Original Article
Cukurova Anestezi ve Cerrahi Bilimler Dergisi

Comparison of the Hemodynamic Response of Intravenous and Topical Lidocaine to Endotracheal Intubation

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Abstract

Aim: To compare the effects of 10% lidocaine spray and intravenous (IV) lidocaine on hemodynamic responses, postoperative throat pain, and coughing following laryngoscopy and endotracheal intubation.

Methods: A total of 120 patients, aged 18 to 65 years and scheduled for elective surgery, were randomized into two groups: Group 1 (n=60) received 10% lidocaine spray (three puffs, 30 mg), while Group 2 (n=60) was administered 1.5 mg/kg of IV lidocaine. Intubation was performed by the same individual three minutes after mask ventilation. Systolic, diastolic, and mean arterial blood pressures, along with heart rate, were recorded at baseline and at 1, 2, 4, 6, 8, and 10 minutes after intubation. Immediately upon transfer to the recovery unit, coughing and throat pain were assessed. The data were compared using ANOVA, Scheffe, and repeated measures tests, with the significance level being accepted as $p<0.05$.

Results: The comparative analysis between the groups revealed a significantly lower heart rate at 1 minute after intubation in Group 2 ($p=0.03$). No significant differences were observed in systolic and mean arterial blood pressure measurements. Diastolic blood pressure at 10 minutes was significantly lower in Group 2 ($p=0.02$). Postoperative throat pain and coughing were statistically lower in Group 1 than in Group 2 at the postoperative first hour ($p<0.001$ and $p<0.003$, respectively).

Conclusions: There was no significant difference in the suppression of hemodynamic responses between the groups, except for the heart rate measured at 1 minute. Throat pain and coughing were lower in the lidocaine spray group.

Keywords: *Intubation; hemodynamic response; throat pain; cough*

1. Introduction

Endotracheal intubation involves the placement of a tube into the trachea to secure the airway or control respiration.[1] The primary indication for endotracheal intubation is to ensure airway patency and safety in patients undergoing general anesthesia.[2] During laryngoscopy and intubation, increased plasma concentrations of norepinephrine and adrenaline lead to elevated blood pressure and heart rate, premature ventricular contractions, ventricular extrasystoles, and arrhythmias, thereby affecting myocardial oxygen consumption.[3] Following laryngoscopy and intubation, there is typically an increase in heart rate by approximately 20 beats per minute, systolic blood pressure by 50 mmHg, and diastolic blood pressure by 30 mmHg. These changes peak within 1-2 minutes and return to baseline values after 5 minutes, but they are transient and generally well-tolerated in healthy individuals without causing further problems.[1,4,5] To prevent the undesirable effects associated with intubation, several measures can be implemented, including deepening the administered general anesthesia, utilizing vasodilators that suppress the sympathoadrenal response, employing alpha and beta-adrenergic blockers, precurarization, administering short-acting opioids prior to anesthesia induction, applying topical anesthesia to the laryngeal area, and administering intravenous (IV) lidocaine a few minutes before the procedure.[1]

Lidocaine, one of the drugs utilized in the above-mentioned procedures, functions as both a local anesthetic and an antiarrhythmic agent. It exhibits analgesic effects on the dorsal horn neurons of the spinal medulla when administered intravenously. The cough reflex is suppressed by inhibiting afferent C fibers in the larynx, observed at doses above 5 mg/kg.[6] Topically applied lidocaine is rapidly absorbed through the mucosa, locally suppressing tactile stimuli. The recommended IV dose for controlling hemodynamic responses dur-

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ing airway procedures (intubation, extubation, and laryngoscopy) is 1.5 mg/kg, administered 3 minutes before the procedure.[7-10] Contraindications for lidocaine include second- and third-degree heart block, severe sinoatrial block, hypersensitivity reactions to the drug, and concurrent use of class-1 antiarrhythmic drugs. Systemic side effects primarily affect the cardiovascular and central nervous systems.[11]

To our knowledge, the effects of IV and topical lidocaine on reducing hemodynamic responses to laryngoscopy and endotracheal intubation have not been previously investigated. Thus, this study aimed to compare the efficacy of these two different administrations of lidocaine.

