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Clinical reports

Malignant hyperthermia with normal calcium-induced calcium release rate of sarcoplasmic reticulum in skeletal muscle

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Introduction

Although the mortality rate of malignant hyperthermia (MH) has decreased dramatically in the past two decades, it remains one of the serious complications of anesthesia. An accelerated calcium-induced calcium release (CICR) rate of sarcoplasmic reticulum (SR) is known to be a major causative factor of MH. Approximately 20% of fulminant MH cases, however, have other unexplained causes [1–4]. We report here a man who suffered from fulminant MH during general anesthesia 24 years ago at Kanto Teishin Hospital [5], but did not show any sign of MH in three recent operations at Tokai University Hospital. His muscle biopsy test revealed a normal CICR rate and a normal Ca uptake of SR.

Case report

A 53-year-old man, weighing 55 kg, was admitted to Tokai University Hospital for acute appendicitis. He had a history of MH, diagnosed at Kanto-Teishin Hospital, where he had undergone wide resection of the stomach for duodenal ulcer 21 years before his first presentation to us. Anesthesia had been induced with thiamylal 300 mg after the administration of d-tubocurarine 3 mg, and was maintained with N_2O—O_2 halothane [5]. His trachea was intubated, with the assistance of suxamethonium 100 mg. Pancuronium was used as an intraoperative muscle relaxant. The surgery lasted approximately 2 h, 30 min. His rectal temperature increased from 37.8°C just after the induction of anesthesia to 39°C just before the end of surgery. His temperature increased further after the reversal of the pancuronium with atropine and neostigmine. He became tachypneic and his skin color revealed cyanotic change in the peripheral regions of his extremities and in his lips. His temperature transiently reached 40.5°C, in spite of whole-body cooling carried out with a cooling mat and ethanol evaporation. Analysis of his arterial blood gas revealed pH 6.55, base excess (BE) −29.8 mEq/l. He showed almost complete recovery 7 h after whole-body cooling and the intravenous administration of bicarbonate (530 mEq in total).

In the recent series of operations, performed at our institution, an emergency appendectomy operation was performed (first operation) without any problem, with the patient under spinal anesthesia combined with epidural anesthesia. Postoperative pathological examination diagnosed appendicular cancer.

Eighteen days after the first operation, right hemicolectomy was performed (second operation). Anesthesia was induced with 120 mg of propofol, after the intravenous administration of dantrolene 60 mg, and was maintained with fentanyl, propofol, epidural block, and N_2O—O_2. His airway was managed with a laryngeal mask. His rectal temperature decreased from 36°C to 35.2°C during the 2-h, 23-min operation. Results for serum electrolytes, serum creatine kinase (CK), arterial blood gas analysis, and urinary analysis were all normal. Two hours after the end of the operation, his temperature had increased to 38.2°C in the intensive care unit (ICU), and this was associated with shivering. Intramuscular sulpyrine and intravenous flurbiprofen decreased his temperature slightly. Sixty milligrams of dantrolene, however, was ineffective. His temperature had gradually returned to normal by day 6 after the operation.

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Five months after the second operation, a skeletal muscle biopsy test was performed at Toho University Omori Hospital, and this revealed a normal CICR rate and normal Ca uptake in SR.

One year and 9 months after the first operation, he was hospitalized again, for common bile duct cancer, and a choledochectomy with cholecystectomy (third operation) was scheduled. Anesthesia was induced with propofol, and then his trachea was intubated, with the assistance of vecuronium. An epidural block and the intravenous anesthetics, fentanyl and propofol, were used for the maintenance of anesthesia. Sixty milligrams of dantrolene was administered prophylactically during the operation. The 5-h, 15-min operation was completed without any particular problem. In the ICU, his temperature gradually increased from 36.6°C to 38°C. Forty milligrams of dantrolene was administered three times within 24 h after the operation. It was not, however, effective in reducing his temperature. However, flurbiprofen 50 mg brought down his high body temperature, although its effect was transient. His temperature had gradually returned to normal by day 20 after the operation.

Discussion

MH is a hereditary disease that is triggered by volatile anesthetics, which accelerate the CICR rate, and depolarizing muscle relaxants. Our patient had no particular family history suggestive of MH. The pathophysiology of MH is considered to be caused primarily by an abnormally high Ca level in skeletal muscle cytoplasm, and secondarily by such factors as the contracture of skeletal muscle, extreme energy production, and acidosis. Although almost 80% of fulminant MH patients have an accelerated CICR rate, the genesis of MH in the remainder of the patients is not certain. In our patient, at the end of the operation performed 24 years ago, his body temperature had increased to more than 40°C, and tachypnea, cyanosis, and extreme metabolic acidosis were observed. Although it is difficult to analyze precisely the pathophysiology of the MH that occurred at that time, these signs and symptoms strongly suggest that he had the fulminant type, according to the clinical criteria of MH in Japan [6], and that MH was "very likely", based on the MH clinical grading scale because his score was regarded as 40 [7]. Therefore, we did not use any triggering agent, such as depolarizing muscle relaxant or volatile anesthetic. We maintained the patient's anesthesia basically with fentanyl, propofol, and epidural block in the last two operations. We did not reverse vecuronium after the third operation, as we considered the possibility that an anticholinesterase agent could be the causative agent of MH [5,8]. The intraoperative prophylactic administration of dantrolene in the last two operations may not have been necessary, because his muscle biopsy test revealed a normal CICR rate, and dantrolene is considered to be a specific suppressant of CICR [3,9,10].

In summary, we have experienced a 53-year-old male patient who suffered from fulminant MH 24 years ago, but did not show any sign of MH in recent operations, this being achieved by excluding the use of MH triggering agents. His muscle biopsy test revealed a normal CICR rate and a normal SR Ca uptake. We therefore consider that his MH was caused by factors other than an accelerated CICR rate.

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