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RESEARCH ARTICLE

Effect of Preoperative Dexmedetomidine Nebulisation on the Hemodynamic Response to Laryngoscopy and Intubation - A Prospective Observational Study

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Abstract

Background: Laryngoscopy and endotracheal intubation are known to trigger sympathetic stimulation, resulting in increased heart rate and blood pressure. These hemodynamic responses can be detrimental in patients with limited cardiovascular reserve. Dexmedetomidine, an α2-adrenergic agonist, has shown promise in attenuating these responses, with the nebulized form offering a non-invasive alternative to intravenous administration. **Objective:** To evaluate the effect of preoperative nebulized dexmedetomidine on heart rate and blood pressure changes following laryngoscopy and intubation. **Methods:** A randomized study was conducted on ASA I and II adult patients aged 18–60 years undergoing elective surgeries under general anesthesia. Patients were divided into two groups: one received nebulized dexmedetomidine (1 µg/kg) 30 minutes before induction, and the other received nebulized saline. Hemodynamic parameters (HR, SBP, DBP, SpO_2) were recorded at baseline, post-nebulization, before induction, and at 1, 5, and 10 minutes after intubation. Mixed-effects statistical modeling was used for analysis. **Results:** There was a significantly lower increase in heart rate in the dexmedetomidine group after laryngoscopy compared to the saline group (P = 0.015). No significant difference in systolic blood pressure was observed between the groups. The dexmedetomidine group also required lower doses of propofol and fentanyl intraoperatively, without notable adverse effects or excessive sedation. **Conclusion:** Nebulized dexmedetomidine at 1 µg/kg effectively attenuates the heart rate response to laryngoscopy and intubation without significant side effects, making it a viable, non-invasive premedication alternative in adult surgical patients.

Keywords: Attenuation, Dexmedetomidine, General Anaesthesia, Hemodynamic Response, Laryngoscopy, Nebulisation

1. Introduction

Endotracheal intubation and laryngoscopy are essential skills in the administration of general anesthesia and the critical care of patients, first described by Rowbotham and Magill in 1921. These procedures stimulate the sympathoadrenal system, leading to the release of catecholamines into the bloodstream. This results in a temporary pressor response, marked by increased Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart Rate (HR).

This response is a somatovisceral reflex and is influenced primarily by the duration and intensity of the procedure. In pediatric patients, it can sometimes trigger a vagally mediated bradycardia due to reflex inhibition of the heart.

1. Stoelting RK
   - HR increases by 20–40% above baseline.
   - Peaks within 30 seconds of laryngoscopy.
   - Returns to baseline within 5–10 minutes.

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2. King *et al.*
   - Described increases in HR and BP due to reflex sympathetic discharge.
   - Average HR increase: 20–30 bpm.
3. Shribman AJ *et al.*, – Br J Anaesth:
   - Studied HR response during laryngoscopy.
   - Reported:
     - HR increased by 26 ± 7 bpm
     - Peak at 1 minute
     - Effect lasted for up to 5 minutes
4. Singh H *et al.*, – Anaesthesia:
   - HR increased by 15-30 % depending on duration and difficulty of intubation.
   - Prolonged intubation led to more pronounced tachycardia.

While healthy individuals or ASA I patients generally tolerate these hemodynamic changes well, patients with limited cardiovascular reserve—such as those with coronary artery disease, arrhythmias, cardiomyopathy, congestive heart failure, hypertension, poor intracranial compliance, or advanced age—are at higher risk of serious complications like myocardial ischemia, acute heart failure, or cerebrovascular hemorrhage.

The hemodynamic response to intubation under anesthesia was first documented by Donegan *et al.,* Since then, various strategies have been explored to attenuate or prevent this response. These include minimizing the duration of laryngoscopy, performing a smooth intubation, and using methods like airway nerve blocks (superior and recurrent laryngeal nerves), topical lignocaine, beta-blockers, calcium channel blockers, and intravenous lignocaine.

