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Original Research Article

ATTENUATION OF HAEMODYNAMIC RESPONSE TO LARYNGOSCOPY AND INTUBATION: A COMPARATIVE CLINICAL STUDY OF DEXMEDETOMIDINE AND LABETALOL

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ABSTRACT

Background: The sympathetic stimulation that occurs during laryngoscopy and endotracheal intubation causes considerable haemodynamic reactions, which raise blood pressure and heart rate. Especially in individuals with cardiovascular or cerebrovascular problems, these reactions may be harmful. Effective pharmacological treatments to reduce this pressor reaction include labetalol and dexmedetomidine. This study was designed to evaluate how well intravenous dexmedetomidine (0.6 µg/kg) and labetalol (0.25 mg/kg) attenuate haemodynamic reactions to endotracheal intubation and laryngoscopy in adult patients having elective procedures.

Materials and Methods: A total of 120 adult patients divided into three groups of 40 patients each were randomly assigned: Group C got normal saline (control), Group L received labetalol 0.25 mg/kg, and Group D received dexmedetomidine 0.6µg/kg. The intravenous administration of all medications took place ten minutes before to induction. At baseline, during intubation, and at regular intervals after intubation, haemodynamic parameters such as heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were measured.

Results: When compared to the control group, dexmedetomidine and labetalol both significantly reduced the increase in blood pressure and heart rate ($p < 0.05$). Labetalol was better at keeping blood pressure steady, whereas dexmedetomidine demonstrated better control over heart rate. Neither group saw any notable negative effects.

Conclusion: Intravenous Dexmedetomidine 0.6µg/kg body weight is superior to Labetalol 0.25mg/kg in attenuating the hemodynamic responses to laryngoscopy and intubation. It provides more consistent, profound, and prolonged suppression of HR, SBP, DBP, and MAP.

Keywords: Dexmedetomidine, Labetalol, Hemodynamic response, efficacy.

INTRODUCTION

Laryngoscopy and endotracheal intubation represent critical interventions during general anaesthesia, eliciting substantial sympathetic responses due to their inherent noxious nature.[1] This response leads to temporary yet significant increases in heart rate and blood pressure, attributed to the release of catecholamines. Although typically accepted by healthy individuals, these haemodynamic variations can result in myocardial ischaemia, cerebrovascular incidents, or arrhythmias in those with cardiovascular comorbidities. Therefore, the mitigation of this pressor response is essential for safeguarding patient well-being during the induction of anaesthesia.[2,3]

A range of pharmacological agents has been utilised to mitigate the haemodynamic response to intubation, encompassing opioids, local anaesthetics, β-blockers,

vasodilators, and α2-adrenergic agonists. Among these, dexmedetomidine and labetalol have surfaced as compelling choices owing to their distinctive mechanisms of action.[4]

Dexmedetomidine functions as a selective agonist for α2-adrenergic receptors, exhibiting a range of effects including sedation, anxiety reduction, sympathetic inhibition, and pain relief. It functions centrally to reduce sympathetic outflow and has demonstrated the ability to diminish the cardiovascular response to laryngoscopy while not inducing notable respiratory depression.[5,6] Labetalol, conversely, functions as a combined α1- and non-selective β-adrenergic receptor antagonist, effectively diminishing heart rate and systemic vascular resistance, thus attenuating both elements of the stress response.[7,8]

