Original Article

Effects of Oropharyngeal Lidocaine Spray Before Endotracheal Intubation on Heart Rate, Blood Pressure, and Arrhythmia in Patients Undergoing Coronary Artery Bypass Grafting Surgery: A Randomized Clinical Trial

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Abstract

Background: Coronary artery disease is a growing disease in human societies. A considerable number of patients ultimately require coronary artery bypass graft (CABG) surgery. Laryngoscopy and endotracheal intubation in these patients may lead to increased heart rate (HR) and blood pressure (BP), which can exacerbate myocardial ischemia. This study aimed to investigate the potential effect of local lidocaine administration before endotracheal intubation on reducing atrial fibrillation attacks, BP changes, HR, length of hospital stay, and mortality in patients undergoing CABG surgery.

Methods: In this randomized controlled clinical trial, a total of 60 candidates for CABG surgery were randomly divided into a lidocaine spray (LS) group with 30 patients and a control (C) group. Patients were randomly assigned to two groups by using computer software. In the LS group, two puffs of 10% LS were used before anesthesia induction and two puffs during laryngoscopy for endotracheal intubation. Distilled water spray was used in the C group. Mean arterial pressure (MAP) and HR at baseline (T0), one minute after anesthesia induction (T1), and in timeline durations after endotracheal intubation were measured and recorded. Finally, the patients were monitored for atrial fibrillation, length of stay in the intensive care unit (ICU), and in-hospital mortality.

Results: The frequency of atrial fibrillation, length of hospital stay, and hospital mortality in patients receiving LS and the C group did not have a significant difference ($P>0.05$). The HR was significantly lower in patients in the LS group than in the C group two (T4), three (T5), five (T7), and ten (T8) minutes after intubation.

Conclusion: This study showed that patients who received LS before intubation had better hemodynamic stability and a lower chance of tachycardia.

Keywords: Coronary artery bypass, Lidocaine, Arterial pressure, Heart rate, Arrhythmias, Cardiac

Introduction

Coronary artery disease is an important concern in human societies, reducing the life expectancy of individuals and imposing a substantial cost on healthcare systems. In some countries, ischemic heart disease has higher mortality and morbidity than cancer and road accidents. Although interventions such as angiography and the use of cardiac stents to open occluded arteries are feasible for many patients, some patients finally require coronary artery bypass graft (CABG) surgery. Arrhythmias and conduction disturbances are commonly observed after this surgery, leading to prolonged hospitalization and an increased risk of stroke.[1]

During the induction of anesthesia for CABG, direct laryngoscopy and endotracheal intubation are significant stimuli that can result in unwanted responses in the cardiovascular, respiratory, and other physiological systems. While hemodynamic changes begin with premedication and the induction of anesthesia, the major changes, such as increased heart rate (HR), arrhythmias, and blood pressure (BP), are observed moments after direct laryngoscopy and endotracheal intubation. These changes peak 1–2 minutes after laryngoscopy and usually return to baseline levels within 5 minutes. These transient changes are well tolerated by healthy individuals, but in susceptible patients, especially those with systemic

hypertension, coronary artery disease, abdominal aortic aneurysm, intracranial aneurysm, recent myocardial infarction, and those undergoing coronary artery bypass surgery, sudden changes in HR and BP can cause serious problems.[2]

In the respiratory system and airways, bronchospasm and bronchiolar spasm can pose additive risks. These stimuli can occasionally lead to arrhythmias such as atrial fibrillation, which is one of the most common arrhythmias after coronary artery bypass surgery.[3] While these arrhythmias are self-limiting, they increase the length of hospital stays, leading to increased costs.[4]

A recent study has shown that the duration of intubation in the intensive care unit (ICU) is the strongest predictor of 30-day and one-year mortality in patients with heart failure undergoing CABG. Various pharmacologist techniques have been utilized to reduce unwanted hemodynamic responses, such as deepening anesthesia, vasodilators, calcium channel blockers, and opioids, with variable results.[5]

One study by Bilgi et al demonstrated that the use of 10% lidocaine spray (LS) 5 minutes before intubation in CABG surgery significantly affected QT dispersion duration, a potential factor in increasing the risk of cardiac arrhythmias.[6] Another study suggested that intubation is associated with changes in stress-related parameters.[7]

There are few studies investigating the effect of routine use of topical lidocaine before intubation in CABG patients and the patient outcomes post-surgery. Finding a safe and cost-effective method to reduce post-surgical complications is important, and this study sought to examine the potential impact of topical lidocaine on hemodynamic stability and outcomes in CABG patients.

