Cardiovascular Responses to Fiberoptic Intubation: A Comparison of Orotracheal and Nasotracheal Intubation

Yoshihiro SHIBATA, Kazufumi OKAMOTO*, Morimasa MATSUMOTO, Kazuo SUZUKI, Michiaki SADANAGA** and Tohru MORIOKA

We compared the cardiovascular responses between nasal and oral intubation with a fiberoptic bronchoscope under the combination of neuroleptic analgesia (NLA) and topical anesthesia. The 16 patients studied were divided into 2 groups: the nasal intubation group (N group: 8 patients) and the oral intubation group (O group: 8 patients). There were significant changes in systolic, diastolic and mean arterial pressures in the N group and in the pressure rate quotient in the O group. Diastolic arterial pressure and heart rate were significantly higher in the N group than in the O group before induction of general anesthesia. The rate pressure product (RPP) was significantly higher in the N group than in the O group at some points during the procedure. The individual RPP in both groups was relatively stable except for one patient in the N group, who had a marked increase in RPP during the procedure. We conclude that, under the combination of NLA and topical anesthesia, the cardiovascular responses to oral fiberoptic intubation are less severe than those to the nasal approach. The oral approach is recommended, especially in patients with coronary artery disease, taking into consideration of the cardiovascular responses to fiberoptic intubation. (Key words: cardiovascular responses, fiberoptic intubation, orotracheal intubation, nasotracheal intubation)

(Shibata Y, Okamoto K, Matsumoto M, et al.: Cardiovascular resporses to fiberoptic intubation: a comparison of orotracheal and nasotracheal intubation. J. Anesth 6: 262–268, 1992)

Tracheal intubation by laryngoscopy following a standardized induction dose of thiopental is often associated with hypertension and tachycardia[1]. These sympathetically-mediated stress responses may cause serious complications in patients with cardiovascular problems[2,3]. Various methods have been advocated to alleviate these stress responses[4–8].

The flexible fiberoptic bronchoscope is a useful tool to accomplish tracheal intubation without a direct laryngoscope[9]. In a previous study, we found that fiberoptic oral intubation under the combination of neuroleptic analgesia (NLA) and topical anesthesia produced no significant cardiovascular changes[10]. However, Smith et al.[11] reported that significant hemodynamic

*Department of Anesthesiology, *Division of Intensive and Critical Care Medicine, **Surgical Center, Kumamoto University Medical School, Kumamoto, Japan*

Address reprint requests to Dr. Shibata: Department of Anesthesiology, Kumamoto University Medical School, 1-1-1 Honjo, Kumamoto, 860 Japan

J Anesth 6:262–268, 1992

changes occurred after fiberoptic nasal intubation. The purpose of this study was to compare the cardiovascular responses between nasal and oral intubation with a fiberoptic bronchoscope under the combination of NLA and topical anesthesia.

Methods

Sixteen adult surgical patients, aged 39 to 73 years, in whom difficult intubation was expected for oral cavity diseases or cervical spine diseases, were selected for this study. All patients consented to participate in this study. They were divided into 2 groups: the nasal intubation group (N group: 8 patients) and the oral intubation group (O group: 8 patients).

Patients were premedicated with atropine sulfate (0.5 mg i.m.) and hydroxyzine chloride (50 mg i.m.) 30 minutes before the induction of anesthesia. An intravenous route was established and continuous ECG monitoring was started in the operating room. Systolic arterial pressure (SAP), mean arterial pressure (MAP) and diastolic arterial pressure (DAP) were measured by using an automated sphygmomanometer with an arm cuff, and oxyhemoglobin saturation (Sp_{O_2}) by a pulse oximeter. After about a 5 min stabilization period, droperidol (2.5–5.0 mg) and fentanyl (100–200 μg) were administered. Topical anesthesia with an 8% lidocaine spray was then given over the oral mucosa in both groups. In those of the N group, 2% lidocaine jelly and 1:5000 adrenaline was applied for topical anesthesia of the nasal mucosa and for the prevention of nasal hemorrhage.

