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Original Article

Comparison of Mallampati scores and hemodynamic responses between elderly and younger patients: Prospective cohort study

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S U M M A R Y

Background: This study aimed to evaluate the effect of aging on the Mallampati score, intubation time, and hemodynamic response for endotracheal intubation during induction of anesthesia.
Methods: One hundred and twenty patients were enrolled and allocated according to age to either group N (35–49 years, n = 60) or group E (65–74 years, n = 60). Patients were administered 3 MAC (minimum alveolar concentration) of sevoflurane for 5 min to induce anesthesia. Systolic blood pressure (SBP), mean arterial pressure (MAP), diastolic blood pressure (DBP), pulse pressure (PP), and heart rate (HR) were recorded before (baseline), immediately after (T_0), and at 1-min intervals during the first 4 min after endotracheal intubation (T_1–T_4). The Mallampati score and intubation time were also recorded.
Results: There were significant differences between groups with regard to overall changes in SBP, MAP, DBP, and HR. The change in SBP and MAP was higher in group E than in group N at T_0 and T_1. HR was significantly lower in group E than in group N at T_0, T_1, and T_2. The Mallampati score and intubation time were significantly higher in group E than in group N. After controlling for the Mallampati score, there were no significant differences between the groups; however, HR was significantly lower in group E than in group N.
Conclusion: After intubation, the changes in SBP, MAP and DBP, Mallampati score, and intubation time were higher, and changes in HR were lower in elderly patients. The changes in SBP, MAP and DBP in elderly patients are associated with the changes in Mallampati score.

1. Introduction

As life expectancy increases with the development of new medical technology, the proportion of the total elderly population has increased and accounted for 13.8% of the population in South Korea in 2015.[1] Accordingly, the proportion of elderly patients requiring medical and/or surgical care has increased; currently, the number of elderly patients aged 65 years and over account for more than 30% of the total number of patients undergoing surgeries in our hospital.

Endotracheal intubation performed under laryngoscopy, as required for general anesthesia, can increase the reactivity of the upper airway because of manipulation of the laryngoscope and intubation, potentially resulting in laryngospasm. It may also increase sympathetic tone and lead to temporary hypertension, tachycardia, and arrhythmia.[2]

In order to prevent these excessive cardiovascular responses to endotracheal intubation, the spraying of a local anesthetic over laryngeal structures or intravenous administration of medications such as lidocaine, opioids, beta-blockers, vasodilators, calcium channel blockers, or an overpressure technique that uses 2–3 MAC of the anesthetic agent have been used.[3–5] However, these techniques cannot completely prevent cardiovascular and/or laryngeal responses. These cardiovascular reactions can lead to serious complications such as heart failure, myocardial infarction, or subarachnoid hemorrhage.[6,7]

Particularly in elderly patients, as their age increases, arterial stiffness, systemic vascular resistance, and the release of

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catecholamines to external stimuli increase and arterial compliance and the activity of baroreceptors decrease, causing severe hemodynamic responses to endotracheal intubation in elderly patients.[8–10] Mallampati score, most commonly used clinical test to predict for difficult endotracheal intubation, was also reported to increase with age.[11] Further, tooth decay and a decreased range of motion in the neck make intubation more difficult,[7] which can cause elderly patients to be more vulnerable to the possible risks of endotracheal intubation.

Therefore, the authors compared the differences in the hemodynamic responses, Mallampati score, and intubation time between young adults and elderly patients during intubation by controlling the amount of sevoflurane administered while inducing anesthesia. The authors also evaluated the relations between the Mallampati score, intubation time, and hemodynamic responses.

2. Materials and methods

2.1. Study design and patients

The present study used a prospective cohort design, and was conducted and written according to the STROBE statement.[12]

The study protocol was approved by the Institutional Review Board of Samsung Changwon Hospital **(2015-SCMC-032-00)**. This study was carried out according to the principles of the Declaration of Helsinki, 2013 and written informed consent was obtained from all participants before their inclusion in this study.

The inclusion criteria were patients scheduled for surgery under general anesthesia, with ASA physical status I or II, and those who agreed to participate in this study. Exclusion criteria included the following: a history of hypertension, diabetes, cardiovascular disorder-related drug use, neurologic disease, and patients who were expected to have a difficult intubation.

One hundred and twenty patients were assigned into two groups of 60 each, with one group of young adults aged from 35 to 49 years (group N), and the other group of elderly patients aged 65–74 years (group E). These patients were enrolled consecutively from January 1, 2015, until the required number of patients was reached.