Methods

This double-blinded randomized control trial was designed to investigate the effects of LS in patients undergoing CABG surgery. In this trial, 60 patients were divided into LS and control groups, and consent for the anesthesia method was obtained from all patients. Patients with specific conditions such as previous arrhythmias, cardiomyopathy, renal and hepatic dysfunction, lidocaine sensitivity, and specific respiratory problems were excluded from the investigation. Twenty-five patients were randomly assigned to two groups by using computer software, which was utilized for random allocation. In the lidocaine group, 2 puffs of 10% LS (Iran Darou©) were used before inducing anesthesia and tracheal intubation, while in the control group, distilled water spray was used. This trial was performed in one tertiary center, which is the main referral hospital for surgery cases located in the northwest of Iran.

Similar containers with labels A and B were used to ensure that the physicians were unaware of the type of applied spray. Only the clinical pharmacology responsible in the hospital was aware of the content of each spray, and to reduce the bias of the smell of LS, the attending physician who intubated the patient using LS and the physician who recorded the patient's symptoms were different.

The treating physician and the researcher responsible for analyzing and monitoring data were unaware of the type of spray used, making this a double-blind study. The anesthesia method was the same for all patients. Following pre-medication with midazolam and fentanyl, an arterial line for BP monitoring was established using a 20-gauge angiocath. Baseline vital signs, including mean arterial pressure (MAP) using central pressure monitoring, HR, and arterial oxygen saturation, were assessed and recorded.

In the LS group, lidocaine was sprayed into the back of the tongue and around the glottis before inducing anesthesia, and after consistent induction of anesthesia with midazolam, fentanyl, and cisatracurium, LS was administered again to the vocal cords and trachea following laryngoscopy. Subsequently, endotracheal intubation was performed using size 8.5 and 7.5 tubes for males and females, respectively. Anesthesia maintenance for all patients was achieved using isoflurane in oxygen, and propofol infusion was used during cardiopulmonary bypass. Patients taking vasoactive drugs were excluded from the study.

MAP, HR, and arterial oxygen saturation were measured and recorded at baseline (T0), one minute after induction of anesthesia (T1), 30 seconds (T2), and one (T3), two (T4), three (T5), four (T6), five (T7), and 10 (T8) minutes after endotracheal intubation. During ICU and hospital stays, the patients were followed for atrial fibrillation, length of stay in the ICU, and hospital mortality.

Data on patient characteristics were presented using descriptive statistics (means and standard deviations). Data analysis involved the use of the chi-square test (or Fisher's exact test as needed) for comparing frequencies between the two groups, the independent t-test for comparing means, and repeated measurements analysis (Friedman test if necessary) for comparing quantitative outcomes over time intervals. Statistical analysis was performed using SPSS, version 17.

According to the study by Bilgi et al,[6] at least 30 people were determined in each group, considering the 95% confidence interval (Z1-α/2 = 1.96) and the power of the test at 80% (Z1-β = 0.84).

Results

In this study, patients undergoing coronary artery bypass surgery were examined and divided into two LS (n = 30) and control (n = 30) groups. The average weight of the patients in the lidocaine and control groups was 72.7 ± 3.61 kg and 71.9 ± 59 kg, respectively. In the LS group, 63.3% were male, and in the control group, 56.7% were male. Figure 1 shows the consort chart for patient selection.

Based on our findings, the frequency of atrial fibrillation in patients receiving LS and the control group after surgery during recovery demonstrated no significant difference

($P > 0.05$, Figure 2).

Table 1 compares the mean HR at baseline (T0), one minute after anesthesia induction (T1), 30 seconds (T2), one minute (T3), and four (T6) after intubation in patients in the two groups. The independent samples t-test revealed that there was no significant difference in the HR at baseline (T0), one minute after anesthesia induction (T1), 30 seconds (T2), one minute (T3), and four (T6) after intubation in the two groups ($P > 0.05$). However, a significant difference was observed in the HR at two (T4), three (T5), five (T7), and ten (T8) minutes after intubation in patients in the two groups receiving LS and the control group ($P < 0.05$). The mean HR was lower in the LS group.

Based on the results of Table 2, the MAP was not significantly different in the two groups at baseline (T0), one minute after anesthesia induction (T1), 30 seconds (T2), one minute (T3), three (T5), four (T6), five (T7), and ten (T8) minutes after intubation, and only the MAP

was significantly lower in the LS group after two minutes of intubation.

The length of ICU stay was 0.6 ± 2.2 and 0.3 ± 2.1 days in the LS and control groups, respectively ($P = 0.474$). There was no significant difference in in-hospital mortality between the patients in the LS and control groups ($P = 0.313$).

The mean percentage of oxygen saturation was measured by pulse oximetry (SpO_2) in the two groups. Although SpO_2 was lower in the LS group at the base time, patients in the lidocaine group had significantly higher SpO_2 after intubation.

No significant difference was found between the two groups regarding in-hospital mortality or the length of the recovery room observation.

