Ain-Shams Journal of Anesthesiology

ORIGINAL ARTICLE

Open Access

Efficacy of dexmedetomidine in attenuating pressor response to laryngoscopy and endotracheal intubation under bispectral index controlled anesthesia: a prospective randomized double-blinded study

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Abstract

Background Laryngoscopy and endotracheal intubation may lead to a remarkable hemodynamic pressor response. Dexmedetomidine, an α_2-adrenergic receptor agonist, can be effectively used to attenuate this pressor effect. This study was aimed to compare the efficacy of two different doses of dexmedetomidine (0.5 μg/kg and 1.0 μg/kg) in attenuation of hemodynamic pressor response to largyngoscopy and endotracheal intubation under bispectral index (BIS) monitoring. One hundred twenty adult patients with American Society of Anesthesiologists (ASA) physical status I or II posted for various elective surgeries under general anesthesia were enrolled to receive an intravenous (IV) infusion of dexmedetomidine 0.5 μg/kg (group D1; $n = 40$), 1.0 μg/kg (group D2; $n = 40$) or normal saline over 15 min (group C; $n = 40$). The primary outcome measure was to assess the hemodynamic changes while the secondary outcome measures were to assess sedation, dose of propofol required for induction and side effects.

Results The mean HR, SBP, DBP, and MAP remained significantly lower in both dexmedetomidine groups as compared to control group after study drug infusion, after induction, at and after intubation ($P < 0.05$). Group D2 also had significantly lower mean HR, SBP, DBP, and MAP in comparison to group D1 ($P < 0.05$). The induction dose of propofol was significantly less in dexmedetomidine groups as compared to control group ($P < 0.05$). Ramsay sedation scale (RSS) score was found to be significantly more in both groups D1 and D2 after study drug infusion ($P<0.001$). No significant difference was noted in incidence of side effects ($P = 0.907$).

Conclusions Dexmedetomidine (0.5 μg/kg and 1.0 μg/kg) was found to be effective in attenuating the hemodynamic pressor response to laryngoscopy and endotracheal intubation with BIS monitoring.

Trial registration CTRI, CTRI/2020/03/024088. Registered 19 March 2020.

Keywords Bispectral index, Dexmedetomidine, Endotracheal intubation, Hemodynamic pressor response, Laryngoscopy

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Background

A remarkable increase in sympathetic activity is generally noted during laryngoscopy and endotracheal intubation, which is noxious and deleterious stimuli. The proprioceptors in response to tissue irritation in the supraglottic region and trachea initiated these

stimuli. The glossopharyngeal and vagus nerves transmit impulses from these receptors to the brainstem which leads to increased hypothalamo-pituitary activity further resulting into increase in circulating plasma catecholamines. Although this transient response is of no consequence in healthy individuals but even short lasting stimulation may be detrimental for patients with associated co-morbidities like hypertension, ischemic heart disease, coronary artery disease, or cerebrovascular disease in terms of increased morbidity and mortality. (Shribman et al. 1987; Aleem et al. 2012).

This stress response has been reduced by several drugs and maneuvers (Joffe and Deem 2013) with varying benefits and side effects, which include technical considerations to minimize the stimulation of proprioceptors present in airway (Saghaei and Masoodifar 2001; Haidry et al. 2013), topical and regional anesthesia (Ganeshan et al.2020), inhalational anesthetic agents (Zbinden et al. 1994), non-anesthetic intravenous adjuvants and intravenous anesthetic (IV) agents (Hosalli et al. 2014).

A highly selective α_2-adrenergic receptor agonist, dexmedetomidine, with a α_2:α_1 specificity of 1620:1 can be effectively used in attenuating the pressor effect related to laryngoscopy and endotracheal intubation. Due to its action at presynaptic α_2-adrenergic receptors located at the locus coeruleus, it has sedative, hypnotic and antinociceptive properties. This results in blockade of norepinephrine release, inhibits sympathetic activity thus terminating the pain signals and thereby blunts the pressor response associated with laryngoscopy and endotracheal intubation (Tanskanen et al. 2006).

The bispectral index (BIS) is a processed electroencephalographic (EEG) parameter which was developed specifically to evaluate patient responses during drug induced anesthesia and sedation (Xing et al. 2018) A BIS score analyzes an index value between 0 and 100 that indicates the patient's level of consciousness, a value of 100 corresponds to patient being completely awake, whereas 0 corresponds to a profound state of coma or that of unconsciousness (Kelley 2010)

Although different doses of dexmedetomidine (0.5–2.0 μg/kg) have been used in various studies which suggested its efficacy in blunting the hemodynamic pressor response but a few studies have incorporated BIS monitoring which is an indicator of adequate depth of anesthesia. The adequate depth of anesthesia is a prerequisite for minimal hemodynamic changes during larngoscopy and endotracheal intubation which can be best achieved by using BIS monitoring during intraoperative period. (Mahajan et al. 2018) We have chosen 0.5 and 1.0 μg/kg of dexmedetomidine in our study since the adverse effects of dexmedetomidine such as hypotension and bradycardia are more likely to occur at higher doses (> 1.0 μg/kg) and the lower doses (0.5–1.0 μg/kg) reported to have a reduced incidence of adverse effects and more cost effective. We hypothesized that IV dexmedetomidine infusion would be effective in blunting hemodynamic pressor responses to largyngoscopy and intubation with minimal side effects using BIS monitoring. So in present study, we intended to assess and compare the efficacy of two different doses of dexmedetomidine (0.5 μg/kg and 1.0 μg/kg) along with control group to find out its optimal dose in attenuation of hemodynamic pressor response to largyngoscopy and intubation with a BIS range of 40–60 at which the depth of anesthesia is maintained in all patients.

