Original Article

Role of Dexmedetomidine in Attenuating Stress Response During Laryngoscopy and Intubation: A Prospective Comparative Study

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Abstract

Background: Laryngoscopy and endotracheal intubation produce sympathetic stimulation, resulting in transient tachycardia and hypertension. Dexmedetomidine, a selective alpha-2 adrenergic agonist, provides sympatholysis and sedation and is used to blunt this peri-intubation stress response. The objective is to evaluate the role of intravenous dexmedetomidine in attenuating haemodynamic stress response during laryngoscopy and endotracheal intubation in adult patients undergoing elective surgery under general anaesthesia. **Material and Methods:** This prospective comparative study included 60 adult patients at Kamineni Institute of Medical Science, Narketpally, Telangana, India, from August 2024 to July 2025. Patients were divided into two equal groups. Group D received dexmedetomidine and Group C served as the control group. Heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were recorded at baseline, before induction, at intubation, and after intubation. Adverse events were documented. **Results:** Baseline demographic and clinical variables were comparable between the groups. At intubation, mean heart rate was lower in Group D than Group C. Systolic blood pressure, diastolic blood pressure, and mean arterial pressure were also significantly lower in Group D during the intubation period and remained better controlled up to 10 minutes after intubation. Tachycardia and hypertension after intubation were less frequent in Group D, while mild bradycardia and hypotension were manageable. **Conclusion:** Dexmedetomidine effectively attenuated the haemodynamic stress response to laryngoscopy and endotracheal intubation and provided better peri-intubation cardiovascular stability without serious adverse events.

Keywords: Dexmedetomidine; laryngoscopy; endotracheal intubation; stress response; haemodynamic response; general anaesthesia.

Received: 08 April 2026 **Revised: 23 April 2026** **Accepted: 11 May 2026** **Published: 22 May 2026**

Introduction

Laryngoscopy and endotracheal intubation are essential components of airway management during general anaesthesia. Although these procedures are brief, mechanical stimulation of the larynx, trachea, and supraglottic structures triggers a distinct sympathetic response. The classical description of reflex circulatory changes during direct laryngoscopy has been confirmed by later studies showing rises in heart rate, arterial pressure, and circulating catecholamines.[1-4] In most healthy individuals, this response is transient and tolerated. In patients with limited cardiovascular reserve, hypertension, ischaemic heart disease, cerebrovascular disease, or raised intracranial pressure, even a short-lived surge in haemodynamic variables can increase perioperative risk.[2,5]

The pressor response is mediated through complex neurohumoral pathways involving sympathetic activation, catecholamine release, vasopressin response, and changes in autonomic tone.[4,6] The magnitude of the response depends on the depth of anaesthesia, duration and force of laryngoscopy, intubation difficulty, patient comorbidities, and anaesthetic drugs used during induction. Attenuation of this response is therefore an important anaesthetic goal, particularly in elective surgical patients in whom adequate preparation and controlled drug administration are feasible. Several agents, including opioids, beta-blockers, lignocaine, magnesium sulphate, vasodilators, and alpha-2 agonists, have been evaluated for this purpose with variable efficacy and safety profiles.

Dexmedetomidine is a highly selective alpha-2 adrenergic agonist with sedative, anxiolytic, analgesic-sparing, and sympatholytic actions.[7,8] By reducing central sympathetic outflow and noradrenaline release, it helps control tachycardia and hypertension associated with noxious perioperative stimuli. Its ability to provide sedation with minimal respiratory depression has supported its growing perioperative use.[8] However, excessive sympatholysis is associated with bradycardia and hypotension, making dose selection and patient monitoring clinically important.

Previous studies have shown that dexmedetomidine reduces haemodynamic responses during laryngoscopy and endotracheal intubation, with differences reported according to dose, route,

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DOI:
10.21276/amit.2026.v13.i2.683

How to cite this article: Prasad PK, Peddinti KC. Role of Dexmedetomidine in Attenuating Stress Response During Laryngoscopy and Intubation: A Prospective Comparative Study. Acta Med Int. 2026;13(2):250-254.

timing, comparator drug, and anaesthetic depth.[9-14] Indian studies have also supported its usefulness in controlled anaesthesia practice, but locally generated data remain useful because patient characteristics, institutional protocols, and clinical monitoring practices differ across centres. This study was conducted with the objective of evaluating the role of dexmedetomidine in attenuating stress response during laryngoscopy and endotracheal intubation among adult patients undergoing elective surgery under general anaesthesia. Assessment of these trends can guide local anaesthesia protocols and support rational use of sympatholytic premedication during airway manipulation. The primary objective was to compare peri-intubation heart rate and blood pressure responses between dexmedetomidine and control groups, while secondary objectives were to assess mean arterial pressure trends and adverse events.

