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A Comparative Evaluation of Dexmedetomidine and Fentanyl to Attenuate Haemodynamic Response to Laryngoscopy and Intubation: A Prospective Randomized Double-Blind Study

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ABSTRACT

The study aimed to conduct a comparative evaluation of the efficacy of dexmedetomidine and fentanyl in attenuating the hemodynamic response to laryngoscopy and intubation in patients undergoing elective surgeries. Laryngoscopy and intubation often induce sympathetic stimulation, leading to undesirable increases in heart rate (HR) and blood pressure. The impact of these drugs on mitigating these responses was systematically investigated to provide insights into their clinical utility. This prospective, double-blind, randomized, study involved 100 participant with 1 and 2 of ASA grade undergoing elective surgeries under general anesthesia. Patients were randomly assigned to two groups, with one group receiving 1 mcg kg^{-1} dexmedetomidine and the other 2 mcg kg^{-1} fentanyl before induction. The study included rigorous monitoring of various hemodynamic parameters, such as HR, systolic and diastolic blood pressure and mean arterial pressure, at different time points during the perioperative period. Ethical committee approval and informed written consent were obtained. The baseline characteristics, including gender and age distribution, were comparable among the two groups. Dexmedetomidine (1 mcg kg^{-1}) demonstrated superior efficacy in blunting the hemodynamic response compared to fentanyl at 2 mcg kg^{-1}. Dexmedetomidine exhibited a significant reduction in HR at various time points after laryngoscopy and intubation compared to fentanyl. The systolic and diastolic blood pressure responses were also more effectively attenuated by dexmedetomidine. However, bradycardia was observed more frequently in the dexmedetomidine group. Intravenous administration of dexmedetomidine (1 mcg kg^{-1}) proved more efficacious in attenuating the hemodynamic response to laryngoscopy and intubation, offering a favorable profile in terms of safety and recovery from anesthesia. In contrast, fentanyl at 2 mcg kg^{-1} demonstrated lesser efficacy in mitigating the pressor response. Both agents were considered safe for use in elective surgeries, providing valuable insights into their comparative utility in clinical practice.

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Key Words
Hemodynamic response, Laryngoscopy, Intubation, Fentanyl, Dexmedetomidine

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INTRODUCTION

Laryngoscopy and tracheal intubation are known to persuade hypertension and tachycardia, attributed to the raised catecholamines concentration in plasma following sympathetic stimulation. The resultant increase in arterial pressure typically reaches its peak within 1-2 minutes, returning to baseline levels within five min[1]. While this response may be inconsequential in individuals with normal health, it poses a significant risk of morbidity in patients with concomitant cerebrovascular or cardiovascular conditions[2]. The laryngoscopic response can elevate myocardial oxygen demand, potentially leading to complications in vulnerable individuals. To mitigate this stress response, various prophylactic interventions have been explored, including the administration of local anesthetics, opioids, vasodilators, beta blockers, magnesium, increased concentrations of volatile anesthetics or α-2 adrenergic agonists[3].

No single pharmacological substance has been universally acknowledged as the utmost suitable to mitigate the hemodynamic responses associated with laryngoscopy. The drawbacks of these agents range from insufficient control of hemodynamics to the manifestation of various adverse effects, such as severe hypotension, bradycardia, arrhythmias, chest wall rigidity, and delayed recovery. Alpha 2 (α2) adrenergic agonists, such as clonidine, have been recognized for their ability to diminish sympathetic tone and effectively reduce stress responses during laryngoscopy[4,5].

Dexmedetomidine, an extremely selective α2 receptor agonist with eightfold higher affinity and α2 selectivity compared to clonidine, offers distinct advantages. Notably, dexmedetomidine exhibits anxiolytic properties, induces sedation and analgesia, and provides superior hemodynamic control without eliciting respiratory depression[6]. Its abbreviated duration of action minimizes interference with the recovery from anesthesia. Additionally, dexmedetomidine contributes to a reduction in intraoperative volatile anesthetic and opioid needs for maintenance of anesthesia, as evidenced by its capacity to decrease the MAC (minimum alveolar concentration) of volatile anesthetics by up to 90% [1,7,8].