Methods

This prospective randomized double-blind study included a total of one hundred twenty patients of either sex aged 18–55 years, weighing 50–70 kg belonging to American Society of Anesthesiologists (ASA) physical status I or II posted for various elective surgeries under general anesthesia. The study was conducted after approval from institutional ethical committee. The exclusion criteria being patient's refusal, uncooperative patients, patients with respiratory, cardiac, hepatic, or renal disease (ASA physical status III or above), patients with any known hypersensitivity or contraindication to dexmedetomidine, patients with significant neurological, psychiatric, or neuromuscular disorders, patients with history of convulsions, bleeding or thyroid disorder and anticipated difficult airway which requires > 20 seconds to intubate. The study was conducted between March 2020 and February 2021 which is registered in Clinical Trials Registry-India (CTRI/2020/03/024088).

Using a computer generated table of random numbers, the study population was randomly divided into three groups with 40 patients in each group. Patients received an IV infusion of dexmedetomidine (0.5 μg/kg) in 100 ml normal saline over 15 min in group D1 ($n = 40$); received an IV infusion of dexmedetomidine (1.0 μg/kg) in 100 ml normal saline over 15 min in group D2 ($n = 40$) and an IV infusion of 100 ml normal saline over 15 min in group C ($n = 40$), (Fig. 1).

All patients underwent a thorough pre-anesthetic evaluation prior to surgery. A written informed consent was obtained after explaining about the procedure on the night before surgery and alprazolam 0.5 mg was given orally to all patients. All patients were kept nil per oral for at least 8 h before surgery. For the purpose of double blinding, two investigators have participated in this study; an anesthesiologist who was not part of the study prepared the study drug infusions and another anesthesiologist who was unaware of group allocation did the data collection and analysis.

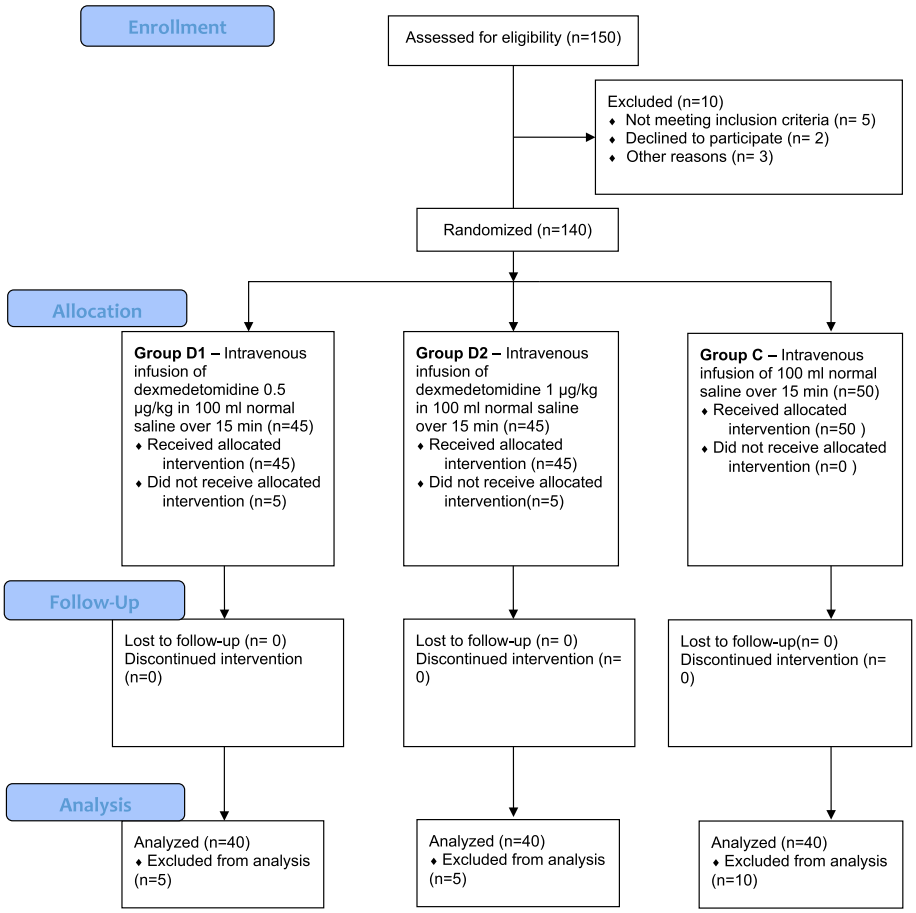


Fig. 1 CONSORT flow diagram

All standard monitors which included non-invasive blood pressure (NIBP), electrocardiogram (ECG) and pulse oximeter (SpO_2) along with BIS (Kelley 2010) monitor (COVIDIEN BIS LoC Channel module) were attached after arrival of the patients in the operation theater. IV cannula was procured and a ringer lactate solution was started thereafter. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and ECG were recorded as baseline (T_B) vital parameters. Before infusion of the study drug, Ramsay sedation scale (RSS) score was recorded. Patients then received the study drug based on group allocated. After study drug infusion (T_A), HR, SBP, DBP, and MAP were recorded at the end of infusion of dexmedetomidine. RSS score was also recorded at the end of study drug infusion.

