Blood Pressure, Heart Rate and Catecholamine Response during Fiberoptic Nasotracheal Intubation under General Anesthesia

Takayuki TSUBAKI, Kazuya AONO*,
Takahisa NAKAJIMA* and Akio SHIGEMATSU**

Arterial blood pressure (ABP) and heart rate were recorded at one-minute intervals during several stages of intubation in the fiberscope group and the laryngoscope group, to determine if fiberoptic nasotracheal intubation would result in fewer hemodynamic and catecholamine responses than when intubation was performed with a Macintosh laryngoscope. Blood samples were also taken to measure plasma catecholamine concentration immediately after intubation with the fiberscope.

The mean ABP in the laryngoscope group was slightly greater than that of the fiberscope group for 4 min after intubation. Heart rates at 2 min and 4 min after intubation in the laryngoscope group were significantly greater than those for the fiberscope group. Even immediately after intubation, the mean plasma levels of epinephrine and norepinephrine were unchanged in the fiberscope group. Arterial oxygen saturation (Sp_{O_2}) was maintaind within normal range during both of intubation procedures, although the time required for intubation was longer than in the laryngoscope group. Other cardiovascular complications were more common in the laryngoscope group than in the fiberscope group.

These results suggest that fiberoptic intubation results in less severe stress than does laryngoscopic intubation. Fiberoptic intubation should therefore be used not only in patients with difficult airway, hypertension, ischemic heart disease, or cerebrovascular atherosclerosis, but also it is recommended for all patients for whom nasotracheal intubation is indicatecd. (Key words: broncho-fiberscope, tracheal intubation)

(Tsubaki T, Aono K, Nakajima T, et al.: Blood pressure, heart rate and catecholamine response during fiberoptic nasotracheal intubation under general anesthesia. J Anesth 6: 474–479, 1992)

*Department of Anesthesiology, Kokura National Hospital, Kitakyushu, *Fukuoka Dental College, Fukuoka, **University of Occupational and Environmental Health, Kitakyushu, Japan*

Address reprint requests to Dr. Tsubaki: Department of Anesthesiology, Kokura National Hospital, Harugaoka 10, Kokuraminami-Ku, Kitakyushu City, 802 Japan

J Anesth 6:474–479, 1992

It is known that, as a result of varing degrees of sympathetic stimulation, tracheal intubation is associated with hypertension and tachycardia. An increase in plasma catecholamine concentration after tracheal intubation has recently been reported[1–3]. This increase can be the cause of arrythmias,

myocardial ischemia, cardiac failure, and intracranial hemorrhage.

Fiberoptic bronchoscopic nasotracheal intubation was introduced in 1967[4] to aid anesthesiologists when a difficult intubation was encountered. It had been anticipated that the use of the fiberscope for tracheal intubation might attenuate the pressor response as compared with direct laryngoscopy[5], because of less stimulation to the anterior pharynx. On the other hand, it has been reported that cardiovascular responses assocaited with fiberoptic orotracheal intubation under general anesthesia was more severe than those with a Macintosh laryngoscope[6].

The present study was carried out to clarify the differences in hemodynamic and catecholamine response under general anesthesia as compared to intubation with a Macintosh laryngoscope. The advantages of this intubating method have also been reviewed.

Patients and Method

35 patients underwent various types of oral surgery for which nasotracheal intubation was indicated. Studies were performed on ASA physical status (PS) I-II patients without cardiovascular diseases. They were divided into two groups: 1) nasotracheal intubation with a fiberoptic endoscope (Olympus BF IT10, diameter 6 mm); 2) nasotracheal intubation with a No. 3 Macintosh laryngoscope blade and a Magil's forceps. Intubations were performed by seven residents with limited training. They had attempted to carry out nasotracheal intubations only about 5~15 times using a laryngoscope, and lacked experience with the fiberscope at the start of this study except for training in intubation using a model of the head and neck. If a resident failed to intubate within 60 sec, the patient was ventilated through a mask again until a second trial was begun. If the second trial failed, a staff anesthesiologist accomplished the intubation. Patients in both groups were premedicated orally with Nitrazepam 5–10 mg, or another minor tranquilizer almost equivalent to this dose 2 hours before the operation. Continuous ECG monitoring was established after their arrival in the operating room. After a cuff were applied on patient's upper arm, ABP and heart rate were recorded at one-minute intervals by an automatic oscillometric blood pressure monitor and printer (Nippon Colin BP308 or CBM3000) during all procedures. Blood samples were taken from a catheter inserted into a cutaneous vein in the patient's forearm or leg. Arterial blood O_2 saturation (Sp_{O_2}) was continuously monitored by a pulse oxymeter (Criticare 501).

