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Anesthesia Induction Using Esmolol is More Effective in Labile Hypertensive Patients

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=국문초록=

Esmolol을 이용한 마취유도는 불안정성 고혈압 환자에서 더욱 효과적이다

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장영호 · 나영두 · 이주영 · 이정구 · 김진모

배 경: 마취 유도시 발생될 수 있는 교감신경계의 항진을 예방하기 위하여 베타 차단제인 esmolol이 사용될 수 있다. 따라서 평상시 혈압은 정상이나 불안 혹은 자극에 의하여 혈압이 증가하는 불안정성 고혈압 환자의 마취유도시 esmolol을 사용하여 정상 혈압 환자와 비교함으로써 그 유용성을 확인코자 하였다.

방 법: 선택 수술을 받는 정상 혈압 환자 20명 (제 1군)과 불안정성 고혈압 환자 20명 (제 2군)을 대상으로 마취유도시 esmolol (1 mg/kg)을 정주한 다음 기관내삽관후 0.25, 1, 2, 3, 4, 5분에 심박동수, 혈압 및 맥압승치의 변화를 측정하여 비교하였다.

결 과: 심박동수는 기관내삽관 1분후부터 1군에 비하여 2군에서 감소를 나타내었 다. 수축기 혈압은 2분후부터 1군에 비하여 2군에서 감소를 나타내었고 이완기 혈압은 기관내삽관후 2분후에서 2군에서 감소를 나타내었으며 평균동맥압은 2분과 5분에서 의미있는 감소를 나타내었다. 맥압승치는 전 시간대에 걸쳐 2군에서 의미있는 감소를 나타내었다. 기관내삽관후 2군에서는 심박동수의 증가는 나타나지 않았으며 수축기압은 15초 후에서만 증가하였다.

결 론: Esmolol을 이용한 마취유도시 정상 혈압 환자에 비하여 불안정성 고혈압 환자에서 심박동수와 수축기 혈압이 더욱 감소되었으며 전 시간대에서 맥압승치의 감소 효과로 인하여 심장 부하의 감소에 훨씬 더 효과적임을 알 수 있었다. **(Korean J Anesthesiol 1997; 33: S9~S13)**

핵심 용어: 마취: 유도. 혈압: 고혈압.

Labile hypertension or white coat hypertension refers to the elevation in blood pressure (BP) manifested in some patients due to stress and anxiety caused by an office visit[1]. Although it has long been known that BP temporarily increases when a patient enters a doctor's office, little attention was given to this phenomenon until it was reported as "white coat hypertension" by Pickering et al[2].

For the induction of anesthesia, many drugs were introduced to alleviate the sympathetic stimulation due to intubation[3-6]. An ultra-short acting cardioselective beta-blocker, esmolol as a bolus has been reported to prevent the sympathetic adrenergic reactions following induction of anesthesia. This drug is useful not only in laryngoscopy and endotracheal intubation, but also in other stressful

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intraoperative phases and hypertension during recovery from anesthesia. However, the usefulness of esmolol in anesthetic induction for labile hypertensive patients has not been concluded until now.

In this study, the usefulness of esmolol given as a bolus for preventing the increases in BP and heart rate (HR) following the induction of anesthesia in patients with labile hypertension was investigated. Rate-pressure product (RPP) was calculated concurrently.

PATIENTS AND METHODS

We studied 40 patients, ASA physical status 1 and 2, after receiving informed consent. The group 1 (n=20) consisted of the patients with normal BP and the group 2 (n=20) was the patients with labile hypertension. All patients with diabetes mellitus, autonomic neuropathy, cerebrovascular disease, or ischemic heart disease were excluded. The demographic data of the two groups are presented in Table 1.

We defined labile hypertensive patients as having a normal home BP despite labile systolic BP (SBP) greater than 140 mmHg irrespective of diastolic BP (DBP). Labile BP measurements were checked on two seperate visits after the initial. Twenty labile hypertensive patients were investigated by using esmolol (1 mg/kg) to block the hemodynamic responses of tracheal intubation compared to the 20 normotensive patients. Preanesthetic medication consisted of 0.2 mg glycopyrrolate and 2~3 mg midazolam (according to body weight) IM 30 minutes before anesthetic induction in the both groups.

BP and HR were checked three times repeatedly upon arrival in the operating room (baseline, BL). For induction of anesthesia, thiopental sodium (5 mg/kg) was injected 30 seconds after intravenous injection of vecuronium bromide (0.1 mg/kg) and esmolol (1 mg/kg) in all patients. Endotracheal intubation was performed 90 seconds after the injection of thiopental sodium.

