A comparison of the effects of lidocaine or magnesium sulfate on hemodynamic response and QT dispersion related with intubation in patients with hypertension


Abstract: Background: The aim of this study was to investigate the effect of magnesium administered before induction on the hemodynamic response and QT dispersion (QTd) related with intubation in hypertensive patients and to compare it with lidocaine.

Methods: Patients with essential hypertension who were under ≤ 65 years old, scheduled for elective surgery with a Mallampati score of I-II were included in the study. Patients were randomly divided into three groups; group M (n=20) received magnesium sulfate, group L was prescribed lidocaine, and group C (control group) received saline. Standard 12-lead ECG readings were taken before the induction of anesthesia and at the first and fifth minutes following intubation.

Results: There were no statistically significant differences between the groups in terms of age, sex and demographic characteristics. There was no significant difference in the QT interval values before induction and 5 minutes after intubation in all groups. In group M, QTd values were significantly lower at the first and fifth minutes than before induction. There were no statistically significant differences in QTd values at different times in group L and group C.

Conclusion: QTd is not increased during tracheal intubation in hypertensive patients so there is no need for magnesium sulfate for these patients. But as QTd has been shown to increase during tracheal intubation for coronary artery disease patients, magnesium sulfate might be useful for those patients although future studies are required to confirm this statement.

Key words: Lidocaine; magnesium; hypertension; QT dispersion; intubation.

INTRODUCTION

General anesthesia is a critical component of care for patients undergoing surgery, particularly in hypertensive individuals. Laryngoscopy and tracheal intubation (TI) applied during the induction of general anesthesia can lead to an increase in sympathetic activation and catecholamine release. This effect is more likely in patients with hypertension (1-3). As a result, changes may occur in cardiac electrical activity (tachycardia, arrhythmia) and hemodynamic response (increase in blood pressure) (1, 3). Supraventricular and ventricular arrhythmias and also an increase in blood pressure are important factors that affect morbidity and mortality in patients with hypertension (4, 5). Arrhythmogenic adverse effects of volatile anesthetic agents also contribute to changes in cardiac electrical activity (6, 7).

Electrocardiography (ECG) is a reliable indicator commonly used to detect pathological electrical activity. The QT interval shows ventricular repolarization, and any increase in the duration of the QT interval is a risk factor for arrhythmia (8). QT dispersion (QTd) is the difference between the maximum QT and minimum QT in 12-lead ECG and reflects the different parts of the ventricular repolarization. The QTd duration of hypertensive patients is longer than that for normotensive patients and shows a good correlation between ventricular arrhythmia and blood pressure (9-11).

Lidocaine, beta-adrenergic blockers and opioids have been reported to reduce sympathetic activity and QT prolongation induced by laryngoscopy and tracheal intubation (12-14). Magnesium

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(Mg) can improve the hemodynamic response and reduce the catecholamine release and cardiovascular response to the intubation procedure (15-17). However, there is no adequate information about the effect of magnesium after TI on QTd in the literature.

The aim of this study was to investigate whether there is a QTd increase in hypertensive patients and to explore the effect of magnesium compared with lidocaine administered before induction on the hemodynamic response and QTd with intubation in these patients.

**METHODS**

After receiving approval from the Institutional Ethics Committee, we obtained written informed consent from all participants. Patients with essential hypertension who were under ≤65 years old, scheduled for elective surgery and had a Mallampati score of I-II were included in the study. Essential hypertension was defined as a systolic blood pressure >140 mmHg and/or a diastolic blood pressure >90 mmHg that requires regular antihypertensive (beta blocker, calcium channel blocker and angiotensin converting enzyme inhibitor) drug therapy and all of the included patients were on antihypertensive medication. Patients with secondary hypertension were not included in the study. Participants were excluded if they declined to enter or continue the study or did not provide written informed consent. We also excluded patients who had major renal and hepatic diseases, asthma, chronic obstructive pulmonary disease, cardiovascular disease, a known allergy to magnesium sulfate or other drugs, cardiac arrhythmia, electrolyte imbalance, or a prolonged QT interval. Patients in whom intubation took more than 30 seconds were also excluded from the study, as were patients undergoing cardiovascular surgery and caesarean section.

