

## Tracheal Intubation does not Provoke Bronchospasm in Patients with Bronchial Asthma under Thoracic Epidural Anesthesia

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**Abstract :** Background : The purpose of this study was to survey the occurrence of bronchospasm during upper abdominal surgery in patients with bronchial asthma who underwent gastrectomy under thoracic epidural anesthesia either with or without tracheal intubation. Methods : Fifty patients with bronchial asthma who underwent gastrectomy were managed with epidural anesthesia either with (n=19) or without (n=31) tracheal intubation during surgery. The occurrence of bronchospasm during anesthesia and surgery was studied. Results: None of the patients whose trachea was intubated developed bronchospasm (0/19[0%]). There was only one episode of mild bronchospasm(1/31[3%]) immediately after thoracic epidural anesthesia in the patients whose trachea was not intubated. The bronchospasm disappeared after the establishment of thoracic epidural anesthesia. There was no statistically significant difference in the incidence of bronchospasm between the patients whose trachea was intubated and those who were not intubated. Conclusions: Under thoracic epidural anesthesia, tracheal intubation did not provoke bronchospasm, and the occurrence of bronchospasm during upper abdominal surgery was low even in patients with bronchial asthma.

**Key words :** Epidural anesthesia, Tracheal intubation, Bronchial asthma, Bronchospasm

### Introduction

The decision to give epidural anesthesia for patients with bronchial asthma remains controversial. Although an improvement of the wheezing<sup>1)</sup> and amelioration of status asthmaticus<sup>2)</sup> after epidural anesthesia have been reported, there are reports of occurrence of bronchospasm after epidural anesthesia.<sup>3,4)</sup> In addition, more patients with bronchial asthma have been reported to develop bronchospasm when the trachea was intubated even under inhalation anesthetics.<sup>5,6)</sup> However, since these reports were the result of analyses of patients who underwent various types of surgeries,<sup>5,6)</sup> interpretation of the results is difficult. To date there have been no reports,

which have analyzed the occurrence of bronchospasm in patients with bronchial asthma who underwent the same type of surgery with thoracic epidural anesthesia.

We retrospectively studied the occurrence of bronchospasm in patients with bronchial asthma under thoracic epidural anesthesia who underwent upper abdominal surgery with or without tracheal intubation. Our results showed that tracheal intubation did not provoke bronchospasm and the incidence of bronchospasm was low even in patients with bronchial asthma.

### Subjects and Methods

The medical and anesthesia records of patients with bronchial asthma who underwent upper ab-

dominal surgery during the period of 20 years from August 1973 to December 1994 at our hospital were retrospectively reviewed. During the period, details of anatomical sites of surgery and concurrent diseases were recorded on anesthesia records, using a punch card system. The medical records of each patient with bronchial asthma who underwent gastrectomy were reviewed precisely. Frequency of attacks of bronchial asthma before surgery, medications for bronchial asthma and results of spirogram of each patient were abstracted. In our hospital, upper abdominal surgery was performed under thoracic epidural anesthesia with intravenous sedation with or without tracheal intubation at the discretion of each anesthesiologist until the end of 1994. Thereafter, sevoflurane and propofol became clinically available at our hospital, and since then we routinely intubate the trachea in patients with bronchial asthma.

The severity of bronchial asthma was classified into three groups according to Kingston and Hirshman's classification<sup>7)</sup> with some modifications. In brief, the patients who had a history of wheezing but were not taking any drugs for bronchial asthma were classified as Group I; those who had a history of wheezing and were currently taking bronchodilators and/or steroids were in Group II, and those who had current wheezing despite taking bronchodilators and/or steroids were in Group III. The patients whose forced expiratory volume in one second was less than 80% of the predicted value despite medication with bronchodilators and/or steroids were included in Group III.

Bronchospasm during anesthesia and surgery was defined to be present when there was a description of "wheezing" on the anesthesia records.

