10 minutes pre-intubation. Comparing the Mean DBP between the two groups at all intervals after laryngoscopy and intubation, group

B had significantly lower values than group A ($p<0.05$). Similar observation was observed by Smitha et al (2014) [11], Silpa et al (2020) [12], Jatin et al (2021) [13] that the Dexmedetomidine 1µg/kg had a better control of blood pressure than Dexmedetomidine 0.5 µg/kg and significantly better than the control group.

Mean of mean arterial pressure: At the start of the study, no marked differences were observed in the mean arterial pressure (MAP) of the two groups ($p>0.05$). Following drug infusion, the MAP of both cohorts dropped. After 5 minutes of drug administration, no significant divergence in MAP values was found ($p>0.05$). Nevertheless, when evaluating the MAP values of both sets of participants at 10 minutes post drug infusion and just before intubation, the difference was statistically significant ($p<0.05$). Following laryngoscopy and intubation, the MAP values in both groups increased, with a highly significant difference between the two groups at all time points ($p<0.05$). Group B had a lower MAP than Group A. Smitha et al (2014) [11], Silpa et al (2020) [12], Jatin et al (2021) [13] all noted similar outcomes that coincide with our study. Dhanchandra L et al (2019) [15] also noticed comparable results indicating that both doses of Dexmedetomidine (0.5µg/kg & 0.75µg/kg) can reduce the hemodynamic reactions to laryngoscopy and intubation, however 0.75µg/kg has more hemodynamic stability than 0.5µg/kg, thus exhibiting a dose-dependent effect of dexmedetomidine.

Mean induction dose of propofol: The mean induction dose of propofol for Group A was 1.40 ± 0.08 mg/kg, and for Group B, 1.32 ± 0.08 mg/kg. A statistical analysis showed that there was a significant difference between the mean induction doses in the two groups (p value<0.05). This suggests that Group B requires a smaller amount of propofol than Group A. Neha Sharma et al (2018) [16] reported that the use of Dexmedetomidine resulted in a decrease of the induction dose of propofol. No serious side effects such as bradycardia, hypotension, or respiratory depression were seen in both groups. Bon Sebastian et al (2017) [14] similarly found no episodes of bradycardia, hypotension, hypertension, or respiratory depression in any of the patients in their study.

CONCLUSION

Our research indicates that 1µg/kg of Dexmedetomidine given through intravenous injection is more successful in moderating the hemodynamic parameters during direct laryngoscopy and intubation when compared to 0.5µg/kg. Furthermore, the induction dose of propofol is decreased when a higher dose of Dexmedetomidine is administered. Additionally, no significant side effects were recorded in either group, indicating that 1µg/kg Dexmedetomidine infusion is the superior option in terms of efficacy and safety. However, the study has its limitations, such as the lack of a control group and the absence of plasma catecholamine concentration and invasive blood pressure measurement, the results point to the superiority of 1µg/kg Dexmedetomidine infusion.

FINANCIAL ASSISTANCE

Nil

CONFLICT OF INTEREST

The authors declare no conflict of interest

AUTHOR CONTRIBUTION

Savita Meena and Kalyani took the initiative in formulating the study, conducting a literature review, creating the manuscript and gathering the data. Siddharth Sharma then performed the statistical analysis and all authors contributed to the proofreading and review of the final manuscript.

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