Tokai J Exp Clin Med., Vol. 31, No. 1, pp. 35-38, 2006

Increased Dosage of Propofol in Anesthesia Induction Cannot Control the Patient's Responses to Insertion of a Laryngeal Mask Airway

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(Received October 14, 2005; Accepted February 2, 2006)

An increased dosage of propofol is frequently administered to reduce responses to insertion of the laryngeal mask airway (LMA). However, its clinical effect remains unknown. We investigated whether an increased dosage of propofol reduces responses to LMA insertion. Sixty adult patients were divided into 3 groups according to induction dosage of propofol (2.0 mg/kg, 2.5 mg/kg and 3.0 mg/kg). The patient's responses including body movement and the upper airway reflex were observed. The bispectral index (BIS) score as the index of the sedation level was monitored. There were no significant differences among the three groups in responses to LMA insertion, and no correlation was seen between the BIS score and the responses. These results suggest that propofol alone at clinical dosage levels does not completely control responses to LMA insertion. It is also suggested that the monitoring of BIS score is not effective in predicting responses to LMA insertion. Combination of propofol and analgesics such as fentanyl may be useful in reducing responses to LMA insertion.

Key words: laryngeal mask airway, propofol, bispectral index

INTRODUCTION

Laryngeal mask airway (LMA) is generally inserted without any muscle relaxant; however, insertion of the LMA requires a sufficient depth of anesthesia to suppress the upper airway reflex and patient movement. Propofol, which is a sedative drug, has the ability to suppress the upper airway reflex, and has been available as the most common anesthetic for LMA insertion. However, LMA insertion occasionally induces some responses such as gagging, coughing, laryngospasm, or body movement. Accordingly, an increased dosage of propofol is frequently administered to reduce the responses to LMA insertion in anesthesia induction; however, its clinical effect is unknown. This study was performed to investigate whether an increased dosage of propofol for anesthesia induction has a beneficial effect on the responses to LMA insertion.

SUBJECTS AND METHODS

Sixty consecutive adult patients (American society of anesthesiologist physical status classification: I or II) who were scheduled to undergo general anesthesia with a laryngeal mask for minor surgery were selected for this study. Any patients with respiratory, cardiovascular, or neurological diseases were excluded. We obtained informed consent from all patients. The patients were randomly divided into 3 groups by a difference in an induction dose of propofol; 2.0 mg/kg, 2.5 mg/kg and 3.0 mg/kg. All patients were medicated with 3 mg of midazolam (sedative drug) for pre-anesthetic sedation, 0.5 mg of atropine sulfate and 20 mg of famotidine (H_2-receptor antagonist) for reduction of gastric acid intramuscularly 30 minutes before induction of anesthesia. In the operating room, we applied a blood pressure cuff, electrocardiogram, pulse-oxymeter, and bispectral index (BIS) on electroencephalogram (A-1050, Aspect Medical Systems, Newton, MA, USA) as a monitor of the sedation level.

The assigned bolus dose of propofol was injected over 30 seconds through a peripheral intravenous route with administration of 6 l/min flow of oxygen. After the loss of eyelash reflex with BIS score to ≤ 50 was confirmed, LMA (size 3 or 4) was inserted. The blood pressure, heart rate and BIS score before induction of anesthesia and after LMA insertion were recorded. The patient's body movements during LMA insertion were classified in 4 grades (1: none, 2: a slight movement of the upper and lower extremities, 3: a moderate movement including the trunk, 4: the failed insertion of the LMA with a marked movement). The upper airway reflex during LMA insertion was also grouped into 4 stages (1: none, 2: swallowing, 3: cough, 4: laryngospasm). The same anesthesiologist conducted LMA insertion and evaluated the responses in all patients.

The values were expressed as the mean ± S.D. The changes in the blood pressure, heart rate and BIS score before anesthesia induction and after LMA insertion were tested by the paired t test. The difference among the groups were analyzed using the one-way analysis of variance (ANOVA) followed by Fisher's test. The Kruskal-Wallis test or Mann-Whitney's U test was used to evaluate responses to LMA insertion. A value of $P < 0.05$ was considered to be statistically significant.

