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*Original Research Article*

# Attenuation of Hemodynamic Responses to Laryngoscopy and Endotracheal Intubation with Dexmedetomidine: A comparison Between intravenous and Intranasal Route -A Randomized Controlled Study

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***Abstract***: ***Introduction***: Laryngoscopy and endotracheal intubation are associated with significant haemodynamic responses, which may be detrimental in susceptible patients. Dexmedetomidine is known to attenuate these responses, and alternative routes of administration such as the intranasal route may offer comparable efficacy with improved safety and convenience. ***Aims***: To compare the effectiveness of intranasal versus intravenous dexmedetomidine in attenuating haemodynamic responses to laryngoscopy and endotracheal intubation. ***Materials and Methods***: This prospective, open-label, randomized controlled study was conducted over 18 months at Topiwala National Medical College & B. Y. L. Nair Charitable Hospital. A total of 134 adult patients undergoing elective surgery under general anaesthesia were randomized to receive dexmedetomidine either by the intranasal (IN) or intravenous (IV) route. Heart rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were recorded at baseline, post-drug administration, during intubation, and up to 10 minutes post-intubation. Dexmedetomidine was administered intravenously at a dose of 0.5 µg/kg and intranasally at a dose of 1 µg/kg, 40 minutes prior to the procedure. ***Results***: Both groups were comparable with respect to age and gender distribution. Baseline SBP was significantly lower in the IN group compared to the IV group (119 ± 6.64 vs 123 ± 7.02 mmHg, $p = 0.001$), with a persistent difference at 10 minutes post-drug ($p = 0.039$). Post-intubation SBP showed significant attenuation in the IN group at 4, 5, and 10 minutes ($p < 0.05$). DBP values were comparable pre-intubation; however, from 1 to 10 minutes post-intubation, DBP was significantly lower in the IN group (all $p < 0.001$), indicating superior haemodynamic stability. ***Conclusion***: Intranasal dexmedetomidine is as effective as, and in certain parameters superior to, intravenous dexmedetomidine in attenuating haemodynamic responses to laryngoscopy and endotracheal intubation.

**Keywords**: Dexmedetomidine; Intranasal; Intravenous; Laryngoscopy; Endotracheal Intubation; Haemodynamic Response.

## INTRODUCTION

Hemodynamic changes during induction of general anaesthesia, laryngoscopy, endotracheal intubation, and extubation remain major concerns in anaesthetic practice. Laryngoscopy and endotracheal intubation are noxious stimuli that provoke sympathetic stimulation, resulting in an increase in heart rate (HR) and mean arterial pressure (MAP) [1]. These acute haemodynamic fluctuations may, in rare cases, predispose susceptible patients to myocardial ischemia and other cardiovascular complications [2]. Therefore, effective attenuation of these responses is of paramount importance.

 

Various pharmacological agents and techniques have been employed to blunt the haemodynamic response to laryngoscopy and intubation [3]. These include intravenous lignocaine, adrenergic blocking agents (α- and β-blockers), vasodilators such as hydralazine, sodium nitroprusside, and nitroglycerine, deep inhalational anaesthesia, intravenous opioids, and topical airway anaesthesia using lignocaine. However, no single agent has been universally accepted as the most appropriate for this purpose.

Dexmedetomidine (DEX), a highly selective, short-acting, centrally acting α2-adrenergic agonist, possesses sedative, analgesic, and anxiolytic properties without causing respiratory depression. DEX inhibits noradrenaline release and induces sedation and hypnosis via presynaptic α2 receptors in the locus ceruleus, while its sympatholytic effects are mediated through postsynaptic α2 receptors, preventing tachycardia and hypertension [4]. Due to these properties, both intravenous (IV) and intranasal (IN) dexmedetomidine have been shown to effectively attenuate the haemodynamic stress responses associated with laryngoscopy and endotracheal intubation.