A potent narcotic, fentanyl, characterized by short duration of action and quick onset, is commonly employed to balance anesthesia. Administration of 2 mcg kg^{-1} Fentanyl dose, 5 min former to laryngoscopy, effectively alleviates the hemodynamic stress response followed by endotracheal intubation and laryngoscopy. Fentanyl, as a synthetic opioid, attenuates the response of cardiovascular system by reducing sympathetic outflow, through its interaction with opioid receptors[9]. The objective of current study is to compare the effectiveness of Fentanyl and Dexmedetomidine, administered as a bolus dose former to induction, specifically in their ability to blunt the hemodynamic stress response elicited by laryngoscopy and endotracheal intubation.

MATERIALS AND METHODS

Following institutional ethical committee approval and obtaining informed written consent from participants, this prospective, randomized, double-blind study was undertaken with a cohort of 100 patients classified as ASA grade 1 and 2. These patients were scheduled for elective surgical procedures under general anesthesia at the Department of Anaesthesiology, G. K. General Hospital (GKGH), and Gujarat Adani Institute of Medical Sciences (GAIMS), Bhuj, Gujarat, India, during the period from October 2018 to July 2020. Inclusion and exclusion criteria were applied to determine the eligibility of patients for participation in the study.

Inclusion criteria:

- Age range 18-60 years
- ASA (American Society of Anaesthesiologists) grade I or II
- Patients scheduled for elective surgical procedures under general anesthesia

Exclusion criteria:

- Patient refusal to participate in the study
- ASA Grade III or higher
- Presence of cardiovascular or metabolic diseases, COPD, or bronchial asthma
- Patients with neurological diseases
- History of impaired hepatic and renal function
- History of alcohol and drug abuse
- Physical dependence on narcotics
- Use of antidepressants, beta-blockers, anticonvulsants, antipsychotics or anxiolytics,
- Presence of difficult airway
- Laryngoscopy and intubation taking more than 45 sec or requiring multiple attempts

Patients meeting the study criteria were enrolled during pre-anesthetic checkup, where they were provided with a patient information sheet detailing the risk and benefit profiles of both drugs. Upon their agreement to participate, patients were included in the study. Overnight fasting was instituted after 10:00 p.m. and as premedication, patients were administered oral ranitidine 150 mg and oral alprazolam 0.5 mg on the night before surgery. Through computer-generated random number sequencing, patients were randomly allocated into two groups of 50 each. The group

assignment, enclosed in a sealed envelope generated from the random number sequence, was revealed only at the time of intubation, with notification to the present anaesthetist.

Intravenous access was established using an IV cannula of 18G and all patients preloaded with crystalloid fluid at a rate of 8-10 mL kg^{-1}. Standard monitoring, including pulse oximetry, ECG and non-invasive blood pressure, was initiated. Premedication involved the administration of Inj. Ondansetron (0.08 µg kg^{-1} IV) and Inj. Glycopyrrolate (0.004 µg kg^{-1} IV). Baseline measurements of systolic and diastolic blood pressure, mean arterial pressure and heart rate, were recorded before and 10 min after pre-medication for all patients. Group D received a 1 µg kg^{-1} Dexmedetomidine diluted in 10 ml normal saline 10 min before laryngoscopy and intubation.

Group F received 2 µg kg^{-1} Fentanyl, dilute in 10 ml normal saline, administered 10 min former to intubation and laryngoscopy. To maintain blinding, the drug was prepared by an anesthetist not involved in the study and the observing anesthetist was unaware of the drug's content. Patients underwent preoxygenation with 100% oxygen for 3 min and induction with intravenous propofol (1.5-2 mg kg^{-1}), along with muscle relaxation facilitated by suxamethonium (2 mg kg^{-1}). Manual ventilation of the patient's lungs with 100% oxygen was performed. Laryngoscopy was attempted 90 seconds after succinylcholine administration, followed by tracheal intubation using an appropriately sized cuffed disposable endotracheal tube.

Hemodynamic parameters, including heart rate, systolic blood pressure, diastolic blood pressure and mean arterial blood pressure, were recorded during laryngoscopy and intubation, as well as 1, 2, 3, 4.5 and 10 min after intubation and post-extubation. Post-intubation, patients were maintained with isoflurane, O2 (33%), N2O (66%), and non-depolarizing muscle relaxant (vecuronium), administered as a bolus IV dose of 0.08 µg kg^{-1}, followed by intermittent doses of 0.02 µg kg^{-1} for muscle relaxation. Surgery commenced after the collection of the last hemodynamic data at 10 minutes post-intubation.