IV glycopyrrolate 0.004 mg/kg and tramadol 2 mg/kg were administered as pre-medication in all patients. One hundred percent of oxygen was given to all patients for 3 min before induction of anesthesia with IV propofol titrated to achieve a BIS value in a range of 40–60 (± 5). Intermittent positive pressure ventilation (IPPV) was given for 1 min after the administration of IV succinylcholine 1–1.5 mg/kg. An experienced anesthesiologist performed laryngoscopy and endotracheal intubation within a duration of 20 seconds with an appropriate sized cuffed endotracheal tube. The pressor responses were assessed with constant BIS values between 40 and 60 (± 5). Patients who required > 20 seconds for laryngoscopy and who developed bronchospasm or laryngospasm were excluded from the study. The hemodynamic parameters (HR, MAP, SBP, DBP, and SpO_2) and BIS values were recorded after the infusion (T_A) of study drug, after induction (T_I) with propofol, at intubation (T_0), at the interval of 1 min till 5 min, and then at every 5 min (10, 15, 20, 25, and 30) till 30 min.

Using a closed circuit throughout, anesthesia was maintained with isoflurane (MAC 1.0–1.2) and nitrous oxide in oxygen (67% N_2O + 33% O_2) along with controlled ventilation. The neuromuscular blockade was achieved with the initial loading dose of vecuronium 0.1 mg/kg IV and 0.02 mg/kg bolus IV as intermittent boluses when required for maintenance. At the end of

surgery, the reversal of neuromuscular blockade was done using IV neostigmine 0.05 mg/kg and glycopyrrolate 0.008 mg/kg followed by extubation after achieving adequate muscle power and recovery from residual neuromuscular blockade.

The hemodynamic changes (HR, SBP, DBP, and MAP) from baseline up to 30 min after intubation were assessed and noted as a primary outcome measure. In addition, secondary outcome measures were assessment of sedation using RSS score preoperatively, i.e., before infusion with dexmedetomidine and after completion of infusion (before induction). After the end of study drug infusion (dexmedetomidine), the dosage of propofol required for induction was also noted and the assessment of the effect of two varying doses of dexmedetomidine on dosage of IV propofol required for induction was also done. Nausea, vomiting, bradycardia, hypotension, and respiratory depression were noted as the side effects/complications.

Statistical analysis

With an alpha error of 0.05 and power of 80%, an estimated sample size of 35.77 was obtained for each group based on our pilot study and taking heart rate as primary objective. The sample size was increased and rounded off to 40 patients in each group considering 10% loss during follow up. Standard qualitative and quantitative tests were used to compare the data (chi-square test, Kruskal-Wallis test, paired or unpaired Student's *t* test and analysis of variance i.e. ANOVA). Microsoft Excel and MedCalc software were used for carrying out statistical analysis. Chi-square test was used to compare categorical variables with percentages and Kruskal-Wallis test was used to compare categorical data like age, sex and weight. Intergroup numerical data were compared using ANOVA and unpaired *t* test along with Tukey's test for post-test analysis while intragroup numerical data was analyzed using paired *t* test. $P < 0.001$ was considered to be highly significant and $P < 0.05$ was considered to be statistically significant.

Results

Among the three groups, the demographic profile was comparable in terms of mean age, weight, sex, and ASA physical status ($P > 0.05$). The mean duration of surgery ($P = 0.589$) was also comparable among three groups (Table 1).

The baseline (T_B) mean HR, SBP, DBP, and MAP were comparable among three groups ($P > 0.05$). The mean HR significantly increased from the baseline value (T_B) at intubation (T_0) ($P < 0.001$) in group C which remained significantly higher till 10 min although it started to decrease after 3 min. In group D1, HR significantly increased ($P = 0.014$) at intubation, which remained significantly higher from 2 to 5 min ($P < 0.001$) which started to decrease after 4 min. In group D2, although the HR slightly increased to 70.93 ± 4.13 beats/min at intubation but it was significantly lower than baseline value, ($P < 0.001$) which remained significantly lower than baseline value at all time intervals thereafter ($P < 0.001$). On intergroup comparison, the mean HR remained significantly higher in group C as compared to both groups D1 and D2 till 10 min and 25 min, respectively, ($P < 0.001$). In group D2, it remained significantly lower than group D1 at all time intervals after infusion till 25 min ($P < 0.001$) (Fig. 2).

