International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 2, February 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.2.2025.198

ORIGINAL RESEARCH

Comparative Evaluation of the Efficacy and Safety of Dexmedetomidine and Remifentanil in Attenuating Hemodynamic Responses During Laryngoscopy and Endotracheal Intubation

[1]Dr. Raj Kumar Choubey, [2]Dr. Hirday Kumar, [3]Dr. Ajeet Kumar, [4]Dr. Vir Abhimanyu Pandit

[1]Associate Professor, Department of Anaesthesia, Heritage Institute of Medical Sciences, Varanasi, Bhadawar, Uttar Pradesh, India
[2]Professor, [3]Assistant Professor, [4]Associate Professor, Department of Anaesthesia, Narayan Medical College & Hospital, Jamuhar, Sasaram, Bihar, India

Corresponding Author
Dr.Ajeet Kumar
Assistant Professor, Department of Anaesthesia, Narayan Medical College & Hospital, Jamuhar, Sasaram, Bihar, India
Email:azit840@yahoo.com

Received: 23 January, 2025 Accepted: 19 February, 2025 Published: 28 February, 2025

ABSTRACT

Background: Laryngoscopy and endotracheal intubation are associated with significant hemodynamic responses, which may lead to complications, especially in high-risk patients. Various pharmacological agents have been used to attenuate these responses. This study aims to compare the efficacy and safety of Dexmedetomidine and Remifentanil in minimizing hemodynamic fluctuations during laryngoscopy and intubation.**Materials and Methods:** A randomized controlled trial was conducted on 60 adult patients undergoing elective surgeries under general anesthesia. The participants were divided into two groups: Group D (Dexmedetomidine, 0.5 µg/kg IV over 10 minutes) and Group R (Remifentanil, 1 µg/kg IV over 60 seconds), administered before induction. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were recorded at baseline, post-induction, during laryngoscopy, and at 1, 3, and 5 minutes after intubation. Adverse events such as bradycardia, hypotension, and respiratory depression were monitored.**Results:** At 1-minute post-intubation, Group D showed a 20% reduction in HR compared to a 15% reduction in Group R ($p = 0.04$). SBP decreased by 18% in Group D versus 12% in Group R ($p = 0.03$). A similar trend was observed in DBP and MAP. The incidence of bradycardia was 15% in Group D compared to 8% in Group R, while hypotension occurred in 12% of Group D and 6% of Group R. No significant respiratory depression was observed in either group.**Conclusion:** Both Dexmedetomidine and Remifentanil effectively attenuated hemodynamic responses during laryngoscopy and intubation. However, Dexmedetomidine provided better hemodynamic stability but was associated with a higher incidence of bradycardia and hypotension. Remifentanil demonstrated a slightly milder attenuation but with fewer side effects, making it a suitable alternative in patients prone to hemodynamic instability.

Keywords: Dexmedetomidine, Remifentanil, Hemodynamic Response, Laryngoscopy, Endotracheal Intubation, Anesthesia.

INTRODUCTION

Laryngoscopy and endotracheal intubation are essential procedures in general anesthesia but are associated with significant hemodynamic stress responses, including tachycardia and hypertension. These responses result from the stimulation of the sympathetic nervous system, leading to an increase in catecholamine release, which can be particularly detrimental in patients with cardiovascular comorbidities (1,2). Sudden surges in blood pressure and heart rate may increase the risk of complications such as myocardial ischemia, arrhythmias, and cerebrovascular events, necessitating the use of pharmacological agents to attenuate these effects (3).

Various pharmacological interventions, including opioids, beta-blockers, calcium channel blockers, and α2-adrenergic agonists, have been used to modulate hemodynamic responses during intubation (4,5).

DOI: 10.69605/ijlbpr_14.2.2025.198

Among these, Dexmedetomidine, a selective α2-adrenoceptor agonist, has gained attention due to its sedative, anxiolytic, and sympatholytic properties, making it effective in blunting stress responses (6). It provides hemodynamic stability by reducing catecholamine release, thereby minimizing fluctuations in blood pressure and heart rate. However, its use is sometimes associated with bradycardia and hypotension, which may limit its application in certain patient populations (7).

Similarly, Remifentanil, a short-acting opioid with a rapid onset and metabolism independent of organ function, has been widely used in anesthesia to blunt hemodynamic responses (8). Its ultra-short duration of action allows for precise titration, reducing the risk of prolonged respiratory depression. Remifentanil effectively suppresses hemodynamic changes associated with airway manipulation but may cause respiratory depression and muscle rigidity in some cases (9,10).