After the completion of intubation, 1.0 vol% enflurane in 50% nitrous oxide in oxygen at a 4 L/min flow for 5 minutes was administered. The BP and HR were measured at 0.25, 1, 2, 3, 4 and 5 minutes after intubation using

Table 1. Demographic Data

	Normotension	Labile hypertension
Patients (n)	20	20
Age (yr)	45.1±11.6	42.7±8.2
Sex (M/F)	11/9	9/11
Weight (kg)	64.4±10.7	61.6±3.2
HR (bpm)	80.3±20.4	89.7±17.0
SBP (mmHg)	121.2±9.5	152.8±10.4*
DBP (mmHg)	77.4±11.9	89.1±10.7*
RPP (mmHg · beats/min)	9,689±2,399	13,755±3,094*

HR=heart rate; SBP=systolic blood pressure; DBP= diastolic blood pressure; RPP=rate-pressure product. *; $p<0.05$ compared to normotension.

Accutorr®(Datascope, USA). The RPP was calculated with SBP and HR.

All data are expressed as mean±SD. Absolute hemodynamic values were used for intragroup comparison with BL and percent change values for intergroup comparison. Statistical comparisons were performed by using Student's t-tests. A p value <0.05 was considered statistically significant.

RESULTS

1) Heart rate change

The effects on HR of esmolol in response to induction of anesthesia and tracheal intubation are shown in figure 1. Tracheal intubation resulted in an increase of HR at 0.25 minute after intubation in normotensive patients (group 1) and significantly decreased at 5 minutes in labile hypertensive patients (group 2) from BL levels. Following the intubation, the HR in patients with normotensive patients did not decrease to the BL until 5 minutes elapsed, but in labile hypertensive patients was decreased from 1 minute to 5 minutes after intubation continually compared to BL level. The percent change of HR in group 2 had significantly decreasing effects from 1 minute to 5 minutes compared to group 1. The maximal decreasing level of HR in group 2 was 11.2±12.3% at 5 minutes.

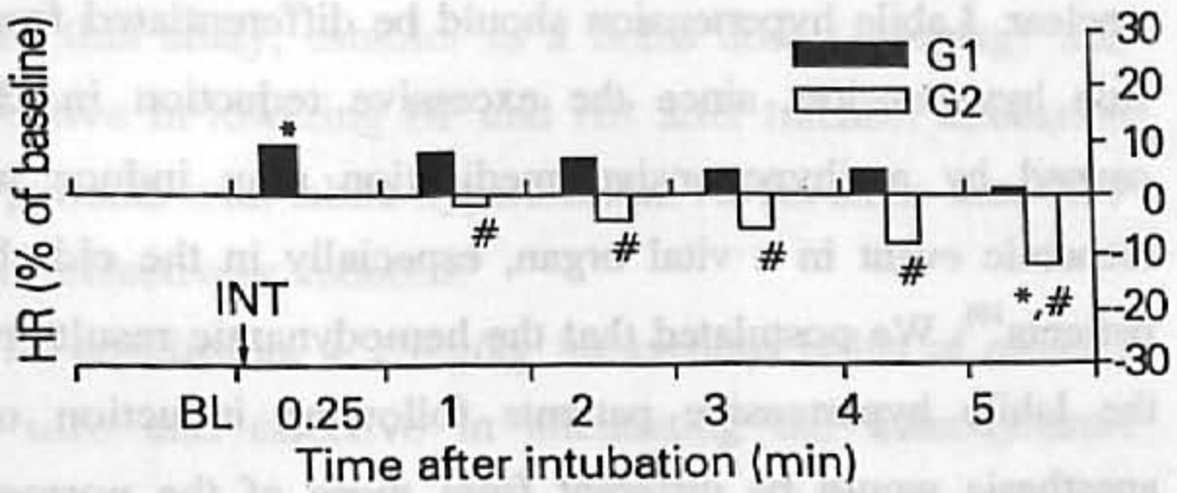

Fig. 1. The effects of esmolol on heatr rate (HR) in response to induction of anesthesia and tracheal intubation G1; normotensive patients, G2; labile hypertensive patients, BL; baseline, INT; intubation. *,$p<0.05$ comparered to BL: #, $p<0.05$ compared to G1.