Dexmedetomidine is also effective in relieving preoperative anxiety and nervousness, making it an ideal premedication agent [5]. Several studies have established the efficacy of preoperative intravenous dexmedetomidine in attenuating the laryngoscopic stress response [6]. However, adverse haemodynamic effects such as hypotension, bradycardia, and rarely cardiac arrest, along with delayed recovery due to its sedative effects, have limited its widespread use via the intravenous route [7]. Consequently, alternative routes of administration, such as the intranasal route, have been proposed to minimize these adverse effects while maintaining clinical efficacy.

## MATERIALS AND METHODS

**Study Design:** This study was conducted as an open-label, randomized, controlled, prospective study.

**Place of Study:** The study was carried out at a tertiary care hospital.

**Duration of Study**: The study was conducted over a period of 18 months, following approval from the Institutional Ethics Committee.

**Ethical Justification:** The study was initiated only after obtaining approval from the Institutional Ethics and Research Committee. Written informed consent was obtained from the patient or parent/guardian prior to enrollment.The identity and personal details of all participants were kept strictly confidential throughout the study.

**Study Population:** Adult patients scheduled for elective surgical procedures under general anaesthesia with endotracheal intubation were included in the study.

**Sample Size:** A total of 134 patients were enrolled and randomly allocated into two groups.

**Study variable:**

- Demographic Variables
- Age Distribution
- Gender Distribution
- Distribution of Anaesthesia Type
- Heart Rate (HR)
- Systolic Blood Pressure (SBP)
- Diastolic Blood Pressure (DBP)
- Mean Arterial Pressure (MAP)
- Sedation Score (Ramsay Sedation Scale)
- Inclusion Criteria:
- Patients aged 18–60 years.
- Body weight > 40 kg.
- Both male and female patients.
- Patients undergoing elective surgery under general anaesthesia with endotracheal intubation.
- Patients or their parent/guardian willing to provide written informed consent.
- Patients classified as American Society of Anesthesiologists (ASA) physical status I or II.

**Exclusion Criteria:**

- Known allergy or hypersensitivity to dexmedetomidine.
- Presence of intranasal pathology such as nasal ulcers, polyps, or deviated nasal septum.
- Moderate to severe respiratory disease.
- Patients with advanced heart block or ventricular dysfunction.
- Pregnant patients.
- Endotracheal intubation requiring more than one attempt.
- Intubation time > 30 seconds.
- Patients classified as ASA physical status III, IV, or V.
- Patients undergoing laparoscopic surgeries.
- Patients with neurodevelopmental disorders or known psychiatric illness.

**Sample Size Calculation**

The sample size was calculated based on a comparison of the mean arterial pressure (MAP) values between the two groups using data from a similar study conducted by Shrivastava P et al. [14]. In the reference study, the MAP at one minute after intubation was 94.82 ± 11.06 mmHg in the intravenous dexmedetomidine group and 86.80 ±

 

11.86 mmHg in the intranasal dexmedetomidine group.

The power of the study was set at 90%, with an alpha error of 0.01. The sample size was calculated using the standard formula for comparison of two means, resulting in a total sample size of 134 patients.

## RESULT

**Table1: Ageand Gender Distribution of Participants**

| GENDER | Female | | Male | |
|---|---|---|---|---|
| AGE GROUP | Counts | % ofTotal | Counts | % ofTotal |
| 26-35 | 3 | 2.2% | 2 | 1.5% |
| 36-40 | 4 | 3.0% | 6 | 4.5% |
| 41-45 | 12 | 9.0% | 9 | 6.7% |
| 46-50 | 16 | 11.9 % | 21 | 15.7 % |
| 51-55 | 17 | 12.7 % | 11 | 8.2% |
| 56-60 | 18 | 13.4 % | 15 | 11.2 % |

**Table2: Age Distribution by Genderand Mode of Anaesthesia**

| | IN | | IV | |
|---|---|---|---|---|
| | F | M | F | M |
| Mean | 50.4 | 49.7 | 48.9 | 48.8 |
| Standard deviation | 5.82 | 7.9 | 7.54 | 6.82 |
| Median | 51 | 48 | 49 | 48 |
| Minimum | 40 | 26 | 33 | 33 |
| Maximum | 62 | 60 | 59 | 60 |

