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Efficacy of Intravenous Dexmedetomidine Versus 4% Lignocaine Nebulization in Attenuating Hemodynamic Responses to Laryngoscopy and Endotracheal Intubation

Dr Rajasri Kunche[1], Dr Pushpalatha Vantepaka[2], Dr Jyothsna Devi M[3], Dr Imala P[4], Dr Kiran Madhala[5], Dr Aavula Muralidhar[6]

[1]Assistant Professor, Department of Anaesthesiology, Gandhi Medical College, Secunderabad, Telangana, India
[2]Assistant Professor, Department of Anaesthesiology, Gandhi Medical College, Secunderabad, Telangana, India
[3]Associate Professor, Department of Anaesthesiology, Gandhi Medical College, Secunderabad, Telangana, India
[4]Postgraduate, Department of Anaesthesiology, Gandhi Medical College, Secunderabad, Telangana, India
[5]Professor, Department of Anaesthesiology, Gandhi Medical College, Secunderabad, Telangana, India
[6]Professor and Head, Department of Anaesthesiology, Gandhi Medical College, Secunderabad, Telangana, India

Corresponding Author:

Dr Imala P
Postgraduate, Department of Anaesthesiology, Gandhi Medical College, Secunderabad, Telangana, India

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ABSTRACT

Background: Laryngoscopy and endotracheal intubation provoke significant sympathetic stimulation, often resulting in abrupt hemodynamic fluctuations. Pharmacological strategies such as intravenous dexmedetomidine and lignocaine nebulization are frequently employed to attenuate these responses. This study compared the efficacy of intravenous dexmedetomidine and 4% lignocaine nebulization in modulating peri-intubation hemodynamic changes.
Methods:A randomized comparative study involving 100 ASA I–II adults undergoing elective surgery under general anesthesia was conducted. Participants were allocated equally into Group A (dexmedetomidine 0.5 µg/kg IV infusion) and Group B (4% lignocaine nebulization, 3 mL). Baseline characteristics included age, sex, weight, ASA status, and Mallampati class (Table 1). Hemodynamic parametersheart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP)were recorded at baseline and at 1, 3, 5, and 10 minutes post-intubation (Tables 2–3). Adverse events were monitored throughout (Table 4).
Results: Both groups were comparable at baseline. HR remained stable in both groups at all time points, with no significant intergroup differences (p> 0.05). SBP exhibited a mild rise at one minute in both groups, followed by gradual normalization, without significant differences across intervals. DBP and MAP showed similar physiological patterns, demonstrating no meaningful intergroup variation. Complications were infrequent: bradycardia occurred more often in the lignocaine group (18% vs. 6%), and hypotension was more common in the dexmedetomidine group (14% vs. 4%), though none reached statistical significance.
Conclusion: Intravenous dexmedetomidine and 4% lignocaine nebulization provide **comparable and effective attenuation of hemodynamic responses** during laryngoscopy and intubation, with minimal and clinically manageable adverse effects. Both agents represent safe pre-intubation strategies in ASA I–II adult surgical patients.

Keywords*:Dexmedetomidine, Lignocaine Nebulization, Hemodynamic Response, Laryngoscopy, Intubation, Anesthesia..*

INTRODUCTION

Laryngoscopy and endotracheal intubation are indispensable components of general anesthesia, yet they remain among the most potent airway stimuli capable of triggering abrupt sympathetic activation [1]. Mechanical stimulation of the oropharyngeal and laryngotracheal structures produces sharp increases in heart rate and arterial pressure, responses that

can be harmful in individuals with limited cardiovascular reserve, cerebrovascular disease, or uncontrolled hypertension [2,3]. Attenuating these hemodynamic surges has therefore become a crucial objective in modern anesthetic practice.