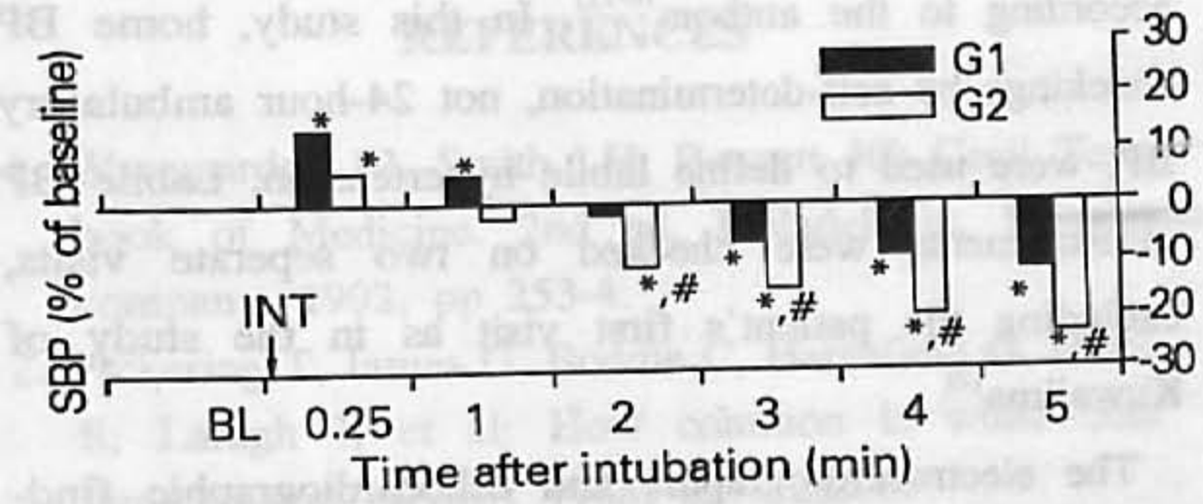

Fig. 2. The effects of esmolol on systolic blood pressure-(SBP) in response to induction of anesthesia and tracheal intubation. G1; normotensive patients, G2; labile hypertensive patients, BL: baseline, INT; intubation. *,$p<0.05$ compared to BL; #<0.05 compared to G1.

2) SBP change

SBP was significantly increased compared to the BL at 0.25 and 1 minute after intubation in group 1 but only at 0.25 minute in group 2. After 3 minutes following intubation, the SBP in group 1 was decreased significantly from BL. But in group 2, the SBP was decreased significantly from BL after 2 minutes following intubation (Fig. 2). The percent change of SBP in group 2 had significantly decreasing effects from 2 minutes to 5 minutes compared to group 1. The maximal decreasing level of SBP in group 2 was $22.6\pm10.9\%$ at 5 minutes.

3) DBP and MAP (mean arterial pressure) changes

The DBP was significantly decreased compared to the BL after 3 minute following intubation in group 1. But

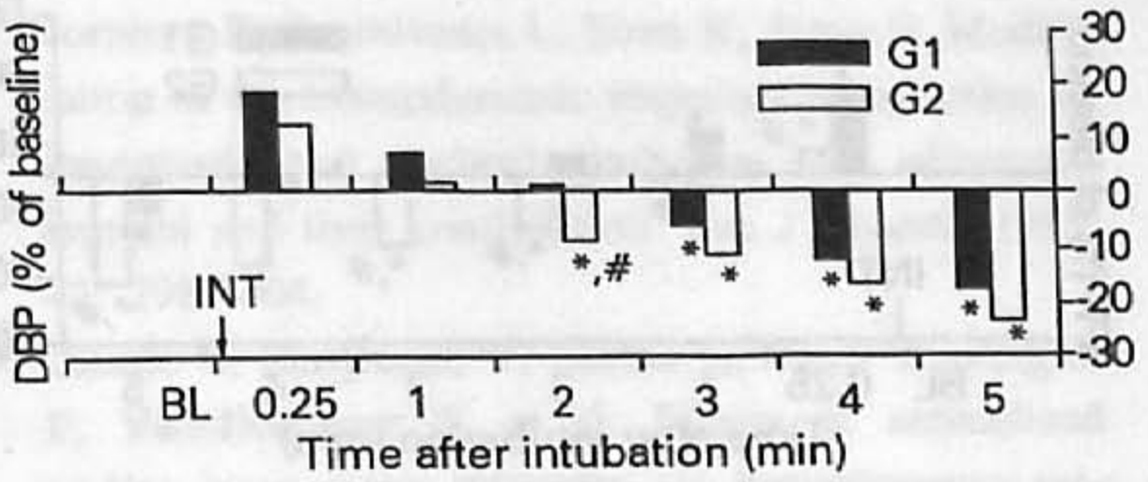

Fig. 3. The effects of esmolol on diastolic blood pressure-(DBP) in response to induction of anesthesia and tracheal intubation. G1; normotensive patients, G2; labile hypertensive patients, BL;baseline, INT; intubation, *,<0.05 compared to G1.