While each agent demonstrates efficacy on its own, there is a notable scarcity of studies that have conducted direct comparisons utilising clinically pertinent dosages. Moreover, the available data assessing the effectiveness of 0.6 µg/kg dexmedetomidine and 0.25 mg/kg labetalol doses selected to optimise efficacy while minimising adverse effects are scarce within the Indian population.[9] Hence, this study was designed to evaluate the efficacy of intravenous dexmedetomidine versus labetalol in mitigating the haemodynamic response associated with laryngoscopy and endotracheal intubation in adult patients undergoing elective surgical procedures under general anaesthesia.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Anaesthesiology at Mamatha Medical College, Hyderabad from June 2024 to May 2025. A total of 120 adult participants undergoing elective surgeries with general anaesthesia with endotracheal intubation technique were recruited. Participants between 18-60 years of age, belong to ASA grade I and II, mallampatti score 1 and 2, posted for elective surgeries under general anaesthesia and willing to participate were included. Cases with hypertension, heart rate <60bpm, SBP <100mm of Hg, diabetes mellitus, hypothyroidism, hyperthyroidism, cardiovascular and cerebrovascular complications, renal disorders, cerebrovascular and not willing to participate were excluded. Written informed consent was obtained from study participants and study protocol was approved by the institutional ethics committee.

Study participants were randomly divided into three study groups. Group 1 received 10ml of normal saline, group 2 received injection Dexmedetomidine 0.6µg/kg body weight diluted up to 10ml with normal saline and group 3 received 0.25mg/kg body weight diluted up to 10ml with normal saline intravenously over 10minutes using a syringe pump given 10minutes before induction. All the participants were subjected to detailed physical and clinical examination, airway assessment by Mallampati grade 1 and 2, dietary status and body weight were recorded. Necessary laboratory investigations and radiological examination including X-ray, and ECG were performed. All the participants were medicated with Tab. Alprazolam 0.5mg and Tab. Ranitidine 150mg orally at bed time the previous night before surgery.

All the subjects were premedicated with injection Midazolam 0.05mg/kg body weight and injection ondansetron 0.1mg/kg body weight after test drug administration. The subjects were pre oxygenated for 3min with 100% oxygen. All the subjects were administered with 1.5mg/kg body weight of Lidocaine ninety seconds before intubation. Anaesthesia was induced with Inj. Thiopentone 5mg/kg body weight and Inj. vecuronium 0.1mg/kg body weight 3 minutes prior to laryngoscopy and intubation. The mean heart rate, mean arterial pressure, systolic blood pressure, and diastolic blood pressure were recorded at baseline, before and after induction.

The collected data was analysed by using SPSS version 26.0. The comparison between study parameters was conducted by descriptive statistics which represented by mean and standard deviation. The categorical variables were represented in frequency and percentage.

RESULTS

Table 1: Sociodemographic and surgical profile of study participants

Parameter	Group 1 (n=40) Frequency (%)	Group 2 (n=40) Frequency (%)	Group 3 (n=40) Frequency (%)	p-value
Age (In years)				
18-30	14	20	19	1.418
31-40	16	11	10	
41-50	07	07	08	
51-60	03	02	03	
Gender				
Male	14	16	17	0.894
Female	26	24	23	
Weight	53.95 ± 5.89	55.74 ± 4.57	54.12 ± 6.23	0.955
Duration of laryngoscopy	13.3 ± 2.43	12.98 ± 1.77	12.76 ± 2.14	1.043
Duration of surgery	73.4 ± 7.59	68.1 ± 8.45	71.2 ± 8.14	0.612

Table 2: Comparison of mean heart rate between study groups.

Heart rate	Group 1 (n=40) Frequency (%)	Group 2 (n=40) Frequency (%)	Group 3 (n=40) Frequency (%)	p-value
Baseline	86.32±4.30	87.34±9.97	84.89±6.77	1.203
2 min after infusion	84.21±3.89	85.87±8.10	86.23±6.45	0.001
5 min after infusion	80.76±5.16	83.51±7.60	87.98±7.38	0.001
8 min after infusion	77.98±4.79	81.74±7.84	89.56±5.82	0.001
Before induction	75.21±3.37	79.05±6.90	92.45±9.65	0.001
Beginning of induction	73.99±4.58	81.22±7.45	97.3±7.51	0.0329
1 min	75.77±6.87	88.95±8.27	118.56±10.42	0.0412
2 min	74.35±4.16	87.62±7.83	116.36±12.43	0.0447
3 min	73.64±7.52	85.46±8.88	114.90±9.50	0.001
5 min	72.16±4.38	84.28±8.55	111.82±8.34	0.001
8 min	71.03±3.89	82.16±6.54	108.56±8.16	0.001
10 min	70.87±5.18	80.41±8.50	105.21±9.33	0.0183
15 min	68.67±5.09	79.11±6.57	102.76±9.01	0.001