Hypotension, defined as a mean blood pressure decrease exceeding 20% of the baseline value, was treated with fluids and vasopressor drugs. Bradycardia, defined as a heart rate below 60/min, was addressed with an intravenous injection of atropine (0.6 mg). Data were presented as Mean±Standard Deviation, number and frequency. Statistical analysis involved independent t-tests for intergroup comparison and paired t-tests for intragroup comparison, utilizing SPSS and Open EPI SOFTWARE. The significance of the P value was interpreted as follows $p>0.05$ indicated insignificance, $p<0.05$ indicated significance and $p<0.001$ was considered highly significant.

RESULTS

In Group D, the mean age of patients was 38.96±12.78 years, whereas in Group F, it was 39.36±14.72 years. The mean age ranged from 38.96±12.78 years to 39.36±14.72 years in both groups, indicating no significant difference in age distribution between the two groups ($p>0.05$) (Table 1). All groups were comparable in terms of age distribution.

In Group D, male patients constituted 42% and female patients constituted 58%, while in Group F, male patients comprised 38% and female patients comprised 62%. The distribution of patients in terms of gender, as reflected in the table, demonstrated a comparable male-to-female ratio between the two groups (Table 1). The duration of surgery in Group D was 107±11.21 minutes, whereas in Group F, it was 101.48±14.80 min. A significant difference in the mean duration of surgery was observed between the two groups ($p<0.05$) (Table 1).

The baseline mean heart rate demonstrated comparable values between the groups, indicating no statistically significant difference ($p>0.05$). During laryngoscopy, Group D (Dexmedetomidine) displayed a markedly lower mean heart rate of 81.72±5.71 beats/min in contrast to Group F (Fentanyl), which registered 104.9±9.60 beats/min ($p<0.0001$) (Table 2, Fig. 1).

In Group D, mean heart rates at 1-5 and 10-min post-laryngoscopy and intubation were 80.90±5.62, 79.3±5.94, 78.30±5.8, 74.40±5.88, 75.30±5.88, and 74.10±6.15 beats/min, respectively. Group F recorded corresponding values of 108.82±11.0, 109.4±9.87, 111.5±9.34, 113.42±9.19, 111.2±9.21 and 110.1±8.41 beats/min, revealing a significant difference ($p<0.0001$) (Table 2, Fig. 1). Following extubation, Group D exhibited a mean heart rate of 91.32±7.29 beats/min, significantly lower than Group F's 108.32±11.4 beats/min ($p<0.0001$). Notably, a substantial elevation in mean heart rate during laryngoscopy persisted up to 5 min post-intubation and then at 10 min and extubation in Group F compared to Group D, demonstrating statistical significance ($p<0.0001$) (Table 2, Fig. 1).

Baseline systolic blood pressure data were comparable between groups, showing no statistically significant difference ($p>0.05$). In Group D (Dexmedetomidine), an immediate post-infusion increase in systolic blood pressure was observed (121.4±6.26 mm Hg) compared to Group F (Fentanyl) (117.16±9.90 mm Hg). Subsequently, during laryngoscopy, mean systolic blood pressure in Group D decreased to 112.36±6.27 mm Hg, further decreasing at 1-5 and 10 min after laryngoscopy and intubation (Table 3, Fig. 2).

In Group F, systolic blood pressure during laryngoscopy was 117.14±9.57 mm Hg. Following this,

Table 1: Demographic details of study participants of both groups

Parameters	Group D	Group F	p-value
Age (years)			
18-30	16 (32%)	15 (30%)	0.8849
31-40	15 (30%)	14 (28%)	
41-50	10 (20%)	11 (22%)	
51-60	6 (12%)	5 (10%)	
> 60	3 (6%)	5 (10%)	
Gender			
Male	21(42%)	19(38%)	0.6827
Female	29 (58%)	31(62%)	
Duration of Surgery	107.6±11.21	101.48 ± 14.80	0.0218*

Data were expressed as n (%), Mean±SD. *P<0.05 statistically significant by unpaired t-test

Table 2: Intraoperative Heart Rate comparison between two groups.