RESULTS

There was no significant difference among the three groups regarding the demographic and clinical characteristics (Table 1). The systolic pressure decreased significantly after LMA insertion in all groups, and there

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Table 1 Patient's characteristics

Characteristic	2.0 mg/kg	2.5 mg/kg	3.0 mg/kg
Age (years)	47 ± 12	43 ± 13	45 ± 14
Weight (kg)	56.8 ± 8.2	61 ± 9.3	57.1 ± 9.7
Height (cm)	158.8 ± 8.2	163.1 ± 8.1	163.4 ± 7.8
BIS in pre-induction	94 ± 4	95 ± 4	94 ± 2

Values are mean ± SD.
2.0 mg/kg, 2.5 mg/kg, 3.0 mg/kg = induction dose of propofol
No difference between each group for age, weight, height, and pre-induction BIS score.

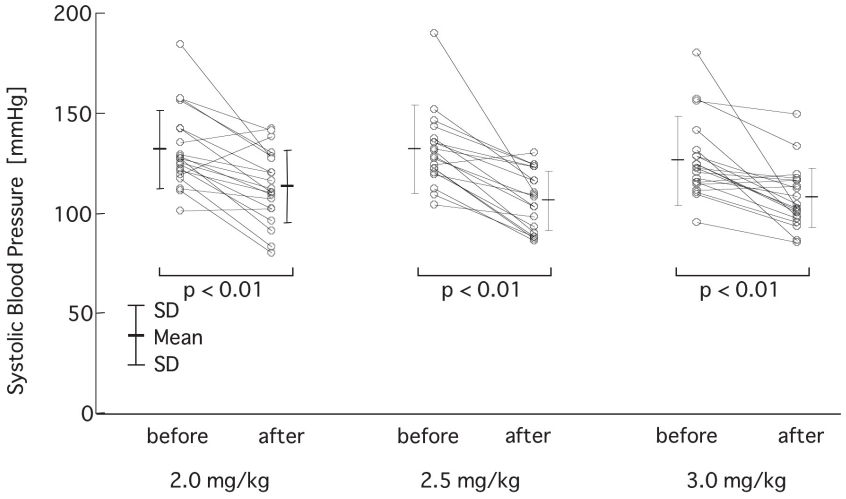

Fig. 1 Changes in Systolic Blood Pressure

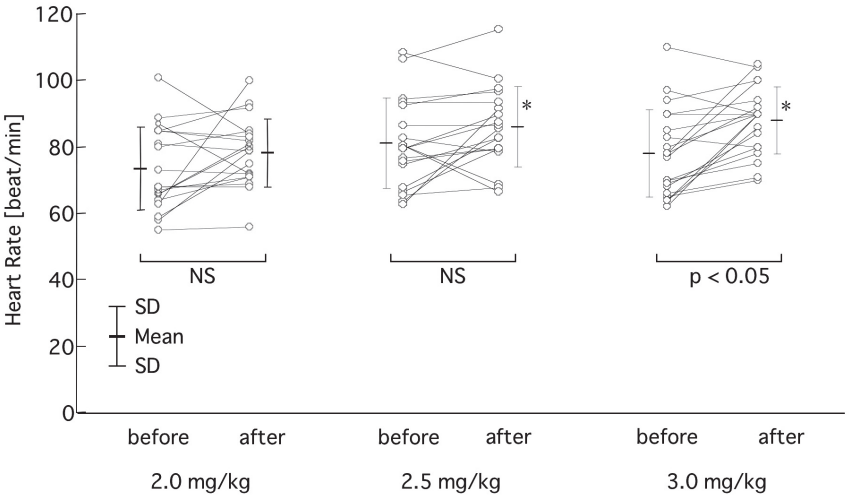

Fig. 2 Changes in Heart Rate
NS = no significant difference, *p $<$0.05 vs after LMA insertion in 2.0 mg/kg group.

was no difference among the groups (Fig. 1). Fig. 2 shows the changes in the heart rate. The heart rate significantly increased after LMA insertion in 3.0 mg/kg group, which was significantly higher for 2.5 mg/kg and 3.0 mg/kg group after LMA insertion, compared to the 2.0 mg/kg group. The BIS score significantly decreased after LMA insertion in each group and was lower in 2.5 mg/kg and 3.0 mg/kg group than in 2.0 mg/kg group (Table 2). Table 3 shows the results of the responses, which include the body movements and the pharyngolaryngeal reflex, in LMA insertion. There is no significant difference among the three groups. The LMA insertion was failed in one patient in 2.5 mg/kg group because of marked head movement, and inhaled induction was applied to its patient. In 2 patients of 3.0 mg/kg group, a laryngospasm-like response occurred after LMA insertion, and then, a small dose of suxamethonium chloride was intravenously administered. The BIS score in each patient with and without responses to LMA insertion are shown in Figure 3. There is no dif-