Materials and Methods

Study design and setting: This prospective comparative study was conducted in the Department of Anaesthesiology, Kamineni Institute of Medical Science, Narketpally, Telangana, India. The institution is a tertiary care teaching hospital providing elective and emergency surgical services across multiple specialties with routine perioperative monitoring and post-anaesthesia care facilities.

Study period: The study was carried out from August 2024 to July 2025 after institutional approval and informed consent from all participants.

Study population: A total of 60 adult patients scheduled for elective surgery under general anaesthesia with endotracheal intubation were included. Patients of either sex, aged 18-60 years, belonging to American Society of Anesthesiologists physical status I or II, and requiring direct laryngoscopy were considered eligible. Patients with anticipated difficult airway, uncontrolled hypertension, significant cardiac conduction abnormality, severe hepatic or renal dysfunction, chronic beta-blocker therapy, allergy to study drug, pregnancy, or requirement for rapid sequence induction were excluded.

Sample size and sampling: The sample size of 60 patients was selected based on feasibility during the defined study period and on clinically meaningful differences in post-intubation haemodynamic parameters reported in previous studies [9-12]. Consecutive eligible patients were recruited and divided into two equal groups of 30 patients each.

Group allocation and intervention: Group D received intravenous dexmedetomidine 1 microgram/kg diluted in normal saline and administered slowly over 10 minutes before induction. Group C served as the control group and received standard anaesthetic management with an equal-volume saline infusion as per institutional protocol. All patients were monitored for heart rate, non-invasive blood pressure, electrocardiography, and oxygen saturation throughout the peri-intubation period.

Anaesthesia technique: After preoxygenation, anaesthesia was induced using standard intravenous induction agents. Neuromuscular blockade was achieved to facilitate direct laryngoscopy and endotracheal intubation. Laryngoscopy was performed by an experienced anaesthesiologist, and haemodynamic observations were recorded at predefined time points: baseline, before induction, at intubation, and at 1, 3, 5, and 10 minutes after intubation. Systolic blood pressure, diastolic blood pressure, and mean arterial pressure were documented at baseline, intubation, 5 minutes, and 10 minutes.

Outcome measures and statistical analysis: The primary outcome was attenuation of heart rate and blood pressure response during laryngoscopy and endotracheal intubation. Secondary outcomes included mean arterial pressure trends and adverse events such as bradycardia, hypotension, hypertension, tachycardia, desaturation, arrhythmia, or delayed recovery. Quantitative variables were expressed as mean ± standard deviation and compared using the independent samples t-test. Categorical variables were expressed as frequency and percentage and compared using chi-square test or Fisher exact test. A p-value less than 0.05 was considered statistically significant.

Results

A total of 60 patients were included in the study and divided into two equal groups. Group D received dexmedetomidine, while Group C served as the control group. Each group included 30 patients, and all patients were analysed. Baseline demographic and clinical characteristics were comparable between the two groups, as shown in [Table 1].

Table 1: Baseline demographic and clinical characteristics

Variable	Group D: Dexmedetomidine (n=30)	Group C: Control (n=30)	p-value
Age, years	38.6 ± 10.8	39.9 ± 11.2	0.648
Male/Female	17/13	16/14	0.795
Body weight, kg	65.8 ± 8.9	66.4 ± 9.3	0.799
ASA I/II	18/12	17/13	0.793
Duration of surgery, minutes	82.4 ± 18.6	85.1 ± 19.2	0.583

Both groups were comparable with respect to age, sex distribution, body weight, ASA physical status, and duration of surgery. No statistically significant difference was observed in baseline parameters, indicating that both groups were suitable for haemodynamic comparison.

Heart rate increased after laryngoscopy and endotracheal intubation in both groups. However, the rise was significantly lower in the dexmedetomidine group at intubation and at all post-intubation intervals. The maximum mean heart rate was 93.2 ± 9.8 beats/min in Group D compared with 111.6 ± 11.4 beats/min in Group C at intubation, as shown in [Table 2].