2. Materials and Methods

This study included 120 patients, aged 18–65 years, who were scheduled for elective surgery at the Dicle University Faculty of Medicine, had an American Society of Anesthesiology score of I-III, and no had contraindications for general anesthesia. The study received approval from the Diyarbakir Clinical Research Ethics Committee (December 21, 2009; number 2009_77) and was conducted in accordance with the principles of the Declaration of Helsinki.

Patients, having provided informed consent, were randomized into two groups. We create randomization using computer generated random number. The exclusion criteria were a history of difficult intubation, predictors of difficult intubation (such as Thyromental distance, Interincisor gap, Mallampati class, head and neck movement), duration exceeding 30 seconds, multiple intubation attempts (more than one attempt) , hypertension, arrhythmias, beta blockers and calcium channel blockers use and previous head-neck surgeries.

Patients arrived to the operating room after 6 hours preoperative fasting and received an IV infusion of 0.9% NaCl at 10 mL/kg/hour through a 20-G cannula. No premedication was administered. Anesthesia was induced using 2 mg/kg of propofol, 2 µg/kg of fentanyl, and 0.1 mg/kg of vecuronium bromide, administered intravenously. In addition to the patients' demographic data, their baseline systolic, diastolic, and mean arterial blood pressures (SBP, DBP, and MAP, respectively), along with heart rate (HR) values, were recorded before induction. Endotracheal entubation was formed by an anesthesia assistant experienced more than three years who was blinded to the groups. Ventilation was maintained with 100% oxygen during induction. Laryngoscopy and endotracheal intubation were performed by the same individual three minutes after induction.

Group 1 (n = 60) received three puffs (30 mg) of 10% lidocaine spray 3 minutes before direct laryngoscopy. Group 2 (n = 60) received 1.5 mg/kg of 2% lidocaine IV bolus 3 minutes before laryngoscopy. Intubation was performed with 7-8-mm tubes for females and 8-9-mm tubes for males. The cuff was inflated to 20 cmH_2O to prevent air leakage. In all groups, anesthesia was maintained using 50% O_2-air (3L/min) and 2-3% sevoflurane. Hemodynamic parameters (SBP, DBP, MAP, and HR) were recorded at baseline and at 1, 2, 4, 6, 8, and 10 minutes after intubation by another anesthesia assistant who also blinded to group assignments and was not present during induction. Hypotension (SBP < 90 mmHg or >30% drop from baseline) was managed with repeated 2.5 mg doses of ephedrine. Bradycardia (HR < 50 bpm) was treated with 0.5 mg of IV atropine. Hypertension (SBP > 200 mmHg or >30% increase from baseline) was managed by increasing the inspired gas concentration by 0.5 MAC. The surgical incision was allowed following the completion of the data recording process. Postoperative throat pain and coughing were assessed upon the patient's arrival in the recovery unit.

2.1. Statistical Analysis

Given the lack of comparable studies on the effects of topical versus IV lidocaine on hemodynamic responses and postoperative throat pain, sample size calculation was based on a similar study investigating the impact of topical lidocaine on post-intubation throat pain. Using the OpenEpi program, it was determined that 60 patients per group were required to achieve 80% power and a 95% confidence interval. Simple randomization continued until target numbers were reached between January 1, 2010, and June 1, 2010.

Statistical analyses were performed using SPSS for Windows version 12.0. Student's t-test was used for analysis. The results were expressed as median or standard deviation values with the 10th and 90th percentiles. Variance analysis was utilized for age, height, and weight. The ci-square test was conducted to compare gender and the incidence of hoarseness and throat pain. The Kruskal-Wallis and Mann-Whitney tests were performed to compare symptoms between groups, with *p* values of <0.05 being considered significant.

3. Results

There were no significant differences between the groups in terms of age, gender, height, or weight ($p > 0.05$) (Table 1).

HR comparisons revealed a significantly lower value at 1 minute after intubation in Group 2 compared to Group 1 ($p = 0.03$). At 10 minutes, HR was significantly lower in Group 1 than in Group 2 ($p = 0.01$). No significant differences were observed at other measurement times ($p > 0.05$) (Table 2).

Table 1

Demographic data of the participants

	Group 1 (n = 60)	Group 2 (n = 60)	p
Age (years)	42.25 ± 12.10	38.98 ± 12.90	>0.05
Height (cm)	165.08 ± 6.75	165.58 ± 8.25	>0.05
Weight (kg)	70.31 ± 13.52	69.28 ± 12.72	>0.05
Gender (F/M)	33/27	35/25	>0.05

Group 1: lidocaine spray, Group 2: intravenous lidocaine, F: female, M: male, Data presented as mean ± standard deviation.