A 5.8 mm O.D. bronchofiberscope (BFS) (Type P20, Olympus Co.) and a spiral endotracheal tube with a cuff (6.5–7.5 mm I.D.) were used in this study. The BFS was inserted into the endotracheal tube prior to endoscopy. The tip of the BFS was then advanced into the posterior pharynx via the nares in the N group or via the oral cavity in the O group, and 2 ml of 2% lidocaine was first injected through the suction channel of the BFS. The tip of the BFS was then advanced about 1 cm proximal to the glottis and the vocal cords were clearly visualized. The second 2 ml of 2% lidocaine was then applied. The tip of the BFS was gently advanced into the trachea through the glottis. During this procedure, 2 ml of 2% lidocaine was applied when the tip of the BFS was positioned at each of the following points in the trachea: 1 and 3 cm distal to the glottis, and 2 cm proximal to the carina.

Subsequently, the tip of the BFS was maintained 2 cm proximal to the carina while the endotracheal tube was gently advanced. To avoid impaction of the tip of the endotracheal tube on the arytenoids or the vocal cords, the endotracheal tube was rotated clockwise or counter-clockwise by approximately 90°. This facilitated passage of the endotracheal tube through the larynx[9]. The endotracheal tube was then advanced through the glottis into the trachea. Care was taken to ensure that the tip of the BFS and endotracheal tube did not reach the carina.

SAP, MAP, DAP, heart rate (HR), and Sp_{O_2} were measured before and after NLA, when the tip of the BFS was positioned at the posterior pharynx, 1 cm proximal to the glottis, 1 cm distal to the vocal cords and 2 cm proximal to the carina, just after endotracheal intubation, and before induction of general anesthesia. The rate pressure produce (RPP)[12] and pressure rate quotient (PRQ)[13] were calculated as follows: RPP = SAP × HR, and PRQ = MAP/HR, respectively. If a cough occurred during fiberoptic intubation, it was recorded at each point. The duration of time for intubation was established as the interval between the

Table 1. Patient characteristics

	Nasal intubation (n=8)	Oral intubation (n=8)
Sex Female/Male	3/5	4/4
Age (year)	57.6 ± 9.2	59.9 ± 11.1
Weight (kg)	56.5 ± 8.6	56.8 ± 13.7
Height (cm)	160.1 ± 8.7	153.8 ± 12.5
Hypertensive patients	3	3

No significant difference between the two groups.

completion of NLA and endotracheal intubation. All patients were encouraged to breathe deeply throughout the procedure and, if the Sp_{O_2} fell below 90%, oxygen was delivered by an insufflation technique.

During post-operative rounds, each patient was asked whether he or she could recall the fiberoptic intubation procedure, and whether it was very uncomfortable. In addition, the presence of hoarseness and sore throat was evaluated. All values are expressed as means ± SD. Statistical analyses within a group were performed by the analysis of variance with repeated measures followed by application of Bonferroni's modification of the t-test. Comparisons between groups were performed by Fisher's exact test or an unpaired Student's t-test. $P < 0.05$ was considered significant.

Results

Table 1 shows the demographic data of the 2 groups. There was no significant difference in the demographic data of the two groups. The administered doses of droperidol and fentanyl were 3.1 ± 1.2 mg and 162 ± 52 μg in the N group, and 3.4 ± 1.3 mg and 125 ± 46 μg in the O group, respectively. The time required for intubation was 12.0 ± 5.0 minutes in the N group and 16.0 ± 6.6 minutes in the O group. There were no significant differences in the doses of droperidol and fentanyl, or in the duration of time for tracheal intubation between the two groups.

Table 2 shows the cardiovascular responses to nasal or oral fiberoptic intubation under NLA and topical anesthesia. There were significant changes in SAP, DAP and MAP in the N group and in PRQ in the O group. DAP and HR were significantly higher in the N group then in the O group at prior to induction of general anesthesia. RPP was significantly higher in the N group than in the O group at some points during the procedure.

Figure 1 shows individual changes of RPP in the N and the O groups. The individual RPP in both groups was relatively stable except for one patient in the N group, who had a marked increase in RPP during the procedure. Figure 2 shows individual changes of PRQ in both groups. The individual PRQ in both groups was relatively stable except for one in the O group, who had a marked increase in PRQ due to a decrease in HR when the tip of the bronchoscope was positioned at the posterior pharynx.