2. Aim and Objectives

- The primary aim was to study the heart rate changes following laryngoscopy and intubation in two groups.
- The secondary aim was to evaluate the effects of blood pressure response to laryngoscopy and intubation.

3. Review of Literature

Dexmedetomidine, an α2-adrenergic receptor agonist, is well known for its sedative, anxiolytic, and sympatholytic properties. While intravenous dexmedetomidine has been widely studied, the nebulized route has recently gained interest due to its non-invasive administration, potential to attenuate stress responses during laryngoscopy and intubation, and better patient acceptability. Hussain *et al.,* conducted a randomized study in India to evaluate the effects of nebulized dexmedetomidine as a premedication agent. The study demonstrated that nebulized dexmedetomidine effectively blunted the hemodynamic response to laryngoscopy and intubation. Patients had stable heart rates and blood pressures with no significant adverse effects, indicating the safety of this route of administration[1].

Misra *et al.*, evaluated the efficacy of nebulized dexmedetomidine in adult surgical patients and found a significant reduction in heart rate and blood pressure during and after laryngoscopy. The authors concluded that dexmedetomidine via nebulization could be a promising alternative to intravenous administration, offering comparable benefits with minimal sedation and no respiratory depression[2].

Sheth *et al.,* focused on the preoperative anxiolytic and sedative effects of nebulized dexmedetomidine. Their findings revealed a significant reduction in preoperative anxiety levels and improved patient cooperation during induction, without excessive sedation or respiratory compromise. They suggested the nebulized form to be advantageous in day-care surgeries[3]. Suryawanshi *et al.,* conducted a prospective observational study in an Indian population comparing nebulized dexmedetomidine with saline. Their study highlighted a significant reduction in the pressor response to intubation, with stable hemodynamics throughout the periintubation period. They emphasized its utility in patients with cardiovascular comorbidities, due to its favorable safety profile[4].

Shrivastava *et al.*, explored the use of nebulized dexmedetomidine in pediatric patients. Their study found it to be well-tolerated, effective in preoperative sedation, and helpful in reducing the requirement of intravenous induction agents. Importantly, no major side effects were reported, suggesting that nebulized dexmedetomidine could be a useful premedication in children[5].

Kaila *et al.*, compared nebulized versus intravenous dexmedetomidine in adult patients undergoing,

elective surgery. They concluded that the nebulized route provided similar attenuation of the intubation response as the intravenous route, with fewer adverse effects such as bradycardia and hypotension. Patient satisfaction scores were higher in the nebulization group[6].

4. Material and Methods

Inclusion Criteria:

ASA I and II Age 18-60 years
Both genders undergoing elective surgery under general anaestheisa with endotracheal intubation

Exclusion Criteria:

Predicted difficult airway Pregnancy
Comorbidities- hypertension, seizure disorders, renal failure, poor cardiopulmonary reserve BMI >30KG/M^2
Parameters Observed Heart Rate, Sbp, Dbp, SpO_2
Readings were recorded with Base line
After nebulisation

- Before induction,
- After laryngoscopy - 1 minute(T1)
- 5 minute (T5) and
- 10 minutes (T1)

Methodology

As mention in the figure 1, 120 patients undergoing elective surgery requiring general anaestheisa and endotracheal intubation. Day prior to surgery preoperative visit made, explained about study protocol and consent for the same obtained. On the day of surgery at preoperative room patient were assigned to two groups. Group D (dexmedetomidine) patient received 1mcg/kg dexmedetomidine nebulisation diluted in 3-4 ml of 0.9% saline, 30 minutes prior to induction of anaesthesia Group E (saline) patients received 0.9% saline nebulisation (3-4 ml), 30 min before induction of anaesthesia.