Patients were randomly divided into three groups: group M (n = 20) received magnesium sulfate, group L was prescribed lidocaine, and group C (control group) received the same volume of saline. Syringes were prepared according to the randomization list by a researcher who was not involved in the study. For group M, 10 mg/kg magnesium sulfate was prepared, while group L received 1 mg/kg lidocaine; saline was used to administer these preparations, and the total volume was adjusted to 15 ml. The dose of magnesium was chosen according to previous studies (18). Control group patients (group C) received 15 ml of saline. After patients were taken to the operating room, syringes were delivered to a blinded researcher.

Patients received no premedication. An intravenous 20-gauge cannula was inserted into the dorsum of one hand for all patients. On arrival in the operating room, staff connected the patients to routine monitors, including a pulse oximeter for peripheral oxygen saturation (SpO₂), automated cuffed blood pressure for non-invasive blood pressure (NIBP) and electrocardiogram (EKG). The syringes, which had been prepared according to randomization and delivered to the researcher, were given intravenously over a period of 30 seconds, one minute before the induction.

Anesthesia was induced with propofol 2 mg kg⁻¹ in all patients; 0.5 mg kg⁻¹ rocuronium was given, and 100% O₂ was applied by mask ventilation. The patient’s trachea was intubated by an experienced anesthesiologist after providing adequate relaxation. Anesthesia was maintained with sevoflurane % 1.5-2.5 in a 50% N₂O-O₂ mixture. Respiratory rates were adjusted to maintain end-tidal CO₂ between 30 and 40 mmHg. It was planned to give 1 mcg/kg fentanyl when the mean arterial pressure (MAP) increased over 20% of the baseline 5 minutes after intubation. Hemodynamic parameters, including MAP and heart rate (HR), were recorded before and after induction and at certain intervals after intubation. Standard 12-lead ECG (Nihon Kohden, Model EKG-1350K, Japan) readings were taken before the induction of anesthesia and at the first and fifth minutes following intubation. ECG recordings were performed at a speed of 25 mm/sec. The longest QT interval in the ECG records of all derivation was measured by two researchers blinded to the patient’s group. QTd was recorded as the difference between the maximum and the minimum QT values (QTd = maximum QT – minimum QT).

**STATISTICAL ANALYSIS**

Before the beginning of the study, PASS 12 Power Analysis & Sample Size Software was used for calculation of sample size. It was calculated that the minimum total sample size should be used as 52 in the evaluation that Cohen’s d value was calculated as 0.8, statistical power level as 80%, and p value as <0.05. The power of the present study was assessed with the PASS 12 Power Analysis software. Cohen’s d value was calculated as 0.8, and p value was used as <0.05. With a total sample size of 60, the study was shown to have a power of 86.02%.
EFFECTS OF LIDOCAINE AND MAGNESIUM SULFATE

Table 1

<table>
<thead>
<tr>
<th>Demographic Characteristics of patients</th>
<th>Group M (Magnesium)</th>
<th>Group L (Lidocaine)</th>
<th>Group C (Control)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients (n)</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>58.1 ± 5.99</td>
<td>55.9 ± 9.94</td>
<td>56.8 ± 7.95</td>
<td>0.692</td>
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<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>7 (% 35)</td>
<td>9 (% 45)</td>
<td>10 (% 50)</td>
<td>0.634</td>
</tr>
<tr>
<td>Female</td>
<td>13 (% 65)</td>
<td>11 (% 55)</td>
<td>10 (% 50)</td>
<td></td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>30.71 ± 5.59</td>
<td>28.51 ± 5.17</td>
<td>29.91 ± 4.23</td>
<td>0.382</td>
</tr>
<tr>
<td>ASA I/II/III/IV</td>
<td>0/20/0/0</td>
<td>0/20/0/0</td>
<td>0/20/0/0</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Values are expressed as mean (SD) or n (%).

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) for Windows, version 11.5. Continuous variables were tested for a normal distribution with the Kolmogorov-Smirnov test and were expressed as mean ± standard deviation (SD) or median (minimum ± maximum). Nominal variables were expressed as the number of cases.

One-way analysis of variance (ANOVA) was used to look for significant differences between group means. Differences among the three-group medians were estimated by the Kruskal Wallis test. Paired t test was used to check the significance of difference in QTd values before and after the induction within the same group; p < 0.05 was considered statistically significant. Bonferroni correction was made to control type I error in all sub-analyses.