Table 2: Comparison of heart rate between the two groups

Time interval	Group D: Dexmedetomidine	Group C: Control	p-value
Baseline	82.4 ± 8.6	81.8 ± 8.9	0.791
Before induction	78.6 ± 7.9	82.1 ± 8.4	0.101
At intubation	93.2 ± 9.8	111.6 ± 11.4	<0.001
1 min after intubation	90.8 ± 8.7	108.4 ± 10.6	<0.001
3 min after intubation	86.5 ± 8.1	101.2 ± 9.8	<0.001
5 min after intubation	82.7 ± 7.6	94.6 ± 8.9	<0.001
10 min after intubation	79.8 ± 7.2	87.4 ± 8.2	<0.001

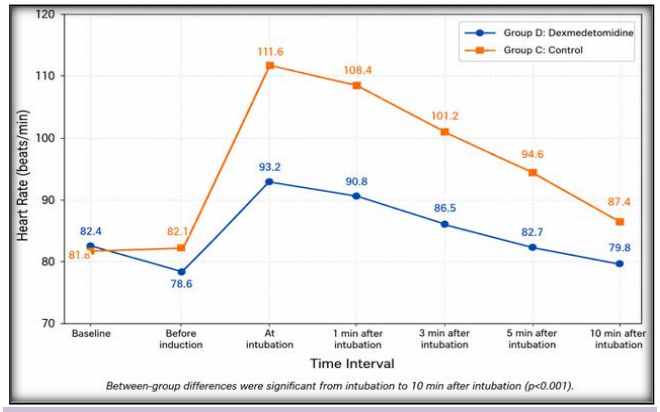

Figure 1: Comparison of heart rate between the two groups

Systolic blood pressure, diastolic blood pressure, and mean arterial pressure were similar at baseline. After intubation, all blood pressure parameters were significantly higher in the control group. Dexmedetomidine produced a smaller pressor response at intubation and better haemodynamic stability during the immediate post-intubation period, as demonstrated in [Table 3].

Dexmedetomidine was generally well tolerated. Mild bradycardia and hypotension were observed in a small number of patients in Group D and were managed with standard treatment. Hypertension and tachycardia after intubation were significantly less frequent in Group D than in Group C. No oxygen desaturation, severe arrhythmia, or delayed recovery was observed, as shown in [Table 4].

Table 3: Comparison of blood pressure parameters between the two groups

Parameter	Time interval	Group D: Dexmedetomidine	Group C: Control	p-value
SBP, mmHg	Baseline	126.8 ± 10.4	128.1 ± 11.2	0.644
SBP, mmHg	At intubation	135.4 ± 11.6	158.2 ± 13.8	<0.001
SBP, mmHg	5 min after intubation	123.6 ± 9.2	138.7 ± 10.6	<0.001
SBP, mmHg	10 min after intubation	120.8 ± 8.9	130.4 ± 9.8	<0.001
DBP, mmHg	Baseline	78.4 ± 7.8	79.1 ± 8.2	0.735
DBP, mmHg	At intubation	84.6 ± 8.1	96.8 ± 9.4	<0.001
DBP, mmHg	5 min after intubation	78.9 ± 7.4	88.6 ± 8.5	<0.001
DBP, mmHg	10 min after intubation	76.2 ± 7.1	82.4 ± 7.8	0.002
MAP, mmHg	Baseline	94.5 ± 8.1	95.4 ± 8.6	0.678
MAP, mmHg	At intubation	101.5 ± 8.9	117.3 ± 10.2	<0.001
MAP, mmHg	5 min after intubation	93.8 ± 7.8	105.3 ± 8.7	<0.001
MAP, mmHg	10 min after intubation	91.1 ± 7.5	98.4 ± 8.1	<0.001

Table 4: Adverse events observed during the study

Adverse event	Group D: Dexmedetomidine (n=30)	Group C: Control (n=30)	p-value
Bradycardia	2 (6.7%)	0	0.492
Hypotension	3 (10.0%)	1 (3.3%)	0.612
Hypertension after intubation	2 (6.7%)	11 (36.7%)	0.010
Tachycardia after intubation	3 (10.0%)	14 (46.7%)	0.003
Oxygen desaturation	0	0	NA

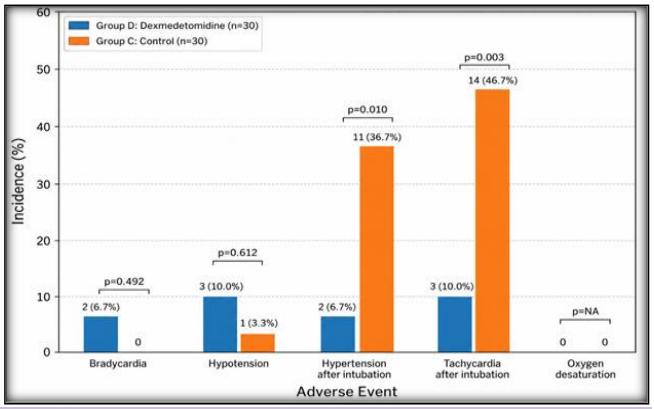

Figure 2: Adverse events observed during the study

Overall, the findings indicate that dexmedetomidine significantly attenuated the stress response during laryngoscopy and endotracheal intubation. Patients receiving dexmedetomidine had lower heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure during the critical intubation period compared with the control group.

