Neuromuscular Effects of Sevoflurane in a Patient with Myasthenia Gravis

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Myasthenia Gravis (MG) is an autoimmune disease characterized by a reduction in functional acetylcholine receptors at neuromuscular junctions[1]. The majority of patients with MG have anti-acetylcholine receptor antibodies. These antibodies inactivate or destroy acetylcholine receptors on the muscle end plates, and some of the patients with MG are treated with anti-cholinesterases. Since these patients may be abnormally sensitive to muscle relaxants[2,3], anesthetic management without muscle relaxants is advisable for surgery.

In this report, we describe the evoked electromyographic (EMG) responses of a patient with MG during sevoflurane anesthesia.

Case Report

A 62-yr-old man, 67 kg in weight and 172 cm in height, was scheduled for left knee arthroscope for the left inner meniscus injury. The patient had ptosis and dysphasia 8 years earlier and MG (Osserman IIa) was diagnosed. Four years after the diagnosis, the patient had been treated with methylprednisolone 15 mg every other day for one year, and then the dose was decreased to 5 mg every other day and maintained until his surgery. The patient showed no clinical manifestations of MG. He had a very high titer of anti-acetylcholine receptor antibodies (39 nmole·l^{-1}; normal range < 0.6 nmole·l^{-1}). His HLA-type A and B loci were A 2/31 and B 46/56, −/6. Before surgery, the patient gave informed consent to participate in data collection protocols.

The patient was given 0.5 mg of atropine intramuscularly half an hour before anesthesia induction. To assess the neuromuscular response to sevoflurane, the evoked EMG of adductor pollicis brevis muscle was recorded with a surface electrode using a neuromuscular transmission monitor (Relaxograph®, AMCO). The ulnar nerve was stimulated by a train-of-four (TOF) method (2 Hz; stimulus duration, 0.1 ms, every 20s). The control values for EMG were established while the patient was awake. Anesthesia was induced with 3 MAC sevoflurane in a mixuture of 3 $l \cdot min^{-1}$ of nitrous oxide and 3 $l \cdot min^{-1}$ of oxygen. EMG response is shown in figure 1. Five minutes after induction, the height of the first twitch (T1) began to decrease, reaching to 15% of

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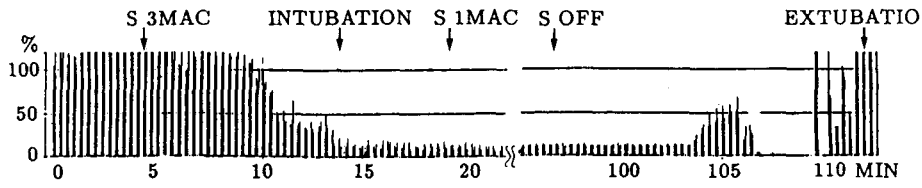

Fig. 1. Evoked adductor pollicis EMG response to ulnar nerve stimulatoin (2 Hz trains of four). The trace shows the first twitch (T1) through the fourth twitch (T4). The patient showed 85% reduction of T1 height and no TOF-fade during anesthesia.
S: sevoflurane

preinduction height 13 minutes after induction. Then trachea was intubated smoothly. The reduction of T1 height was used as an index of the degree of neuromuscular blockade. Anesthesia was maintained with 1 MAC of sevoflurane in a mixture of 4 $l \cdot min^{-1}$ of nitrous oxide and 2 $l \cdot min^{-1}$ of oxygen. Hydrocortisone, 100 mg, was intravenously administered during the operation.

Throughout sevoflurane anesthesia the height of T1 was reduced by 85% and there was no TOF fade. Surgery was completed in 75 min. Ten minutes after discontinuation of sevoflurane and nitrous oxide, T1 began to increase. The patient was able to perform a sustained head lift and hand grip. Then the trachea was extubated and he was immediately able to cough. He had no signs of residual neuromuscular blockade during the recovery period. After the operation, hydrocortisone was intramuscularly administered 50 mg × 3 for one day and 25 mg × 3 for one day. The post-operative course was uneventful.