**Table3: Distribution of Anaesthesia Type by Gender**

| SEX | Female | | Male | |
|---|---|---|---|---|
| GROUP(IV/IN) | Counts | %of Total | Counts | %of Total |
| IN | 36 | 26.9 % | 31 | 23.1 % |
| IV | 34 | 25.4 % | 33 | 24.6 % |

**Table 4: Systolic Blood Pressure Changes Over Time by Anaesthesia Type**

| | Mean (±Std dev) | | Median (IQR) | | | |
|---|---|---|---|---|---|---|
| GROUP(IV/IN) | IN | IV | IN | IV | p | S |
| Baseline POST DRUG SBP | 119 (6.64) | 123 (7.02) | 119 (114-124) | 124 (118-129) | 0.001 | S |
| 10min POST DRUG SBP | 116 (6.69) | 119 (7.02) | 116 (112-122) | 120 (112-126) | 0.039 | S |
| 20min POST DRUG SBP | 113 (6.72) | 115 (6.06) | 112 (108-118) | 116 (110-120) | 0.124 | NS |
| 30min POST DRUG SBP | 109 (6.24) | 111 (6.03) | 109 (104-114) | 112 (104-116) | 0.19 | NS |
| 40min POST DRUG SBP | 106 (6.21) | 107 (6.67) | 106 (102-110) | 109 (100-113) | 0.245 | NS |
| DURING INTUBATION SBP | 105 (6.01) | 106 (6.6) | 104 (100-110) | 108 (98-110) | 0.624 | NS |
| 1min POST INT SBP | 122 (5.82) | 120 (6.83) | 121 (117-127) | 121 (113-126) | 0.12 | NS |
| 2min POST INT SBP | 121 (5.96) | 119 (5.98) | 120 (115-126) | 120 (113-124) | 0.122 | NS |
| 3min POST INT SBP | 119 | 117 | 118 (114- | 119 (112- | 0.075 | NS |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (6.03) | (6.03) | 124) | 122) | | |
| 4min POST INT SBP | 117 (5.89) | 115 (6.31) | 117 (112-122) | 116 (110-120) | 0.044 | S |
| 5min POST INT SBP | 116 (5.66)) | 113 (6.3) | 116 (110-120) | 116 (109-118) | 0.04 | S |
| 7min POST INT SBP | 114 (5.59) | 112 (6.23) | 114 (110-119) | 114 (108-116) | 0.062 | NS |
| 10min POST INT SBP | 113 (5.61) | 110 (6) | 112 (108-118) | 110 (106-114) | 0.03 | S |

**Table 5: Diastolic Blood Pressure Changes Over Time by Anaesthesia Type**

| | Mean (±Std dev) | | Median (IQR) | | | |
|---|---|---|---|---|---|---|
| GROUP(IV/IN) | IN | IV | IN | IV | p | S |
| Baseline POST DRUG DBP | 74.9 (3.1) | 76.4 (5.54) | 75 (73-77) | 76 (72-82) | 0.169 | NS |
| 10min POST DRUG DBP | 72.9 (3.19) | 73.3 (5.43) | 72 (71-74) | 72 (70-77) | 0.946 | NS |
| 20min POST DRUG DBP | 70.5 (3.27) | 70.3 (5.35) | 70 (68-72) | 69 (66-74) | 0.383 | NS |
| 30min POST DRUG DBP | 67.9 (3.28) | 67.3 (5.39) | 68 (65-70) | 66 (63-70) | 0.179 | NS |
| 40min POST DRUG DBP | 65.3 (3.16) | 64.6 (5.03) | 65 (63-67.5) | 64 (60-68) | 0.226 | NS |
| DURING INTUBATION DBP | 64.4 (3.48) | 63.8 (4.31) | 64 (62-67) | 63 (60-67) | 0.319 | NS |
| 1min POST INT DBP | 78.1 (3.53) | 73.3 (4.34) | 78 (75-80) | 74 (70-76) | < .001 | S |
| 2min POST INT DBP | 76.7 (3.33) | 72.5 (4.36) | 76 (74-78) | 73 (68-75.5) | < .001 | S |
| 3min POST INT DBP | 75.4 (3.42) | 71.5 (4.65) | 75 (72-77.5) | 73 (67-75) | < .001 | S |
| 4min POST INT DBP | 74 (3.38) | 70.3 (4.56) | 74 (71-76.5) | 70 (67-74) | < .001 | S |
| 5min POST INT DBP | 72.4 (3.3) | 69 (4.52) | 72 (70-75) | 69 (66-72) | < .001 | S |
| 7min POST INT DBP | 71 (3.29) | 67.6 (4.54) | 70 (68-73.5) | 68 (64-70) | < .001 | S |
| 10min POST INT DBP | 69.7 (3.36) | 66.4 (4.47) | 69 (67-72) | 66 (62-70) | < .001 | S |