A wide range of pharmacological strategies—opioids, beta-blockers, calcium-channel blockers, and local anesthetics—have been explored to blunt the pressor response, although each exhibits limitations related to variability of onset, short duration, or undesirable adverse effects [3,4]. Dexmedetomidine, a highly selective α2-adrenergic agonist, has gained increasing recognition for its potent sympatholytic, sedative, and opioid-sparing actions. Its ability to suppress central sympathetic outflow effectively moderates peri-intubation cardiovascular changes without producing significant respiratory depression [1,2].

Lignocaine has long been used for airway anesthesia, and nebulized 4% lignocaine offers a convenient, non-invasive method of suppressing afferent airway reflexes. Systematic reviews have confirmed its capacity to reduce the hemodynamic impact of laryngoscopy and tracheal intubation in adults undergoing general anesthesia [4,5]. However, despite strong individual evidence for both agents, direct comparative studies evaluating intravenous dexmedetomidine and nebulized lignocaine remain limited.

Given their distinct mechanisms yet shared clinical purpose, comparing these two approaches is essential for guiding optimal pre-intubation management that is effective, safe, and feasible across diverse perioperative settings. The present study was designed to address this gap by evaluating the relative efficacy of intravenous dexmedetomidine and 4% lignocaine nebulization in attenuating hemodynamic responses to laryngoscopy and endotracheal intubation.

METHODOLOGY

Study Design and Setting

This prospective, randomized comparative study was conducted in the Department of Anaesthesiology, Gandhi Medical College and Hospital, Secunderabad. The study included adult patients scheduled for elective surgical procedures requiring general anesthesia with endotracheal intubation.

Study Population

A total of 100 patients were recruited after screening for eligibility. Individuals aged 18–50 years with American Society of Anesthesiologists (ASA) physical status I or II were included. Both male and female patients were eligible.

Inclusion Criteria

Age between 18 and 50 years
ASA physical status I–II
Elective surgery under general anesthesia
Written informed consent

Exclusion Criteria
Patient refusal
Known allergy to dexmedetomidine or lignocaine
Cardiovascular instability
Hepatic or renal dysfunction
Coagulation abnormalities
Bronchial asthma, seizure disorders, ischemic heart disease
Hypertension or diabetes mellitus
Chronic use of antidepressants, antipsychotics, anxiolytics, or anticonvulsants
Anticipated difficult airway (Mallampati III–IV, restricted neck mobility, craniofacial abnormalities)
Emergency surgeries

Randomization and Allocation
Patients were randomly assigned into two equal groups (n=50 each) using a computer-generated randomization list. Allocation concealment was ensured through sealed opaque envelopes opened immediately before intervention.

Interventions
Group A (Dexmedetomidine): Patients received intravenous dexmedetomidine at 0.5 µg/kg diluted in 100 mL normal saline infused over 10 minutes.

Group B (4% Lignocaine Nebulization): Patients received 3 mL of 4% lignocaine via jet nebulizer over 10 minutes.
All patients were premedicated and monitored with ECG, pulse oximetry, and non-invasive blood pressure. Preoxygenation with 100% oxygen for 3 minutes preceded induction.

Anesthesia Technique
General anesthesia was induced with fentanyl (1 µg/kg), propofol (2 mg/kg), and vecuronium (0.12 mg/kg). Laryngoscopy was performed using a Macintosh blade, and intubation was completed with a cuffed endotracheal tube. Anesthesia was maintained with nitrous oxide and oxygen (3:2), sevoflurane (1%), and intermittent vecuronium doses.

Hemodynamic Monitoring
Heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were recorded at:
Baseline (pre-intervention)
1 minute post-intubation
3 minutes
5 minutes
10 minutes
Complications such as bradycardia, hypotension, and arrhythmias were documented.

Outcome Measures
Primary Outcome:
Attenuation of hemodynamic responses to laryngoscopy and intubation

Secondary Outcome:
Incidence of adverse events

Statistical Analysis
Data were analyzed using standard statistical software. Continuous variables were expressed as mean ± standard deviation and compared using independent *t*-test or Mann–Whitney U test. Categorical variables were compared using Chi-square test. Repeated-measures ANOVA assessed changes over time. A p-value <0.05 was considered statistically significant.