Discussion

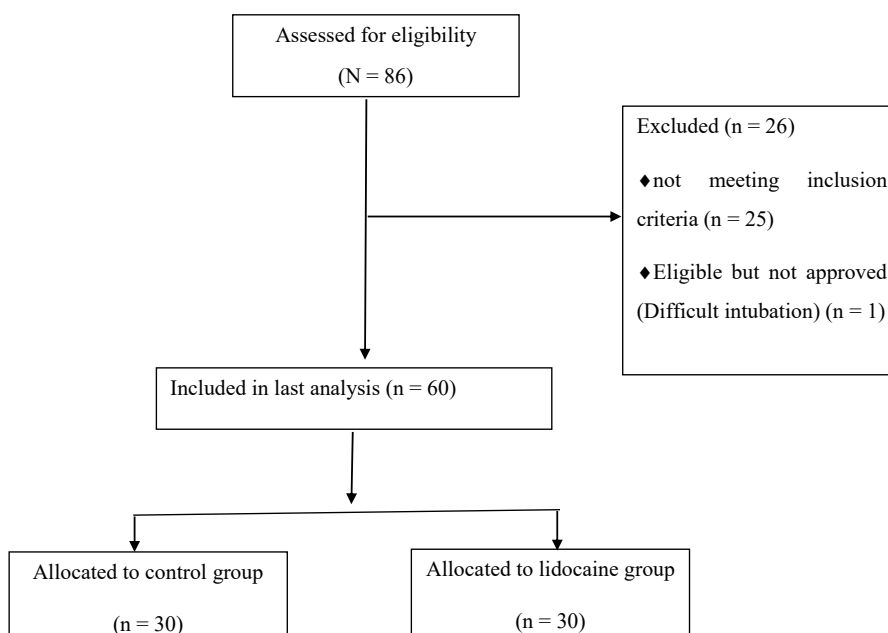Lidocaine as a medium-acting agent is used to relieve pain, and its short onset of action makes it the drug
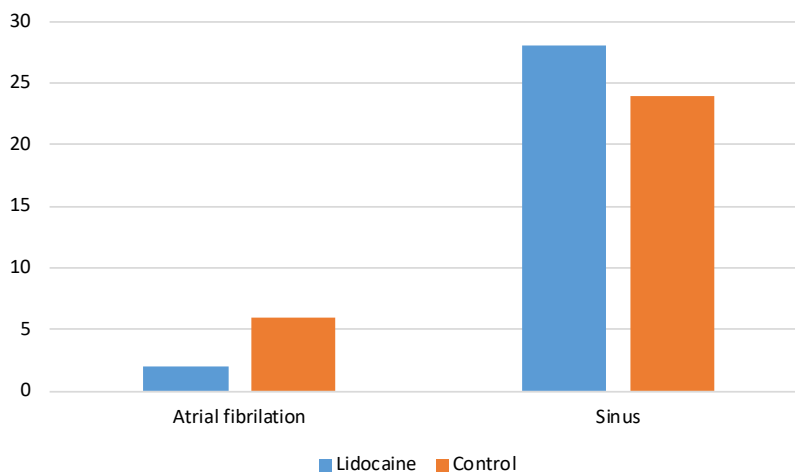

Figure 1. Consort Chart for Patient Selection

Figure 2. The Frequency of Atrial Fibrillation in Patients in the Lidocaine Spray Recipient Group and the Control Group During the Recovery After Surgery

Table 1. The Average Heart Rate at Different Time Points in Patients in Both the Lidocaine Spray and Control Groups

	Lidocaine Group	Control Group	T-test Value	P Value
HR.T0	77.0 ± 16.9	82.5 ± 10.5	-1.503	0.138
HR.T1	71.4 ± 19.2	74.0 ± 9.9	-0.659	0.513
HR.T2	69.1 ± 13.5	74.6 ± 11.3	-1.699	0.095
HR.T3	69.6 ± 15.3	75.0 ± 9.3	-1.656	0.103
HR.T4	65.0 ± 13.5	74.7 ± 9.1	-3.264	0.002
HR.T5	64.3 ± 14.6	71.9 ± 8.5	-2.472	0.016
HR.T6	66.0 ± 15.9	71.4 ± 9.2	-1.601	0.115
HR.T7	65.7 ± 16.4	72.7 ± 8.5	-2.067	0.042
HR.T8	65.2 ± 15.0	71.8 ± 7.4	-2.156	0.035

Table 2. Comparison of the Mean Arterial Pressure at Different Time Points in Patients in the Lidocaine Spray and Control Groups

