原 著

Hemodynamic and catecholamine responses during rapid sequence induction with propofol in hypertensive patients.

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Abstract

Purpose : This prospective controlled study evaluated hemodynamic and catecholamine responses during rapid sequence induction (RSI) with propofol in hypertensive patients.

Methods : Twenty patients for elective surgery were divided into two groups. Group N (n=10) consisted of normotensive patients. Group H (n=10) consisted of hypertensive patients controlled with Ca^{2+} antagonists. RSI was performed using propofol and suxamethonium after precurarization with vecuronium. Measurements included systolic blood pressure (SBP), heart rate (HR) and plasma concentrations of epinephrine (E) and norepinephrine (NE). They were measured before precurarization as baseline (TB), immediately before intubation, i.e., pre-intubation (PREI), immediately after intubation (T0), and 1 min (T1), 2 min (T2) and 3 min (T3) after intubation.

Results : In group N, SBP significantly decreased at PREI and increased at T0 compared with TB, while heart rate (HR) significantly increased at T0. In group H, SBP at TB was significantly higher than that in group N (166±7 vs 141±3 mmHg). SBP in group H significantly decreased at PREI, but returned to the baseline level at T0 showing no significant difference from TB thereafter. HR in group H showed no significant change throughout the time course. Plasma concentrations of epinephrine (E) and norepinephrine (NE) showed no change in either group, whereas the plasma concentration of NE in group H was significantly higher than that in group N at TB, T1 and T3.

Conclusion : We conclude that hypertensive patients show smaller increases in blood pressure and heart rate after endotracheal intubation than normotensive patients during rapid sequence induction with propofol.

Key words; Propofol, Rapid sequence induction, Hypertension

Introduction

Although rapid sequence induction RSI is a useful technique to prevent aspiration in patients with full stomach, it may cause greater hemodynamic changes resulting in cardiovascular problems[1,2]. RSI with thiopentone or thiamylal combined with a low-dose fentanyl is useful in inhibiting the hemodynamic and catecholamine responses in both normotensive and hypertensive patients[3].

In the previous study, we reported that propofol would be more useful for RSI compared with thiamylal regarding hemodynamic and catecholamine responses in normotensive patients[4]. Propofol may attenuate hemodynamic and catecholamine responses to tracheal intubation compared with thiopentone. However, these responses during RSI with propofol have not been fully investigated in hypertensive patients. This study was designed to evaluate hemodynamic and catecholamine responses during RSI with propofol and

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succinylcholine in hypertensive patients as compared to normotensive patients.

Materials and Methods

The protocol of this study was approved by Nagasaki Rosai Hospital Ethical Committee, and written informed consent was obtained from each patient. The subjects of this investigation were 20 ASA physical status 1 or 2 patients scheduled for elective surgery (orthopedics: 18, otolaryngology: 2). We excluded the patients who had ischemic heart disease or cerebral vascular disease preoperatively. They were allocated into one of two groups. Group N (n=10) consisted of normotensive patients. Group H (n=10) consisted of hypertensive patients whose SBP were controlled under 160 mmHg with Ca^{2+} antagonists, e.g., nifedipine 20 - 40 mg/day, manidipine 10 - 20 mg/day, amlodipine 2.5 - 5.0 mg/day or nilvadipine 8 mg/day, preoperatively. Premedication consisted of hydroxyzine 1 $mg \cdot kg^{-1}$, and atropine 0.01 $mg \cdot kg^{-1}$, given intramusculary 30 min before anesthesia. In the operating room, an intravenous catheter was inserted into forearm vein for drug administration, and a radial arterial catheter was inserted for arterial blood pressure monitoring and blood sampling. Lead II of electrocardiogram, Spo2 by pulseoxymetry pulseoxymetry and endtidal CO_2 ($ETCO_2$, Capnomac, Datex, Helsink, Finland) were monitored. After preoxygenation for 3 min, vecuronium 0.015 $mg \cdot kg^{-1}$, was given for precurarization, and 5 min later anesthesia was induced without Sellick's maneuver. Propofol 2 $mg \cdot kg^{-1}$, was administered immediately after injection of lidocaine, 20 mg i.v., with proximal occlusion of the vein to minimize the injection pain caused by propofol. Suxamethonium, 1.5 $mg \cdot kg^{-1}$, was administered consecutively. One minute after induction of anesthesia tracheal intubation was performed within twenty seconds under direct laryngoscopy by the same experienced anesthesiologist. Vecuronium 0.1 $mg \cdot kg^{-1}$, was administered immediately after intubation. Ventilation was controlled to maintain $ETCO_2$ at 35 mmHg while inhaling 100% oxygen until the end of the study.