Two patients in each group required oxygen insufflation during the procedure because of a fall in Sp_{O_2}. Three in each group coughed during the procedure. During post-operative rounds two patients in the N group and three in the O group recalled part of the procedure, but reported that it was not uncomfortable. None of the patients in either group complained of hoarseness. One patient in the N group and two

Table 2. Cardiovascular responses to nasal (N) or oral (O) fiberoptic intubation under NLA and topical anesthesia

		A	B	C	D	E	F	G	H
SAP	N#	136.1±25.5	135.0±23.5	141.1±25.0	143.0±23.6	145.0±21.0	148.3±22.9	148.3±21.1	147.3±23.3
(mmHg)	O	143.8±17.3	131.5±8.6	132.5±17.5	133.8±11.4	132.0±17.3	131.1±8.7	139.8±12.5	133.8±21.2
DAP	N#	78.5±15.1	72.3±10.9	72.8±13.9	81.4±14.0*	78.9±14.9	81.9±15.5	82.8±14.0	85.6±8.5*+
(mmHg)	O	77.8±12.7	70.5±10.9	75.9±13.5	75.4±13.3	73.9±15.7	72.6±9.1	76.9±11.0	73.1±10.5
MAP	N#	97.6±17.6	93.3±14.4	95.6±15.9	101.9±16.3	100.9±16.4	104.0±17.1	104.6±15.8	106.3±12.3
(mmHg)	O	100.0±12.5	90.9±8.4	94.8±14.3	94.9±11.8	93.6±14.1	92.0±7.2	97.9±9.4	93.4±12.7
HR	N	89.4±22.2	93.0±24.3	97.1±22.5	98.9±26.3	95.9±23.3	101.8±26.8	101.1±21.6	103.4±19.9+
(beats·(min^{-1})	O	83.5±21.7	87.0±22.7	80.0±22.4	81.8±19.7	78.9±19.7	80.1±20.9	81.4±20.5	75.9±13.6
RPP	N	12195±4026	12641±4334	13810±4452	14377±5308+	14047±4585	15229±5168+	14903±3358+	14977±2461+
	O	11832±2408	11400±2798	10446±2549	10869±2317	10363±2569	10488±2560	11301±2592	10173±2401
PRQ	N	1.14±0.27	1.04±0.24	1.02±0.29	1.07±0.24	1.09±0.25	1.07±0.29	1.08±0.29	1.08±0.33
	O#	1.28±0.39	1.10±0.28+	1.29±0.50	1.22±0.32*	1.25±0.37	1.22±0.35	1.27±0.33*	1.27±0.30*

All values are mean±SD. A: before NLA, B: after NLA, C,D,E,F: when the tip of the bronchoscope positioned at the posterior pharynx, 1 cm proximal to the glottis, 1 cm distal to the vocal cords, 2 cm proximal to the carina, G: just after intubation, H: before induction of general anesthesia.

#Significant changes over the time course within a group (ANOVA). *Significant differences from B (Bonferroni's modification).

+Significant differences between the groups (Student's t-test).

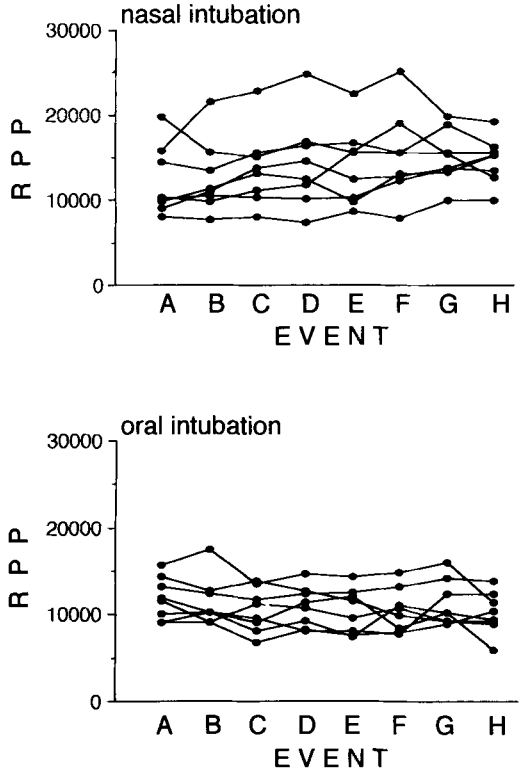

Fig. 1. Individual patient responses in rate pressure product (RPP). For time sequence (A, B, C,... H), see legends in table 2.