We excluded the following patients: those with pulmonary emphysema whose forced expiratory volume in one second was less than 60% of the predicted value, those who underwent emergency surgery, and those who received volatile anesthetics since the induction of anesthesia.

Continuous variables are expressed as mean  $\pm$  SD. The statistical analysis was performed with Student's *t*-test, chi-square test, or Fisher's exact test. A P value less than 0.05 was considered to be statistically significant.

## Results

Over the 20-year period, 6,710 patients were operated on for upper abdominal surgery under thoracic epidural anesthesia. Among them, 57 patients (0.85%) had bronchial asthma and underwent gastrectomy. The trachea was not intubated in 33 patients (non-intubated group,  $n = 33$ ) while it was intubated in 24 patients (intubated group,  $n = 24$ ). Seven patients were excluded from further analysis because of severe pulmonary emphysema ( $n = 2$ ), emergency surgery ( $n = 2$ ), and use of inhalation anesthetics since the induction of anesthesia ( $n = 3$ ). The tracheas of the two patients with severe pulmonary emphysema were not intubated. The other 5 patients who were excluded from the study had their trachea intubated. As a result, a total of 50 patients remained to be analyzed, with

Table 1. Demographics of patients

	Epidural n = 31	Epidural + Intubation n = 19
Sex ( M / F )	20 / 11	14 / 5
ASA physical status ( I / II / III )	17 / 14	10 / 9
Severity of asthma ( I / II / III )	11 / 9 / 11	7 / 5 / 7
Bronchodilator $\pm$ Steroid	20	12
Age ( year )	65.7 $\pm$ 10.9	59.3 $\pm$ 13.1
Height ( cm )	156.8 $\pm$ 9.1	158.5 $\pm$ 7.6
Weight ( kg )	51.3 $\pm$ 10.0	56.8 $\pm$ 12.6
Forced expiratory volume in one second of predicted ( % )	78.1 $\pm$ 20.6	85.7 $\pm$ 21.2
Diagnosis ( Gastric cancer / Submucosal tumor )	30 / 0	18 / 1
Type of surgery ( Distal / Total gastrectomy )	27 / 4	14 / 5
Duration of anesthesia ( min )	242 $\pm$ 64	270 $\pm$ 77

Data are numbers or mean  $\pm$  SD

There were no significant differences among the two groups

31 in the non-intubated group and 19 in the intubated group.

Table 1 shows the demographic data of the 50 patients. The patients were elderly and more than 60% of them (65% [20 of 31] of non-intubated and 63% [12 of 19] of intubated patients) took bronchodilators and/or steroids in the previous year. There were no statistically significant differences in gender, ASA physical status, severity of preoperative bronchial asthma, medication with bronchodilators and/or steroids in the previous year, age, height, weight, forced expiratory volume in one

second (FEV<sub>1.0</sub>)/predicted value of FEV<sub>1.0</sub>, diagnosis, type of surgery, or the duration of anesthesia between the groups.

One patient in the non-intubated group had wheezing on arrival to the operating room. The wheezing in this patient disappeared after the injection of mepivacaine into the epidural space. Table 2 shows the drugs used during anesthesia and surgery. There were no statistically significant differences in the drugs used for premedication, the site of epidural catheterization, total amount of local anesthetics, cephalic spread of epidural