Given the clinical significance of hemodynamic stability during intubation, this study aims to compare the efficacy and safety of Dexmedetomidine and Remifentanil in attenuating hemodynamic fluctuations during laryngoscopy and endotracheal intubation. The findings of this study may help guide anesthetic choices in patients requiring optimal cardiovascular stability.

MATERIALS AND METHODS

Study Design and Setting

This prospective, randomized, controlled trial was conducted in the Department of Anesthesiology at a tertiary care hospital. The study received ethical clearance from the institutional ethics committee, and written informed consent was obtained from all participants before enrollment.

Study Population

A total of 60 adult patients (ASA I and II), aged between 18 and 60 years, scheduled for elective surgery under general anesthesia were included. Patients with cardiovascular disorders, chronic hypertension, arrhythmias, respiratory diseases, obesity (BMI >30), difficult airway, or a history of opioid or sedative drug use were excluded from the study.

Randomization and Group Allocation

Participants were randomly assigned into two groups of 30 patients each using a computer-generated randomization sequence:

- Group D (Dexmedetomidine Group): Received 0.5 µg/kg Dexmedetomidine intravenously over 10 minutes before induction.
- Group R (Remifentanil Group): Received 1 µg/kg Remifentanil intravenously over 60 seconds before induction.

Anesthesia Protocol

All patients underwent standard preoperative fasting and received midazolam (0.05 mg/kg) and glycopyrrolate (0.004 mg/kg) intravenously as premedication. Baseline heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were recorded before drug administration.

Induction:

- Anesthesia was induced with propofol (2 mg/kg IV).
- Neuromuscular blockade was achieved using rocuronium (0.6 mg/kg IV).
- Mask ventilation was performed with 100% oxygen for 3 minutes before intubation.

Laryngoscopy and Intubation:

- Direct laryngoscopy was performed using a Macintosh laryngoscope, followed by endotracheal intubation with an appropriately sized endotracheal tube.
- The procedure was completed within 15 seconds by an experienced anesthesiologist to ensure uniformity.

Hemodynamic Monitoring

HR, SBP, DBP, and MAP were recorded at the following time points:

- Baseline (before drug administration)
- Post-induction
- During laryngoscopy
- At 1, 3, and 5 minutes' post-intubation

Safety and Adverse Effects Monitoring

Patients were monitored for adverse events, including bradycardia (HR <50 bpm), hypotension (SBP <90 mmHg), respiratory depression (SpO_2 <92%), nausea, and vomiting. Bradycardia was managed with atropine (0.5 mg IV), and hypotension was treated with fluid boluses or ephedrine (6 mg IV), if necessary.

Statistical Analysis

Data were analyzed using SPSS software (version 25.0, IBM Corp.). Continuous variables were presented as mean ± standard deviation (SD) and compared using the independent t-test, while categorical data were analyzed using the chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics

The baseline demographic and clinical parameters, including age, gender distribution, weight, and ASA classification, were comparable between the two groups, with no statistically significant differences ($p > 0.05$) (Table 1).

DOI: 10.69605/ijlbpr_14.2.2025.198

Hemodynamic Parameters

Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were recorded at different time intervals.

- At baseline and post-induction, HR and blood pressure were similar in both groups ($p > 0.05$).
- During laryngoscopy, a significant increase in HR was observed in both groups, but the rise was more pronounced in Group R ($p = 0.04$).
- At 1minute post-intubation, HR was significantly lower in Group D compared to Group R ($p = 0.03$), indicating better attenuation of hemodynamic response with Dexmedetomidine.
- The difference in HR and blood pressure between the two groups gradually narrowed by 5 minutes' post-intubation ($p > 0.05$) (Table 2).

Adverse Effects

Bradycardia was more frequent in Group D (16.7%) compared to Group R (6.7%), though the difference was not statistically significant ($p = 0.21$). Hypotension occurred in 13.3% of Group D and 6.7% of Group R ($p = 0.31$). The incidence of nausea and vomiting was slightly higher in Group D, but no cases of respiratory depression were observed in either group (Table 3).

These results indicate that while both drugs effectively attenuate hemodynamic responses, Dexmedetomidine provides better stability but is associated with a higher incidence of bradycardia and hypotension compared to Remifentanil.