Discussion

There have been many studies of the neuromuscular effects of volatile anesthetics in patients with MG. Nilsson et al.[4,5] reported that in patients with MG 1.8 MAC halothane induced 10% to 20% reduction of T1 height and 1.9 MAC isoflurane induced 30% to 50% reduction of T1 height. In the present study, 1 MAC sevoflurane induced 85% reduction of T1 height. These results suggest that volatile anesthetics have considerable neuromuscular blocking effect in MG patients.

Various factors may affect the sensitivities of MG patients to volatile anesthetics. According to Nilsson et al[4,5], HLA-B8 is related to TOF fade induced by halothane and by isoflurane. They suggested that the occurrence of HLA-B8 together with anti-acetylcholine receptor antibodies increase the incidence of neuromuscular block and TOF fade induced by these anesthetics. Our patient had a high titer of anti acetylcholine receptor antibodies. His HLA-B locus was B 46/56 and B −/6, but HLA-B8 was negative. He exibited no TOF fade, but strong neuromuscular blockade was induced by sevoflurane. This may be partly due to the high titer of anti-acetylcholine receptor antibodies and the absence of HLA-B8.

Regarding the anesthetics, it is said that sevoflurane promotes the neuromuscular blocking effects of non-depolarizing muscle relaxants[6]. According to Itagaki et al.[6], sevoflurane showed the most potent promoting activity for neuromuscular blocking effects of non-depolarizing muscle relaxants compared with other available volatile anesthetics. In the present study, this promoting activity for neuromuscular blocking effects induced by sevoflurane together with the high

titer of anti-acetycholine receptor antibodies probably caused the marked reduction of T1 height.

Sevoflurane is quickly taken up and eliminated because ot its low blood/gas partition coefficient[7,8]. In the present study, the patient was intubated 15 min after induction with 3 MAC of sevoflurane, and was extubated 15 min after discontinuation of sevoflurane.

In summary, we described a patient with MG showing an increased sensitivity to sevoflurane. He had a high titer of anti-acetylcholine receptor antibodies. One MAC sevoflurane produced marked neuromuscular blockade. The patient recoverd rapidly without signs of residual neuromuscular block after discontinuation of sevoflurane. Because of the potent and reversible neuromuscular blocking effect and easy controlability of anesthetic depth, sevoflurane may be a choice of anesthetics in the patients with MG.

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References

1. Seybold ME: Myasthenia gravis; a clinical and basic science review. JAMA 250:2516–2521, 1983
2. Blitt CD, Wright WA, Peat J: Pancronium and the patient with myasthenia gravis. Anesthesiology 42:624–626, 1975
3. Bell CF, Florence AM, Hunter JM, et al: Atracurium in the myasthenia patient. Anaesthesia 39:961–968, 1984
4. Nilsson E, Paloheimo M, Muller K, et al: Halothane-induced variability in the neuromuscular transmission of patient with myasthenia gravis. Acta Anaesthesiol Scand 33:395–401, 1989
5. Nilsson E, Muller K: Neuromuscular effects of isoflurane in patients with myasthenia gravis. Acta Anaesthesiol Scand 34:126–131, 1990
6. Itagaki T, Tai M, Katsumata T, et al: A clinical and experimental study on potentiation with sevoflurane of neuromuscular blocking effects of vecuronium and pancuronium (abstract in English). Masui (Jpn J Anesthesiol) 37:943–954, 1988
7. Duncan AH, Fredenk S: Clinical characteristic and biotransformation of seveflurane in healthy human volunteers. Anesthesiology 54:100–106, 1981
8. Strum D, Eger EI, Johnson B, et al: Toxicity of sevoflurane in rats. Anesth Analg 66:769–773, 1987