

# Intravenous ephedrine abolished suspected bronchoconstriction during general anesthesia in a patient undergoing beta-adrenergic blocker therapy for hypertension

### ABSTRACT

We report a case of intravenous ephedrine administration that abolished suspected bronchoconstriction during general anesthesia in a patient undergoing beta-adrenergic blocker therapy for hypertension and who was subsequently diagnosed postoperatively as having bronchial asthma. A 54-year-old man who had childhood asthma was scheduled for laparoscopic cholecystectomy at our institution. The preanesthetic interview suggested full resolution of his childhood asthma. His capnogram showed an airway obstructive pattern immediately after the initiation of mechanical ventilation. However, after administration of ephedrine due to low blood pressure during surgery, his obstructive capnogram reverted to normal. On postoperative day 3, he was diagnosed as having bronchial asthma. Furthermore, we found that small airway obstruction as indicated in his preoperative pulmonary function test (PFT) had been overlooked. Two important points arise from this case. First, the use of beta-blockers for the treatment of hypertension in patients potentially having obstructive lung disease should be avoided. Second, clinicians should carefully check the preoperative PFT results in detail to ensure that nothing has been overlooked.

**Key words:** Beta-adrenergic blocker therapy; ephedrine; obstructive lung disease; preanesthetic pulmonary function test

### Introduction

Perioperative bronchospasm is not rare.<sup>[1]</sup> The safe use of cardioselective beta-blockers has been reported in patients with airway hyperreactivity and heart failure or ischemic heart disease.<sup>[2]</sup> However, it has been documented that in the absence of concomitant cardiovascular disease, routine use of a beta-blocker for the treatment of hypertension should be avoided in patients with asthma.<sup>[3]</sup> Here, we report a case in which administration of intravenous ephedrine abolished suspected bronchoconstriction during surgery under general anesthesia in a patient with a history of childhood asthma undergoing beta-adrenergic blocker therapy for hypertension

after small airway obstruction was overlooked in his preanesthetic pulmonary function test (PFT).

### Case Report

A 54-year-old man (174 cm, 72 kg) who had childhood asthma was scheduled for laparoscopic cholecystectomy. He had been treated for hypertension with a beta-adrenergic blocker (atenolol 100 mg/day) at an outside clinic from age 50 years, although he had no other cardiovascular disease. The preanesthetic interview revealed that he had experienced no symptoms of asthma nor use of medication for more than

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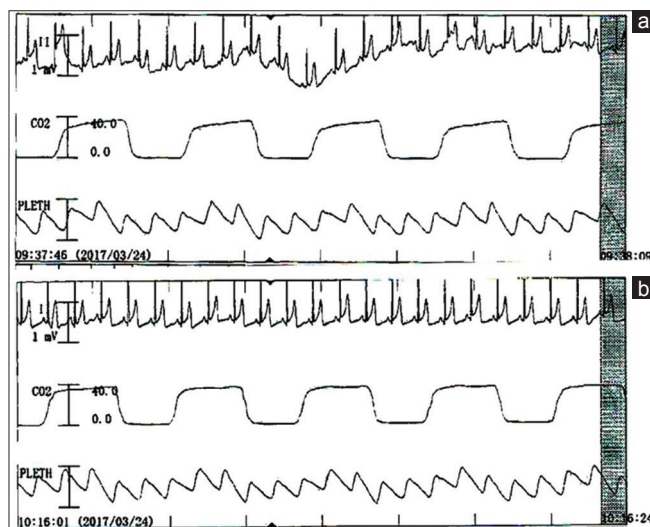
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40 years. His chest X-ray showed no abnormalities, and his preoperative PFT showed a percent vital capacity (%VC) of 89.4% and forced expiratory volume in one second (FEV1.0) of 84.6%, suggesting full resolution of his childhood asthma.

In the operating theater, after induction of anesthesia tracheal intubation was performed; anesthesia was maintained with desflurane at an end-tidal concentration of 3.0% supplemented by intermittent boluses of fentanyl and continuous remifentanyl infusion (0.1–0.15 mcg/kg/min). His lungs were ventilated with a tidal volume of 500 mL and respiratory rate of 12/min with 35% oxygen (fresh gas flow, 3 L/min) under pressure control ventilation-volume guaranteed (PCV-VG<sup>®</sup>) mode with an Avance CS2 equipped with ecoFLOW<sup>®</sup> (GE Healthcare UK Ltd., Buckinghamshire, UK). His capnogram showed an airway obstructive pattern immediately after the initiation of mechanical ventilation [Figure 1a]. His airway pressure during pneumoperitoneum was approximately 24–26 cm H<sub>2</sub>O. Because his blood pressure dropped to 83/54 mmHg in the middle of surgery, we administered 4 mg of ephedrine intravenously. His systolic blood pressure immediately increased to over 100 mmHg, and his airway pressure dropped to 19–21 cm H<sub>2</sub>O about 10 min after its administration. Furthermore, his obstructive capnogram reverted to normal about 20 min after ephedrine [Figure 1b]. No other interventions were undertaken except for the administration of ephedrine. The pneumoperitoneum was maintained at 10 mmHg during laparoscopy. Neuromuscular block was reversed at the end of surgery with intravenous sugammadex 200 mg. His trachea was extubated without incident. His respiratory status on the ward was stable without wheezing and 99% SpO<sub>2</sub> under O<sub>2</sub> administered at 5 L/min through face mask.