Measurements included hemodynamic and catecholamine responses and arterial blood gas analysis (ABG). SBP, HR and ST change in lead II of electrocardiogram were automatically analyzed continuously (Bioview, Nippon Koden, Tokyo, Japan). The data were presented consecutively, i.e., before precurarization as baseline (TB), immediately before intubation, i.e., pre-intubation (PREI), immediately after intubation (T0), and 1 min (T1), 2 min (T2) and 3 min (T3) after intubation. Arterial blood samples were drawn at TB, T1 and T3. Plasma concentrations of epinephrine (E) and norepinephrine (NE) were measured with fully automated high-performance liquid chromatography-fluorometric system (model HLC-8030 Catecholamine Analyzer, Tosoh, Tokyo, Japan) and ABG was analyzed with ABL-4® (Radiometer Corp., Copenhagen, Denmark).

The data were expressed as mean±SEM. Student t-test for unpaired data was used for statistical analysis of the differences between two groups. Differences among repeated measures were analyzed by analysis of variance and Scheffe F test. A p value<0.05 was considered significant.

Results

Although the mean age of patients in group H was significantly higher than that of group N, the two groups were almost similar in other demographic data (table). We had no patients with intubation difficulties, and the duration of laryngoscopy was similar between the groups. ABG showed no deterioration in either group throughout the time course in which Pa_{O_2} values were more than 300 mmHg and Pa_{CO_2} values were less than 45 mmHg, and there was no marked acidemia or

Table. Patient Group Characteristics

	Group N	Group H
Number	10	10
Male / Female	8 / 2	4 / 6
Age (years)	42± 5	64± 2*
Weight (kg)	58± 2	58± 3

Note: Data are mean±SEM.
Group N = normotensive patients; Group H = hypertensive patients who are controlled under 160mmHg with Ca^{2+} antagonists.
*P<0.01 vs Group N.

alkalemia. There was no ischemic ST change throughout the time course in either group. During the study period, we did not have any patient who required any treatment due to severe hypertension, tachycardia, hypotension or bradycardia. There was no patient who revealed ischemic heart disease or cerebral vascular disease postoperatively.

The changes of SBP and HR are shown in figures 1 and 2, and plasma concentrations of E and NE are shown in figures 3 and 4, respectively. In group N, SBP significantly decreased at PREI and increased at T0 compared with TB, while HR significantly increased at T0. In group H, SBP at TB was significantly higher than that in group N. SBP in group H significantly decreased at PREI, but returned to the baseline level at T0 showing no significant difference from TB thereafter. HR in group H showed no significant change throughout the time course. Plasma concentrations of E and NE showed no change in either group, whereas the plasma concentration of NE in group H was significantly higher than that in group N at TB, T1 and T3.

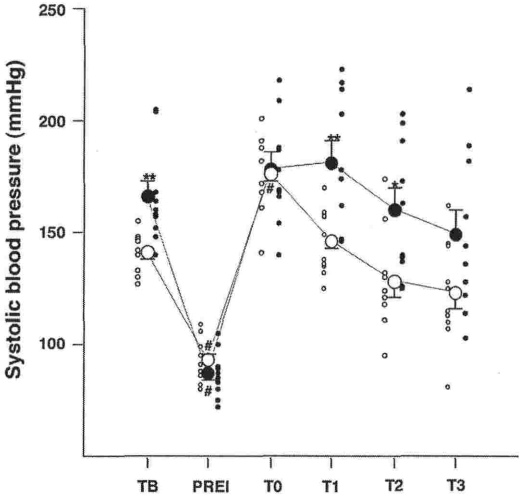

Fig 1. Time course of change of systolic blood pressure in group N and group H (mean±SEM and individual data of each group).

Closed circle: group H, Open circle: group N.

*p<0.05 vs group N, ** p<0.01 vs group N, #p<0.01 vs T0.