Table 2. Drugs used during anesthesia and surgery

	Epidural (n=31)	Epidural + Intubation (n=19)
Premedication		
Anticholinergic drug (AS/SB)	31/0	16/2
Benzodiazepine (D/F)	25/3	16/0
Pentobarbital/Hydroxyzine	10/3	3/7
Site of epidural puncture		
Th7-8/8-9/9-10/10-11	4/18/8/0	1/15/0/1
unknown	1	2
Local anesthetics (without epinephrine)		
MEP/LID/BUP	31/1/7	19/0/12
Cephalic spread of epidural blockade (5-10 min after first injection)		
Th4 /Th5	26/1	13/0
unknown	4	6
Amount of initial dose of MEP (mg ± SD)	243 ± 59	263 ± 60
Total amount of MEP (mg ± SD)	775 ± 227	680 ± 259
Induction of general anesthesia (T/D/M)		8/2/9
Intravenous anesthetic		
Benzodiazepine (D/M/F)	27/1/1	6/13*/0
Agonist - Antagonist opioids (P/B)	23/7	7/12
Muscle relaxant (Sch/VB/PB)		12/6/2
Neostigmine		5
Interval from initial dose to intubation (min ± SD)		22.2 ± 18.3
Total amount of intravenous fluid (ml ± SD)	2,338 ± 917	2,579 ± 674
Peak inspiratory pressure after intubation (min ± SD)		13.9 ± 1.5
Sympathomimetic drug (Eph/Eti/DOA)	20/4/11	6/0/4
Aspiration during anesthesia and surgery	0	0
Wheezing during anesthesia and surgery	1	0

\*P < 0.001 compared with M in the epidural group

Data are numbers or mean ± SD

AS = atropine sulfate, SB = spocolamine hydrobromide, D = diazepam, F = flunitrazepam

MEP = mepivacaine, LID = lidocaine, BUP = bupivacaine

T = thiopental, M = midazolam, P = pentazocine, B = butorphanol

Sch = succinylcholine chloride, VB = vecuronium bromide, PB = pancuronium bromide

Eph = ephedrine, Eti = etilefrine, DOA = dopamine

blockade, and initial and total doses of mepivacaine. Local anesthetics without epinephrine were intermittently injected into the epidural space at intervals of 45 to 50 minutes during anesthesia.

Thiopental was administered as an intravenous induction agent for all 7 patients in Group in the intubated group. Benzodiazepines were used as an induction agent in 4 of the 5 patients in Group and in all of the 7 patients in Group in the intubated group. The trachea was intubated after intravenous succinylcholine. Two ml of 4% lidocaine was sprayed into the trachea before tracheal intubation in 2 patients. None of the patients received lidocaine intravenously before tracheal intubation. Benzodiazepines and non-opioid analgesics were administered for intraoperative sedation. The mean time interval from the injection of the main dose of local anesthetics into the epidural space to tracheal intubation was 22.2 minutes.

One episode (3%) of bronchospasm, as evidenced by wheezing and a prolongation of expiration, developed in a patient after epidural anesthesia in the non-intubated group. The bronchospasm disappeared after establishment of epidural anesthesia. There were no episodes of bronchospasm in the intubated group. No significant difference was observed in the incidence of bronchospasm between the non-intubated and intubated groups ( $P > 0.999$ , Table 2). None of the patients had a prolonged expiration after tracheal intubation or abnormally high end-inspiratory pressure in the intubated group. No clinically apparent aspiration of the gastric contents was noted in any patient during anesthesia and surgery.

#### Discussion

Our results showed that the incidence of bronchospasm was low and tracheal intubation did not provoke bronchospasm even in patients with bronchial asthma during thoracic epidural anesthesia.

Warner *et al.* retrospectively studied 628 patients with bronchial asthma and reported a significantly higher incidence of bronchospasm during general anesthesia in patients whose trachea was intubated than in those whose trachea was not intubated (2.6% of 462 patients versus 0% of 166 patients)<sup>5)</sup> In their study, 95% of the patients whose trachea

was intubated received inhalation anesthetics.<sup>5)</sup> Shnider and Pepper also found a higher incidence of bronchospasm in patients whose trachea was intubated than in those whose trachea was not intubated (6.4% of 296 patients versus 1.6% of 183 patients) during general anesthesia with inhalation and intravenous anesthetics in patients with bronchial asthma.<sup>6)</sup> Therefore, tracheal intubation might be an important risk factor in provoking bronchospasm in patients with bronchial asthma during anesthesia.<sup>5,6)</sup> However, since these reports included patients who underwent various types of anesthesia and surgery, the interpretation of the results of these reports is difficult. Our study was the first to analyze the occurrence of bronchospasm in patients with bronchial asthma who underwent the same surgery, i.e., upper abdominal surgery under thoracic epidural anesthesia either with or without tracheal intubation.