RESULTS
A total of 100 patients were enrolled and equally allocated to the dexmedetomidine group (Group A) and the 4% lignocaine nebulization group (Group B). Both groups were comparable at baseline, with no statistically significant difference in age, sex distribution, body weight, ASA physical status, or Mallampati class (Table 1). This ensured that subsequent hemodynamic comparisons reflected true drug effects rather than demographic imbalance.

Table 1. Baseline Demographic and Clinical Characteristics of the Study Groups

Variable	Group A (Dexmedetomidine) Mean ± SD / n(%)	Group B (4% Lignocaine Nebulization) Mean ± SD / n(%)	*p*-value
Age (years)	33.67 ± 9.44	37.77 ± 8.99	0.090
Gender (Female/Male)	29 (58%) / 21 (42%)	24 (48%) / 26 (52%)	0.316
Weight (kg)	54.23 ± 6.57	54.97 ± 7.31	0.684
ASA I / II	28 (56%) / 22 (44%)	21 (42%) / 29 (58%)	0.161
Mallampati Class I / II	16 (32%) / 34 (68%)	22 (44%) / 28 (56%)	0.216

Heart rate trends remained stable throughout the observation period. Neither group demonstrated significant tachycardia or bradycardia following laryngoscopy or endotracheal intubation. At all time points—baseline, 1, 3, 5, and 10 minutes—mean heart rates were similar between the two groups, and none of the intergroup differences reached statistical significance (Table 2). The overall pattern indicated that both interventions provided comparable control of chronotropic responses during airway manipulation.

Table 2. Comparison of Heart Rate Between Groups at Different Time Points

Time Interval	Group A Mean ± SD	Group B Mean ± SD	*p*-value
Baseline	85.67 ± 10.36	85.53 ± 9.34	0.958
1 min	82.20 ± 9.81	85.20 ± 8.81	0.218
3 min	85.83 ± 9.33	83.93 ± 7.47	0.388
5 min	84.90 ± 8.63	86.67 ± 8.66	0.432
10 min	81.70 ± 8.35	82.27 ± 8.73	0.798

Systolic blood pressure behaved similarly in both groups, with a modest rise at one minute after intubation followed by a gradual return toward baseline. Although Group A showed a slightly higher mean systolic value at the 1-minute mark, this difference did not achieve statistical significance. Subsequent recordings at 3, 5, and 10 minutes remained closely matched across the groups (Table 3A).

Table 3. Comparison of Blood Pressure Variables Between Groups

A. Systolic Blood Pressure (SBP)

Time Interval	Group A Mean ± SD	Group B Mean ± SD	*p*-value
Baseline	120.20 ± 11.23	119.37 ± 12.11	0.783
1 min	124.70 ± 9.16	120.13 ± 10.58	0.079
3 min	120.20 ± 11.48	118.97 ± 11.15	0.675
5 min	118.20 ± 10.27	120.03 ± 11.23	0.512
10 min	120.93 ± 12.26	123.80 ± 12.80	0.379

Diastolic pressures mirrored these findings, exhibiting small physiological fluctuations without meaningful intergroup variation at any measured interval (Table 3B).

B. Diastolic Blood Pressure (DBP)

Time Interval	Group A Mean ± SD	Group B Mean ± SD	*p*-value
Baseline	75.77 ± 9.12	75.77 ± 9.58	1.000
1 min	72.73 ± 8.00	76.30 ± 9.06	0.111
3 min	74.00 ± 10.22	73.63 ± 8.89	0.883
5 min	74.07 ± 9.13	75.13 ± 9.79	0.664
10 min	73.97 ± 10.23	73.23 ± 8.24	0.761

Mean arterial pressure also remained comparable, with near-parallel trends in both groups from baseline to the 10-minute period, and all *p*-values exceeding the threshold for statistical significance (Table 3C).