5. Results (Including Observations)

Table 1 comparison of heart rate between Group D and Group E. Baseline, after nebulisation and pre induction hemodynamics show no statistically significant difference. After laryngoscopy and intubation there is significant lower trend of increase in heart rate in

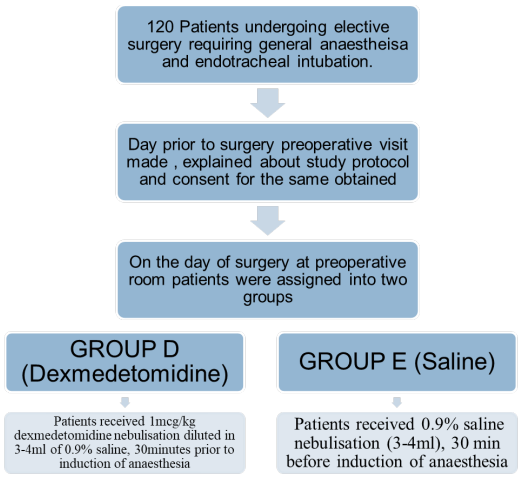

Figure 1. Methodology flow chart.

Table 1. Comparision of heart rate between Group D and Group E

Heart Rate	Group D	Group E	P Value
Baseline	80.40±05.76	81.50±05.30	0.4047
After Nebulisation	86.43±13.56	94.17±12.22	0.26
Pre Induction	87.95±13.34	98.11±11.06	0.14
T1	86.55±13.45	98.40±10.23	0.001
T5	86.45±13.46	93.25±10.11	0.020
T10	84.48±13.50	91.22±9.89	0.020

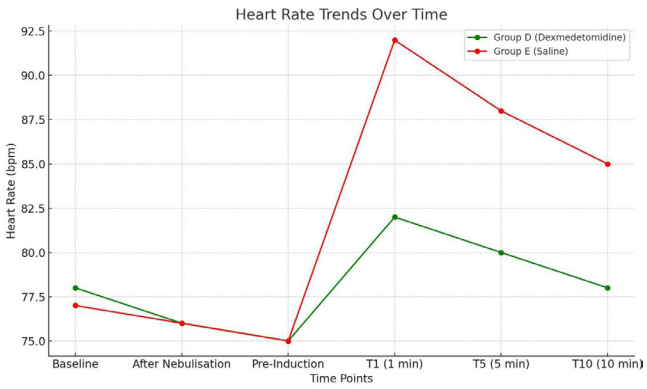

Chart 1. Chart heart rate trends over time.

dexmedetomidine group compared to saline group (P = 0.015) (Chart 1 heart rate trends over time). There is no significant difference in SBP in two groups after laryngoscopy and intubation Changes in Heart Rate (HR) in the dexmedetomidine group and the saline group. (Chart 2 Systolic blood pressure trends over time) Mixed effect modelling showed a significantly lower trend of increase in HR in the dexmedetomidine group versus saline (P < 0.05).

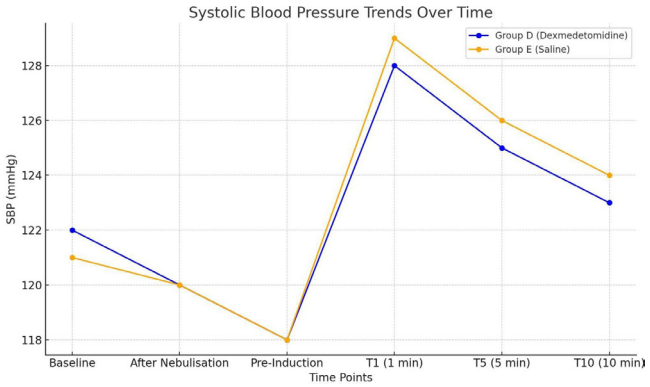

Chart 2. Chart systolic blood pressure trends over time.

6. Discussion

Hemodynamic changes during laryngoscopy and intubation are commonly triggered by factors like lifting the epiglottis, difficulties in visualizing the glottis, tongue displacement, prolonged laryngoscopy, and the act of inserting the tracheal tube.

The cardiovascular response to these stimuli has been well-documented in the literature. Shribman *et al.,* demonstrated a marked increase in heart rate and catecholamine levels following tracheal intubation, highlighting the sympathetic stimulation associated with airway manipulation[7].

Similarly, Singh *et al.,* observed significant hemodynamic fluctuations during laryngoscopy, which could be effectively attenuated with appropriate premedication[8].