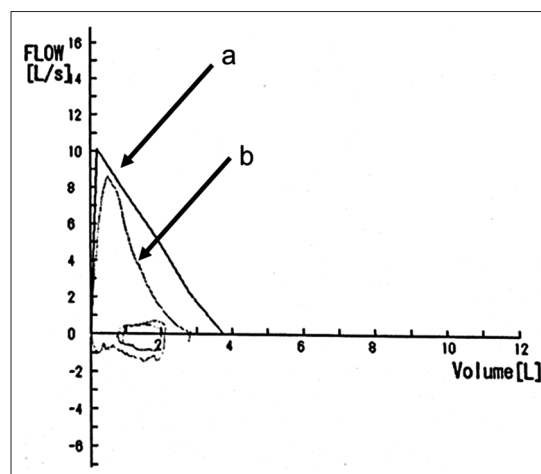


**Figure 1:** The patient's electrocardiogram, capnogram, and plethysmogram (pulse oximetry) from (a) about 10 min before administration of ephedrine and (b) about 20 min after administration of ephedrine

On postoperative day 1, our interview revealed that in recent years, he had been wheezing slightly at the turn of the seasons. On postoperative day 3, he was diagnosed as having bronchial asthma by a respirologist because his exhaled nitric oxide was 47 ppb. After this diagnosis, we carefully rechecked his preoperative PFT results and found a low peak expiratory flow and sharp fall in the flow–volume loop [Figure 2]. The maximal expiratory flow rate at 25% of VC (V25) and V50 values on the flow–volume curve were 3.42 and 1.04 L/s, respectively, and both were quite below expectation (expected V25 and V50 in this patient were 5.23 and 2.20 L/s, respectively). Furthermore, the V50/V25 ratio of 3.29 was greater than 3.0. These results indicated small airway obstruction. Thereafter, his antihypertensive drug was changed from the beta-blocker atenolol to the calcium channel blocker amlodipine. Treatment for bronchial asthma by inhaled ciclesonide was also added.

## Discussion

We completely trusted our patient's preoperative statement that he was asthma-free since his childhood. Furthermore, we overlooked important information on his V50, V25, V50/V25, and shape of the flow–volume loop in the PFT because his %VC and FEV1.0 were normal, and thus we did not consider the possibility of small airway constriction. The Japanese Respiratory Society guidelines state that a V50/V25 greater than 3.0 could be an important sign suggestive of peripheral airway obstruction.<sup>[4]</sup> Moreover, V50 and V25 of adult asthmatic patients are markedly lower than those of healthy adults.<sup>[5]</sup> The V50 and V25 values in this patient were much lower than expected, and V50/V25 was greater than 3.0. Fortunately, the patient did not experience an asthma attack



**Figure 2:** The patient's flow–volume curve from the preoperative pulmonary function test shows a low peak expiratory flow (a) and relatively sharp fall (b) in the flow–volume loop. The straight lines indicate the predicted flow–volume curve for this patient

but only showed an obstructive capnogram with high airway pressure. However, an asthma attack might have occurred in this patient during surgery because obstructive lung diseases are often associated with a high risk of developing bronchospasm during anesthesia.<sup>[1,6]</sup> Hence, we raise the importance of V50, V25, and V50/V25 results in the PFT and the preanesthetic interview in patients with a history of childhood asthma.

Ephedrine works by turning on  $\alpha$  and  $\beta$  adrenergic receptors and was previously used orally as a bronchodilator for the treatment of asthma. In the present patient, administration of ephedrine changed the shape of the obstructive capnogram to normal and decreased the airway pressure with no other interventions. This suggests that intravenous administration of ephedrine dilated the patient's asthmatic bronchi, whereas atenolol, a cardioselective beta-blocker, might have caused slight bronchoconstriction. It was reported that cardioselective beta-blockers could be used safely in patients with airway hyperreactivity and heart failure or ischemic heart disease.<sup>[2]</sup> However, the efficacy of beta blockade in patients with mild obstructive lung disease was suggested to likely extend to those with more severe disease.<sup>[7]</sup> According to the 2017 American Heart Association guideline, beta-blockers are not recommended as first-line agents for hypertension unless the patient has ischemic heart disease or heart failure.<sup>[8]</sup>

In conclusion, the present case raises two important points regarding the preanesthetic examination and the treatment of hypertension. First, the preoperative PFT results should be checked in detail (V50, V25, V50/V25, peak expiratory flow, and shape of the flow-volume loop). Second, the use of beta-blockers for the treatment of hypertension in patients with obstructive lung disease should be avoided if cardiovascular disease requiring beta-blocker therapy is absent.

#### Consent for publication

Written informed consent was obtained from the patient for publication of this case report.

#### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for her images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Nil.

#### Conflicts of interest

There are no conflicts of interest.

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