



Original Article



Comparison of Efficacy of Intravenous Dexmedetomidine Versus Intravenous Lidocaine for Attenuation of Stress Response to Laryngoscopy and Endotracheal Intubation in Patients Undergoing General Anesthesia for Elective Surgeries

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ABSTRACT

Sympathetic stimulation by laryngoscopy and endotracheal intubation raises blood pressure and heart rate, increases the risk of myocardial ischemia, and increases bleeding. **Objectives:** To evaluate how intravenous dexmedetomidine and lidocaine affect the laryngoscopy stress response. **Methods:** This quasi-experimental research was conducted at Sir Ganga Ram Hospital, Lahore. After receiving ethical approval from Fatima Jinnah Medical University's ERC, July 2022 to August 2023 was set as the timeframe. Consecutive sampling was used to select a total of 136 ASA I-II patients, between the ages of 20 and 40 years, and undergoing elective surgeries. They were divided evenly into two groups. Group D was given IV dexmedetomidine (1 µg/kg over 10 min), and Group L was given IV lidocaine (1.5 mg/kg) before laryngoscopy. Baseline, immediately after intubation, and 1-, 3-, and 5-minute intervals, the hemodynamic parameters (MAP and HR) were recorded. Efficacy was assessed by the total cumulative rise in MAP and HR. SPSS version 26.0 was used for the data analysis. **Results:** The HR and MAP after the intubation were significantly lower for dexmedetomidine compared to lidocaine at all time points ($p < 0.001$). The average increases in HR (11.40 ± 2.97 vs. 20.43 ± 6.95 bpm) and MAP (6.99 ± 3.35 vs. 14.19 ± 4.10 mmHg) were lower than those treated with dexmedetomidine. **Conclusions:** Elevation of HR and MAP in all subgroups was lower in those dexmedetomidine than lidocaine. The two drugs demonstrated comparability in safety, although dexmedetomidine was highly effective with haemodynamic stability without additional risk.

INTRODUCTION

Over the past four to five decades, improvements in anesthetic services have dramatically reduced morbidity and mortality among patients undergoing surgery. This drop in mortality is largely the result of more anesthesia providers and the development of safe anesthetic techniques [1]. Securing the airway with endotracheal intubation via direct laryngoscopy remains the gold standard; however, it may have some detrimental effects [2]. Laryngoscopy followed by endotracheal intubation

causes sympathetic stimulation via the pharyngeal plexus, resulting in activation of the cardioaccelerator sympathetic outflow from the T1 to T4 segments of the spinal cord and an elevation in circulating catecholamines secreted by the adrenal medulla [3, 4]. This sympathetic stimulation results in positive inotropic, chronotropic, and dromotropic effects. In cardiovascular disease, this rise in BP and HR may lead to ischemic heart injury [5]. Further, it may lead to increased surgical hemorrhage and poor



visualization of the surgical field. To minimize these detrimental effects, the stress associated with laryngoscopy and intubation should be attenuated [6]. Various studies have stated different methods like prophylactic use of beta blockers, inducing deeper planes of anesthesia, and administration of opioids to minimize the stress response to laryngoscopy [7]. With a short half-life and a higher affinity for alpha-2 receptors, dexmedetomidine is a centrally acting alpha-2 adrenergic agonist. In the spinal cord and central nervous system (CNS), postsynaptic activation of α_2 receptors reduces sympathetic activity, which lowers blood pressure and heart rate [8, 9]. According to one study, MAP decreased by about 9% following the administration of dexmedetomidine in comparison to baseline [10]. In patients undergoing laparoscopic cholecystectomy, intravenous dexmedetomidine was found to be more effective in reducing the hemodynamic response. Conversely, lidocaine showed mixed time-related effects on blood pressure and heart rate by continuously inhibiting heart rate arising and keeping systolic and diastolic blood pressure steady and constant [11]. It is indicated that when administered in conjunction, lidocaine and propofol were not inferior in reducing the hemodynamic response to endotracheal intubation and laryngoscopy, and had fewer side effects [12]. It is important to establish whether these two agents are relatively effective in their operation, bearing in mind the clinical significance of dealing effectively with the stress reactions in such a procedure. Despite the well-documented hemodynamic effects of laryngoscopy and endotracheal intubation, there is still uncertainty regarding the optimal pharmacological agent to attenuate these stress responses effectively. While dexmedetomidine and lidocaine have both been used for this purpose, comparative data on their efficacy, safety, and hemodynamic stability in the perioperative setting remain limited. Moreover, existing studies show inconsistent results regarding their relative benefits, especially in elective surgical populations. Addressing this gap can guide anesthesiologists in selecting the most effective agent for minimizing peri-intubation stress. As available data is still not clear on the comparative efficacy of intravenous lidocaine and dexmedetomidine in the perioperative setting of minimizing the hemodynamic response to laryngoscopy and intubation. This debate will be tackled to achieve better patient outcomes in elective surgery and make significant contributions to anesthetic practice. This study is aimed to determine the effect of intravenous dexmedetomidine and Lidocaine on stress response to the laryngoscopy.