Table 2

Comparison of HR between groups

	Group 1 (n = 60)	Group 2 (n = 60)	*p*
HR, baseline	89.86 ± 15.67	83.81 ± 17.02	0.94
HR, minute 1	84.78 ± 18.00	79.31 ± 13.68	0.03*
HR, minute 2	85.35 ± 14.33	81.28 ± 15.11	0.44
HR, minute 4	81.15 ± 13.59	79.08 ± 17.06	0.54
HR, minute 6	80.80 ± 12.88	80.25 ± 14.03	0.29
HR, minute 8	80.80 ± 13.23	78.86 ± 16.77	0.32
HR, minute 10	78.51 ± 12.18	79.33 ± 18.18	0.01*

HR: heart rate, Group 1: lidocaine spray, Group 2: intravenous lidocaine, Data presented as mean ± standard deviation

SBP and MAP values did not significantly differ between the groups ($p > 0.05$). DBP was significantly lower in Group 2 at 10 minutes ($p = 0.02$), with no significant differences at other measurement times ($p > 0.05$) (Table 3).

Any patients had hypotension and/or bradycardia treated with ephedrine or atropine prior to laryngoscopy. Upon evaluation of the incidence of side effects, it was determined that 12 patients (20%) in Group 1 and 33 patients (55%) in Group 2 experienced throat pain (Figure 1, $p < 0.001$). In addition, coughing was observed in 19 patients (31.7%) in Group 1 and 30 patients (50%) in Group 2 (Figure 2, $p < 0.003$).

Table 3

Comparison of DBP between groups

	Group 1 (n = 60)	Group 2 (n = 60)	p
DBP, baseline	79.53 ± 8.99	77.05 ± 12.05	0.01*
DBP, minute 1	68.78 ± 14.74	66.61 ± 14.50	0.55
DBP, minute 2	75.93 ± 14.24	73.05 ± 14.66	0.29
DBP, minute 4	73.81 ± 13.42	69.53 ± 15.48	0.90
DBP, minute 6	73.85 ± 12.95	70.75 ± 16.59	0.21
DBP, minute 8	74.15 ± 13.62	70.90 ± 14.47	0.78
DBP, minute 10	76.33 ± 12.41	74.45 ± 17.93	0.02*

*DBP: diastolic blood pressure, Group 1: lidocaine spray, Group 2: intravenous lidocaine, Data presented as mean ± standard deviation, *Statistically significant*

Figure 1

Incidence of sore throat

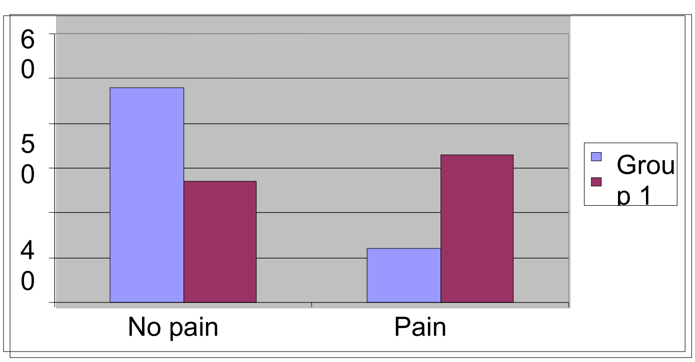
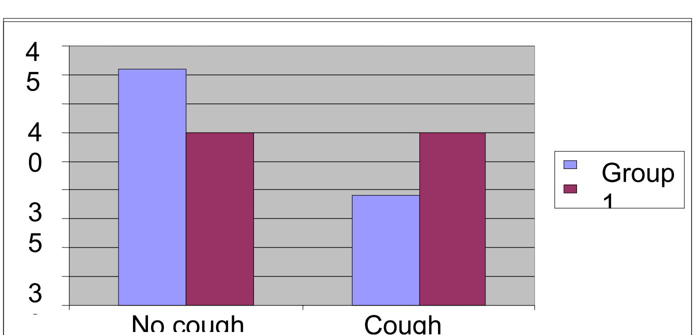


Figure 2

Incidence of cough



4. Discussion

In this study, we observed no significant difference between IV and topical lidocaine in controlling the hemodynamic responses induced by laryngoscopy and intubation, except for HR measured at 1 minute. Throat pain and coughing were found to be lower in the lidocaine spray group.