C. Mean Arterial Pressure (MAP)

Time Interval	Group A Mean ± SD	Group B Mean ± SD	*p*-value
Baseline	90.27 ± 6.93	89.97 ± 5.97	0.858
1 min	89.70 ± 5.74	90.70 ± 7.85	0.576
3 min	89.10 ± 8.10	88.40 ± 6.93	0.720
5 min	88.43 ± 7.62	89.80 ± 6.38	0.454
10 min	89.20 ± 7.45	89.70 ± 7.36	0.795

Adverse events were infrequent in both groups. Bradycardia occurred more often in the lignocaine group, whereas hypotension was noted predominantly in the dexmedetomidine group. However, none of these differences were statistically significant. No serious arrhythmias were recorded, and the majority of participants in both groups completed the procedure without any complications (Table 4).

Table 4. Comparison of Complications Between Groups

Complication	Group A n (%)	Group B n (%)	*p*-value
Arrhythmia	0 (0%)	1 (2%)	0.078
Bradycardia	3 (6%)	9 (18%)	—
Hypotension	7 (14%)	2 (4%)	—
None	40 (80%)	38 (76%)	—

DISCUSSION

This study compared the effectiveness of intravenous dexmedetomidine and 4% lignocaine nebulization in controlling hemodynamic responses to laryngoscopy and endotracheal intubation. Both techniques maintained stable cardiovascular parameters throughout the observation period, and no statistically significant differences were noted between them. These findings demonstrate that each intervention offers comparable protection against the sympathetic surges generated during airway manipulation, consistent with contemporary evidence on airway attenuation strategies.

Baseline demographic characteristics—including age distribution, sex ratio, ASA status, and Mallampati class—were well matched between the groups, ensuring that subsequent hemodynamic variations were attributable to drug effects rather than sample imbalance (Table 1). Heart rate trends remained stable across all measured intervals, and neither group exhibited clinically relevant tachycardia or bradycardia following intubation (Table 2). Similar results were reported by Singh et al., who observed equivalent chronotropic control with intravenous and nebulized dexmedetomidine [6].

Blood pressure behavior also showed parallel patterns. The transient systolic rise at one minute post-intubation was mild in both groups and quickly normalized, while diastolic and mean arterial pressures remained largely unchanged (Table 3). Grover et al. demonstrated comparable pressor attenuation using dexmedetomidine delivered via nebulization [7], and the current results reinforce these observations. Furthermore, lignocaine nebulization has previously been shown to suppress airway reactivity effectively [8], which aligns with the modest and uniform blood pressure responses seen in

this study. Similar hemodynamic stability following pre-operative nebulized dexmedetomidine has also been documented in randomized controlled trials [9].

Adverse events were infrequent, self-limited, and did not differ significantly between groups (Table 4). Slightly higher bradycardia in the lignocaine cohort and a small increase in hypotension in the dexmedetomidine group reflect known pharmacodynamic tendencies but remained clinically manageable. Prior studies evaluating lignocaine with or without dexmedetomidine for airway procedures have similarly reported good safety profiles without major cardiovascular complications [10].

CONCLUSION

This study demonstrates that both intravenous dexmedetomidine and 4% lignocaine nebulization provide effective attenuation of the hemodynamic responses associated with laryngoscopy and endotracheal intubation in ASA I–II adults undergoing elective surgery. Heart rate, systolic and diastolic pressures, and mean arterial pressure remained stable in both groups, with no statistically significant differences at any interval. Adverse events were infrequent and clinically manageable, supporting the safety of both interventions. These findings indicate that either agent may be selected based on patient profile, clinical preference, and resource availability. Overall, both techniques offer reliable, well-tolerated options for achieving peri-intubation cardiovascular stability.

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