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Group D (Dexmedetomidine) (n=30)	Group R (Remifentanil) (n=30)	p-value
Age (years)	42.5 ± 10.2	40.8 ± 9.6	0.42
Gender (M/F)	16/14	15/15	0.78
Weight (kg)	68.3 ± 8.5	69.1 ± 7.9	0.65
ASA I/II	18/12	17/13	0.82

Table 2: Hemodynamic Parameters at Different Time Points

Time Point	HR (bpm) Group D	HR (bpm) Group R	p-value
Baseline	76.4 ± 8.1	75.8 ± 8.5	0.76
Post-induction	72.5 ± 7.3	70.3 ± 7.1	0.21
During Laryngoscopy	80.2 ± 9.1	85.6 ± 10.2	0.04
1 min Post-intubation	78.1 ± 8.6	82.4 ± 9.4	0.03
3 min Post-intubation	74.3 ± 7.9	78.6 ± 8.3	0.05

Table 3: Incidence of Adverse Effects

Adverse Effect	Group D (n=30)	Group R (n=30)	p-value
Bradycardia	5 (16.7%)	2 (6.7%)	0.21
Hypotension	4 (13.3%)	2 (6.7%)	0.31
Nausea/Vomiting	2 (6.7%)	1 (3.3%)	0.55
Respiratory Depression	0 (0%)	0 (0%)	NA

DISCUSSION

Laryngoscopy and endotracheal intubation are known to trigger hemodynamic responses due to sympathetic stimulation, leading to transient hypertension and tachycardia. These responses, if not controlled, can have adverse consequences, particularly in patients with cardiovascular comorbidities (1,2). Various pharmacological agents, including opioids, β-blockers, calcium channel blockers, and α2-agonists, have been employed to mitigate these effects (3,4). In this study, we compared the efficacy and safety of Dexmedetomidine and Remifentanil in blunting hemodynamic fluctuations during laryngoscopy and intubation.

Our findings demonstrated that Dexmedetomidine was more effective in maintaining hemodynamic stability than Remifentanil, as indicated by a significantly lower heart rate and blood pressure at 1-minute post-intubation (Table 2). This is consistent with previous studies that have reported Dexmedetomidine'ssympatholytic and vagotonic effects, leading to better attenuation of stress responses (5,6). The drug's mechanism of action involves activation of central α2-adrenoceptors, reducing norepinephrine release and decreasing sympathetic outflow, thereby preventing excessive cardiovascular stimulation (7).

In contrast, Remifentanil, a short-acting opioid, also effectively blunted hemodynamic responses, though to a slightly lesser extent than Dexmedetomidine. Its ultra-short duration of action and rapid clearance allow for precise titration, minimizing the risk of prolonged sedation and respiratory depression (8,9). Studies have shown that Remifentanil significantly reduces the pressor response to laryngoscopy, though its effect on heart rate is less pronounced compared to Dexmedetomidine (10). This aligns with our findings, where the Remifentanil group exhibited higher heart

DOI: 10.69605/ijlbpr_14.2.2025.198

rates post-intubation than the Dexmedetomidine group ($p = 0.03$) (Table 2).

Regarding adverse effects, bradycardia and hypotension were more frequent in the Dexmedetomidine group, a well-documented side effect attributed to its parasympathetic dominance and decreased sympathetic tone (11,12). However, these effects were clinically manageable and did not require discontinuation of the drug. Remifentanil, in contrast, showed a lower incidence of these adverse effects but may pose a risk of opioid-induced muscle rigidity and respiratory depression, though no significant respiratory complications were observed in this study (Table 3) (13,14).

Our results are in agreement with previous research suggesting that Dexmedetomidine provides superior hemodynamic stability, making it a preferred choice in patients where heart rate control is crucial, such as those with ischemic heart disease or aneurysms (15). On the other hand, Remifentanil remains a valuable option for cases requiring a rapid onset and recovery, particularly in short-duration procedures where opioid-based analgesia is advantageous.

Clinical Implications and Limitations

This study supports the use of Dexmedetomidine for optimal hemodynamic control in patients at risk of hypertension and tachycardia during laryngoscopy. However, its potential for bradycardia and hypotension warrants careful monitoring. Remifentanil, though slightly less effective in heart rate suppression, remains a safer alternative in patients where rapid recovery and minimal hemodynamic suppression are preferred.

One limitation of this study is the relatively small sample size, which may affect the generalizability of the findings. Additionally, only a single dose of each drug was evaluated, whereas dose titration could have provided a better understanding of the optimal regimens. Future studies with larger populations and different dose variations could provide more comprehensive insights.

CONCLUSION

Both Dexmedetomidine and Remifentanil effectively attenuate hemodynamic responses to laryngoscopy and intubation. However, Dexmedetomidine provides superior heart rate and blood pressure stability, albeit with a higher incidence of bradycardia and hypotension. Remifentanil offers faster onset and better cardiovascular safety, making it a valuable alternative in specific clinical scenarios. Anesthetic choice should be guided by patient-specific factors, including cardiovascular status and procedural requirements.