Since there have been anecdotal reports of the occurrence of bronchospasm during epidural anesthesia in patients with bronchial asthma,<sup>3,4)</sup> epidural anesthesia was therefore thought to provoke bronchospasm in patients with bronchial asthma. On the other hand, there have also been reports of a disappearance of wheezing<sup>1)</sup> and an amelioration in the status asthmaticus<sup>2)</sup> after thoracic epidural anesthesia in patients with bronchial asthma. None of our patients with bronchial asthma under thoracic epidural anesthesia developed bronchospasm after tracheal intubation, and the incidence of bronchospasm was low. The bronchospasm in one patient, who had wheezing before epidural anesthesia, disappeared after the establishment of epidural blockade. In addition, the bronchospasm in the other patient who developed bronchospasm after the beginning of epidural blockade also disappeared after the establishment of epidural blockade.

Our study has some limitations; it was a retrospective analysis and the number of patients was not large. However, our patients were elderly and more than 60% of the patients (65% of the non-intubated group and 63% of the intubated group) took bronchodilators and/or steroids in the preceding year. Since the incidence of bronchospasm during anesthesia in patients with bronchial asthma is higher in older patients and in patients who have episodes of bronchospasm in the preced-

ing year,<sup>5)</sup> our patients might have had a higher risk for developing bronchospasm during anesthesia and surgery.

High thoracic epidural block with bupivacaine increases the threshold of constriction of bronchial smooth muscle to inhalation of acetylcholine in subjects with hyperactive airway.<sup>8)</sup> A recent report showed that thoracic epidural anesthesia did not increase airway resistance in patients with bronchial asthma.<sup>9)</sup> Since local anesthetics given intravenously inhibit the cough and upper airway reflexes to mechanical and chemical stimuli,<sup>10)11)</sup> the inhibitory effect of thoracic epidural anesthesia on the bronchial smooth muscle is thought to be partly due to the effects of systemically absorbed local anesthetics given in the epidural space.<sup>2)12)</sup> The disappearance of wheezing after thoracic epidural anesthesia with lidocaine in a patient with bronchial asthma has been previously reported.<sup>13)</sup> In that study, the plasma concentrations of lidocaine ranged from 2.5 to 3.9 microgram·ml<sup>-1</sup> when wheezing disappeared after epidural anesthesia. When wheezing reappeared, the plasma concentration of lidocaine was 1.9 microgram·ml<sup>-1</sup>. The mean time interval from the injection of the main dose of local anesthetics to tracheal intubation was 22.2 minutes in our patients. Thereafter, they received intermittent injections of 3–10 ml 2% mepivacaine every 45–50 minutes. Since the plasma concentration of mepivacaine peaks at 15–20 minutes after epidural injection,<sup>14)</sup> the concentration of mepivacaine in our patients was thus speculated to be high enough to inhibit bronchoconstriction at the time of tracheal intubation and during surgery. Two of our patients were noted to have bronchospasm; one patient had bronchospasm before the induction of anesthesia, and the other patient had bronchospasm after induction of anesthesia. Bronchospasm in the two patients disappeared during anesthesia and surgery.

Although benzodiazepines have a direct dilating effect on the bronchial smooth muscle,<sup>15)16)</sup> over 100 times higher concentrations than that attained in clinical practice are required to dilate the bronchial smooth muscle. However, the possibility cannot be completely disregarded that intravenous diazepam and midazolam in our patient may have

attenuated bronchoconstriction with an additive or synergistic effect to systemically absorbed local anesthetics from the epidural space.

We conclude that under thoracic epidural anesthesia, tracheal intubation did not provoke bronchospasm and there was a low incidence of bronchospasm even in patients with bronchial asthma.

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