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Case Report

Malignant hyperthermia in young patient undergoing a surgical procedure under general anesthesia

Abstract

Malignant hyperthermia (MH) is a hypermetabolic disease induced by the administration of anesthetic drugs in patients with genetic susceptibility. Its incidence ranges from 0.02% to 0.0153%. Here, we report the case of an 18-year-old male patient with no previous relevant surgical, medical, or family history of disease, who while undergoing a scheduled orthopedic surgical procedure under general anesthesia for the correction of left congenital talipes equinovarus, presented hyperthermia (41.8°C), muscular stiffness, tachycardia, trismus, increased blood pressure, and increased CO_2 levels two hours after the induction of anesthesia. Malignant hyperthermia was suspected and managed following the protocol of the Colombian Anesthesiology and Resuscitation Association (SCARE), and MH diagnosis was confirmed with response to dantrolene. Following diagnosis and symptom management, the patient was transferred to the intensive care unit due to the high risk of death and ventilatory failure. While MH is a potentially lethal condition, a timely identification and pharmacological treatment of symptoms may lead to a significant improvement of the prognostic outcome. Cases of malignant hyperthermia have been previously reported; nonetheless reporting this case contributes to update the data on regional and international prevalence. Importantly, it also documents and provides the medical community an approach to treat malignant hyperthermia.

Introduction

Malignant hyperthermia is a disorder that leads to a hypermetabolic state induced by the administration of anesthetic drugs (Sevorane, halothane, isoflurane succinylcholine and propofol) in individuals with genetic susceptibility to MH. In 1962, the first case of MH was reported in a 21-year-old man with a fractured tibia and fibula who had previous history of ten close relatives that had died while under anesthesia. That patient presented a crisis while under general anesthesia with halothane, however he survived despite not having received a specific treatment for this reaction [1,2]. In 1970, Kalow, Britt and Terreau developed the caffeine halothane contracture test (CHCT), which can detect patients with susceptibility to MH (SMH), by studying a portion of freshly biopsied skeletal muscle tissue. To date, the CHCT test is the only one available to accurately diagnose malignant hyperthermia [3].

The incidence of MH among patients undergoing general anesthesia ranges from 0.004% to 0.1%. In Japan, the frequency of cases of MH has been reported to be 0.0136%, being higher in men older than 18 years of age. In Colombia, The Colombian Anesthesia Association has reported a frequency of MH cases ranging from 0.0153% to 0.02%, and according to resolution 430 of 20 February 2013 of the Ministry of Health of Colombia [4], MH was classified as an orphan disease, which is defined as a chronically debilitating and serious disease with a prevalence lower than 1 in 5000 people [5]. Therefore, it becomes relevant to report cases such as the one herein described.

Malignant hyperthermia results from an abnormal induction and prolonged regulation of ryanodine type 1 receptors, which regulate calcium flux during cell depolarization, leading to a structural modification of the L-type voltage sensitive receptor -dihydropyridine receptors of skeletal muscle cells. The excess of calcium influx from the sarcoplasmic reticulum of these cells leads to increased levels of intracellular calcium, oxygen consumption, increased cellular metabolism, heat production, and increased intracellular acid content, which results in sustained muscle rigidity and cell degranulation, as well as hyperkalemia, arrhythmias, and increased levels of plasma myoglobin.

Clinical manifestations refer to the signs observed during, or shortly after the initiation of general anesthesia in the untreated person. The more criteria an individual meets, the more likely it is a malignant hyperthermia crisis. Therefore, if while under anesthesia only a rise in temperature is observed,

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it is unlikely that it's a case of MH. On the other hand, an individual who exhibits all clinical findings is almost certain to be susceptible to present MH [6]. Currently, individuals with family history of MH can get tested for genetic susceptibility to MH, and these tests can be ordered during the pre-anesthetic assessment.

One of the most important advancements in the understanding of MH occurred in 1975, when dantrolene, a muscle relaxant available since 1967, was shown to inhibit the progression of MH, and in addition to provide an effective treatment. To date, dantrolene is considered to be the antidote for MH, as it has been shown to exert a direct effect on the sarcoplasmic reticulum by regulating the function of ryanodine receptors. Although initially dantrolene was only available for oral administration, and its use was limited to the pre-treatment of patients with known MH, an intravenous (IV) version of the medication became available and increasingly popular due to the demonstrated effectiveness of its use as treatment for malignant hyperthermia in humans [7]. Due to the significant risk of death, a timely diagnosis of MH is crucial, and if diagnosed, medical management should be initiated as soon as possible.

