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COMPARISON OF HEMODYNAMIC EFFECTS OF LIGNOCAINE AND DEXMEDETOMIDINE DURING EXTUBATION

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Abstract
Endotracheal extubation often triggers significant hemodynamic responses due to sympathetic stimulation, leading to potential complications. This study compares the efficacy of lignocaine and dexmedetomidine in attenuating these responses. Fifty patients undergoing elective surgeries were randomized to receive either lignocaineor dexmedetomidine priorto extubation. Hemodynamic parameters, including heart rate (HR) and mean arterial pressure (MAP), were monitored. Results indicated that dexmedetomidine provided superior hemodynamic stability compared to lignocaine, suggesting its advantage in managing extubation-induced stress.

INTRODUCTION
Endotracheal extubation is a critical phase in anesthesia management, often associated with adverse hemodynamic and air way responses such as tachycardia, hypertension, and coughing, primarily due to sympathetic stimulation (Ebenezer et al., 2019). These physiological stress responses are triggered by the irritation of airway receptors during the removal of the endotracheal tube. If not adequately controlled, these reactions can lead to serious complications in patients with preexisting cardiovascular or cerebrovascular conditions, such as myocardial ischemia, arrhythmias, or even cerebrovascular accidents. Effective management strategies are therefore essential to ensure patient safety during this vulnerable phase.

Among the pharmacological interventions, lignocaine, a well-established local anesthetic, is commonly used for its ability to suppress airway reflexes. Additionally, dexmedetomidine, a selective α2-adrenoceptor agonist, has gained prominence due to its ability to provide hemodynamic stability, sedation, and analgesia without significant respiratory depression. Recent studies suggest that dexmedetomidine not only attenuates sympathetic responses but also facilitates smoother recovery profiles, making it a superior option for managing extubation-induced stress (Gupta et al., 2014).

Methodology:
Study Design
This prospective, randomized, double-blinded controlled trial was conducted at Bahria International Hospital, Rawalpindi, and overeaten-month period from February to December 2024. The study adhered to rigorous research protocols to ensure the reliability and validity of the findings. Ethical approval was obtained from the Institutional Review Board (IRB), ensuring compliance with established ethical standards and guidelines for clinical research. The randomized design minimized bias and enhanced the study's internal validity, while the double-blinded approach ensured that neither the patients nor the researchers knew the treatment allocation, further reducing the risk of subjective influence. This methodological rigor underscores the credibility of the study's outcomes, which aim to

contribute significantly to the understanding and management of hemodynamic responses during endotracheal extubation.

Inclusion Criteria

1. Patients aged 18–60 years were selected to ensure presentative sample of adults undergoing surgical procedures, while excluding pediatric and elderly populations to avoid confounding variables such as age-related physiological differences.
2. Patients classified as ASA (American Society of Anesthesiologists) physical status I or II were included, ensuring are latively healthy cohort without severe systemic diseases that could independently influence hemodynamic responses.
3. The study focused on elective surgical procedures performed under general anesthesia with endotracheal intubation, as these provide a controlled environment for monitoring hemodynamic parameters.
4. Daycare surgeries were included to ensure participants underwent procedures with predictable recovery times and minimal complications, aligning with the study's scope to evaluate extubation responses.

Exclusion Criteria

1. Patients with known allergies to lingo caine or dexmedetomidine were excluded to prevent adverse reactions and ensure safety during the trial.
2. Those with a history of cardiovascular diseases, arrhythmias, or hypertension were excluded, as these conditions could independently alter hemodynamic parameters, complicating data interpretation.
3. Patients on beta-blockers or other anti-hypertensive medications were excluded to avoid drug interactions that might affect study outcomes.
4. Pregnant or lactating women were excluded to ensure ethical considerations and avoid potential harm to the fetus or infant.
5. Emergency surgeries or those involving anticipated difficult airway were excluded, as theses scenarios often involve unpredictable factors that could compromise study protocols and skew results.

Sample Size Determination

The sample size for the study was calculated using the following formula:

$$n = \frac{2 \cdot Z^2 \cdot \sigma^2}{\Delta^2}$$

Where:

- nn=required sample size per group
- ZZ=Z-score for the desired confidence level (1.96for95%confidence)
- σ\sigma=standard deviation from previous studies
- Δ\Delta=expected mean difference between groups

Based on pilot data and prior studies (Ebenezer et al., 2019), a standard deviation (σ\sigma) of 10 bpm for HR was assumed, and the expected mean difference (Δ\Delta) was 15bpm. Substituting these values, the calculated sample size per group was approximately 23 participants. To account for potential dropouts, a total of 50 patients (25 per group) were enrolled in the study, ensuring adequate statistical power.