RESULTS

Sixty patients were included in the study. The patients were randomly assigned to one of three groups. There were no statistically significant differences between the groups in terms of age, sex and demographic characteristics (p > 0.05 for all) (Table 1).

There were no statistically significant differences between the groups regarding heart rate (p > 0.05 for all) (Fig. 1). MAP values at 15 minutes after intubation were lower in group M and L compared with group C (p < 0.05). No significant difference in MAP was observed at any other times (p > 0.05) (Fig. 2).

When compared within groups, there was no significant difference in the QT interval values before induction and 5 minutes after intubation in all groups (p > 0.05 for all). QTd values were significantly lower (36.6 ± 13.44) at fifth minute than before induction (51.6 ± 18.25) in group M (p < 0.05).

There were no statistically significant differences in QTd values at different times in group L and group C (p > 0.05). All patients were followed in the post-operative care unit for one hour and no adverse effect was seen.

DISCUSSION

This study showed that magnesium applied before induction significantly reduced the QTd during intubation in patients with hypertension. The effect of magnesium on the duration of QTd after TI has not been reported in the literature thus far. Both the catecholamine release and the stress response that occur during the laryngoscopy and tracheal intubation can cause serious complications in patients
with cardiovascular and cerebral disease, leading to an increase in mortality and morbidity (2, 4).

Hypertensive patients are closely affected by QT interval changes. The QT interval is prolonged in these patients (19). It was reported that QTdl was a simple and non-invasive screening test measured manually and could be used as an indicator for preventing sudden cardiac death in hypertensive patients (20, 21). Additionally, QTdl was prolonged after TI, and this prolongation may be much more significant in patients with coronary and hypertensive patients (22). Therefore QTdl evaluation in this specific group of patients is of particular importance. However, the information to reduce QTdl in the literature is very limited. When the QTdl was over 40 ms, it had 88% sensitivity and 57% specificity for predicting persistent ventricular tachycardia (23). Although there are several studies claiming that QTdl reflects the different parts of the ventricular repolarization and is well correlated to ventricular arrhythmias (20, 21, 23), some studies were questioned in the literature (24, 25). COUMEL et al. claimed that QT dispersion was difficult to measure in the manual measurement and suggested automated systems. Since we don’t have automated systems, we didn’t use it in the current study and this is one of the limitations of the study.

Previous reports show that lidocaine, magnesium, calcium channel blockers, beta blockers, and opioids can be used to reduce the stress response that occurs after TI (12-15, 26). Lidocaine is an amide-type local anesthetic. It can be used intravenously and also can be given via the tracheal route to prevent a stress response (27, 28). It was reported that high intravenous doses (1.5 mg/kg) of lidocaine could be more effective at reducing tachycardia and hypertension induced by tracheal intubation (29). UGUR et al. used 1 mg/kg lidocaine before induction with sevoflurane. They reported that the adjusted QTdl interval was not affected after the TI (27). In our study, group L had no significant differences in HR and MAP values either before or after TI (Table 1). We believe that lidocaine was effective in preventing stress response to TI. The purpose of giving lidocaine was to prevent increase in HR and MAP. In our study, QTdl intervals were prolonged in the control group but not in the lidocaine group. Our results showed that lidocaine was effective at preventing the prolongation of the QTdl interval (Fig. 3). There was an increase between the baseline and first and fifth minutes QTdl intervals, but it was not significant (p=0.057). Antihypertensive treatment could have caused this difference in the current studies control group (Fig. 3).
may reduce the risk of sudden death. Our results have indicated that Mg administration before TI may have a role in the prevention of QTd prolongation in hypertensive individuals who underwent surgery.

This study has several limitations. There were few patients enrolled in this study. The second limitation is about the administration time of magnesium which could have been given earlier, before the induction. The effectiveness of different doses of magnesium on QTd was not investigated in this study, either. Murray et al. (34) showed that manual measurements could be erroneous compared to automated measurements. However, we didn’t have a special device for automated measurement. So we performed manual measurement. Further studies are required to evaluate the effect of magnesium in uncontrolled hypertensive patients having coronary artery disease.

In summary, QTd is not increased during tracheal intubation in hypertensive patients so there is no need for magnesium sulfate for these patients. But as QTd has been shown to increase during tracheal intubation for coronary artery disease patients, magnesium sulfate might be useful for those patients although future studies are required to confirm this statement.

References