TB= before induction of anesthesia, as baseline, PREI= immediately before intubation, as pre-intubation, T0= immediately after intubation, T1= 1 min after intubation, T2= 2 min after intubation, T3= 3 min after intubation respectively.

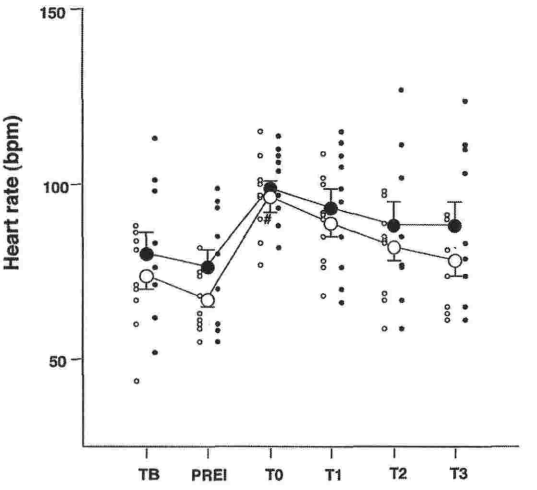

Fig 2. Time course of change of heart rate in group N and group H (mean±SEM and individual data of each group).

Closed circle: group H, Open circle: group N.

#p<0.01 vs T0.

TB= before induction of anesthesia, as baseline, PREI= immediately before intubation, as pre-intubation, T0= immediately after intubation, T1= 1 min after intubation, T2= 2 min after intubation, T3= 3 min after intubation respectively.

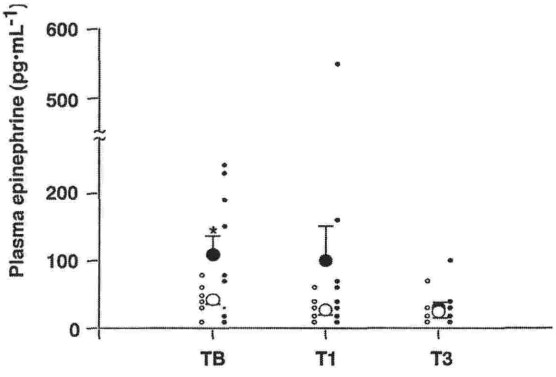

Fig 3. Time course of change of plasma epinephrine concentration in group N and group H (mean± SEM and individual data of each group).

Closed circle: group H, Open circle: group N.

*p<0.05 vs group N.

TB= before induction of anesthesia, T1= 1 min after intubation, T3= 3 min after intubation respectively.

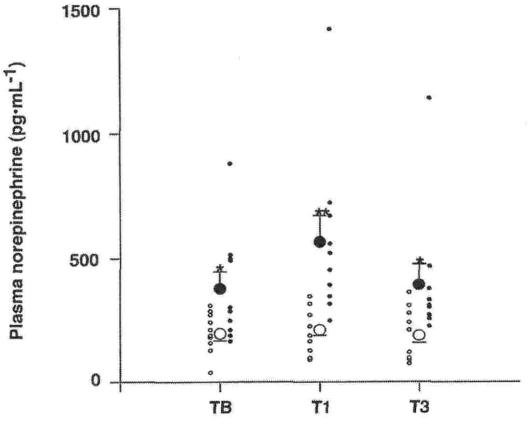

Fig 4. Time course of change of plasma norepinephrine concentration in group N and group H (mean ±SEM and individual data of each group).
Closed circle: group H, Open circle: group N.
*p<0.05 vs group N, **p<0.01 vs group N.
TB= before induction of anesthesia, T1= 1 min after intubation, T3= 3 min after intubation respectively.

Discussion

The results show that treated hypertensive patients have higher baseline values of SBP and plasma E and NE as compared to normotensive patients, and that RSI with propofol causes moderate increases in SBP and HR with no change in plasma catecholamines after endotracheal intubation in normotensive patients, whereas it does not cause a significant increase in SBP, HR or plasma catecholamines in treated hypertensive patients. The results indicate that hypertensive patients would show smaller increases in BP and HR after endotracheal intubation than normotensive patients during RSI with propofol, and thus propofol would be an appropriate anesthetic for this procedure in treated hypertensive patients as well as in normotensive patients.