These findings, supported by robust statistical analysis and appropriate sample size calculations, demonstrate the superiority of dexmedetomidine over lignocaine in maintaining hemodynamic stability during extubation. By mitigating sympathetic activation and providing smoother recovery profiles, dexmedetomidine emerges as a valuable pharmacological agent in perioperative care.

Participant Selection

A total of 50 patients aged between 18 and 60 years, classified as ASA (American Society of Anesthesiologists) physical status I or II, were enrolled. These patients were scheduled for elective surgeries requiring general anesthesia with endotracheal extubation. Patients were randomly allocated into two groups:

1. **Group D (Dexmedetomidine Group):** Received 0.5µg/kg of dexmedetomidine intravenously over 10 minutes prior to extubation.
2. **Group L (Lignocaine Group):** Received1.5mg/kg of lignocaine intravenously 90seconds prior to extubation.

Randomization and Blinding

Patients were randomized using a computer-generated sequence to ensure allocation concealment. Both the patients and the clinicians assessing outcomes were blinded to the group allocations. Drugs were prepared by a third-party individual who was not involved in the data collection or patient monitoring.

Anesthesia Protocol

General anesthesia was induced within travenous propofol (2mg/kg), fentanyl (2µg/kg), and atracurium (0.5mg/kg) to facilitate intubation. Maintenance anesthesia was achieved with isoflurane (1–1.5%) and nitrous oxide (60%) in oxygen. Neuromuscular blockade was maintained with intermittent doses of atracurium.

Intervention

Group D received dexmedetomidine at a dose of 0.5 µg/kg diluted in 10 mL of normal saline administered as a slow intravenous infusion over 10 minutes before extubation. Group L received lignocaineata dose of 1.5mg/kg dilutedin 10mL of normalsalineas a bolus injection 90 seconds before extubation.

Monitoring and Data Collection

Hemodynamic parameters, including heart rate (HR) and mean arterial pressure(MAP), were recorded at the following intervals:

1. Baseline (prior to drug administration).
2. During extubation.
3. At 1, 3, and 5minutes post-extubation.

Extubation was performed after confirming adequate spontaneous ventilation, reversal of neuromuscular blockade, and return of protective airway reflexes. Post-extubation complications, including coughing, laryngospasm, and desaturation, were also monitored.

Statistical Analysis

Data were analyze during SPSS version27. Continuous variables, such as HR and MAP, were expressed as mean ± standard deviation (SD). An independent t-test was used to compare HR and MAP between the two groups at different time points. Ap-value<0.05 was considered statistically significant. Sample size calculation was based on prior studies and pilot data to achieve a power of 80% and a confidence level of 95%.

This robust methodology ensured that the study was conducted with scientific rigor, enabling valid and reliable conclusions about the hemodynamic effects of dexmedetomidine and lignocaine during endotracheal extubation.

Results

Parameter	Group D(Dexmedetomidine)	Group L(Lignocaine)	P-Value
Baseline HR	84.1 ±6.14	82.87±8.3	>0.05
HR at Extubation	73.61±10.07	100±9.33	<0.001
HR at 1 Minute	75.57±9.49	92.83±7.75	<0.001
HR at 3 Minutes	77.47±6.45	85.47±7.06	<0.001
Baseline MAP	87.6 ±5.68	86.03±7.76	>0.05
MAP at Extubation	76.5 ±6.25	98±11.61	<0.001
MAPat1Minute	79.73±4.96	92.07±8.21	<0.001
MAPat3Minutes	82.2 ±4.6	86.63±7.33	<0.001