In a study comparing the efficacy of esmolol, fentanyl, lidocaine, and a placebo in preventing tachycardia and hypertension during endotracheal intubation, Helfman et al.[12] reported that only esmolol consistently and reliably prevented increases in HR and SBP associated with laryngoscopy and intubation, whereas fentanyl and lidocaine were inadequate in preventing HR increases. Consistent with our findings, the authors found that IV lidocaine was only effective in reducing HR at 1 minute following intubation, without significantly affecting SBP or MAP. In another study by van den Berg et al.[13], the effects of magnesium sulfate, esmolol, lidocaine, nitroglycerin, and a placebo on hemodynamic responses were compared. It was determined that esmolol effectively prevented increases in HR and blood pressure induced by laryngoscopy and intubation, while lidocaine and magnesium sulfate failed to suppress the hemodynamic response and were associated with an increased peak HR. Our study also revealed that while IV lidocaine resulted in a lower peak HR at 1 minute compared to the spray form, neither group had significant benefits in terms of HR and blood pressure control at other measurement times.

Sun et al.[14] investigated the hemodynamic effects of 2% topical lidocaine compared to saline during intubation and found that topical lidocaine was more effective in suppressing hemodynamic responses than saline. In contrast, our study determined that topical lidocaine was inadequate in suppressing hemodynamic responses. We consider that these discrepancies among hemodynamic studies may be attributed to variables such as the time from laryngoscopy to drug administration, the duration of laryngoscopy, the presence of premedication, and differences in the induction agents used.

Minogue et al.[15] conducted a study comparing the effects of a placebo and topical lidocaine on coughing and reported that coughing was less frequent in the group that received topical lidocaine, which is consistent with our findings. In another study, Hung et al.[16] compared the effects of benzydamine HCI spray (10 puffs, 1.5 mg), 10% lidocaine spray (10 puffs, 100 mg), and 2% lidocaine spray (10 puffs, 20 mg) applied to the endotracheal tube cuff on postoperative throat pain. They found that the benzydamine group had significantly lower incidences and severity of throat pain compared to the other groups, while the lidocaine group exhibited an increase in both the severity and frequency of throat pain, which was attributed to possible chemical mucosal damage caused by the high dosage of lidocaine. In our study, we employed much lower doses of topical lidocaine, and we did not encounter such effects. Similarly, Maruyama et al.[17] examined different doses of topical lidocaine (8%, Xylocaine pump) for preventing postoperative throat pain and hoarseness following intubation in three groups: L10 (10 puffs), L5 (five puffs), and 1 ml saline (placebo). The authors reported higher incidences of throat pain and hoarseness in the L10 group compared to the L5 and placebo groups, which was considered to be related to local mucosal irritation caused by the menthol, ethanol, and sodium saccharin components in the lidocaine spray. In our study, using a dose of 30 mg, we did not observe such effects and noted a reduction in the incidence of throat pain and coughing. This could be due to our immediate postoperative assessment of the patients, which may not have captured such complications, as well as the lower, non-irritating dose of lidocaine spray used in our study compared to the doses causing irritation in other studies. There are many factors that must be taken into consideration related to throat pain such as head-neck surgery, positions (Trendelenburg), prolonged intubation time, high cuff pressures that could potentially affect postoperative throat pain. It is a limitation that we did not monitor cuff pressure due to technical problems, but we performed our study in low risk group (open abdominal surgeries in supine position< 120 minutes) according to throat pain. Other limitation is not to assess throat and cough during late postoperative period.

5. Conclusion

This study found that IV lidocaine was more effective than topical lidocaine in preventing the increase in HR minute only at 1 minute after intubation and laryngoscopy. Both groups were unsuccessful in suppressing hemodynamic responses. However, topical lidocaine spray was significantly effective in reducing postoperative coughing and throat pain. We think that further studies with larger sample sizes should be planned in different surgeries and patient groups.

Statement of ethics

The study received approval from the Diyarbakir Clinical Research Ethics Committee (December 21, 2009; number 2009_77).

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Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

This Data and materials are available to the researchers.

Author contributions

Both authors contributed equally to the article. Both authors read and approved the final manuscript.

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