Time	Group D (n = 50)	Group F (n = 50)	p-value
Baseline	91.86±5.78	88.96±10.19	0.0832
Before induction	84.46±5.81	97.7±9.88	<0.0001
During laryngoscopy	81.72±5.71	104.9±9.60	<0.0001
After laryngoscopy and intubation			
1 min	80.90±5.62	108.82±11.03	<0.0 001
2 min	79.3±5.94	109.4±9.87	<0.0001
3 min	78.30±5.8	111.5±9.34	<0.0001
4 min	74.40±5.88	113.42±9.19	<0.0001
5 min	75.30±5.88	111.2±9.21	<0.0001
10 min	74.10±6.15	110.1±8.41	<0.0001
After extubation	91.32±7.29	108.32±11.40	<0.0001

Table 3: Comparison of intraoperative systolic blood pressure in between two groups

Time	Group D (n = 50)	Group F (n = 50)	p-value
Baseline	119.92±6.31	116.96±10.02	0.0802
Before Induction	121.4±6.26	117.16±9.90	0.0239
During Laryngoscopy	112.36±6.27	117.14±9.57	0.0039
After Laryngoscopy and Intubation			
1 min	106.6±6.12	123.7±9.97	<0.0001
2 min	105.2±6.23	124.24±9.66	<0.0001
3 min	100.2±5.99	124.8±9.08	<0.0001
4 min	95.20±5.89	123.34±9.24	<0.0001
5 min	96.10±6.32	123.5±10.36	<0.0001
10 min	97.0±6.05	121.0±8.55	<0.0001
After Extubation	116.78±9.11	125.14±10.45	<0.0001

Table 4: Comparison of intraoperative diastolic blood pressure in between two groups

Time	Group D (n = 50)	Group F (n = 50)	p-value
Baseline	79.62±6.32	79.08±6.71	0.6796
Before induction	79.00±6.33	80.36±6.90	0.3069
During laryngoscopy	76.32±6.35	80.32±6.26	0.0020
After laryngoscopy and intubation			
1 min	76.10±6.44	80.0±6.01	0.0023
2 min	76.16±6.33	80.34±8.68	0.0071
3 min	77.10±6.29	80.26±8.94	0.0436
4 min	77.20±6.31	80.48±7.08	0.0162
5 min	77.30±5.99	80.22±7.43	0.0329
10 min	77.20±5.94	80.18±5.56	0.0111
After extubation	79.58±7.09	82.12±5.92	0.0547

Table 5: Comparison of intraoperative mean arterial pressure in between two groups

Time	Group D (n = 50)	Group F (n = 50)	p-value
Baseline	93.36±5.65	92.04±7.34	0.3161
Before induction	93.52±5.58	92.96±7.45	0.6715
During laryngoscopy	88.6±5.62	92.59±6.81	0.0019
After laryngoscopy and intubation			
1 min	86.66±5.60	94.92±6.37	<0.0001
2 min	86.1±5.52	95.2±7.55	<0.0001
3 min	85.1±5.51	95.38±7.67	<0.0001
4 min	83.6±5.51	95.1±6.57	<0.0001
5 min	83.8±5.49	95±7.93	<0.0001
10 min	84.2±5.31	94.16±5.11	<0.0001
After extubation	91.98±6..97	96.46±6.46	0.0012

Table 6: Comparison of intraoperative SPO_2 in between two groups

	Group D (n = 50)	Group F (n = 50)	p-value
Baseline	99.98±0.14	99.94±0.23	0.2961
Before induction	99.98±0.14	99.98±0.14	1.0000
During laryngoscopy	100.00±0.00	99.98±0.14	1.0000
After laryngoscopy and intubation			
1 min	99.96±0.19	99.96±0.19	1.0000
2 min	99.94±0.23	99.94±0.23	1.0000
3 min	99.98±0.14	99.98±0.14	1.0000
4 min	99.94±0.23	99.96±0.19	0.6365
5 min	100.00±0.00	99.98±0.14	1.0000
10 min	99.96±0.19	99.96±0.19	1.0000
After extubation	100.00±0.00	100.00±0.00	1.0000

Table 7: Comparison of Adverse Drug Reactions in between two groups

	Group D (n = 50)	Group F (n = 50)	p-value
Bradycardia	1(2%)	-	0.0262
Pruritis	-	-	-
Nausea	-	4 (8%)	0.0412
Vomiting	-	3 (6%)	0.0786
Hypotension	-	-	-
Shivering	-	3 (6%)	0.0786

an increase in mean systolic blood pressure was observed at 1-5 and 10 min after laryngoscopy and intubation (Table 3, Fig. 2).