In group C, after an initial significant reduction in mean SBP following induction (T_I), it was significantly increased from baseline to 131.63 ± 5.81 mmHg at intubation ($P < 0.001$) which remained significantly higher till 5 min, ($P < 0.001$). In group D1, mean SBP after induction reduced significantly to 118.50 ± 7.25 mm Hg, ($P < 0.001$) followed by a significant rise in mean SBP (130.80 ± 8.41 mm Hg) at intubation ($P = 0.034$) which remained higher than baseline till 15 min post-intubation ($P > 0.05$) but in group D2, after an initial fall in mean SBP (120.58 ± 8.93 mm Hg) after induction, the mean SBP remained significantly lower at all intervals till 5 min ($P < 0.001$). Even after 5 min the mean SBP remained lower till 30 min as compared to baseline mean SBP but it was statistically insignificant ($P > 0.05$). On comparing

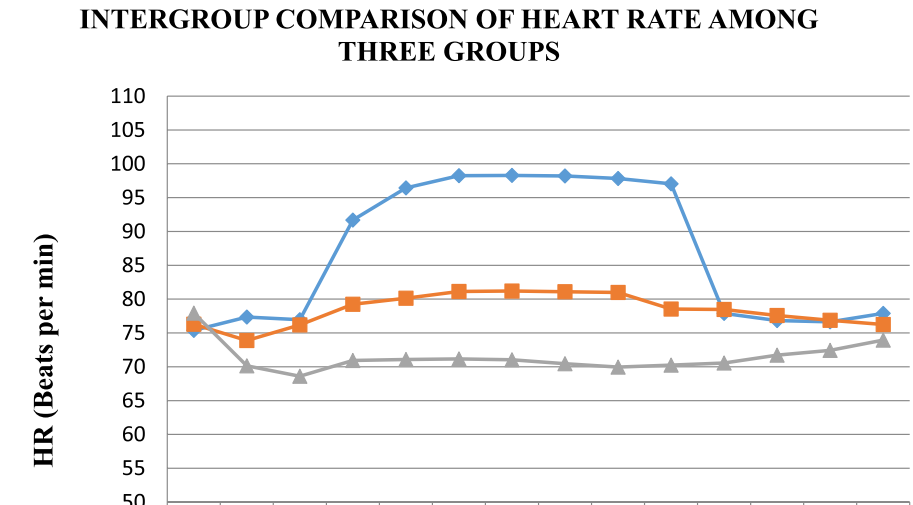
Table 1 Demographic profile and duration of surgery

Parameters	Group C ($n = 40$)	Group D1 ($n = 40$)	Group D2 ($n = 40$)	*P* value
Age (years)	41.28 ± 8.07	40.55 ± 9.42	42.10 ± 6.51	0.958
Weight (kg)	64.15 ± 10.18	62.83 ± 10.51	65.63 ± 10.80	0.639
Sex (M/F)	18/22	21/19	17/23	0.647
ASA PS (I/II)	15/25	18/22	16/24	0.785
Duration of surgery (min)	97.38 ± 13.11	94.25 ± 14.03	95.13 ± 14.78	0.589

Group C—saline, *Group D1*—dexmedetomidine (0.5 µg/kg), *Group D2*—dexmedetomidine (1.0 µg/kg)

ASA American Society of Anesthesiologists, *M* Male, *F* Female

Data expressed as Mean ± Standard deviation and number



	TB	TA	TI	T0	1 min	2 min	3 min	4 min	5 min	10 min	15 min	20 min	25 min	30 min
GROUP C	75.4	77.4	77	91.7	96.4	98.3	98.3	98.2	97.8	97	77.9	76.8	76.7	77.9
GROUP D1	76.3	73.9	76.2	79.2	80.1	81.1	81.2	81.1	81	78.5	78.5	77.6	76.9	76.3
GROUP D2	77.9	70.2	68.6	70.9	71.1	71.2	71	70.5	70	70.3	70.6	71.7	72.4	74

Fig. 2 Comparison of mean HR among three groups

group C and D1, there was no significant difference in mean SBP between two groups at intubation ($P = 0.305$) but it was significantly higher in group C 1 min after intubation till 5 min ($P < 0.001$). In comparison to group D2, from the time of intubation till 15 min, the mean SBP in group C was significantly raised ($P < 0.001$). The mean SBP remained significantly higher in group D1 than group D2 from the time of intubation onwards till 15 min ($P < 0.05$), (Fig. 3).

Similarly, mean DBP significantly increased at intubation in group C ($P < 0.001$) which remained significantly higher till 5 min. In group D1, it was significantly increased from baseline at intubation and 1 min ($P < 0.05$) while it was comparable to baseline DBP at intubation in group D2 ($P = 0.798$). There was a significant rise in mean DBP in group C than group D1 at 1 min ($P < 0.001$) which remained so till 5 min after intubation. Group C had significantly higher mean DBP than group D2 till 5 min ($P < 0.001$). However, the difference in mean DBP was insignificant at all time intervals from 1 min till 30 min ($P > 0.05$), (Fig. 4).

MAP significantly increased to 98.86 ± 4.69 mm Hg at intubation in group C which remained significantly higher till 5 min, ($P < 0.001$). In group D1, a significant increase in MAP was noted at intubation and at 1 min compared to baseline MAP ($P < 0.05$). In group D2, although MAP increased to 92.93 ± 6.80 mm Hg at intubation ($P = 0.173$) but it was insignificant both at intubation and 1 min after intubation ($P = 0.834$). On intergroup comparison, there was a significant rise in MAP in group C than group D1 at 1 min ($P < 0.001$) which remained so till 5 min after intubation, ($P < 0.001$). Group D2 had significantly lower MAP than group C till 20 min ($P < 0.05$). MAP measured at T_0 showed a significant rise in group D1 ($P < 0.001$) till 5 min after intubation ($P < 0.05$), (Fig. 5).