In Colombia, the Colombian Anesthesiology and Resuscitation Association established a protocol for the management of MH, which consists of a series steps to identify clinical manifestations, indications for the administration of dantrolene, physical means to control body hyperthermia, and management of severe metabolic acidosis until symptoms subside. Subsequent management and care are to be provided in an intensive care unit.

Case Report

An 18-year old male student of lower-middle income (Colombian socioeconomic stratum 3), residing in an urban area, with previous medical history of strabismus, and congenital left tales equinovarus, with no previous surgical treatments, was scheduled for surgery by pediatric orthopedics to correct the deformity of his foot. During the preoperative anesthetic assessment, he was classified as having a Mallampati score of II; mouth opening: B; and ASA II anesthetic risk. Therefore, he was cleared for surgery. To achieve general anesthesia, the patient was administered sevorane, propofol and succinylcholine. Two hours after induction of anesthesia, while still in surgery, the patient presented several symptoms consistent with MH including generalized muscular stiffness, accompanied by a sudden rise in temperature in the nasopharynx (41.8°C), tachycardia evolving to supraventricular tachycardia as observed in the monitor, and increased CO_2 (134 mmHg) shown by capnography. Furthermore, metabolic acidosis was evidenced in arterial gas analysis. Altogether, these clinical manifestations strongly suggested the development of a MH crisis, and therefore the surgical act was suspended, and the patient immediately subjected to complete body cooling (Figure 1). Management of MH was initiated with fluid therapy, washes with cold liquids were performed using bladder and orogastric catheters, and following SCARE protocol, the SCARE State line to obtain a dantrolene kit was activated. Therapeutic intervention guidelines indicated a first dose of dantrolene of 2.5 mg/kg, a total 120 mg, which was applied 3 hours after the patient was on the surgical table. Once the improvement of symptoms was achieved, the patient was transferred to the Intensive Care Unit (ICU), and with an indication to continue treatment with dantrolene at a dose of 1 mg/kg every 6 hours for 36 hours, according to the SCARE protocol. During his stay at the ICU, the patient exhibited decreased urine output, with a progressive increase in total creatine phosphokinase (CPK) levels (Table 1), indicating a diagnosis of rhabdomyolysis and renal injury classified as an Acute Kidney Injury Network (AKIN) II, which were treated and managed with fluid therapy and daily control of CPK levels and renal function, both of which exhibited improvement within 30 minutes. The goal was achieved as he presented a slight improvement in urinary output, which avoided the need of renal replacement therapy. In this patient, weaning from mechanical ventilation was difficult, an he was dependent on invasive mechanical ventilation while having no brain lesions, a normal skull tach, prolonged orotracheal intubation that required tracheostomy as a method to ensure an open airway, as well as gastrostomy for enteral feeding.

Figure 1: Patient subjected to body cooling directly in the operating room. Source: Authors.

Table 1: CPK levels during hospital stay.

Samples	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Levels of CPK (U/L)	3290	3700	1887	4125	841	275

This patient presented MH characteristic signs including muscle rigidity, increased CO_2 levels, abrupt temperature increase to 41.8°C; therefore diagnosis of malignant hyperthermia was strongly suspected and therefore treated in order to provide early management (dantrolene) that showed slight improvement of symptoms, thus confirming the diagnosis.

During the hospital stay, he presented multiple complications such as pneumonia, *Pseudomonas aeurginosa* central venous catheter related bloodstream infection, and urinary tract infection, associated to the prolonged stay. He did not present additional fever or muscle stiffness episodes, and CPK levels were stabilized. The patient was transferred

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to a chronic patient care unit, and three months later he was weaned from invasive ventilation, and tracheostomy and gastrostomy tubes were removed.

Discussion

In the case herein reported, the patient was administered general anesthesia induced with sevoflorane and succinylcholine – which are triggers for MH. The patient had unremarkable previous medical history. Thus, assessment during the patient's preoperative evaluation he was considered of low suspicion for MH. A malignant hyperthermia crisis can begin during, or in the following 24 hours after the anesthetic induction. In this case, the patient presented symptoms as early as 2 hours after the initiation of general anesthesia, while the surgical procedure was in progress. The dantrolene was obtained thanks to the SCARE president, it was sent from the Cartagena naval hospital located in same city.