Earlier works by King *et al.*, and Stoelting further described the reflex cardiovascular changes caused by laryngoscopy and tracheal intubation, reinforcing the importance of minimizing these responses for patient safety[9,10].

Dexmedetomidine helps reduce these hemodynamic changes by acting on parts of the brain and medulla that control sympathetic nervous activity, leading to a calming effect on the body's stress response.

Previous studies have shown that intravenous doses between 1 to 2 μg/kg are effective in controlling heart rate and blood pressure during these procedures, but such doses are also linked to side effects like bradycardia, hypotension, and respiratory depression.

In contrast to these earlier findings, our study using nebulized dexmedetomidine showed a reduced increase in heart rate during laryngoscopy but did not result in bradycardia. No significant differences in systolic blood pressure were observed between the dexmedetomidine and saline groups, possibly due to differences in how the drug was administered. Inhaled dexmedetomidine has moderate bioavailability and may be comparable to a lower intravenous dose, which has only mild effects on blood pressure changes.

Another reason for the similar blood pressure responses might be the balanced depth of anesthesia in both groups. Patients in the saline group may have received a higher concentration of inhalational anesthetic (MAC) to achieve the same depth, leading to similar effects on blood pressure.

Our study also found that the use of nebulized dexmedetomidine reduced the required doses of propofol, fentanyl, and other anesthetic drugs during surgery, even though surgery durations were similar. The improved response to surgical incision in the dexmedetomidine group may indicate better pain control.

Unlike some earlier studies with higher intravenous doses, we did not observe increased sedation levels after nebulization, possibly because of the lower dose used or differences in the study population. Other pediatric studies have found that higher nebulized doses may be necessary to achieve adequate sedation in children and adults.

Although dexmedetomidine has been reported to help reduce Postoperative Nausea and Vomiting (PONV), our study did not find a difference between the two groups. This might be due to all patients receiving ondansetron before surgery, the short duration of surgeries, or differences in how dexmedetomidine was administered (as a single preoperative dose in our study rather than as a bolus or continuous infusion).

We used a mixed-effects statistical model to better account for variations in repeated heart rate and blood pressure measurements over time. However, we did not test different doses or compare nebulized versus intravenous administration, which limits how broadly the results can be applied.

7. Summary and Conclusion

Laryngoscopy and intubation, though essential during general anesthesia, often trigger a sympathetic stress

response—causing increased Heart Rate (HR) and Blood Pressure (BP). While healthy patients usually tolerate this well, those with cardiovascular compromise may be at risk of complications.

Objective: To evaluate the effect of nebulized dexmedetomidine (1 µg/kg, 30 mins before surgery) on:

- Primary: Heart rate changes during and after laryngoscopy.
- Secondary: Blood pressure response.

Methodology:

- Participants: ASA I–II, age 18–60 years, undergoing elective surgery with intubation.
- Excluded: Difficult airway, pregnancy, comorbidities like hypertension, renal failure, BMI > 30.
- Parameters: HR, SBP, DBP, SpO_2 — recorded at baseline, post-nebulization, pre-induction, and at 1 min (T1), 5 min (T5), and 10 min (T10) after intubation.

Results:

- Heart Rate:
- Significant attenuation of HR increase in the dexmedetomidine group vs saline (P = 0.015).
- No bradycardia observed.
- Blood Pressure:
- No significant difference in SBP between groups post-intubation.

Discussion:

- Nebulized dexmedetomidine acts centrally to suppress sympathetic activity and blunt stress response.
- Has moderate bioavailability via inhalation and avoids adverse effects common with IV use (e.g., hypotension, bradycardia).
- Maintains hemodynamic stability with better intraoperative pain control and reduced anesthetic requirements.

Conclusion: Nebulized dexmedetomidine (1 µg/kg):

- Effectively attenuates heart rate rise during laryngoscopy.
- Reduces anesthetic and analgesic requirements.
- Is safe, with minimal side effects.
- Offers a viable, non-invasive alternative to IV administration for short elective.

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