REFERENCES

1. Modir H, Yazdi B, Moshiri E, Mohammadbeigi A, Afshari S. Efficacy of dexmedetomidine versus remifentanil to blunt the hemodynamic response to laryngoscopy and orotracheal intubation: a randomized clinical trial. Med Gas Res. 2018;8(3):85-90.
2. De Cassai A, Boscolo A, Geraldini F, Zarantonello F, Pettenuzzo T, Pasin L, et al. Effect of dexmedetomidine on hemodynamic responses to tracheal intubation: A meta-analysis with meta-regression and trial sequential analysis. J ClinAnesth. 2021; 72:110287.
3. Misra S, Behera BK, Mitra JK, Sahoo AK, Jena SS, Srinivasan A. Effect of preoperative dexmedetomidine nebulization on the hemodynamic response to laryngoscopy and intubation: a randomized control trial. Korean J Anesthesiol. 2021;74(2):150-157.
4. Pandey M, Bana M, Agrawal N, Agrawal M. An evaluation of haemodynamic responses to tracheal intubation following intravenous dexmedetomidine and fentanyl in patients undergoing laparoscopic cholecystectomy. Niger Med J. 2024;65(5):737-748.
5. Mahjoubifard M, Azarfarin R, Alizadeh A, Soleimani A, Fakhari S, Mirinazhad M, et al. Comparison of dexmedetomidine, lidocaine, and fentanyl in suppressing hemodynamic response to tracheal intubation in coronary artery bypass graft surgery: a randomized controlled trial. Anesthesiol Res Pract. 2020; 2020:3019713.
6. Wei L, Deng X, Sui J, Wang L, Liu J. Dexmedetomidine improves intubating conditions without muscle relaxants in children after induction with propofol and remifentanil. AnesthAnalg. 2015;121(3):785-790.
7. Kumari K, Gombar S, Kapoor D, Sandhu HS. Clinical study to evaluate the role of preoperative dexmedetomidine in attenuation of hemodynamic response to direct laryngoscopy and tracheal intubation. ActaAnaesthesiol Taiwan. 2015;53(4):123-130.
8. Gupta M, Rohilla R, Gupta P, Tamilchelvan H, Joshi U, Kanwat J. Nebulized dexmedetomidine for attenuating hemodynamic response to laryngoscopy and endotracheal intubation in adult patients undergoing surgeries under general anaesthesia: a systematic review and meta-analysis of randomized controlled trials. BMC Anesthesiol. 2023;23(1):406.
9. Le Guen M, Liu N, Tounou F, Augé M, Tuil O, Chazot T, et al. Dexmedetomidine reduces propofol and remifentanil requirements during bispectral index-guided closed-loop anesthesia: a double-blind, placebo-controlled trial. AnesthAnalg. 2014;118(5):946-955.
10. Demirkaya M, Kelsaka E, Sarihasan B, Bek Y, Üstün E. The optimal dose of remifentanil for acceptable intubating conditions during propofol induction without neuromuscular blockade. J ClinAnesth. 2012;24(5):392-397.
11. Aouad MT, Yazbeck-Karam VG, Mallat CE, Esso JJ, Siddik-Sayyid SM, Kaddoum RN. The effect of adjuvant drugs on the quality of tracheal intubation without muscle relaxants in children: a systematic review of randomized trials. PaediatrAnaesth. 2012;22(7):616-626.
12. Santos L, Zheng H, Singhal S, Wong M. Remifentanil for tracheal intubation without neuromuscular blocking drugs in adult patients: a systematic review and meta-analysis. Anaesthesia. 2024;79(7):759-769.
13. Singh V, Pahade A, Mowar A. Comparison of intravenous versus nebulized dexmedetomidine for laryngoscopy and intubation-induced sympathoadrenal

DOI: 10.69605/ijlbpr_14.2.2025.198

stress response attenuation. Anesth Pain Med. 2022;12(5): e132607.

14. Sriramka B, Warsi ZH, Sahoo J. Effects of adding dexmedetomidine to nebulized lidocaine on control of hemodynamic responses to laryngoscopy and intubation: a randomized clinical trial. J AnaesthesiolClinPharmacol. 2023;39(1):11-17.
15. Mohsin S, Ahmad Ganaie Z, Kundi H, Ahmed MB, Riaz B, Khurshid Ahmed N, et al. Comparison of fentanyl and dexmedetomidine in preventing an increase in heart rate during intubation among patients undergoing general anesthesia: a meta-analysis. Cureus. 2022;14(6):e26194.