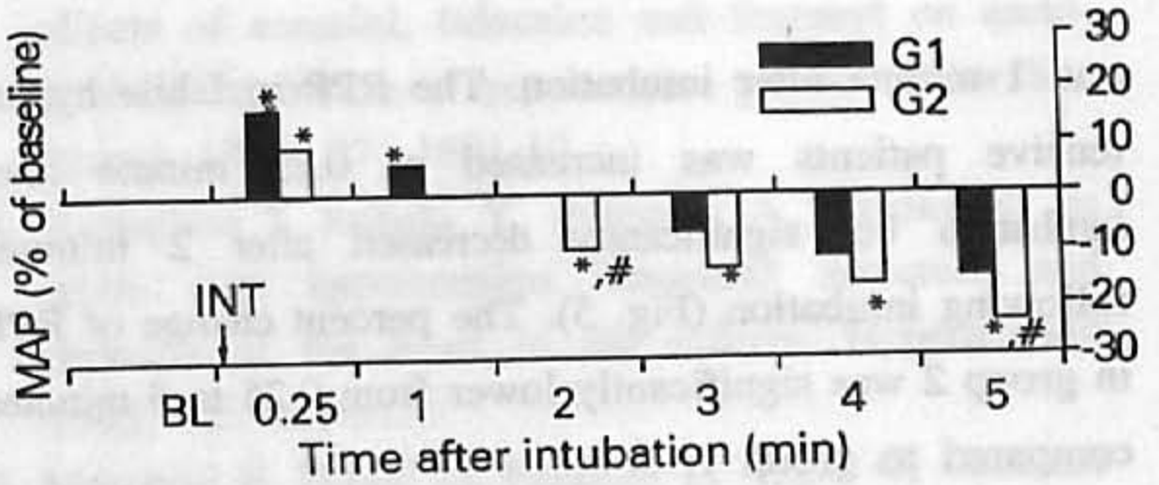

Fig. 4. The effects of esmolol on mean arterial pressure-(MAP) in response to induction of anesthesia and tracheal intubation. G1; nomotensive patients, G2; labile hypertensive patients, BL; baseline, INT; intubation. *,<0.05 compared to BL; #,<0.05 compared to G1.

in group 2, DBP was significantly decreased after 2 minutes following intubation(Fig. 3). Following the intubation, the percent change of DBP in group 2 reveals a significant difference only at 2 minutes compared to group 1. The maximum decreasing percentage of DBP in group 2 was $23.3\pm12.8\%$ at 5 minutes. MAP was significantly increased compared to the BL at 0.25 minute and 1 minute after intubation in group 1 but only at 0.25 minute in group 2. After 2 minutes following intubation, only the MAP in group 2 was decreased significantly from BL (Fig. 4). The percent change of MAP in group 2 had significantly decreasing effects at 2 minutes and 5 minutes compared to group 1. The maximal decreasing level of MAP in group 2 was $23.1\pm11.4\%$ at 5 minutes.