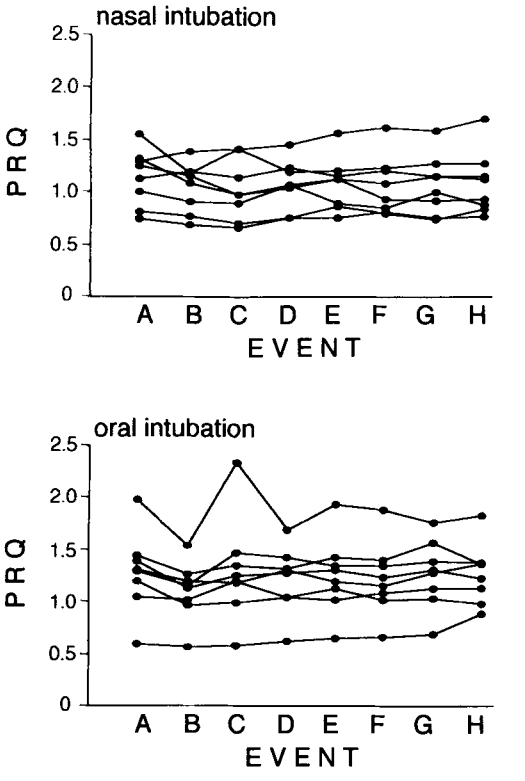

Fig. 2. Individual patient responses in pressure rate quotient (PRQ). Legends are same in figure 1.

in the O group complained of a sore throat. None of the patients had intra- or postoperative evidence of ischemic heart disease.

Discussion

The marked elevation of SAP and HR associated with tracheal intubation may lead to life-threatening complications, such as myocardial ischemia, heart failure and intracranial hemorrhage, especially in patients with coronary artery disease, systemic arterial hypertension, and aneurysmal vascular diseases[2,3]. To attenuate these stress responses due to reflex sympathetic discharge resulting from laryngo-pharyngeal and endotracheal stimulation, various pharmacologic interventions have been advocated, including deep anesthesia with barbiturates or inhalational agents[4], intravenous or topical lidocaine[5], beta-blockers[6], narcotics[7], and clonidine[8].

The supplemental use of low-dose fentanyl is a common approach to modify these stress responses[7]. Splinter et al.[14] demonstrated that the combined use of about 3 $mg \cdot kg^{-1}$ of thiopental and 1.5–3.0 $\mu g \cdot kg^{-1}$ of fentanyl effectively attenuated the elevations of SAP and HR during laryngoscopy and intubation. Chung et al.[15] also reported the beneficial effects of low-dose fentanyl. In this study, we used droperidol as a sedative instead of thiopental, to keep patients in the semi-awake state and to avoid upper airway obstruction by the sedative itself during the procedure.

Droperidol has a marked tranquilizing and amnestic effect[16]. In addition, droperidol has alpha-adrenergic blocking and vasodilating effects[16]. Thus, the combination of droperidol and fentanyl may be more potent to minimize the fluctuations of SAP and HR than fentanyl alone during fiberoptic intubation. Furthermore, this combination may prevent uncomfortable memories of the procedure[16].

In the present study, we found that fiberoptic oral intubation under the combination of NLA and local anesthesia produced no harmful cardiovascular responses during the procedure. RPP[12], reflecting myocardial oxygen demand, is recommended to be maintained at less than 12,000 to prevent myocardial ischemia. The individual RPP was stable in the O group during the procedure. PRQ[13] is recommended to be maintained at greater than one to prevent myocardial ischemia. The individual PRQ did not show a significant decrease during the procedure. The results were consistent with our previous study[10].

On the other hand, we found that fiberoptic nasal intubation produced significant cardiovascular responses. SAP, DAP and MAP showed significant changes during the procedure. RPP was significantly higher at some points during the procedure. In addition, RPP in one patient of the N group showed a marked increase during the procedure.