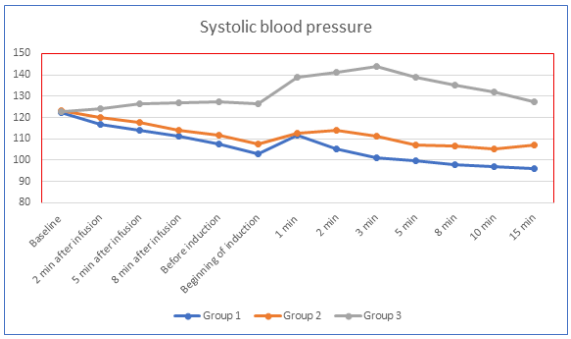

Figure 1: Comparison of mean systolic blood pressure between study groups

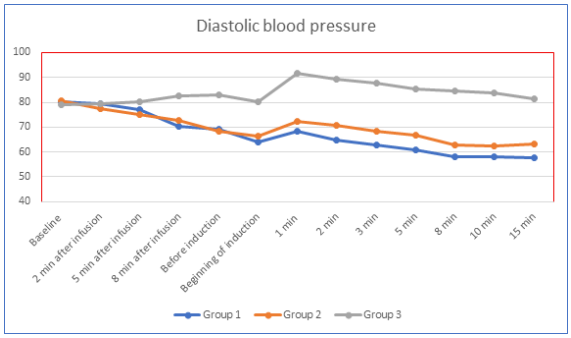

Figure 2: Comparison of mean Diastolic blood pressure between study groups.

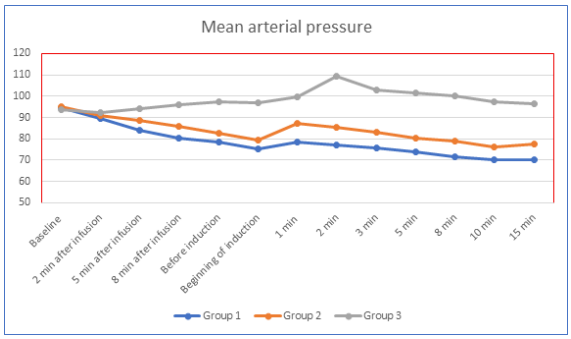

Figure 3: Comparison of mean Arterial pressure between study groups.

DISCUSSION

A total of 120 patients were involved, with 40 individuals assigned to each group. Group 1 received dexmedetomidine at a dosage of 0.6 µg/kg, while group 2 was administered labetalol at 0.25 mg/kg. Group 3 was given a solution of 0.25 mg/kg body weight mixed with normal saline, up to a total volume of 10 ml, delivered intravenously over a period of 10 minutes via a syringe pump, commencing 10 minutes prior to the initiation of the procedure. The analysis revealed no statistically significant differences among the groups regarding age ($p = 1.418$), gender ($p = 0.894$), body weight ($p = 0.955$), duration of laryngoscopy ($p = 1.043$), or duration of surgery ($p = 0.612$). This indicates that the groups exhibited comparable baseline demographic and surgical characteristics, thereby reducing the likelihood of confounding [Table 1].

Initially, the heart rates (HR) among the three groups were approximately equivalent ($p = 1.203$). However, following a mere two minutes of drug infusion, significant disparities in heart rate were observed. Group 1 consistently exhibited the lowest heart rate, indicating superior regulation of the pressor response. Group 2 exhibited certain parallels to Group 1, albeit to a lesser extent. However, significant variations in heart rate (HR) were observed commencing 2 minutes post-initiation of the drug infusion. One hundred and ten beats per minute. The statistical significance ($p < 0.05$) remained consistent throughout the duration following infusion, indicating that both dexmedetomidine and the alternative treatment were effective, albeit the latter demonstrated inferior performance compared to Group 1. Meanwhile, Group 1 exhibited a notable increase, with dexmedetomidine reflecting superior efficacy [Table 2].