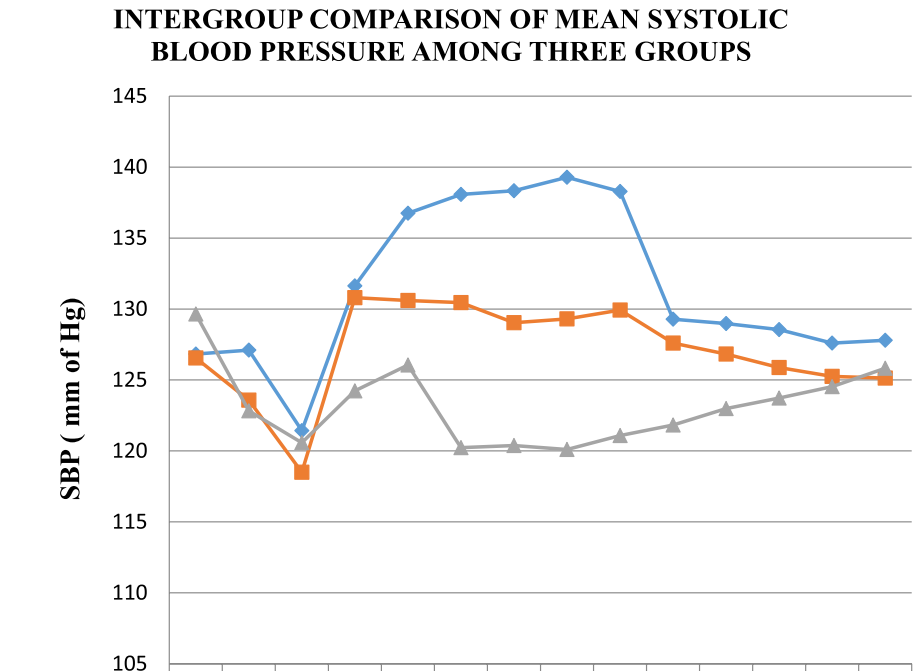
The mean RSS was comparable among three groups before infusion of study drug ($P = 0.898$), (Fig. 6). However, after infusion of study drug, significantly more number of patients had the mean RSS of 2 and 3 in group D1 and group D2 respectively ($P < 0.001$), (Fig. 7).

The mean dose of propofol required in group C (120.75 ± 14.21 mg) was significantly higher than in group D1 (80.50 ± 10.61 mg), and group D2 (68.75 ± 10.42 mg), ($P < 0.001$), (Fig. 8).The difference in terms of incidence of side effects/complications was not significant among three groups ($P = 0.907$), (Table 2).

Discussion

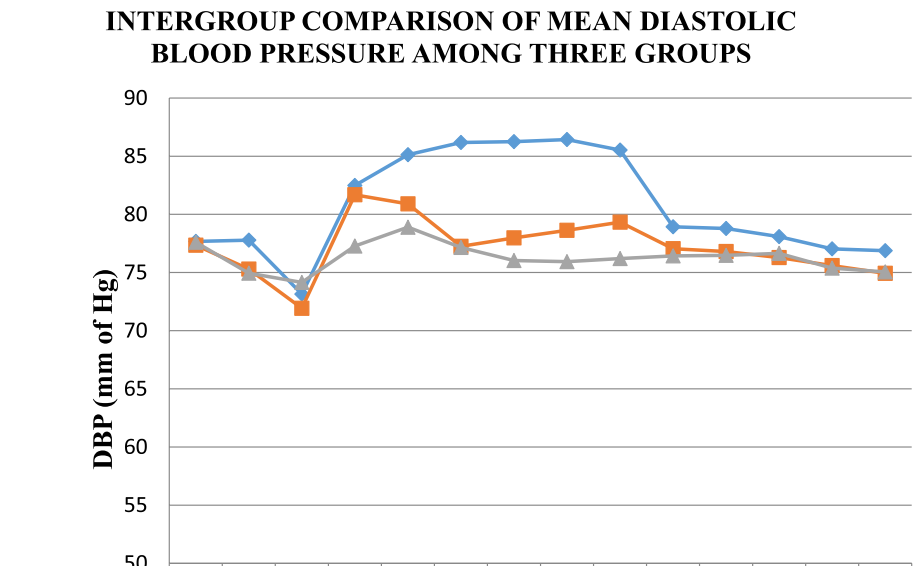
The present study revealed that hemodynamic parameters were stable in group D1 and D2 when compared to control group. Dexmedetomidine (1.0 μg/kg) was found to be better in blunting the hemodynamic pressor response as hemodynamic parameters (HR, SBP, DBP, and MAP) remained lower from their baseline values till 30 min in group D2.

The mean HR at intubation showed a significant increase in both group C and group D1 from their