Discussion

The present study evaluated the role of dexmedetomidine in attenuating haemodynamic stress response during laryngoscopy and endotracheal intubation. The groups were comparable in baseline demographic and clinical variables, strengthening the interpretation that observed peri-intubation differences were related to the intervention rather than baseline imbalance. The

main finding was that dexmedetomidine produced significantly lower heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure at intubation and during the immediate post-intubation period.

The cardiovascular response to laryngoscopy and intubation is well documented. Early studies by King et al. and later work by Shribman et al. established that airway instrumentation produces reflex circulatory activation and catecholamine release.[4] Kayhan et al. also showed that blood pressure, heart rate, epinephrine, norepinephrine, and vasopressin increase in response to laryngoscopy and intubation.[6] In the present study, the control group demonstrated the expected pattern, with a clear rise in heart rate and blood pressure at intubation and persistence of higher values during the first 10 minutes. This confirms that standard induction alone did not completely suppress the sympathetic response.

Dexmedetomidine reduced both chronotropic and pressor responses. This is consistent with its pharmacological profile as a selective alpha-2 adrenergic agonist producing central sympatholysis, anxiolysis, and anaesthetic-sparing effects.[7,8] Yildiz et al. reported that a single pre-induction dose of dexmedetomidine blunted haemodynamic responses during laryngoscopy and reduced anaesthetic requirements.[9] Similar findings were reported by Sebastian et al., who showed effective attenuation of intubation response with intravenous dexmedetomidine, with 0.75 microgram/kg described as an optimal dose in their study.[10] Mahajan et al. also found that dexmedetomidine attenuated pressor response under bispectral index-controlled anaesthesia.[11]

The present results are also aligned with comparative studies evaluating dexmedetomidine against esmolol and other agents. Reddy et al. reported superior or more sustained haemodynamic suppression with dexmedetomidine compared with esmolol during laryngoscopy and intubation.[13] Studies comparing different doses and routes have shown that dexmedetomidine remains effective through intravenous and intranasal administration, although onset, sedation, and adverse-event profiles differ.[10,12,14] In this study, bradycardia and hypotension were observed more often in the dexmedetomidine group but were mild and manageable. Conversely, post-intubation hypertension and tachycardia were markedly lower in the dexmedetomidine group, supporting its protective role during a short but intense sympathetic stimulus.

Clinically, these findings suggest that dexmedetomidine is useful for maintaining cardiovascular stability during airway instrumentation in elective surgical patients. Careful patient selection, slow infusion, and close haemodynamic monitoring remain essential, especially in patients with conduction abnormalities, baseline bradycardia, hypovolaemia, or compromised ventricular function. The drug should be integrated into a balanced anaesthetic plan rather than used as an isolated measure.

Limitations: The study was conducted at a single centre with a modest sample size. Catecholamine levels, bispectral index monitoring, and depth-of-anaesthesia quantification were not assessed. Allocation concealment and assessor blinding were not applied. Only short-term peri-intubation haemodynamic outcomes were evaluated, limiting assessment of postoperative cardiovascular events. High-risk cardiac patients and emergency airways were excluded, so the findings primarily apply to elective ASA I-II patients under controlled conditions.

Conclusion

Dexmedetomidine significantly attenuated the haemodynamic stress response associated with laryngoscopy and endotracheal intubation in adult patients undergoing elective surgery under general anaesthesia. Compared with the control group, patients receiving dexmedetomidine showed lower heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure during intubation and the early post-intubation period. The drug also reduced the frequency of tachycardia and hypertension after intubation. Mild bradycardia and hypotension were observed but were manageable with standard measures. Dexmedetomidine is therefore a useful peri-intubation adjunct when administered carefully with vigilant haemodynamic monitoring. These findings support its use in selected elective cases, particularly when undesirable tachycardia or hypertension is anticipated during airway manipulation.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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