Following induction, the systolic blood pressure in Group 3 exhibited a significantly greater increase compared to that observed in Groups 1 and 2. The measurement reached a maximum of 143.88 mmHg at the three-minute mark. Group 1 exhibited the most consistent haemodynamic profile, characterised by a gradual decline in SBP from the onset to the conclusion of the induction period [Figure 1].

At baseline, the diastolic blood pressure did not demonstrate statistical significance ($p>0.05$). Following the infusion and induction, Group 3 exhibited a significantly greater increase in diastolic blood pressure compared to Groups 1 and 2, indicating a more pronounced sympathetic response.

Group 1 consistently exhibited the lowest diastolic pressures throughout the duration of the study, indicating superior management of perioperative haemodynamics [Figure 2].

Initially, the study revealed no notable disparity in mean arterial pressure among the groups. Nonetheless, following the administration of the drug and throughout the laryngoscopy, Group 3 exhibited significantly elevated MAP values at all subsequent time points ($p < 0.05$), peaking at 109.52 mmHg two minutes post-induction. Group 1 consistently exhibited the lowest MAP values, indicating a superior ability to regulate fluctuations in blood flow [Figure 3].

Gupta S et al. conducted a prospective, randomised, double-blind study involving 60 patients, who were assigned to either group D (n=30), receiving redexmedetomidine, or group L (n=30), receiving labe A. A study revealed that Group D (15.1 ± 0.2 min) achieved the target MAP (60–70 mmHg) in a shorter duration compared to Group L (18.2 ± 0.5 min), with this discrepancy being statistically significant ($P < 0.05$). The MAwass levels observed in group p D were lower than those in Group L; however, the difference was not particularly significant. Group D exhibited a significantly reduced heart rate at various intervals compared to Group L. The clarity of the surgical field appears to be comparable across both groups. The research indicated that dexmedetomidine provided superior haemodynamic stability and enhanced visibility of the operative field during functional endoscopic sinus surgery compared to labetalol.[10] El-Shmaa NS et al. conducted a study involving 90 individuals of both genders, who were randomly divided into three distinct groups: Group A received 1 µg/kg of dexmedetomidine via intravenous administration, Group B was administered 0.25 mg/kg of labetalol through an IV, and Group C was given 10 mL of saline. I've. I have discovered A significant decrease ($P < .05$) was observed in heart rate, mean blood pressure, and rate-pressure product in groups A and B when compared to group C, as well as in group A relative to group B. A significant decrease ($P <.05$) in heart rate, mean blood pressure, and rate-pressure product was observed in groups A and B immediately prior to intubation when compared to group C. In comparison to the baseline, there was a significant increase in HR, MBP, and RPP consistently observed in group C. The mean induction dose of propofol (mg) in group A was found to be statistically significantly lower than that observed in groups B and C. The research indicates that dexmedetomidine is more effective than labetalol in mitigating the stress response associated with laryngoscopy and intubation, all while ensuring safety.[11] Mrunalini Patel and her team assigned 60 patients into two distinct groups: group D was administered 1 microgram/kg of dexmedetomidine, while group L received 0.25 mg/kg of labetalol. Both the dexmedetomidine and labetalol cohorts exhibited reduced heart rates and mean arterial pressures in reaction to intubation; however, the dexmedetomidine cohort demonstrated a statistically significant reduction in both heart rate and arterial pressure in response to intubation. The dexmedetomidine group exhibited a statistically significant sedative effect. Dexmedetomidine 1 µ/kg administered slowly over a duration of 10 minutes intravenously, 5 minutes prior to induction, demonstrates superior efficacy compared to labetalol 0.25 mg/kg in mitigating cardiovascular responses associated with laryngoscopy and intubation.[12]