Table 2 Changes in Bispectral Index

	2.0 mg/kg (n = 20)	2.5 mg/kg (n = 20)	3.0 mg/kg (n = 20)
Before induction	94 ± 6	96 ± 6	95 ± 5
After LMA insertion	36 ± 5*†	30 ± 4*	31 ± 2*

Values are mean ± SD.
2.0 mg/kg, 2.5 mg/kg, 3.0 mg/kg = induction dose of propofol
* $p < 0.05$ vs before induction value. † $p < 0.05$ vs 2.5mg/kg and 3.0mg/kg group in after LMA insertion.

Table 3 Responses to LMA insertion

Responses		2.0 mg/kg	2.5 mg/kg	3.0 mg/kg
Movement to LMA insertion	1. No movement	18	14	17
	2. Small	1	5	3
	3. Moderate	1	0	0
	4. Large	0	1	0
Reflex to LMA insertion*	1. No reflex	17	18	18
	2. Swallowing reflex	2	0	0
	3. Cough, breath holding	1	1	0
	4. Laryngospasm	0	0	2

Numbers express the number of patients.
2.0 mg/kg, 2.5mg/kg, 3.0mg/kg = induction dose of propofol
A degree of body movement to LMA insertion: 1. none, 2. a slight movement of the upper and/or lower extremities, 3. a moderate movement including the trunk, 4. a marked movement preventing insertion.
A degree of pharyngolaryngeal reflex to LMA insertion: 1. none, 2. swallowing reflex, 3. cough or breath-holding, 4. laryngospasm.
* In the 2.5 mg/kg group, one patient is not included because of a failed insertion of the LMA due to marked movement of the head.

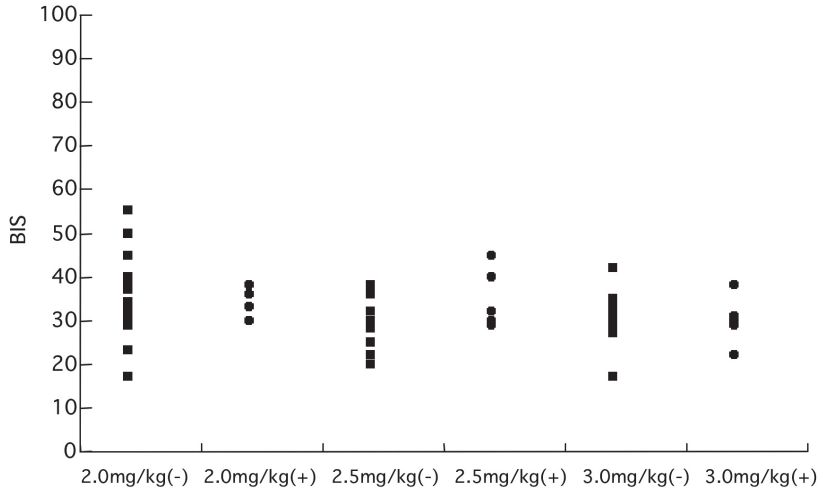

Fig. 3 Bispectral index and responses to LMA insertion
(+): positive responses, (-): negative responses
There is no difference in the BIS values between the patients with and without responses to LMA insertion in each group.

ference in the BIS score between the patients with and without a response to LMA insertion in each group.