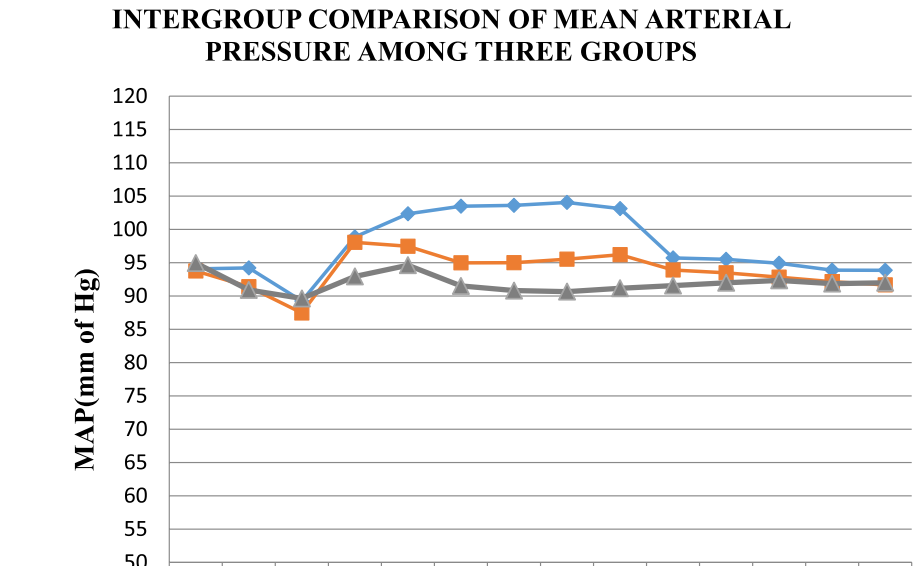
	TB	TA	TI	T0	1 min	2 min	3 min	4 min	5 min	10 min	15 min	20 min	25 min	30 min
GROUP C	127	127	121	132	137	138	138	139	138	129	129	129	128	128
GROUP D1	127	124	119	131	131	130	129	129	130	128	127	126	125	125
GROUP D2	130	123	121	124	126	120	120	120	121	122	123	124	125	126

Fig. 3 Comparison of mean SBP among three groups



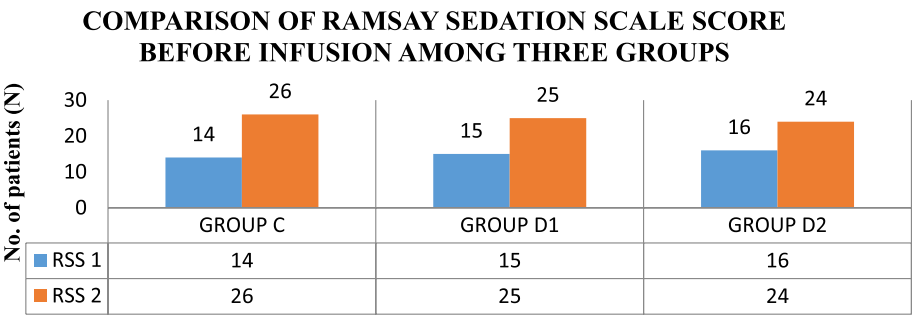
	TB	TA	TI	T0	1 min	2 min	3 min	4 min	5 min	10 min	15 min	20 min	25 min	30 min
GROUP C	77.68	77.78	73.15	82.48	85.13	86.18	86.25	86.43	85.53	78.93	78.78	78.08	77.03	76.88
GROUP D1	77.35	75.3	71.93	81.68	80.9	77.25	77.98	78.63	79.33	77.05	76.8	76.28	75.6	74.93
GROUP D2	77.6	74.95	74.15	77.28	78.9	77.15	76.03	75.93	76.2	76.43	76.48	76.65	75.38	75.05

Fig. 4 Comparison of mean DBP among three groups



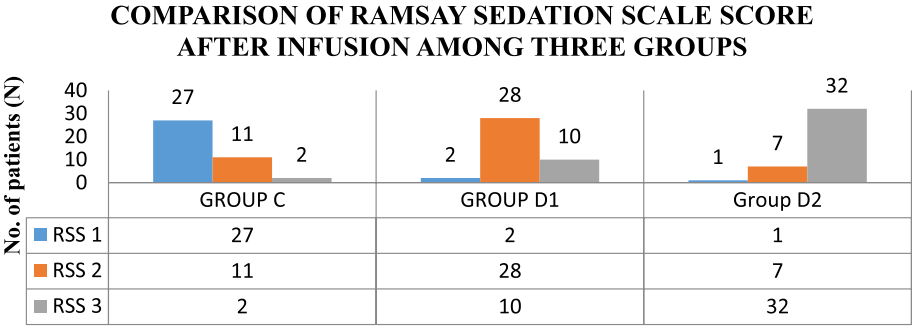
	TB	TA	TI	T0	1 min	2 min	3 min	4 min	5 min	10 min	15 min	20 min	25 min	30 min
GROUP C	94.1	94.2	89.2	98.9	102	103	104	104	103	95.7	95.5	94.9	93.9	93.9
GROUP D1	93.8	91.4	87.5	98.1	97.5	95	95	95.5	96.2	93.9	93.5	92.8	92.2	91.7
GROUP D2	95	90.9	89.6	92.9	94.6	91.5	90.8	90.7	91.2	91.6	92	92.3	91.9	92

Fig. 5 Comparison of MAP among three groups



	GROUP C	GROUP D1	GROUP D2
RSS 1	14	15	16
RSS 2	26	25	24

Fig. 6 Comparison of Ramsay Sedation Scale (RSS) score before infusion of study drug among three groups



	GROUP C	GROUP D1	Group D2
RSS 1	27	2	1
RSS 2	11	28	7
RSS 3	2	10	32

Fig. 7 Comparison of Ramsay Sedation Scale (RSS) score after infusion of study drug among three groups