	Lidocaine Group	Control Group	T-test Value	P Value
MAP.T0	109.3 ± 29.8	97.4 ± 9.8	2.075	0.138
MAP.T1	89.7 ± 12.1	88.6 ± 7.9	0.441	0.661
MAP.T2	79.4 ± 12.4	83.1 ± 8.6	-1.311	0.195
MAP.T3	77.0 ± 12.3	80.1 ± 8.0	-1.172	0.246
MAP.T4	74.5 ± 8.1	79.1 ± 6.1	-2.469	0.016
MAP.T5	76.1 ± 10.2	78.1 ± 6.6	-0.901	0.371
MAP.T6	76.3 ± 8.8	78.6 ± 7.2	-1.139	0.261
MAP.T7	77.2 ± 10.7	77.8 ± 7.3	-0.23	0.812
MAP.T8	77.6 ± 9.1	77.5 ± 7.2	0.063	0.950

of choice in many emergency conditions.[8] Previous studies have failed to find drugs that could improve hemodynamic stability during rapid intubation.[9] This study aimed to investigate the effect of oropharyngeal LS before tracheal intubation on HR, BP, and arrhythmia in patients undergoing heart surgery. Laryngoscopy and intubation are stressful as they lead to an increase in HR and BP.[10] The hemodynamic response to laryngoscopy and intubation, which is characterized by tachycardia and increased BP, is well known. It is believed that the stimulation of mechanoreceptors in the tracheal wall, epiglottis, and vocal cords is the cause of this hemodynamic response.

Elevated HR is recognized as an independent predictor of adverse events after surgery. Previous studies have shown that for every 20 beats per minute increase in HR, the chance of intraoperative mortality increases by 3050%.[11] A higher HR during surgery is considered a risk factor for postoperative myocardial infarction.[12] Preventing an increase in HR using beta-blockers is of particular importance in non-cardiac surgeries, especially in vascular surgeries.[13, 14]

Reich et al demonstrated that an HR > 100 beats per minute in the early postoperative period is an independent risk factor for postoperative myocardial infarction, but it has no impact on stroke or postoperative mortality.[15]

Furthermore, Fillinger et al reported that an HR of over 80 beats per minute before the induction of anesthesia is associated with increased mortality. All these studies used human resources recorded during a very close period to CABG surgery in operating room.[16] Shribman et al concluded that laryngoscopy alone or following intubation increases arterial pressure and catecholamine levels, and intratracheal tube insertion is significantly associated with an increase in HR.[17] These changes reach their maximum rate 60 seconds after intratracheal tube insertion and take 5–10 minutes to resolve. If no specific measures are taken to prevent this hemodynamic response, the patient's HR can increase by 26%–66%, and systolic BP can increase by 36%–45%. These effects are more harmful in patients with high BP.[17,18]

The findings of the present study revealed that there was no significant difference in the frequency of atrial fibrillation between patients receiving LS and the control group during heart surgery recovery ($P > 0.05$).

The force applied by the laryngoscope at the base of the tongue during the lifting of the epiglottis is responsible for the hemodynamic response to laryngoscopy and intubation.[19]

In our study, LS had a greater effect on HR than arterial pressure. It seems that after laryngoscopy and endotracheal tube insertion, a stable period without sudden increases or decreases in arterial pressure was achieved using local lidocaine. However, this decrease in HR and BP at certain time intervals can also be attributed to the combined effects of fentanyl and inhalation agents administered during anesthesia maintenance.

In line with our findings, Lee et al demonstrated that the MAP at 5 and 2.5 minutes and HR at 5 minutes were significantly higher in the control group than in the 10% LS group. They used LS on the laryngeal and intratracheal tissues of patients 2 minutes before intubation.[20]

As observed in the study by Shribman et al, the primary cause of the sympathetic adrenal response after laryngoscopy and endotracheal tube insertion is the supraglottic pressure with the laryngoscope blade and the stimulation of the mucosa with the endotracheal tube. Topical lidocaine administration may reduce this stimulation and consequently prevent sympathetic adrenergic secretion.[17,21]

Mostafa et al found that LS before anesthesia induction is an effective method for controlling the pressor response in patients undergoing laryngoscopy or intubation.[7] Although this study with a limited sample size could not give exact recommendations about the administration of LS for all patients, the results of this study could help physicians in some patients when routine interventions fail to maintain hemodynamic stability, especially in those patients who had hemodynamic instability in previous tracheal intubations and needed re-intubation. Golzari et al reported that lidocaine is used safely in many patients with different diseases through various roots.[22]

Limitations of the Study

The main limitation of our study was the relatively small

number of patients. Conducting the study on a larger population can increase the statistical power of our study. However, we did not match the left ventricular ejection fraction in the two groups, which could affect hemodynamic changes. In addition, some patients used beta-blockers before the operation. Although randomization could match the two groups to some degree, drugs used before surgery could affect our results.

Conclusion

Our findings confirmed that patients who received LS before intubation had better hemodynamic stability and a lower chance of tachycardia.

Author contributions

Conceptualization: Alireza Mahoori.
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Writing–review & editing: Reza Hajizadeh.

Consent for publication

Written informed consent was obtained from all patients. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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