Why did the nasal approach exhibit more prominent cardiovascular responses? One possible cause is presumably due to the sympathoadrenal stimulation of the nasal mucosa by the insertion of the fiberscope and the endotracheal tube. Topical anesthesia with 2% lidocaine jelly for the nasal mucosa was presumably not enough to block the stimulation. In addition, topical application of 1:5,000 adrenaline to the nasal mucosa may have affected the cardiovascular function.

Incidentally, three in each group coughed during the procedure. Coughing may produce marked cardiovascular changes. To prevent coughing during the procedure, it appears important that a topical anesthesia with 2% lidocaine is applied properly on the mucosa of the oropharynx, larynx and trachea. The tip of the fiberscope should also be carefully advanced to avoid touching the structures of the airway and thus causing sympathoadrenal stimulation.

In conclusion, we have shown that under the combination of NLA and topical anesthesia, the cardiovascular responses to oral fiberoptic intubation are less severe than those to the nasal approach. Although nasal fiberoptic intubation is generally easier than the oral approach because the nasopharynx is more in line with the glottis, the oral approach is recommended, especially in patients with coronary artery disease, taking into consideration of the cardiovascular responses to fiberoptic intubation.

(Received Aug. 26, 1991, accepted for publication Oct. 24, 1991)

References

1. Stoelting RK: Circulatory changes during direct laryngoscopy and tracheal intubation. Anesthesiology 47:381–384, 1977
2. Fox EJ, Sklar GS, Hill CH, et al: Complications related to the pressor response to endotracheal intubation. Anesthesiology 47:524–525, 1977
3. Roy WL, Edelist G, Gilbert B: Myocardial ischemia during non-cardiac surgical procedures in patients with coronary-artery disease. Anesthesiology 51:393–397, 1979
4. Milocco I, Axson-Lof B, William-Olsson G, et al: Haemodynamic stability during anaesthesia induction and sternotomy in patients with ischaemic heart disease. A comparison of six anaesthetic techniques. Acta Anaesthesiol Scand 29:465–473, 1985

5. Denlinger JK, Ellison N, Ominsky AJ: Effects of intratracheal lidocaine on circulatory responses to tracheal intubation. Anesthesiology 41:409–412, 1974
6. Safwat AM, Reitan JA, Misle GR, et al: Use of propranolol to control rate-pressure product during cardiac anesthesia. Anesth Analg 60:732–735, 1981
7. Martin DE, Rosenberg H, Aukburg SJ, et al: Low dose fentanyl blunts circulatory responses to tracheal intubation. Anesth Analg 61:680–684, 1982
8. Ghignone M, Quintin L, Duke PC, et al: Effects of clonidine on narcotic requirements and hemodynamic responses during induction of fentanyl anesthesia and endotracheal intubation. Anesthesiology 64:36–42, 1986
9. Dellinger RP: Fiberoptic bronchoscopy in adult airway management. Crit Care Med 18:882–887, 1990
10. Matsumoto M, Okamoto K, Nakamura M, et al: Cardiorespiratory effects of fiberscope-guided orotracheal intubation under neuroleptanalgesia. Masui (Jpn J Anesthesiol) 39:S581, 1990
11. Smith JE, Mackenzie AA, Sanghera SS, et al: Cardiovascular effects of fibrescope-guided nasotracheal intubation. Anaesthesia 44:907–910, 1989
12. Robinson BF: Relation of heart rate and systolic blood pressure to the onset of pain in angina pectoris. Circulation 35:1073–1083, 1967
13. Buffington CW: Hemodynamic determinants of ischemic myocardial dysfunction in the presence of coronary stenosis in dogs. Anesthesiology 63:651–652, 1985
14. Splinter WM, Cervinko F: Haemodynamic responses to laryngoscopy and tracheal intubation in geriatric patients: effects of fentanyl, lidocaine and thiopentone. Can J Anaesth 36:370–376, 1989
15. Chung F, Evans D: Low-dose fentanyl: haemodynamic responses during induction and intubation in geriatric patients. Can Anaesth Soc J 32:622–628, 1985
16. Marshall BE, Wollman H: General anesthetics. The Pharmacological Basis of Therapeutics. Edited by Gilman AG, Goodman LS, Rall TW, Murad F. New York, MacMillan Publishing Co., 1985, pp. 276–301