4) RPP change

The RPP in normotensive patients was increased at 0.25

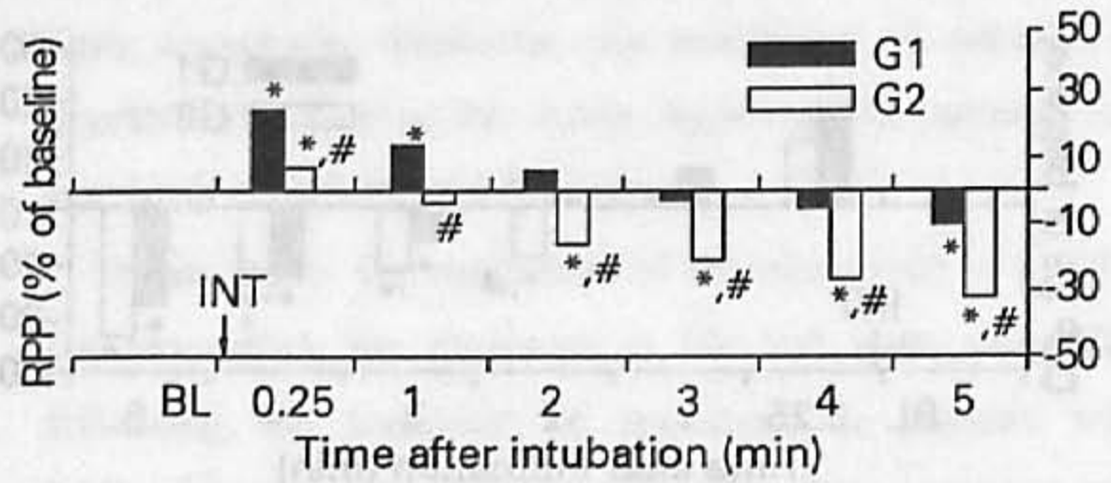

Fig. 5. The effects of esmolol on rate-pressure product-(RPP) in response to induction of anesthesia and tracheal intubation. G1; normotensive patients, G2; labile hypertensive patients, BL; baseline, INT; intubation. *, <0.05 compared to BL;#, <0.05 compared to G1.

and 1 minute after intubation. The RPP in labile hypertensive patients was increased at 0.25 minute after intubation but significantly decreased after 2 minutes following intubation (Fig. 5). The percent change of RPP in group 2 was significantly lower from 0.25 to 5 minutes compared to group 1.

DISCUSSION

The ideal method or regimen for anesthetic induction to the patients with labile hypertension has not been concluded. Anesthesiologists have employed a multitude of drugs to block the hemodynamic responses to tracheal intubation, such as fentanyl, alfentanil, lidocaine and esmolol etc.[3-6] Lidocaine has been found to be inconsistently effective[7,8]. Fentanyl in doses greater than or equal to 5 μg/kg has been reported to be effective but this regimen may lead to apnea, excessive sedation and chest wall rigidity preoperatively, and to nausea, vomiting and respiratory depression postoperatively. In the study of Helfman[4], only esmolol provided consistent and reliable protection against increases in both HR and SBP accompanying laryngoscopy and intubation after using placebo, lidocaine, fentanyl and esmolol. Park et al.[9] observed that esmolol preloading provided a reliable protection against increases in both HR and SBP accompanying laryngoscopy and intubation in true hypertensive patients. Although labile hypertension is common in clinical anesthetic practice, its pathogenesis remains unclear. Labile hypertension should be differentiated from true hypertension, since the excessive reduction in BP caused by antihypertensive medication may induce an ischemic event in a vital organ, especially in the elderly patients[10]. We postulated that the hemodynamic results of the labile hypertensive patients following induction of anesthesia would be different from those of the normotensive and true hypertensive patients. In this study, we investigated 20 labile hypertensive patients, using esmolol (1 mg/kg) to block the hemodynamic responses of tracheal intubation compared to the 20 normotensive patients.

The definition of the labile hypertension is variable according to the authors[10-12]. In this study, home BP checkings by self-determination, not 24-hour ambulatory BP, were used to define labile hypertension. Labile BP measurements were checked on two seperate visits, excluding the patient's first visit as in the study of Kuwajima[12].

The electrocardiographic and echocardiographic findings of the labile hypertensive patients are different from the true hypertensive and normotensive patients[12]. Left atrial dimension is significantly larger in the true hypertension than in the normotensive patients, whereas that in the labile hypertensive patients does not differ from that in the normotensive patients. Patients with labile hypertension have a tendency of disturbed diastolic function, although systolic reserve remains unaltered. In this study, we did not monitor the echocardiography but there was no abnormal electrocardiographic finding on ECG in the two groups.

Sedatives such as thiopental sodium and benzodiazepine can be effective in lowering BP in labile hypertension. But in this study, if the effect after the injection of thiopental sodium was the major factor the significant results would appear at the highest plasma concentration time after thiopental injection. The maximum effect of a bolus thiopental sodium was seen within 60 seconds and followed by rapid redistribution to other lean, vessel-rich tissues, primarily skeletal muscle[13]. But the peak effects of a loading dose of esmolol are seen within 5 to 10 minutes[14]. Therefore, the effect of thiopental sodium to labile hypertension could be somewhat ruled out by the

pharmacokinetics of thiopental sodium in this study.

In this study, esmolol as a bolus dose (1 mg/kg) was effective in lowering BP and HR after tracheal intubation in patients with labile hypertension. At the same time RPP was effectively reduced.

In conclusion, a 1 mg/kg intravenous bolus of esmolol is safe and effective in attenuating the hemodynamic response to tracheal intubation in labile hypertensive patients. When considering effect on RPP concurrently, this dose of esmolol can more reduce the myocardiac loading following tracheal intubation in labile hypertensive patients than in normotensive patients.

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