**Figure1: Mean Arterial Pressure Changes Over Time by Anaesthesia Type**

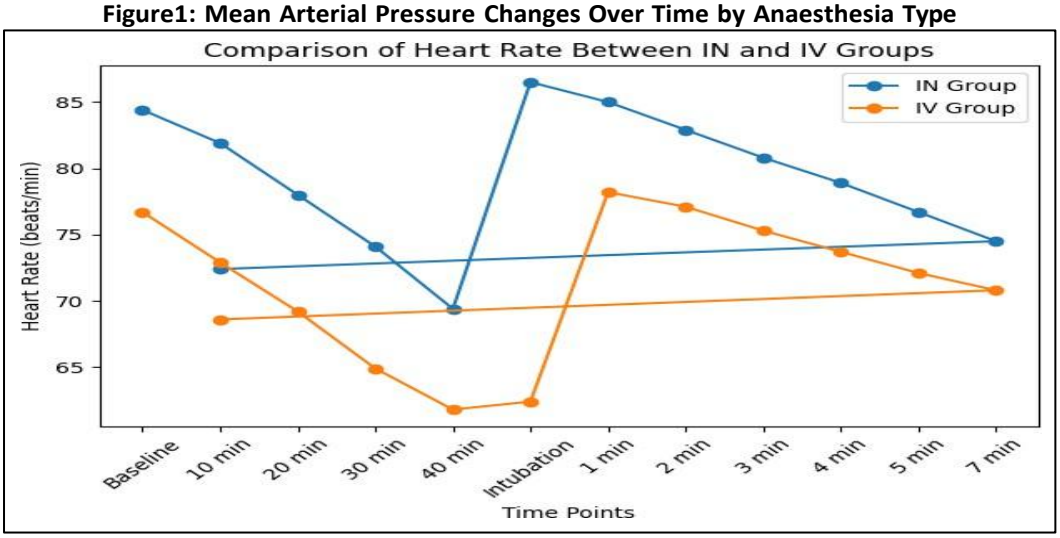


**Figure 2: Heart Rate Changes Over Time by Anaesthesia Type**

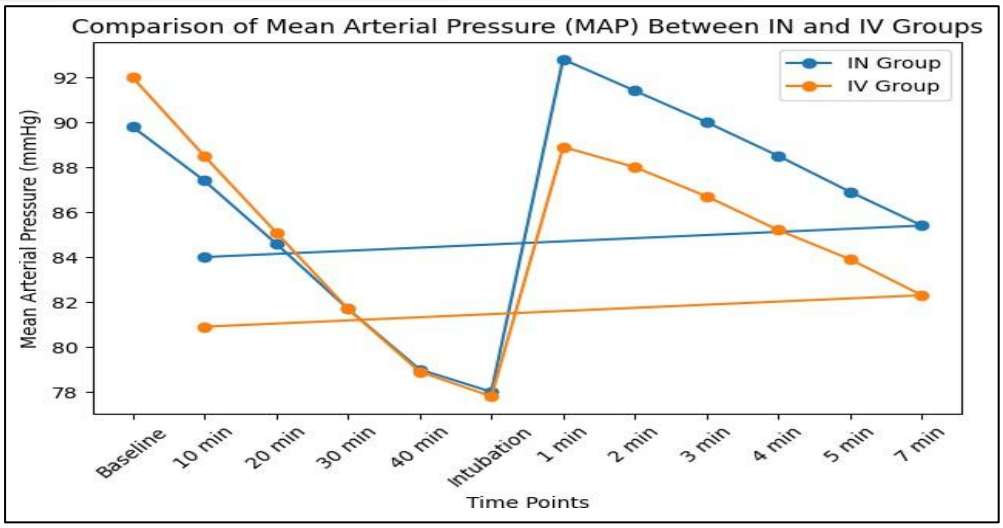


**Table 1: Age and Gender Distribution of Participants**

The majority of participants were distributed between the age groups of 46–60 years. Among females, the highest proportion was observed in the 56–60 years age group (18 participants, 13.4%), followed by 51–55 years (17 participants, 12.7%) and 46–50 years (16 participants, 11.9%). Among males, the maximum representation was seen in the 46–50 years age group (21 participants, 15.7%), followed by 56–60 years (15 participants, 11.2%) and 51–55 years (11 participants, 8.2%). The least number of participants in both genders belonged to the 26–35 years age group.

**Table 2: Age Distribution by Gender and Mode of Anaesthesia**

The mean age of female participants receiving inhalational (IN) anaesthesia was 50.4 ± 5.82 years, while those receiving intravenous (IV) anaesthesia had a mean age of 48.9 ± 7.54 years. Among male participants, the mean age was 49.7 ± 7.9 years in the IN group and 48.8 ± 6.82 years in the IV group. The median age ranged between 48 and 51 years across all groups, with ages spanning from 26 to 62 years, indicating comparable age distribution across gender and anaesthetic techniques.

**Table 3: Distribution of Anaesthesia Type by Gender**

Inhalational anaesthesia was administered to 36 females (26.9%) and 31 males (23.1%), while intravenous anaesthesia was used in 34 females (25.4%) and 33 males (24.6%). Overall, both anaesthesia techniques were almost equally distributed between males and females, indicating balanced group allocation.