METHODS

This quasi-experimental study was conducted in 1 year, that is, between July 2022 and August 2023, in the Sir Ganga Ram Hospital, Lahore, after receiving the approval of the Institute review board of Fatima Jinnah Medical University, Lahore. 136 patients were included in the study via a non-probability consecutive sampling method based on the nature of the intervention applied. The sample size was calculated based on an expected mean difference of 4.9 mmHg in mean arterial pressure (MAP) between the dexmedetomidine group (88.30 ± 10.24) and the Lidocaine group (93.20 ± 10.10), measured 5 minutes post-laryngoscopy and intubation [8]. The study enrolled patients aged 20–40 years of both genders, classified as ASA physical status I or II, scheduled for elective surgery, and who had given informed consent. Exclusion criteria included anticipated or documented difficult intubation, allergy to the study drugs, Mallampati class III or IV airway, uncontrolled hypertension, diabetes mellitus, body mass index (BMI) above 30 kg/m^2 , obstetric cases, laryngoscopy lasting more than 15 seconds, or use of beta-blockers. Standardized operational definitions were applied: the stress response was described as transient hemodynamic changes during laryngoscopy and intubation, reflected by elevations in HR and BP. Attenuation of stress response was defined as the difference in MAP and HR from baseline to peak values, assessed immediately after intubation and at 1, 3, and 5 minutes. Efficacy was measured as a lower cumulative change in MAP and HR from baseline across the observation period. Hypotension was defined as MAP <60 mmHg, and bradycardia as HR <50 bpm when associated with hypotension. Based on the anesthetic plan selected by the attending anesthesiologist, patients were split equally into two groups. In Group D, dexmedetomidine ($1 \mu\text{g/kg}$ diluted in 100 mL normal saline) was administered intravenously over 10 minutes, finishing five minutes before induction. Group L was given intravenous lidocaine (1.5 mg/kg) three minutes before intubation and laryngoscopy. Upon arrival in the operating room, patients were monitored using standard equipment (pulse oximetry, non-invasive blood pressure, ECG), and baseline MAP and HR were recorded using a cardiac monitor (model: BSM-2301K). Induction was carried out using IV propofol ($1.5\text{--}2 \text{ mg/kg}$) followed by atracurium (0.5 mg/kg), and patients were ventilated with 1 MAC isoflurane in 100% oxygen for 3 minutes. Laryngoscopy and endotracheal intubation were performed by the same anesthesiologist for all cases, with confirmation of tube placement through end-tidal CO_2 . No surgical stimuli were applied during the 5-minute study period post-intubation MAP and HR, among other hemodynamic parameters, were measured right after intubation and then at 1, 3, and 5 minutes. Phenylephrine

(0.5–1 µg/kg) was used to treat hypotension, and atropine (0.01 mg/kg) was used to treat bradycardia. Labetalol (1–2 mg) was used to control tachycardia and hypertension. A structured proforma was used to record demographic and intraoperative variables, including age, gender, BMI, ASA grade, and surgery type. SPSS version 26.0 was used to analyze the data. For both qualitative and quantitative variables, descriptive statistics were computed. The study used a t-test to compare hemodynamic changes and a chi-square test to compare side effects, with a p-value of less than 0.05 indicating statistical significance.

