

# A case of malignant hyperthermia during anesthesia induction with sevoflurane

## -A case report-

Yoon Sook Lee, Woon Young Kim, Se Hwa Lee, Sung Moon Baek, Se Jin Ok, Jae Hwan Kim, and Young Cheol Park

Department of Anesthesiology and Pain Medicine, Korea University Ansan Hospital, Ansan, Korea

We experienced a case of malignant hyperthermia (MH) in 6-year-old boy during anesthesia induction for strabismus surgery. It has been generally reported that sevoflurane can induce the delayed onset of MH in the absence of succinylcholine. Our case of MH was elicited after about 2–3 min of sevoflurane administration with N<sub>2</sub>O, O<sub>2</sub> and rocuronium. However, we successfully treated the patient by early recognition of his condition and administering symptomatic treatment and dantrolene. (Korean J Anesthesiol 2010; 59: S6-S8)

**Key Words:** Dantrolene, Malignant hyperthermia, Sevoflurane.

Malignant hyperthermia (MH) is a chain reaction of symptoms that are triggered in susceptible individuals by commonly used inhalation agents such as halothane, enflurane, isoflurane and sevoflurane and also muscle relaxants such as succinylcholine. The symptoms of MH include a greatly increased body metabolism, high fever and muscle rigidity. It is known that sevoflurane and desflurane are less potent triggers that produce a more gradual onset of MH [1,2]. Yet we encountered a case of MH during anesthetic induction with sevoflurane, and the patient was successfully treated by early recognition of his condition and administering symptomatic treatment and dantrolene.

## Case Report

A 6-year-old, 25 kg boy was scheduled for strabismus surgery in both eyes. Neither the patient nor his family had any history of neuromuscular disease or a special family history. He had not previously received general anesthesia. The preoperative laboratory examinations were within the normal values. The patient received atropine 0.25 mg IM for premedication 30 min before induction. The preoperative vital signs were blood pressure: 90/50 mmHg, heart rate: 92 beats/min, respiratory rate: 24/min and axillary temperature: 36.4°C. The patient received ketamine 50 mg IV for sedation before induction in the

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Corresponding author: Woon Young Kim, M.D., Department of Anesthesiology and Pain Medicine, Korea University Ansan Hospital, 516, Gojan-dong, Danwon-gu, Ansan 425-707, Korea. Tel: 82-31-412-5291, Fax: 82-31-412-5294, E-mail: ckssis@korea.ac.kr

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waiting room.

Anesthesia was induced with sevoflurane 2.5 vol% by mask ventilation in a mixture of nitrous oxide and oxygen (FiO<sub>2</sub> 0.5). Fifteen mg of rocuronium bromide was injected during induction. About 2 min after injection of rocuronium bromide, a size 5.0 cuffed endotracheal tube was inserted without any difficulty under direct laryngoscopy. Then 1 min after intubation, the heart rate of patient was increased from 160 to 195 beats/min. At first, the tachycardia was considered to be due to stimulation by the tracheal intubation, but the end tidal carbon dioxide concentration (ETCO<sub>2</sub>) was concurrently increased from 35 to 65 mmHg within 5 min. The oral temperature was increased to 38.9°C within 5 min after induction. No significant changes in the muscle tone and skin appearance were noted. We suspected MH, so we stopped using sevoflurane and N<sub>2</sub>O. The patient was hyperventilated with 100% O<sub>2</sub> through a new anesthetic circuit, and consequently the ETCO<sub>2</sub> was decreased to 45 mmHg. The patient was administered midazolam 1 mg and sufentanyl 15 µg intravenously for sedation after discontinuing the sevoflurane and we started propofol infusion as maintenance because propofol is known to be a safe anesthetic agent in patients with MH.

For decreasing the body temperature, active cooling was immediately initiated by ice water massage and applying ice packs on the chest, back and axillary area. Arterial cannulation was done to continuously monitor the blood pressure and for the arterial blood gas analysis. This was done via external jugular cannulation for rapid infusion of cold IV fluid and central administration of drugs for resuscitation if it was need, and we placed a Foley catheter for checking the hour urine output. The arterial blood gas analysis was pH: 7.294, PaCO<sub>2</sub>: 41.2 mmHg, PaO<sub>2</sub>: 435.2 mmHg and the base excess: -10.1 mM/L. The myoglobin in the serum was normal and the urine was negative for myoglobin. The creatine phosphokinase and potassium levels in the serum were normal. We administered 8.4% sodium bicarbonate 10 ml for correcting the acidosis. Thirty minutes min after anesthetic induction, the patient showed an oral temperature of 38°C, a pulse of 160 beats/min, a blood pressure of 140/70 and we detected newly occurring ventricular premature beats (4–5/min) on the echocardiogram. So, we decided to stop the general anesthesia and surgery and administer dantrolene. But we didn't have dantrolene, so we requested dantrolene from the Korea orphan drug center.