After extubation mean systolic blood pressure was 116.780±9.11 in Dexmedetomidine Group as compared to 125.14±10.45 mm of Hg in Fentanyl Group. ($p<0.0001$) (Table 3, Fig. 2). There was significant rise in mean systolic blood pressure in Group F (Fentanyl) as compared to Group D (Dexmedetomidine), during laryngoscopy and throughout anesthesia till extubation, which was statistically significant ($p<0.0001$) (Table 3, Fig. 2).

Baseline diastolic blood pressure was comparable between groups, with no statistically significant difference ($p>0.05$). In Group D (Dexmedetomidine), during laryngoscopy, mean diastolic blood pressure was 76.32±6.35 mm Hg and subsequent measurements at 1-5 and 10 min after laryngoscopy and intubation showed values ranging from 76.10±6.44 mm Hg to 77.20±5.94 mm Hg. In Group F (Fentanyl), during laryngoscopy, mean diastolic blood pressure was 80.32±6.26 mm Hg, and subsequent measurements at 1-5 and 10 min after laryngoscopy and intubation ranged from 80.0±6.01 mm Hg to 80.18±5.56 mm Hg. Post-extubation, mean diastolic blood pressure in the Dexmedetomidine Group was 79.58±7.09 mm Hg, compared to 82.12±5.92 mm Hg in the Fentanyl Group. The significant increase in mean diastolic blood pressure in Group F (Fentanyl) compared to Group D (Dexmedetomidine) during laryngoscopy and perioperatively was highly significant (Table 4, Fig. 3).

Intraoperative baseline mean arterial pressure was comparable between both groups ($p>0.05$). In Group D (Dexmedetomidine), mean blood pressure during laryngoscopy was 88.6±5.62 mm Hg, followed by measurements at 1-5 and 10 min after laryngoscopy and intubation ranging from 86.66±5.60 mm Hg to 84.2±5.31 mm Hg. In Group F (Fentanyl), mean arterial pressure during laryngoscopy was 92.59±6.81 mm Hg, and subsequent measurements at 1-5 and 10 min after laryngoscopy and intubation ranged from 94.92±6.37 mm Hg to 94.16±5.11 mm Hg. Post-extubation, mean arterial pressure in the Dexmedetomidine Group was 91.98±6.97 mm Hg, compared to 96.46±6.46 mm Hg in the Fentanyl Group, showing high significance.

The rise in mean arterial pressure was highly significant in Group F (Fentanyl) compared to Group D (Dexmedetomidine) during laryngoscopy, at every 1-min up to 5 min after intubation and then at 10 min and extubation ($p<0.0001$) (Table 5, Fig. 4).

There was no significant difference observed in SPO2 between the two Groups ($p>0.05$) (Table 6, Fig. 5). Intraoperatively bradycardia (pulse<50 beats/min) was observed in 1 patient in Dexmedetomidine Group, in which no treatment was required and in Group F 4 had nausea, 3 had vomiting and 3 had shivering (Table 7).

DISCUSSIONS

The outcomes of this investigation, aimed at assessing the impact of dexmedetomidine compared to fentanyl on patients undergoing laryngoscopy, revealed no increase in heart rate (HR) compared to baseline in the dexmedetomidine group. Dexmedetomidine significantly reduced HR at 1st, 2nd, 3rd, 4th, 5th and 10th min post-intubation compared to baseline. In comparison to fentanyl, dexmedetomidine induced a more pronounced decrease in systolic blood pressure at 1st, 2nd, 3rd, 4th, 5th and 10th min and in diastolic blood pressure at 1st, 2nd, 3rd, 4th, 5th and 10th minutes post-intubation. Significantly divergent systolic and diastolic blood pressure responses between the dexmedetomidine and fentanyl groups were observed at 1st, 2nd, 3rd, 4th, 5th and 10th minutes post-intubation. Moreover, the reduction in mean arterial pressure (MAP) was more pronounced in the dexmedetomidine group compared to the fentanyl group at 1st, 2nd, 3rd, 4th, 5th and 10th min, demonstrating statistical significance.