Kumari K et al. conducted a study involving 80 patients, divided into two distinct groups. One cohort received dexmedetomidine, while the other cohort was administered a placebo. Research indicated that the increase in heart rate was most pronounced in the placebo group, reaching 32.57%, while the dexmedetomidine group exhibited the least elevation at 12.96%. The group administered dexmedetomidine exhibited significantly lesser elevations in systolic blood pressure, diastolic blood pressure, and mean blood pressure post-intubation compared to the placebo group.[13]

Shetabi H et al. conducted a study examining the effects of two distinct doses of intravenous labetalol on the physiological response to endotracheal intubation. A total of 72 patients were categorised into three distinct groups, each receiving either 0.1 mg/kg or 0.2 mg/kg of labetalol, along with normal saline, administered intravenously 10 minutes prior to extubation. Significant variations in SBP changes were observed among the three groups at 1, 3, and 5 minutes post-extubation ($P=0.009$, and $P=0.009$, respectively). Not equivalent to 0.005, respectively. Individuals administered 0.2 mg/kg of labetalol did not exhibit an increase in diastolic blood pressure following extubation ($P>0.05$). One-minute post-extubation, a significant disparity in DBP was observed among the three groups ($P=0.03$). A significant disparity in the MAP was observed among the three groups at the one and three-minute marks post-extubation. $P=0.029$ and $P=0.012$, respectively. The heart rates among the three groups exhibited minimal variation ($P>0.05$). Both doses of labetalol mitigate the alterations in blood flow that occur during the extubation of the trachea.[14]

Singla D et al. conducted a randomised division of 160 patients into two distinct cohorts: cohort D, which received 1.0 $\mu g \cdot kg^{-1}$ intravenous dexmedetomidine, and cohort L, which was administered 0.3 $mg \cdot kg^{-1}$ intravenous labetalol in 100 mL of normal saline prior to induction. Following intubation, the mean systolic blood pressure (SBP) recorded in group L patients (128.0 ± 13.866) surpassed that of group D patients (123.2 ± 10.672). Subsequently, the SBP remained relatively stable until the moment of extubation. Furthermore, individuals in group D exhibited a tendency towards reduced diastolic pressure (73.1 ± 9.683 vs. 79.2 ± 14.153, P value .0017) following intubation in comparison to those in group L. Furthermore, individuals administered inj. labetalol exhibited an

elevated incidence of bradycardia and hypotension. The research indicates that dexmedetomidine may surpass labetalol for hospitalised patients prone to significant fluctuations in blood pressure or heart rate, as it maintains more stable blood flow, particularly during periods of stress, and is associated with a reduced incidence of side effects.[15]

Hatami M et al. conducted a randomised clinical trial involving 70 participants. The subjects were divided into two distinct groups. The group receiving dexmedetomidine was administered 0.5 µg/kg of the agent combined with 100 ml of saline solution, while the patients in the second group were given 0.25 mg/kg of labetalol prior to the administration of anaesthesia. The average systolic blood pressure, average diastolic blood pressure, average arterial blood pressure, and average heart rate exhibited significant variations between the two groups at various time points (p-value < 0.05). The research indicated that dexmedetomidine outperformed labetalol in its efficacy to reduce diastolic blood pressure, systolic blood pressure, heart rate, and mean arterial blood pressure.[16] These findings suggest that dexmedetomidine may be a more effective choice for managing cardiovascular stability during anaesthesia. Further studies could explore the long-term implications of these results on patient outcomes and overall recovery.

CONCLUSION

The results demonstrating that intravenous Dexmedetomidine 0.6µg/kg body weight is superior to Labetalol 0.25mg/kg in attenuating the hemodynamic responses to laryngoscopy and intubation. It provides more consistent, profound, and prolonged suppression of HR, SBP, DBP, and MAP. Labetalol remains an effective alternative but may offer less sustained control, particularly during the peak sympathetic stimulation immediately after intubation.

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