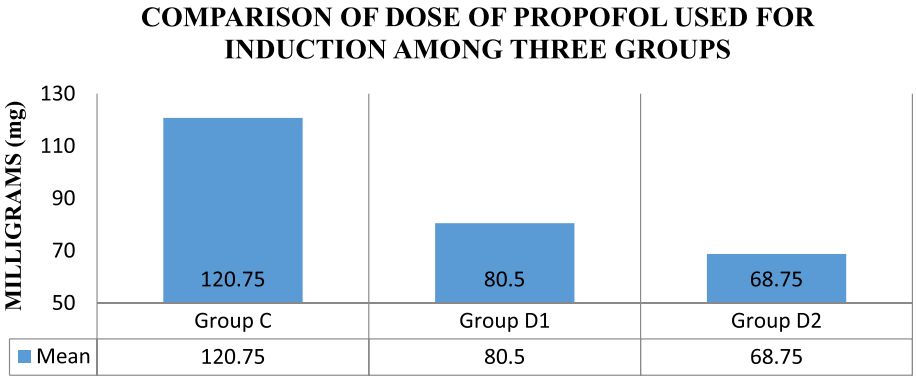


Fig. 8 Comparison of dose of propofol required for induction among three groups

Table 2 Incidence of side effects or complications among three groups

Side effects/ complications	Group C ($n = 40$)	Group D1 ($n = 40$)	Group D2 ($n = 40$)	*P* value
Hypotension	0 (0)	0 (0)	1 (2.5)	0.907
Bradycardia	0 (0)	1 (2.5)	2 (5.0)	
Nausea	0 (0)	0 (0)	0 (0)	
Vomiting	0 (0)	0 (0)	0 (0)	
Respiratory depression	0 (0)	0 (0)	0 (0)	

Group C—saline; *Group D1*—dexmedetomidine (0.5 μg/kg), *Group D2*—dexmedetomidine (1.0 μg/kg)

Data expressed as number (percentage)

baseline HR while it remained significantly lower from baseline value in group D2. Although the rise in mean HR in group D1 was statistically significant but it was clinically insignificant. When compared to group C, the mean HR returned to baseline values earlier in group D1. However, mean HR remained lower from baseline values in group D2 at all time intervals. This depicted that HR remained stable in both groups D1 and D2 but found to be more stable in group D2. So, when compared to its lower dosage (0.5 μg/kg), dexmedetomidine (1 μg/kg), seems to be optimal dose in blunting hemodynamic pressor response. A similar rise in mean HR was observed in control group as compared to dexmedetomidine group (0.5 μg/kg) by Lee and Kim (Lee and Kim 2017). The mean HR remained significantly lower in dexmedetomidine group till 5 min post-intubation which corresponds to our study. A significant reduction in mean HR was reported by Mahajan et al. and Sharma et al. after study drug infusion in dexmedetomidine group (1 μg/kg) which remained significantly lower from their baseline values at all time intervals and subsequent rise in mean HR following intubation in control group (group C) which concurs with our study (Mahajan et al.; Sharma et al. 2018). Gupta et al. also observed similar findings in which mean HR in group III (1 μg/kg dexmedetomidine) remained lower in contrast to group I (0.5 μg/kg dexmedetomidine) throughout the study which supports the results of our study (Gupta et al. 2016).

Mean SBP, DBP, and MAP were reduced in both groups D1 and D2 which might be attributed to decreased circulating catecholamines due to α_2 agonistic action of dexmedetomidine. An adequate depth of anaesthesia was provided by BIS monitoring during laryngoscopy and endotracheal intubation. Since SBP, DBP, and MAP remained significantly lower from their baseline values even during and after intubation, group D2 (1 μg/kg dexmedetomidine) had more favourable blunting of hemodynamic pressor response, thus seems to be more optimal dose of dexmedetomidine.

Lee and Kim noted a comparable mean SBP, DBP and MAP between control group and dexmedetomidine group (0.5 μg/kg) in their study after the infusion of study drug (Lee and Kim 2017). There was a significant rise in mean SBP in control group after intubation which remained so till 5 min post-intubation. These findings concur with our study. There was a significant increase in SBP, DBP, and MAP after intubation in control group and reduction after induction according to some authors which is consistent with our findings; however, it was lesser with 0.5 μg/kg dexmedetomidine. In dexmedetomdine group, Sharma et al. found significantly lesser mean SBP, DBP and MAP (1 μg/kg dexmedetomidine) throughout the study till 10 min post-intubation (Sharma et al. 2018). Gupta et al. reported a significantly lesser mean SBP till 10 min post-intubation in group III (1 μg/kg dexmedetomidine) (Gupta et al. 2016). Both of these studies supported the results of our findings in terms of mean SBP. The lesser increase in SBP and quicker return to baseline SBP in our study may be due to use of BIS monitoring and restricting the time period of largyngoscopy to < 20 seconds. A similar trend was being observed for both DBP and MAP by various authors in their studies

which signifies the importance of maintaining adequate depth of anesthesia during laryngoscopy and endotracheal intubation by BIS monitoring which was responsible for hemodynamic stability in patients who received 1.0 μg/kg of dexmedetomidine (Lee and Kim 2017; Mahajan et al. 2018; Sharma et al. 2018 and Gupta et al. 2016).