RESULTS

The mean age of participants in Group D was 33.85 ± 5.51 years and 34.43 ± 4.53 in Group L. There was also a similarity in gender distribution, where Group D had 61.8% and Group L had 54.4% males. The average BMI was almost similar in both groups, which was 26.91 ± 3.93 in Group D and 26.78 ± 4.11 in Group L. The Majority of the participants in both groups were classified as overweight (64.7% in Group D and 69.1 in Group L), and a smaller proportion of participants were found to have normal BMI. Group D and L had 55.9% and 58.8% patients with ASA I and the rest had ASA II respectively (Table 1).

Table 1: Demographics and Clinical Characteristics of Patients

Characteristics	Group D (N=68)	Group L (N=68)
Age (years)	33.85 ± 5.51	34.43 ± 4.53
20–30 years	22 (32.4%)	20 (29.4%)
31–45 years	46 (67.6%)	48 (70.6%)
Gender		
Male	42 (61.8%)	37 (54.4%)
Female	26 (38.2%)	31 (45.6%)
BMI (kg/m ²)	26.91 ± 3.93	26.78 ± 4.11
Normal weight	24 (35.3%)	21 (30.9%)
Overweight	44 (64.7%)	47 (69.1%)
ASA Status		
ASA I	38 (55.9%)	40 (58.8%)
ASA II	30 (44.1%)	28 (41.2%)

At baseline, both groups showed similar HR (84.99 ± 2.95 vs. 85.43 ± 3.02 bpm) and MAP (92.93 ± 4.08 vs. 93.59 ± 3.55 mmHg; p > 0.05). Following intubation, Group D always exhibited much lower values of HR and MAP at all time points, including the values immediately following intubation (HR: 96.38 ± 4.48 vs. 105.85 ± 7.09 bpm; MAP: 99.91 ± 5.65 vs. 107.78 ± 5.88 mmHg p < 0.001). The same trend followed at 1, 3 and 5 minutes. The mean change from baseline in HR (11.40 ± 2.97 vs. 20.43 ± 6.95 bpm) and MAP (6.99 ± 3.35 vs. 14.19 ± 4.10 mmHg) was also significantly lower in Group D (p < 0.001), indicating superior attenuation of the hemodynamic response by Dexmedetomidine (Table 2).

Table 2: Comparison of Hemodynamic Changes Between the Study Groups

Intervals	Parameters	Group D	Group L	p-Value
Baseline	HR	84.99 ± 2.95	85.43 ± 3.02	0.391
	MAP	92.93 ± 4.08	93.59 ± 3.55	0.314
Immediately after Intubation	HR	96.38 ± 4.48	105.85 ± 7.09	<0.001
	MAP	99.91 ± 5.65	107.78 ± 5.88	<0.001
1 Minute Post Intubation	HR	94.00 ± 5.69	103.53 ± 7.34	<0.001
	MAP	98.25 ± 5.80	105.24 ± 6.27	<0.001
3 Minutes Post Intubation	HR	89.47 ± 4.95	97.54 ± 7.52	<0.001
	MAP	94.94 ± 5.73	99.51 ± 6.40	<0.001
5 Minutes Post Intubation	HR	86.21 ± 4.76	92.04 ± 7.08	<0.001
	MAP	91.88 ± 5.26	96.26 ± 5.92	<0.001
Change from Baseline	Δ HR	11.40 ± 2.97	20.43 ± 6.95	<0.001
	Δ MAP	6.99 ± 3.35	14.19 ± 4.10	<0.001

The incidence of adverse events was low in both groups. Hypotension and bradycardia each occurred in 1 patient (1.5%) in both groups. Arrhythmias were reported in 1 patient (1.5%) in Group D and none in Group L. No cases of allergic reactions were reported. These findings suggest that both Dexmedetomidine and Lidocaine were well-tolerated, with a similar and minimal side effect profile (Table 3).