Control blood samples and control readings of ABP and pulse rate were taken after a stabilization period of 10 minutes. Anesthesia was induced with about 50% N_2O and 2% Enflurane. This concentration of agents and controlled lung ventilation was maintained for ten minutes, followed by the administration of succinylcholine chloride 1 $mg \cdot kg^{-1}$. Nasal tracheal intubation was then performed with a fiberscope or laryngoscope. Blood samples were taken immediately after tracheal intubation and immediately before the start of the operation. The blood samples (5 ml) were collected into heparinized tubes, and centrifuged as soon as possible. The separated plasma was frozen at −80°C until it was analyzed with high-pressure liquid chromatographic techniques (HPLC).

In the group 1, a 7.5 mm (for men) or 7.0 mm (for women) nasotracheal tube (Portex, profile cuff) was generously lubricated with lidocane jelly. A fiberscope was lubricated with liquid paraffin and inserted through the nasotracheal tube and then through the selected nostril into the pharynx.

After identifying the vocal cords,

Table 1. Levels of arterial blood pressure and heart rate at different stages during nasotracheal intubation

	stages of intubation								
	I	II	III	IV	V	VI	VII	VIII	IX
	systolic arterial pressure (mmHg)								
1)	113±12	98±12[a]	127±27[c]	132±18[a]	130±24[b]	123±14[b]	114±15	111±16	109±16
2)	113±14	96±11[a]	109±18	130±27[b]	134±32[a]	128±25[b]	123±23	115±19	109±15
	diastolic arterial pressure (mmHg)								
1)	66±8	50±10[a]	71±15	76±14[a]	69±15	68±10	59±8	58±10	57±6
2)	68±13	58±10[a]	64±18	79±21[c]	79±22[b]	73±18	68±15	64±12	59±11
	pulse rate (beats/min)								
1)	74±20	79±18	95±20[a]	100±15[a]	93±17[c]†	93±20[c]	86±19‡	86±19	84±17
2)	80±16	87±16	93±13[a]	107±13[a]	108±12[a]†	103±10[a]	102±10[a]‡	99±13[a]	94±12[a]

[a] $P < 0.01$, [b] $P < 0.02$, [c] $P < 0.05$ compared with baseline value.
† $P < 0.05$, ‡ $P < 0.02$ difference between each group.
Stages: I, awake and at baseline, II, after the induction of anesthesia
III, during insertion of fiberscope or tracheal tube
IV, immediately after intubation
V~IX, represents 1, 2, 3, 4, 5 min after strage III respectively
1) fiberscope group, 2) Macintosh laryngoscope group.
Data are given as mean ± SD.

the fiberscope was advanced into the trachea, and the nasotracheal tube was subsequently advanced into the trachea via the nostril. After removal of the fiberscope, the endotracheal tube cuff was inflated, and breath sounds over both lung fields were auscultated.

The time from removal of the mask to the start of initial inspiration after intubation was measured as the time required to intubate.

On the next morning after extubation, patients were interviewed with regard to the degree of pain in their laryngeal or pharyngeal region, and they were again interviewed every day until the pain disappeared. The duration of the pain was then noted. The degree of pain was ranked as follows: 1. no pain; 2. light pain; 3. severe pain. Complications occurring during the intubation procedure were also noted.

The data from these patients were examined for statistical significance by paired or unpaired Student's t-tests or χ^2 test. $P < 0.05$ was considered statistically significant. All data are presented as the mean ± SD.

Results

Eighteen patients (11 women and 7 men, mean age 31.3 ± 17.5 yr) were intubated with a fiberoptic endoscope and seventeen patients (11 women and 6 men, mean age 29.1 ± 12.9 yr) with a No. 3 Macintosh laryngoscope blade.

The fiberoptic intubation procedure failed only in a 36-yr-old female patient. In this case, the fiberscope could not pass through her nose as she had narrow nasal cavities. The data from this case were thus discarded. There were no intubation failures with the Macintosh laryngoscope.