**Systolic Blood Pressure (SBP)**

Baseline post-drug SBP was significantly lower in the IN group compared to the IV group (119 ± 6.64 vs. 123 ± 7.02 mmHg; $p = 0.001$). A significant difference persisted at 10 minutes post-drug administration (116 ± 6.69 vs. 119 ± 7.02 mmHg; $p = 0.039$). However, SBP values at 20, 30, 40 minutes post-drug administration and during intubation did not show statistically significant differences between the groups. Post-intubation, significant differences were noted at 4 minutes ($p = 0.044$), 5 minutes ($p = 0.040$), and 10 minutes ($p = 0.030$), with the IN group demonstrating relatively lower SBP values.

**Diastolic Blood Pressure (DBP)**

Baseline and post-drug DBP values up to 40 minutes did not differ significantly between the IN and IV groups ($p > 0.05$). During intubation, DBP remained comparable between groups. However, from 1 minute post-intubation onwards, the IN group consistently demonstrated significantly higher DBP compared to the IV group at all time points up to 10 minutes ($p < 0.001$ for all), indicating better post-intubation diastolic pressure stability in the IN group.

**Mean Arterial Pressure (MAP)**

Baseline post-drug MAP was significantly lower in the IN group compared to the IV group (89.8 ± 3.01 vs. 92 ± 5.31 mmHg; $p = 0.023$). MAP values at 10, 20, 30, and 40 minutes post-drug administration, as well as during intubation, were comparable between the groups. Post-intubation MAP showed a statistically significant difference from 1 minute up to 10 minutes, with consistently higher MAP values in the IN group ($p < 0.001$), indicating superior hemodynamic stability.

Heart Rate (HR)

The IN group demonstrated significantly higher heart rates compared to the IV group at baseline post-drug administration (84.4 ± 5.77 vs. 76.7 ± 5.13 bpm; $p < 0.001$). This significant difference persisted at all post-drug intervals, during intubation, and throughout the post-intubation period up to 10 minutes ($p < 0.001$ for all comparisons). The IV group consistently maintained lower heart rate values, reflecting a greater heart rate attenuation effect.