Table 3: Comparison of Side Effects Among Study Groups

Side Effect	Yes/No	Study Groups		p-Value
		Group D	Group L	
Hypotension	Yes	1 (1.5)	1 (1.5)	1.000
	No	67 (98.5%)	67 (98.5%)	
Bradycardia	Yes	1 (1.5)	1 (1.5)	1.000
	No	67 (98.5%)	67 (98.5%)	
Arrhythmias	Yes	1 (1.5)	0 (0.0)	1.000
	No	67 (98.5%)	68 (100.0%)	
Allergy	Yes	0 (0.0%)	0 (0.0%)	1.000
	No	68 (100%)	68 (100%)	

DISCUSSION

Anesthetic care primarily aims to manage the physiological stress response during surgery, especially in elective procedures. Intravenous lidocaine has long been administered to suppress sympathetic stimulation caused by laryngoscopy and intubation; however, its brief duration of action often limits its effectiveness throughout the peri-intubation period. Dexmedetomidine, which is a 2-α adrenergic agonist, provides a more stable sympathetic blockade as well as regulation of hemodynamic variables, but is still compared with lidocaine [8, 9]. This study compared dexmedetomidine and lidocaine for controlling intubation-induced stress. Participants (mean age 34.14, 58.1% male) had a mean BMI of 26.85. Most were low-risk, classified as ASA I/II (57.4%/42.6%) and Mallampati I/II (56.6%/43.4%), reflecting a typical elective surgery demographic. These attributes are consistent with

anesthetic population profiles reported in the past [13, 14]. There was no significant difference between baseline heart rate (HR) and mean arterial pressure (MAP) between the groups ($p=0.391$ and $p=0.314$, respectively). Patients undergoing lidocaine intubation exhibited a great deal more HR and MAP values at every time point ($p<0.001$). Conversely, dexmedetomidine was consistently associated with lower values of HR and MAP, which confirms the better suppressive effects of dexmedetomidine on tachycardic and hypertensive emissions after laryngoscopy and intubation, which has also been confirmed by previous studies [15-18]. The increase in HR with dexmedetomidine was $11.40 + 2.97$ bpm and $20.43 + 6.95$ bpm with lidocaine ($p<0.001$). On the same note, MAP rose significantly by $14.19 + 4.10$ mmHg in the lidocaine group ($p<0.001$). The subgroup analyses were conducted using age, sex, BMI, and ASA categories and indicated that dexmedetomidine provided better hemodynamic control in all the categories. In cases of combination with propofol or dexmedetomidine, the prior research also reported successful hemodynamic stability in the case of lidocaine [12]. It was noted in the past that dexmedetomidine at the level of $1 \mu\text{g}/\text{kg}$ gave the best results and no significant benefit at lower dosages compared to lidocaine [17, 19]. The two groups had similar and rare adverse events. Hypotension and bradycardia were found in 1.5 percent and 1.5 percent respectively, and arrhythmias were observed in 1.5 percent of cases in the dexmedetomidine group and zero percent in the lidocaine group. There were no allergic reactions ($p=1.000$). The results are in agreement with the past studies that have also recorded these safety profiles [16, 19]. A more recent meta-analysis also determined no general difference in sympathetic response rate between dexmedetomidine and lidocaine, but dexmedetomidine was linked with a little higher rate of bradycardia and sedation [20]. The major strength of this study is that anesthetic protocol was standardized, and using regular monitoring methods improved the reliability of assessment of the hemodynamics. Besides, the results have practical implications on the local clinical population. However, as a single-center study with a small sample size, it cannot be generalized well. Multicenter studies using larger sample sizes should be granted in the future to corroborate these findings and determine the relationship between these findings and long-term hemodynamic stability and postoperative recovery. Also, the quantification of biochemical stress indices including plasma catecholamines and serum cortisol can also be used to further explain the physiological stress response in various anesthetic procedures.

This study is limited by its single-center design and relatively small sample size, which may restrict the

generalizability of the findings. Future multicenter studies with larger cohorts are warranted to validate these results. Additionally, incorporating biochemical markers of stress, such as plasma catecholamines and cortisol, could provide a more comprehensive understanding of the physiological responses and further optimize anesthetic management strategies.

CONCLUSIONS

Despite a little increase in mean arterial pressure and heart rate, dexmedetomidine was proved better than lidocaine in reducing hemodynamics during laryngoscopy and intubation. Its effectiveness was also consistent and was supported by such variables as age, gender, BMI, and ASA score. Also, the side effects were similar in both drugs, and this points out the advantage of dexmedetomidine in maintaining hemodynamic stability without increasing risk.

Authors' Contribution

Conceptualization: YS

Methodology: YS, SA

Formal analysis: YS, SA

Writing and Drafting: YS, SA, MTC, SA, AT, TN

Review and Editing: YS, SA, MTC, SA, AT, TN

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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