Systolic and diastolic arterial blood pressure and pulse rates during the intubation procedure are summarized in table 1. Baseline arterial pressure and pulse rates were similar in both groups. Immediately before the start

Table 2. Cardiovascular complication in process of intubation

	ST-T change	SVPC	VPC	systolic hypertension	diastolic hypertension	total
fiberscope group	0	0	0	1	1	2/1 patient
laryngoscope group	2	2	1	3	4	12/6 patients

systolic hypertension; > 170 mmHg
diastolic hypertension; > 100 mmHg

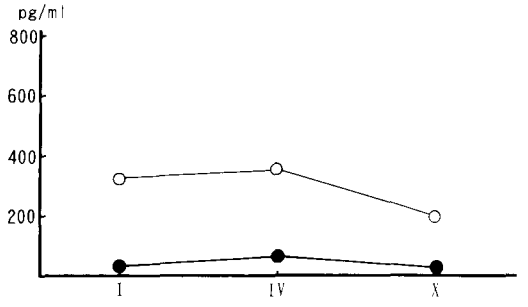

Fig. 1. mean epinephrine (●–●) and norepinephrine (○–○) plasma level during fiberoptic nasal intubation.

Stage I: awake and at baseline (Ep 34±16 $pg \cdot ml^{-1}$, nEp 330±216).

Stage IV: immediately after intubation (Ep 66±62, nEp 359±145).

Stage X: immediately before start of operation (Ep 29±14, nEp 198±125).

of the intubation procedure, ABP was significantly lower than the baseline in both groups. In the laryngoscope group, systolic blood pressure (SBP) was significantly higher than the baseline for a 3-minute period after intubation, and diastolic blood pressure (DBP) was significantly higher than the baseline for a period of two minutes after intubation. On the other hand, in the fiberscope group, SBP was significantly higher than the baseline at the insertion of the fiberscope into the nose and also higher at 2 min and 3 min after intubation. DBP was significantly higher immediately after intubation. ABP in the laryngoscope group was slightly higher than that for the fiberscope group for 4 min after intubation. However, there was no significant difference between the groups.

Pulse rate was significantly higher than the baseline at 0, 2, 3, 4, 5 and 6 min after intubation in the laryngoscope group, and higher at 0, 2 and 3 min after intubation in the fiberscope group. Pulse rates at 2 min and 4 min after intubation in the laryngoscope group were significantly higher than those for the fiberscope group.

The plasma catecholamine levels in the fiberscope patients group are shown in figure 1. Even after intubation the mean epinephrine and norepinephrine levels in plasma did not increase significantly.

The mean time required for a successful intubation was 63 ± 20 sec in the fiberscope group and 53 ± 14 sec in the laryngoscope group. The former was significantly longer than the latter ($P < 0.05$).

There were no patients whose arterial blood O_2 saturation decreased to less than 96% during the intubation procedure with the fiberscope and none less than 94% with the laryngoscope.

Cardiovascular complications were occurred to 1 patient in the fiberscope group and 6 patients in the laryngoscope group. This incidence in the laryngoscope group was significantly higher than that of the fiberscope group ($P < 0.05$). Cardiovascular complications were explained in table 2.

Table 3. Degree of pain experienced after extubation during the following morning

	no pain	light pain	severe pain
fiberscope group	8	5	4
laryngoscope group	5	5	6

Thirty-three patients were interviewed after extubation with regard to the degree of pain in their laryngeal or pharyngeal region. Table 3 shows that 9 patients in the fiberscope group and 11 patients in the laryngoscope group complained of laryngeal pain lasting 1 to 9 days. There was no difference in incidence of pain after extubation and the degree of pain and it's continuity were almost equal in both groups.

Discussion

Tracheal intubation with the laryngoscope is accompanied by increases in ABP and heart rate. One of the reasons of this circulatory change is that the laryngoscope blade applies mechanical nociceptive stimulation to the respiratory tract especially the tongue and laryngeal area, and another reason is that the direct stimulation applied to the trachea or larynx by the insertion of the endotracheal tube. Intubation with the fiberscope is also accompanied by an increase in arterial blood pressure and heart rate, but it would have been expected that the pressor and tachycardiac responses were less than intubation with laryngoscope, because direct pressure on the anterior pharynx is not required owing to the flexibility of fiberscope.

