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ADVANCES IN ANESTHESIA

Malignant Hyperthermia
An Update

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• Masseter spasm • Rhabdomyolysis • Muscle biopsy

Key points

- Malignant hyperthermia (MH) is a rare, autosomal dominant disorder of muscle that places individuals with MH susceptibility (MHS) at considerable risk of death while undergoing standard general anesthetics.
- Early recognition of the signs of MH and prompt treatment of the patient are vital to ensuring a positive outcome. Maintaining carts containing all the equipment useful for treating MH, developing hospital/surgical center protocols with guidance from the Malignant Hyperthermia Association of the United States (see www.mhaus.org), and rehearsals help ensure team preparedness for these events.
- Following an MH crisis, continued monitoring and treatment with dantrolene is necessary, as a significant percentage of patients exhibit signs of increased metabolism again in the next 24 to 36 hours. Patients who have experienced fulminant MH should undergo genetic testing to identify changes in the ryanodine receptor type 1 gene. If an MH causative mutation is found, others in the family can be evaluated with a blood test or even a buccal swab for the same variant found in the proband.
- Appropriate counseling and testing of families thought to be at risk for MH is a critical part of the care of these patients. MHS can be associated with increased risk of heat illness, exercise-induced rhabdomyolysis, and muscle injury from statin drugs.

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INTRODUCTION

The manipulation of neuromuscular function is a trademark skill of anesthesia providers during airway management and surgical procedures. One of the greatest fears among anesthesia providers is to lose control of muscle tone and metabolism due to the pharmacogenetic autosomal dominant disease, MH. In those patients with MHS, even a brief exposure to a drug known to trigger the expression of this disease may lead to a progressive, often catastrophic, hypermetabolic state of sustained muscle contraction and rapidly increasing temperature. The consequences of this hypermetabolic state can include perturbations in acid-base balance, hyperkalemia, multiorgan dysfunction including central nervous system injury, and death. Prompt recognition and treatment of an episode of MH are necessary to optimize patient outcome.

EPIDEMIOLOGY

MHS is inherited in an autosomal dominant manner; however, its expression is highly variable. One patient with a genetic mutation known to cause MH may exhibit signs of the disease during or after the first exposure to a triggering agent, whereas a different patient with the same mutation may undergo multiple triggering anesthetics without demonstrating any signs of MH. Episodes of anesthesia-induced MH are more frequent in men than in women. One study that included more than 4 million surgical patients found that approximately 1 patient per 100,000 suffered from an MH event [1]. Although MH events are extremely rare, prevalence of MHS seems to be much more common, at least 1 in 2000 to 3000 people [2].

Mortality from episodes of MH ranges from 1.4%, reported on events between 1987 to 2006, to 9.5%, reported on events between 2007 to 2012 [3]. In either case, this is a dramatic decrease from when the disease was first described in the 1960s and before treatment with dantrolene. Morbidity from MH events, including muscle pain, prolonged intensive care admission, neurologic injury, renal injury, and cardiac rhythm abnormalities, remains unacceptably high. Full recovery from a fulminant MH event many require many months.

MECHANISM

An MH episode is usually characterized by signs of increased metabolism in response to a known triggering agent, such as potent halogenated inhalational anesthetics or succinylcholine. Nitrous oxide and xenon do not produce contractures in MH-susceptible muscle and thus are considered safe anesthetics for patients with MHS. Less often, individuals with MHS can present with rigidity and increasing temperature to critical levels after exercise, heat-induced illness, or viral syndromes, without any exposure to the classic drug triggers of MH [4–6].

The underlying pathophysiology of MH is altered calcium regulation within the muscle.

In normal muscle, muscle cell membrane depolarization activates the dihydropridine receptor within the wall of t-tubules. The dihydropyridine receptor