Among the early clinical findings, the patient presented generalized muscular stiffness, hypercapnia, a sinus tachycardia that evolved to supraventricular tachycardia, and body hyperthermia as measured in the nasopharynx, which is consistent with the reported frequency of symptoms of MH reported by Larach et al in study in 2010 (hypercapnia 92%, sinus tachycardia 73%, generalized muscle stiffness 41%, tachypnea 27%, masseter spasm 27%), where hypercapnia and sinus tachycardia were identified as the most common in this disease. Regarding the spasm of the masseter muscle, we did not find reports in the reviewed clinical history that mentioned or denied the appearance of this symptom, a fact that is important because this sign is often produced by succinylcholine long before the muscular rigidity generalized [8].

In MH, muscle damage occurs and can be evidenced by increased CPK levels (greater than 10000 U/L, are used for diagnosis). However, this does not occur immediately after the crisis is triggered, even these values may be modified if treatment with dantrolene is started immediately, following the recommendations of the SCARE [9], as this stops breakdown of muscle fibers, and thus lower CPK levels. CPK usually persists altered and on the rise during the first 24 hours after the crisis, after which CPK levels drop [10]. In our patient, the highest increase of CPK levels was observed in sample four, and dantrolene was continued, after which a subsequent decrease was observed until normal CPK levels were reached. Finally, the patient survived the MH crisis. Due to economic limitations of the patient's family and given that the diagnostic tests (test for induced muscular contracture) [11]. are difficult to perform and interpret, they are not routinely used and are performed in specialized centers in Colombia, mainly in Bogotá, the capital.

The patient presented improvement in MH, after the use of dantrolene by the previously indicated doses, the reason for his long stay in the intensive care unit rather than direct lesions of MH were complications such as difficult-to-manage pneumonia that interfered with mechanical ventilatory weaning, sepsis with renal, hemodynamic, hydroelectrolytic and other repercussions.

Malignant hyperthermia is a severe reaction that can be presented by patients with genetic susceptibility, however, they are seldom aware that they have it. This is a rare disorder, however a greater risk of MH has been previously identified in the male population, as it is in this case. In this his case, a young male patient with no previous personal or family history of complications associated with anesthetics, underwent surgery during which he presented various symptoms that strongly suggested development of malignant hyperthermia, therefore the medical team acted immediately, and was able to achieve improvement of symptoms. Despite the complications derived from this crisis continued with the patient presenting rhabdomyolisis, renal injury, and alterations at the levels of CO_2, they were successfully managed, and the patients presented subsequent improvement and satisfactory outcome.

References

1. Denborough MA, Forster JF, Lovell RR, Maplestone PA, Villiers JD (1962) Anaesthetic deaths in a family. Br J Anaesth 34: 395-396. Link: http://bit.ly/2ksN1v1
2. Denborough MA (2008) Malignant Hyperthermia. Anesthesiology 108: 156-157. Link: http://bit.ly/2kjfcN7
3. Kalow W, Britt BA, Terreau ME, Haist C (1970) Metabolic error of muscle metabolism after recovery from malignant hyperthermia. Lancet 2: 895-898. Link: http://bit.ly/2lyCU88
4. Link: http://tiny.cc/et98bz
5. Ibarra P, Robledo B, Galindo M, Niño C, Rincón D (2009) Minimum standards 2009 for practising anaesthesiology in Colombia. Safety Committee. Rev Colomb Anestesiol 37: 235-253. Link: http://bit.ly/2kjfvrf
6. Larach MG, Localio AR, Allen GC, Denborough MA, Ellis FR et al. (1994) A clinical grading scale to predict malignant hyperthermia susceptibility. Anesthesiology 80: 771-779. Link: http://bit.ly/2ktLt3W
7. Kolb ME, Horne ML, Martz R (1982) Dantrolene in human malignant hyperthermia. Anesthesiology 56: 254-262. Link: http://bit.ly/2lDujAW
8. Larach MG, Gronert GA, Allen GC, Brandom BW, Lehman EB (2010) Clinical presentation, treatment, and complications of malignant hyperthermia in North America from 1987 to 2006. Anesth Analg 110: 498-507. Link: http://bit.ly/2m0E9xb
9. Link: http://tiny.cc/7u98bz
10. Ortiz Gómez JR (2008) Anestesia en la hipertermia maligna. Revista Española de Anestesiología y Reanimación 55: 165-174. Link: http://bit.ly/2lyEnva
11. Rojas JE, Wilches MA, Cepeda LA, Garcés MF, Suarez MA, et al. (2008) Molecular Diagnostics of Porcine Stress Syndrome Susceptibility Associated with the Arg615Cys Mutation Using Real-Time PCR with Fluorescent Hybridization Probes. Revista Colombiana de Anestesiología 36: 11-18. Link: http://bit.ly/2lyhN5U

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