It is controversial whether fiberoptic bronchoscopic intubation associates less severe hypertension and tachycardia than intubation with conventional laryngoscope. Ovassapian[5] has reported that in awake fiberoptic nasotracheal intubation cardiovascular responses were decreased. On the contrary, Smith[6] reported that tachycardia in a group undergoing fiberoptic orotracheal intubation was significantly greater than that for a Macintosh laryngoscope group, and that the increase in systolic pressure was sustained for a longer period in the fiberscope group.

The results of this study show that nasotracheal intubation using the fiberscope in comparison with conventional technique results in less tachycardiac response and a similar response in blood pressure. We have previously reported that a significant increase from 29 ± 10 pg·mi^{-1} (at baseline) to 829 ± 475 pg·ml^{-1} (immediately after intubation) in the plasma epinephrine concentration occurred in response to nasal intubation with the laryngoscope[7]. However, the present study shows that such an increase of catecholamine did not occur in the fiberscope group. This suggests attenuated stimulation on laryngeal or pharyngeal area than in laryngoscope group. An increase in plasma epinephrine after intubation with the laryngoscope may play a partial role in the tachycardiac response. It is not in conflict that there is no difference in blood pressures between these two groups with the difference of epinephrine concentration, as tachycardia without marked changes of ABP is occurs after injection of small dose epinephrine.

A longer duration of the intubation procedure may be associated with greater increases in ABP, heart rate, and incidences of cardiovascular com-

plications. In this study, the time for intubation was significantly greater for the fiberscope group than the laryngoscope group, but cardiovascular complications occurred more frequently in the laryngoscope group than in the fiberscope group, as summarized in table 2. Moreover, the decrease of Sp_{O_2} was not remarkable in both groups.

The degree of pain experienced after extubation in the laryngoscope group was not significantly different from that in the fiberscope group (table 2). All patients complained of pain only in their laryngeal region, except for one patient in the fiberscope group and two in the laryngoscope group who experienced pain in the pharynx. We presumed from these results that intubation procedure may causes nociceptive stimulation momentary to the pharyngeal or laryngeal region, but long-continued oppression to these region by inserted tracheal tube may cause these pain.

Moreover, as most resident physicians mastered the method of intubation after about three experiences, we concluded that the technique of fiberoptic intubation is not a difficult one. There are two reasons why it is relatively easy: patients are not in motion after administration of SCC, and the bending of the fiberscope is less for nasal intubation than it is for oral intubation.

The results of this study therefore show that fiberoptic intubation is considered not to give rise excess stimulation on autonomic nervous system via nociceptive passway from larynx or pharynx, and consequently results in less severe stress than laryngoscopic intubation. The use of topical anesthesia in the pharynx, larynx and nasal cavity under fiberoptic intubation will likely further reduce the cardiovascular responses[5,8]. Therefore, fiberoptic intubation should be used for not only patients with difficult airway, hypertension, ischemic heart disease, or cerebrovascular atherosclerosis, but in all patients, if time and cost permits.

(Received Feb. 19, 1991, accepted for publication Mar. 27, 1992)

References

1. Russell WJ, Morreis RG, Frewin DB, et al: Changes in plasma catecholamine concentrations during endotracheal intubation. Br J Anaesth 53:837–839, 1981
2. Derbyshire DR, Chmielewski A, Fell D, et al: Plasma catecholamine responses to tracheal intubation. Br J Anaesth 55:855–860, 1983
3. Meiklejohn BH, Coley S: Pressor and catecholamine response to nasal intubation of the trachea. Br J Anaesth 63:283–286, 1989
4. Murphy P: A fiber-optic endoscope used for nasal intubation. Anesthesia 22:489–491, 1967
5. Ovassapian A, Yelich SJ, Dykes MHM, et al: Blood pressure and heart rate changes during awake fiberoptic nasotracheal intubation. Anesth Analg 62:951–954, 1983
6. Smith JE: Heart rate and arterial pressrue changes during fiberoptic tracheal intubation under general anaesthesia. Anaesthesia 43:629–632, 1988
7. Minote N, Himuro H, Satoh K, et al: Increase in plasma catecholamine concentrations during endotracheal intubation. J Fukuoka Dental College 13:43–53, 1986
8. Benumof J: Management of the difficult or impossible airway. Annual refresher course lectures and clinical update program (ASA) 41:163, 1–6, 1990
9. Smith JE, Mckenzie AA, Sanghera SS, et al: Cardiovascular effects of fiberscope-guided nasotracheal intubation. Anesthesia 44:907–910, 1989