2.2. Anesthesia

The patients received 0.05 mg/kg of midazolam 30 min prior to entering the operating room (OR). After placement of the standard monitoring systems (electrocardiography, noninvasive arterial blood pressure, and pulse oximetry), anesthesia was induced using 2 mg/kg of intravenous propofol and 0.15 mg/kg of vecuronium.

Ventilation was controlled via a facemask with 100% oxygen at 6 L/min and 3 MAC (minimum alveolar concentration) of sevoflurane for 5 min. Patients in group E were given a lower amount of sevoflurane because after 40 years of age, the MAC of volatile anesthetics decreases by 4% every 10 years. The formula used to calculate the necessary amount of sevoflurane was $\left(3\,MAC \times \left(2 - \frac{2\times0.04\times(age-40)}{10}\right)\right)$.[13] Thereafter, endotracheal intubation was performed using a Macintosh blade. All intubations were performed by a single anesthesiologist with more than 10 years of experience. After intubation ventilation was controlled at a tidal volume of 8 mL/kg and at a respiratory rate of 12 breaths/min. Maintenance fluids were given according to "4-2-1" formula.[14]

2.3. Study variables

For each patient, we recorded their age, sex, weight, body mass index (BMI), ASA physical status, Mallampati score, and intubation time. The Mallampati score was measured just prior to intubation.[15–17] Intubation time, predefined as the time from the laryngoscope blade coming into contact with the body to the inflation of the endotracheal tube cuff, was measured by a nurse who did not otherwise participate in this study.

The hemodynamic variables (systolic blood pressure (SBP), mean arterial pressure (MAP), diastolic blood pressure (DBP), pulse pressure (PP) and heart rate (HR)) were measured at the preanesthetic care unit (PACU), after arrival at the OR (Pre), immediately after intubation (T_0), and 1 min after (T_1), 2 min after (T_2), 3 min after (T_3), and 4 min after (T_4) intubation. The change in hemodynamic variables was calculated by comparisons with the hemodynamic variables (pre). Patients showing more than 20% increase in SBP at the PACU compared with SBP in the ward despite premedication, and patients with an SBP more than 180 mmHg during measurement were given anti-hypertensive medication and excluded from the study.

2.4. Statistical analysis

The primary outcome measure of this study was the change in SBP. In order to estimate the required sample size, a pilot study (n = 10; group N) was conducted. The average change in T_0, T_1, T_2, T_3, and T_4 were 18.9, 13.3, 9.2, 6.8 and 2.8, respectively. The standard deviation of the change in SBP ranged from 2.4 to 6.4, and the autocorrelation between adjacent measurements in the same individual was 0.7. For our power calculation, we assumed that the first-order autocorrelation adequately represented the autocorrelation pattern. We aimed to detect a 20% increase in group E compared with group N. With $\alpha = 0.05$ and a power of 80%, we needed 54 patients per group. Considering a loss-to-follow-up rate of 10%, we required 120 patients for the study.

For continuous variables, the normality of the data distribution was first evaluated using the Shapiro-Wilk test. Normally distributed data are presented as the mean ± standard deviation and were analyzed using parametric methods, and non-normally distributed data are presented as median (Q_1–Q_3), which were analyzed using non-parametric methods. Changes in SBP, MAP and HR showed a normal distribution, while changes in DBP and PP did not. Therefore, we also used a q-q plot, which did not indicate any significant deviation from linearity, allowing normal assumptions for the repeated measures analysis of variance (ANOVA). Mauchly's sphericity test indicated that the assumption of sphericity had been violated for SBP(χ^2 (9) = 462.15, P < 0 0.001, W = 0.013), MAP (χ^2 (9) = 584.65, P < .001, W = 0.004), DBP(χ^2 (9) = 637.02, P < .001, W = 0.003), PP(χ^2 (9) = 342.90, P < .001, W = 0.040) and HR (χ^2 (9) = 413.93, P < .001, W = 0.020). Therefore, we used a Wilk's lambda multivariate analysis of variance (MANOVA), followed by Student's *t*-tests with Bonferroni corrections.

To assess the association of the changes in hemodynamic variables with age, gender and Mallampati score, multi-variable linear regression analysis was performed.

Analysis of covariance (ANCOVA) models were utilized to examine group differences in the change in hemodynamic variables, while controlling for the Mallampati score.

Descriptive variables were analyzed using χ^2 analyses or Fisher's exact tests. Data in the figure are expressed as mean ± standard error. P < .05 was considered statistically significant. All statistical analyses were performed using SPSS 23(IBM Corp, Armonk, NY).

3. Results

Out of the 120 participants, 60 were assigned to group N and 60 to group E. Of those, three from group N and seven from Group E received anti-hypertensive medication because their SBP was over