DISCUSSION

In order to reduce responses to LMA insertion, propofol is used at an increased dose. In consideration of this, this study was performed to investigate whether an increased dosage of propofol has a beneficial effect on responses to LMA insertion. The results showed that propofol at 3.0 mg/kg did not reduce the incidence of responses to LMA insertion. There were no significant differences among the three dosage groups for responses to LMA insertion. It has been suggested that an increased dose of propofol does not effectively reduce responses to LMA insertion. Brown *et al.* [1] reported that 2.5 mg/kg propofol combined with 1 μg/kg fentanyl had a favorable effect on responses to LMA insertion. In addition, Smith *et al.* [2] reported that a

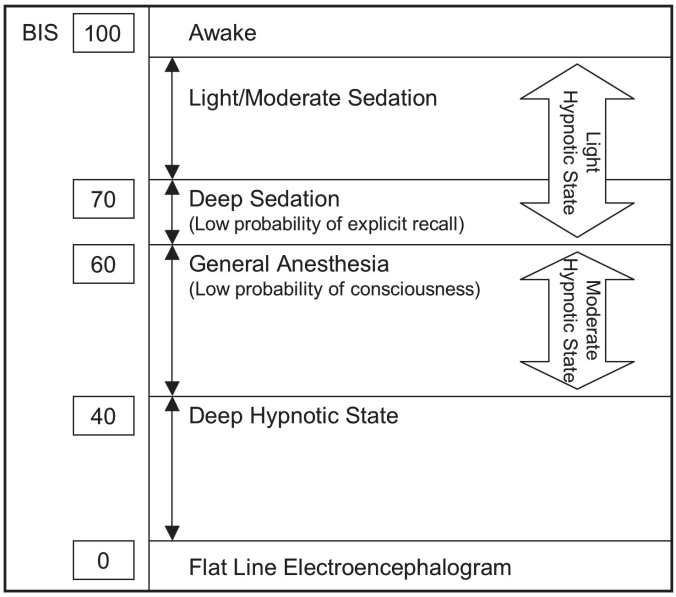

Fig. 4 BIS scores and level of sedation

small dose of fentanyl added to propofol markedly reduced the blood concentration of propofol necessary to suppress the body movement during skin incision. According to Scanlon *et al.*, on the other hand, an inhaled anesthetic, isoflurane, used after induction with 2.5 mg/kg of propofol did not reduce the incidence of responses to LMA insertion [3]. Propofol is a sedative drug commonly used for induction and maintenance of anesthesia, but it has no analgesic effect. Fentanyl is also one of the common opioids used for anesthesia management, and its analgesic effect is 80 times more potent than that of morphine. In addition, it is recognized that inhaled anesthetics are less effective against a noxious stimulus than fentanyl. We found that an increased dose of propofol did not significantly reduce responses to LMA insertion. Our results and previous studies suggest that LMA insertion is a mildly noxious stimulus to the upper airway, and a small dose of fentanyl is therefore helpful to control responses to LMA insertion. Propofol alone at 2.0-3.0 mg/kg did not cause serious hypotension; however, combination of propofol and fentanyl may cause decreased blood pressure and prolonged apnea after insertion of the LMA. Further investigation is necessary to determine the optimal dosage of these drugs.

In this study, bispectral index (BIS) was used to assess the level of sedation. BIS is a scoring system with grades from 0 to 100 points calculated from pertinent clinical data in addition to results from electroencephalographic power spectral analysis and bispectral analysis. Generally, BIS scores of approximately 40-60 are considered to indicate an appropriate sedative/hypnotic state (Fig. 4). Glass *et al.* [4] reported that responses to stimuli were more correlated with BIS than with the plasma concentration of propofol. However, the results from the present study have demonstrated that the use of BIS score is not appropriate for predicting responses to LMA insertion. LMA insertion failed in one patient in the 2.5 mg/kg group because of marked movement of the head; however, the patient's BIS score indicated an appropriate level of sedation. Although the mean BIS score at the time of LMA insertion was significantly lower in either the 2.5 or 3.0 mg/kg group than 2.0 mg/kg group, no significant differences were noted among the three groups in responses to LMA insertion. In addition, there is no correlation in the BIS scores between patients with and without responses to LMA insertion. Laryngospasm, the most unfavorable effect, was seen in two patients in the 3.0 mg/kg group. These results support the clinical findings indicating that a difference in the sedation level due to different dosages of propofol does not correlate with the responses to LMA insertion.

In conclusion, propofol alone at clinical dosage levels did not completely control responses to LMA insertion. Our results and previous studies suggest that the combination of propofol and analgesics such as fentanyl is useful in reducing responses to LMA insertion. It is also suggested that the monitoring of BIS scores is not effective in predicting responses to LMA insertion.

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