In 1992, Scheinin *et al*.[8] conducted a study to investigate the impact of Dexmedetomidine on the sympathoadrenal response during tracheal intubation and its dose-sparing effects on Pentothal and Fentanyl. The double-blind, placebo-controlled study involved 24 ASA I and II patients divided into two groups. One group received 0.6 μg kg^{-1} Dexmedetomidine 10 min pre-induction, while the other group received saline three minutes pre-induction. The Dexmedetomidine group exhibited a 1% increase in systolic blood pressure, 23% in diastolic pressure and 6% in heart rate post-intubation. In contrast, the control group showed higher increases (21-46-29%, respectively) with significant differences ($p<0.001$).

In 1997, Lawrence *et al*.[10] conducted a double-blind, placebo-controlled study, administering a single pre-induction dose of Dexmedetomidine (2 μg kg^{-1}). The systolic blood pressure, diastolic blood pressure, and heart rate were significantly lower in the Dexmedetomidine group during this period ($p<0.001$). Our study results align with those of Lawrence. In 2012, Bajwa *et al*.[11] investigated the impact of pre-

operative Dexmedetomidine on pressor response attenuation and opioid dose reduction. Both groups received inj Dexmedetomidine (1 µg kg^{-1} over 20 min) and Inj Fentanyl (1 µg kg^{-1}) 3 min before induction in the Dexmedetomidine Group. Dexmedetomidine effectively decreased the pressor response to laryngoscopy, intubation, surgery and extubation, with highly significant differences observed ($p<0.001$). Our study findings align with those of Bajwa .

In 2015, Vora investigated Dexmedetomidine's impact on hemodynamic changes during laryngoscopy and its role in laparoscopic surgery anesthesia. Administering a 1 µg kg^{-1} bolus 10 min before induction, followed by a maintenance dose of 0.5 µg kg^{-1}/hrs the study observed significant reductions in mean heart rate and mean arterial pressure in the Dexmedetomidine Group compared to the control group (normal saline). These reductions occurred after the loading dose, post-intubation, 20 and 60 min after pneumoperitoneum, following drug infusion cessation and during extubation ($p<0.05$). Our study is in accordance with the findings of Vora *et al*.[12] Ghorbanlo *et al*.[13], DAS *et al*.[14], Rani *et al*.[15] in 2016 Gogus *et al*.[16] in 2013 and Gunalan *et al*.[17] in 2015 conducted comparative studies on the effectiveness of dexmedetomidine and Fentanyl in diminishing responses to laryngoscopy and intubation. In line with the findings of DAS, our study indicates that dexmedetomidine was more effective than fentanyl in preventing an increase in heart rate (HR), although fentanyl induced lower hypotension. Consistent results were reported by Kataria and Gunalan *et al*.[17] where dexmedetomidine demonstrated superior efficacy over fentanyl in controlling HR and mean arterial pressure (MAP) during laryngoscopy and intubation. Our study corroborates these observations, showing that both dexmedetomidine and fentanyl effectively reduced laryngoscopy and intubation-induced responses. However, dexmedetomidine exhibited greater efficacy in controlling the sympathoadrenal response ($P<0.001$), despite an increased incidence of bradycardia compared to fentanyl.

Rashmi and Komala in 2015[18], Laha *et al*.[3] in 2011 and Kumari *et al*.[19] in 2008-2009 conducted assessments of intravenous dexmedetomidine's impact on hemodynamic responses to laryngoscopy and intubation. Across these studies the dexmedetomidine group exhibited reductions in heart rate (HR), diastolic blood pressure (DBP), systolic blood pressure (SBP), and mean arterial pressure (MAP), affirming its efficacy in attenuating the hemodynamic response to laryngoscopy and intubation. Notably, the specificity of dexmedetomidine, leading to potential adverse effects such as hypotension and bradycardia, was acknowledged in many cases, with hemodynamic changes exceeding 20%. Shu and colleagues also highlighted this concern in 2019[20].

CONCLUSION

Based on our findings, the intravenous administration of dexmedetomidine at a dosage of 1 mcg kg^{-1} demonstrates satisfactory results, yielding a more favorable hemodynamic response. Dexmedetomidine proves to be more effective in attenuating hemodynamic changes without compromising patient safety or impeding the recovery from anesthesia, especially when compared to fentanyl. In contrast, the use of fentanyl at a dosage of 2 mcg kg^{-1} is less effective in mitigating the pressor response associated with laryngoscopy and endotracheal intubation. It is noteworthy that both dexmedetomidine and fentanyl are deemed safe for use in elective surgeries.

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