Harris et al.[6] reported that in normotensive patients, propofol 2.5 mg·kg^{-1} alone did not show an increase in arterial blood pressure after intubation, while thiopentone 4 mg·kg^{-1} alone showed a significant increase. Beck et al. [7] reported that propofol 2 mg·kg^{-1} with alfentanyl 50 mcg·kg^{-1} provided a satisfactory hemodynamics for RSI compared with thiopentone. Hara et al. [4] demonstrated that propofol 2 mg·kg^{-1} alone would be more useful for RSI compared with thiamylal 5 mg·kg^{-1} alone regarding hemodynamic and catecholamine responses in normotensive patients. These studies have demonstrated that propofol is useful for RSI in normotensive patients. The present study show that during RSI with propofol in treated hypertensive patients, BP and HR showed smaller increases after intubation in spite of higher catecholamine concentrations compared with those in normotensive patients.

The essential hypertensive patients have increased activity of sympathetic nervous system[8,9], and might cause an excessive hemodynamic response to the induction of anesthesia compared to normotensive patients. Goldstein[10] estimated 78 studies of plasma catecholamines in patients with essential hypertension, and reported that about 40% of the studies showed statistically significant higher catecholamine levels. Manger et al.[8] reported that there might be mechanisms of impaired inactivation of NE due to faulty metabolism, uptake and decreased storage and binding capacity of intra-axonal granules for NE in hypertensive patients. Kjeldsen et al.[11] reported that plasma catecholamines were positively and significantly correlated with blood pressure in middle-aged men with untreated sustained essential hypertension. In the present study, plasma catecholamines in hypertensive patients were significantly higher than those in normotensive patients throughout the time course, while the plasma concentration of E or NE showed no significant increase after the intubation in either normotensive or hypertensive patients. Mikawa et al.[12] reported that Ca^{2+} antagonists did not attenuate the catecholamine response to intubation, whereas they reduced the pressor effect of circulating NE on resistance vessels, resulting in an attenuation of the increase in blood pressure. The present study suggests that propofol attenuates the catecholamine response to the intubation in Ca^{2+} antagonists-treated hypertensive patients, and that RSI with propofol could be applied safely to treated hypertensive patients in terms of hemodynamic and catecholamine responses.

Nishikawa et al.[13] reported that hemodynamic change after induction of anesthesia in hypertensive patients showed greater suppress compared with that

in normotensive patients, and that the hemodynamic change immediately after intubation in hypertensive patients was significantly greater than that in normotensive patients. Although we observed hypotension at pre-intubation (93±3 and 87±3 mmHg in groups N and H, respectively), they were not critical levels. There were no patients excluded from the study on account of severe hemodynamic suppress such as hypotension or bradycardia.

We adopted the induction dose of propofol according to the report of Naguib et al. [5]. They reported that the ED_{50} and ED_{95} values for abolition of response to eyelash stimulation at 1 min after propofol administration were 1.44 and 2.74 $mg \cdot kg^{-1}$, respectively. In the present study, patients were intubated 1 min after receiving propofol 2 $mg \cdot kg^{-1}$.

We administered lidocaine, 20 mg, before propofol injection to minimize pain during propofol injection. While lidocaine has been reported to limit airway reactivity as measured by cough reflex, the dose required for this effect is a minimum of 1.5 $mg \cdot kg^{-1}$ [14]. Thus lidocaine could not have a significant influence on the present results.

We used atropine 0.01 $mg \cdot kg^{-1}$, intramusculary 30 min before anesthesia as a part of the routine premedication. This dose of atropine did not cause hemodynamic changes such as tachycardia before anesthetic induction in either group H or group N. Thus atropine could not have influenced the results.

We did not use age-matched controls. Patients in group N were significantly younger than those in group H. Generally, older patients have a tendency to be hypertensive, and we did not have enough patients who were older but normotensive. Thus we compared older hypertensive patients with younger normotensive patients in the present study. Regarding a comparison with age-matched controls, further study may be needed.

In conclusion, patients with hypertension have a significantly higher basal plasma concentration of NE than normotensive patients. However, during RSI with propofol, patients with hypertension show smaller increases in BP and HR after endotracheal intubation than normotensive patients. Induction dose of propofol would be useful for RSI in hypertensive patients in terms of hemodynamic and catecholamine responses.

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