## DISCUSSION

The demographic and baseline clinical characteristics of the study participants were well matched between the intranasal dexmedetomidine (IN) and intravenous dexmedetomidine (IV) groups, ensuring the validity and reliability of the comparative analysis. In the study conducted by Niyogi et al. [8], the mean age of patients in the intranasal group was 40.71 ± 10.91 years, while that in the intravenous group was 42.03 ± 12.50 years, with no statistically significant difference. Similar age matching was observed in the study by Harish et al. [9], thereby minimizing age-related confounding factors that could influence haemodynamic responses to dexmedetomidine.

Sex distribution was also comparable between the two groups. In the study by Harish et al. [9], the intranasal group comprised 22 females and 13 males, while the intravenous group included 19 females and 16 males. This balanced gender distribution is crucial, given the known physiological differences in haemodynamic responses between males and females, particularly during stressful stimuli such as laryngoscopy and endotracheal intubation. Such matching enhances the internal validity and generalizability of the findings.

### Heart Rate

The present study demonstrated a consistent and statistically significant difference in heart rate (HR) between the IN and IV dexmedetomidine groups, particularly during the peri-intubation period. The IN group exhibited higher HR values across most time points compared to the IV group, indicating superior attenuation of sympathetic response with the intravenous route.

During laryngoscopy and intubation, the IN group showed a mean HR of 86.5 bpm, significantly higher than the 62.4 bpm observed in the IV group. This difference persisted up to 10 minutes post-intubation. Tayung et al. [10] observed that although both routes effectively reduced HR from baseline, the IV route resulted in a more pronounced reduction.

### Systolic Blood Pressure (SBP)

The present study compared systolic blood pressure variations between IN and IV dexmedetomidine groups during the perioperative period. Both groups exhibited comparable SBP values immediately after induction. However, statistically significant reductions in SBP were observed in the IN group at baseline post-drug administration, at 10 minutes post-drug, and at 4, 5, and 10 minutes post-intubation.

### Diastolic Blood Pressure (DBP)

Both groups demonstrated a reduction in DBP following dexmedetomidine administration. However, the reduction was less pronounced in the IN group.

Following intubation, a transient increase in DBP was observed in both groups, with significantly higher values in the IN group (78.1 mmHg) compared to the IV group (73.3 mmHg). This elevated DBP persisted throughout the 10-minute post-intubation period, with statistically significant intergroup differences at all time points. Similarly, Paul and Abraham [11] reported superior DBP attenuation with IV dexmedetomidine.

### Mean Arterial Pressure (MAP)

Both groups exhibited a gradual decline in MAP following induction. However, the IV group consistently showed slightly lower MAP values than the IN group during the post-drug administration phase.

Post-intubation, a transient rise in MAP was noted in both groups, with the IN group demonstrating higher values throughout the 10-minute observation period. Paul and Abraham [11] also demonstrated a modest but significant MAP reduction with IV dexmedetomidine, with a mean difference of 2.7 mmHg.

### Sedation Profile

The route of dexmedetomidine administration significantly influenced postoperative sedation. At 40 minutes post-drug administration, most patients in the IN group achieved a Ramsay Sedation Scale (RSS) score of 2, indicating calm and cooperative behaviour. In contrast, a higher proportion of patients in the IV group attained an RSS score of 3, reflecting deeper sedation. These findings are consistent with studies by Niyogi et al. [8], which reported significantly higher sedation scores with IV dexmedetomidine.

## CONCLUSION

The study concludes that both intranasal and intravenous administration of dexmedetomidine are effective in mitigating the hemodynamic response associated with laryngoscopy and endotracheal

 

intubation. However, the intranasal route tends to yield a more stable hemodynamic profile in terms of systolic blood pressure. While intranasal being linked to higher diastolic blood pressure, mean arterial blood pressure and heart rate in the post- intubation period. Although these differences are statistically significant, they may not be clinically substantial in most scenarios. Nonetheless, the choice of dexmedetomidine administrationrouteshouldbetailoredbasedonthespecifichemodynamic targetsandpatient characteristics, with intravenous administration representing a better route than the intranasal route.

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