Approximately 90 min after the onset of MH, the patient recovered consciousness and the tracheal tube was extubated. The patient was transferred to the intensive care unit for further observation. About 120 min after onset of MH, we received the dantrolene. The patient showed an oral temperature of 37.5°C, a heart rate of 140 beats/min and a blood pressure of 140/80

mmHg, and he maintained the ventricular premature beats (4–5/min). The arterial blood gas analysis showed a pH of 7.390, a PaCO<sub>2</sub> of 38.0 mmHg, a PaO<sub>2</sub> of 89.5 mmHg and a base excess of -2.5 mM/L.

Dantrolene 25 mg was administered intravenously. Thereafter, the arrhythmia disappeared, and the patient maintained an oral temperature of 36.5–37.4°C and a normal blood pressure and heart rate. But about 2 h after the administration of dantrolene, the patient again showed arrhythmia (ventricular premature beats) and an increased oral temperature of 38°C, a blood pressure of 130/100 mmHg and a heart rate of 130 beats/min. Dantrolene 25 mg was administered again. After the second administration of dantrolene, the arrhythmia, oral temperature, heart rate and blood pressure were all normalized, and the laboratory data and arterial blood gas analysis were normalized 2 days after anesthesia induction.

Further evaluations for MH were refused by the patient's parents. The patient was discharged from the hospital four days after the onset of MH without any problem.

## Discussion

Many early signs of a MH episode can present in various ways and MH may be confused with other medical conditions such as an insufficient depth of anesthesia, hypoxia, hypercarbia, thyrotoxicosis, pheochromocytoma and neuroleptic malignant syndrome [3,4]. A clinical grading scale helps to establish the likelihood of MH in specific problematic cases [5]. It is based on weighted scores for muscle tone, muscle breakdown, acid-base parameters, temperature, tachycardia or other arrhythmias, and the response to dantrolene. We were able to diagnose MH on the basis of the clinical symptoms and the clinical grading scale by Larach et al. [5]. According to this clinical grading scale, when the raw score range is 35–48, the MH rank is 5 and the likelihood of MH is high. The patient in this case had a score of 43. The patient in this case received the score of 43 because the PETCO<sub>2</sub> was > 55 mmHg with appropriately controlled ventilation (15 points), there was an inappropriately rapid increase in temperature (15 points), inappropriate sinus tachycardia (3 points) and an arterial base excess more negative than -8 mEq/L (10 points).

In this case, we used ketamine, sevoflurane, N<sub>2</sub>O and rocuronium bromide during induction. Ketamine and N<sub>2</sub>O are not triggers for MH [6-8] and rocuronium bromide, which is a non-depolarizing muscle relaxant, is also safe for MH.

Since Shulman et al. [1] first reported that sevoflurane triggers MH in MH-susceptible swine, there have been some reports of MH during sevoflurane anesthesia in human. Generally, sevoflurane and desflurane have been reported to be less potent triggers, they produce a more gradual onset of MH [1,2] and the

onset of MH with sevoflurane in humans has been reported to occur both at an early period and after prolonged anesthesia. We encountered a case of MH that developed during anesthesia induction with sevoflurane. It took just about 5 minutes for eliciting the symptoms of MH.

Kinouchi et al. [9] reported MH emerged about 30 minutes after anesthetic induction with sevoflurane in 4-year-old girl who was without a family history of MH and the preoperative laboratory studies did not suggest she was susceptible to MH. Jonassen et al. [10] reported that MH emerged about 20 minutes after anesthetic induction with sevoflurane in a 56-year-old man who was undergoing cardiopulmonary bypass and moderate hypothermia. Cheong et al. [11] reported that MH emerged about 150 minutes after general anesthesia with sevoflurane in a 24-year-old man who was undergoing bilateral sagittal split ramus osteotomy.

As compared with the other case reports, our patient's  $\text{ETCO}_2$  and body temperature were increased simultaneously within 5 minutes after anesthetic induction with sevoflurane. This is the earliest onset among the case reports of MH reported until now.

We know that the time of onset of a fulminant episode of MH is unpredictable, and it can vary from within minutes to within several hours of induction, and the fulminant MH episodes are apparently the result of a rapid, sustained rise in myoplasmic  $\text{Ca}^{2+}$ . However, we could not determine the reason for the rapid onset of MH in this case.

During the preoperative evaluation, our attention was drawn to the patient's strabismus, and strabismus has been observed in MH susceptible patients. However, neither the family history nor the preoperative laboratory studies suggested the patient was susceptible to MH. There is no convenient minimally invasive laboratory test available for MH susceptibility. The halothane and caffeine contracture tests are bioassays and they currently remain the most reliable indicators, but they are not generally used in our country, and so a diagnostic contracture

test was not performed.

This case report demonstrates that sevoflurane can trigger MH within few minutes after exposure and so the patients who are susceptible to MH must be carefully monitored even during anesthetic induction.

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