Patients in both groups D1 and D2 had RSS 2 or 3 after infusion of study drugs. This is due to sedative property of dexmedetomidine. Patients became calm, sedated, and less anxious when compared to patients in group C after infusion of study drug in both groups D1 and D2. Gu et al. recently observed similar findings in their study and concluded that intravenous infusion of dexmedetomidine combined with parecoxib sodium, in addition to prevent stress response of endotracheal intubation, it also calms and resists anxiety (Gu et al. 2020).

Among the three groups, there was a significant difference in mean dose of propofol required for induction. When compared to both group D1 and group C the mean dose of propofol required was significantly lesser in group D2; however, when compared to group C it was also significantly lesser in group D1. Probably due to sedative action of dexmedetomidine there was a significant reduction in dose of propofol required for induction in groups D1 and D2. The dosage requirement of both propofol and remifentanil in the BIS group compared with the non-BIS group ($P < 0.001$) was significantly lower as reported by Zhou et al (Zhou et al. 2018). These findings also concurs with our study. Dutta et al. reported a similar deduction in dose of propofol needed for induction in both non-dexmedetomidine (1.07 mg/kg) and dexmedetomidine (0.91 mg/kg) groups under BIS monitoring (Dutta et al. 2019) However, dosage of propofol needed for induction was lesser than in our study which might be due to use of fentanyl and continuous infusion of dexmedetomidine in their study. Bajwa et al. and Keniya et al. observed similar findings in their respective studies and concluded that dexmedetomidine also had opioid sparing effect (Bajwa et al. 2012; Keniya et al. 2011)

The postsynaptic activation of central α_2A-receptors results in sympatholytic effect which may lead to hypotension and bradycardia. However, in present study, incidence of hypotension, bradycardia and other adverse effects like nausea and vomiting were insignificant among the three groups. Gupta et al. Sharma et al. and Mahajan et al. observed similar findings in terms of insignificant incidence of side effects (Gupta et al. 2016; Sharma et al. 2018; Mahajan et al. 2018). Dutta A et al. reported that 14 patients required atropine (0.6 mg), 9 patients needed mephentermine (6 mg), 2 patients required metoprolol (1.5 mg) and 4 patients required nitroglycerine (750 μg) in their study (Dutta et al. 2019). This higher incidence of adverse effects could be due to bolus dose of dexmedetomidine infused over 10 min instead of 15 min as in our study and continuous infusion of dexmedetomidine as well.

BIS monitoring helps us to maintain adequate depth of anesthesia and being cost effective in terms of reduced intraoperative anaesthetic agents and analgesic consumption. The adequate depth of anesthesia during laryngoscopy and intubation leads to more effective obtundation of hemodynamic pressor response. So, it should be incorporated as an essential parameter to be used during laryngoscopy and intubation. Further studies need to be conducted in patients of ASA PS III and above to find out its optimal dose and prove its effectiveness in terms of hemodynamic stability during laryngoscopy and intubation with BIS monitoring.

As far as limitations of our study are concerned, the hemodynamic parameters were observed up to only 30 min post-intubation, thus any complications occurred 30 min post-intubation (intraoperative or postoperative) were not assessed. In our study, effect of dexmedetomidine and BIS monitoring on consumption of inhalational anesthetic agents was not assessed. The time to recovery after extubation was also not noted in our study. Although we have recorded the dose of induction agent required for induction of anesthesia in all the groups but the opioid sparing effect of dexmedetomidine was not assessed. The postoperative RSS score was also not observed.

Conclusions

We conclude that both doses (0.5 μg/kg and 1.0 μg/kg) of dexmedetomidine were found to be effective in attenuating the hemodynamic pressor response to laryngoscopy and endotracheal intubation under BIS monitoring. However, hemodynamic stability was better in group receiving 1.0 μg/kg of dexmedetomidine. Apart from it, the addition of BIS monitoring with dexmedetomidine reduced the dose of propofol required for induction as well as provided arousable sedation without any significant incidence of side effects among three groups.

Abbreviations

IV	Intravenous
HR	Heart rate
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
MAP	Mean arterial pressure
ECG	Electrocardigram
NIBP	Non-invasive blood pressure
BIS	Bispectral Index
EEG	Electroencephalography
ASA	American Society of Anesthesiologists
CTRI	Clinical Trials Registry-India
IPPV	Intermittent positive pressure ventilation

T_B	Baseline
T_A	After induction
T_0	At intubation
N_2O	Nitrous oxide
O_2	Oxygen
RSS	Ramsay Sedation Scale
ANOVA	Analysis of variance
P	Probability

Acknowledgements
Not applicable.

Authors' contributions
KJ gave concept and design for the study, helped in preparing the manuscript, and acts as a guarantor. SKS reviewed the literature, edited and reviewed the final manuscript. HKN searched as well as reviewed the literature, conducted the study work, analyzed the results statistically, and prepared the manuscript. VP gave the concept and design for the study and reviewed the literature as well. NJ helped in data analysis and manuscript editing. DM did manuscript editing. All authors have read and approved the final manuscript.

Funding
Nil.

Availability of data and materials
Not applicable.

Declarations

Ethics approval and consent to participate
The present study approved by Institutional Ethics Committee, J.L.N. Medical College, Ajmer, Rajasthan, India
Reference No. (979/Acad-III/MCA/2019,dated: 15/05/2019)
A written informed consent was obtained from all the patients who participated in this study.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Received: 11 May 2022 Accepted: 9 March 2023
Published online: 25 March 2023

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