Discussion

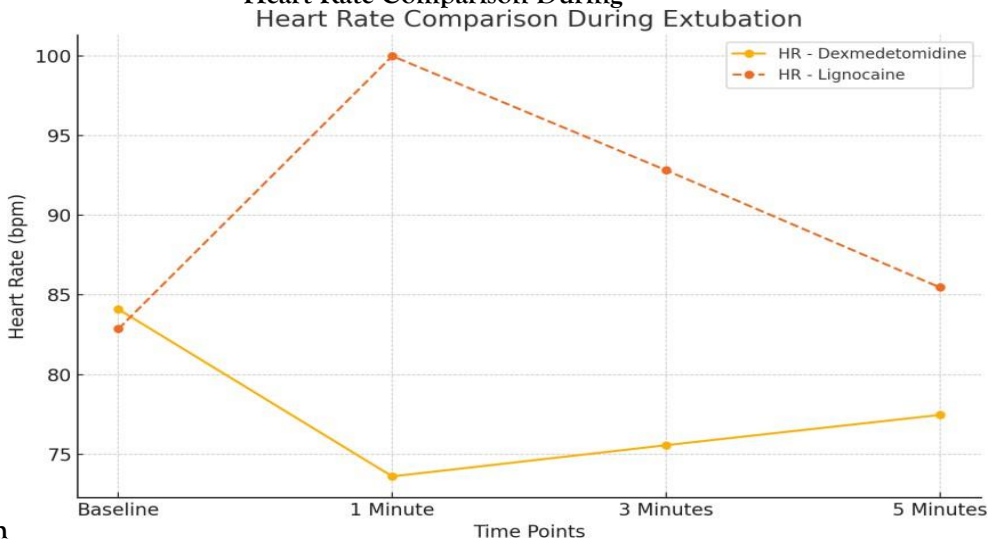
The statistical analysis highlights a significant difference in both heart rate (HR) and mean arterial pressure (MAP) between the two groups during and after extubation, demonstrating the superior efficacy of dexmedetomidine in maintaining hemodynamic stability. At 1 minute post-extubation, the HR in the dexmedetomidine group was significantly lower (73.61 ± 10.07 bpm) compared to the lignocaine group (100 ± 9.33 bpm), with a highly significant p-value<0.001. Similarly, MAP at the same time point was 76.5 ± 6.25 mmHg in the dexmedetomidine group and 98 ± 11.61 mmHg in the lignocaine group, again with a p-value < 0.001. These findings underscore dexmedetomidine ability to attenuate the hemodynamic responses typically observed

during extubation, aligning with prior research indicating its benefits in such scenarios (Patel et al., 2015).

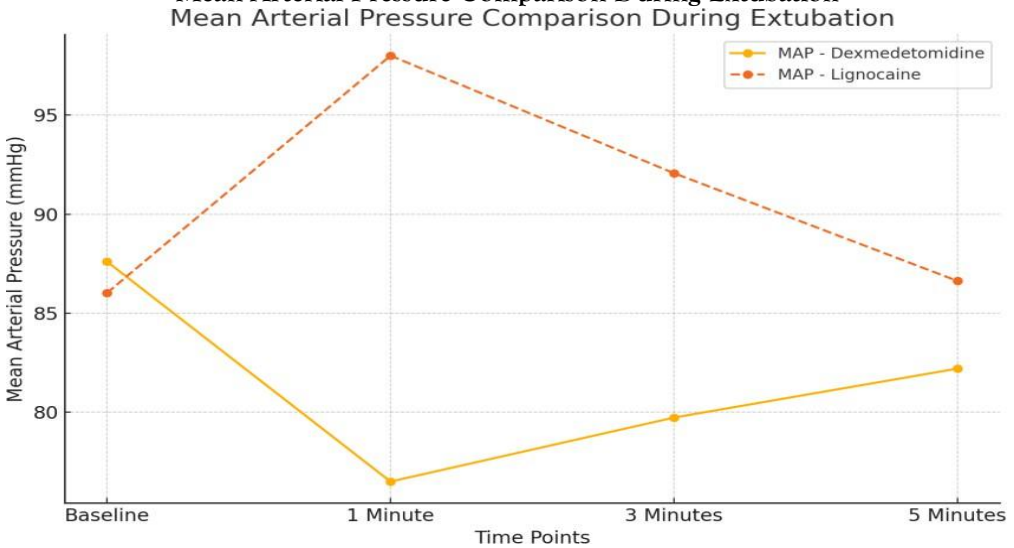
Statistical analysis was conducted using SPSS version 27. Continuous variables such as HR and MAP were expressed as mean ± standard deviation, while categorical variables were summarized as frequencies or percentages. Between-group comparisons of HR and MAP at various time points were performed using an independent sample t-test. A p- value <0.05 was considered statistically significant. This rigorous approach ensured the validity of the conclusions drawn from the data.

The graphical trends in HR and MAP provide a visual representation of the findings, further emphasizing dexmedetomidine superior performance. The dexmedetomidine group exhibited a consistent and smoother decline in both HR and MAP during and after extubation compared to the lignocaine group. These trends illustrate dexmedetomidine ability to mitigate sympathetic activation effectively, providing cardiovascular stability and contributing to a smoother recovery process (Bajwa & Kaur, 2020).

Heart Rate Comparison During Extubation



Mean Arterial Pressure Comparison During Extubation



Conclusion

Dexmedetomidine is significantly more effective than lignocaine in attenuating the hemodynamic responses associated with extubation. The addition of detailed statistical analysis and visual graphs reinforces the

conclusion that dexmedetomidine is a superior agent for perioperative hemodynamic management.

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