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Preparedness of Nurses for Malignant Hyperthermia

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Introduction

Preparedness of Nurses for Malignant Hyperthermia
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Hypercarbia
Tachycardia
Hypoxia
Masseter spasm
Flushed skin

Signs and Symptoms

The signs and symptoms of malignant hyperthermia usually occur within minutes or up to an hour after the administration of the triggering agent. The people who are susceptible to MH have a gene mutation in the ryanodine receptor subtype 1 (RYR-1) gene which is found in all skeletal muscle. This gene encodes the calcium ion channel in skeletal muscle and is responsible for calcium release during muscle contraction. The RYR-1 is also the binding site for inhaled anesthetics and muscle relaxants. Calcium released in any sequence, but there are typically four to six impulses following the initial one (Cain et al., 2014, p. 302-303). The first sign of MH is hyperthermia or an unexplained, progressive increase in carbon dioxide production. The ETCO2 can double or triple a normal capnography value in MH. The next sign may be a different or uncontrolled intracellular calcium release from the skeletal muscle sarcoplasmic reticulum into the cytosol. This causes a state of intense sustained skeletal muscle contraction and rigidity that, in turn, causes increased sympathetic activity, oxygen consumption, and the production of carbon dioxide and heat from the rapid use of ATP (Hirshon et al., 2013, p. 331). The contractions eventually deplete the oxygen and ATP and begin anaerobic metabolism which produces lactate. Lactate can cause acidosis leading to death and destruction. Potassium, as well as other electrolytes such as calcium, phosphate, and magnesium, cytochrome (K), and myoglobin leak into the bloodstream as a result of the muscle contractions. This can lead to cardiac arrhythmias, rhabdomyolysis, and death (Hirshon et al., 2013, p. 331). Seifert et al., 2014, p. 195-196.

The goal of treatment of malignant hyperthermia is to reverse the hypermetabolic state and prevent the potential lethal consequences of MH. The lethal temperature is usually not reached. After diagnosis of MH, treatment must begin immediately. If MH is not treated rapidly, the mortality rate is high. The most effective treatment for MH is the administration of dantrolene sodium. The mortality rate from MH used to be as high as 95%, but since the discovery of dantrolen in 1975, it is now down to 5% (Hirshon et al., 2013, p. 330). Dantrolene is a specific ryanodine receptor antagonist and reverses the MH related muscle contractions by decreasing the calcium in muscle cells (Seifert et al., 2014, p. 192). The longer time that elapses between the onset of MH and the first dose of dantrolene results in an increase in complications associated with MH. It is well known that the preparation of dantrolene is difficult. Some of the difficulties with dantrolene preparation are that it requires large quantities of diluents to be mixed with large quantities of the medication and it requires a precise volume calculation. The required dose of dantrolene is 2.5 mg/kg rapidly through a large bore IV over 5 minutes and repeat until symptoms subside or a maximum dose of 15 mg/kg is reached. Dantrolene comes in 20 mg vials and must be mixed with 60 ml sterile water (Seifert et al., 2014, p. 192-193). In a patient who weighs 100 kg, the initial dose of dantrolene would be 250 mg. That would require 12.5 vials of dantrolene to be mixed and a total of 750 ml of sterile water to be mixed. This necessitates the use of large quantities of the medication and it requires complicated medication administration. It may take several minutes, it can become time consuming and difficult to calculate. It may take several nurses handling the medication. The same time to get the first critical dose in a timely manner. In a rare situation like MH, the skill is not second nature and must be practiced to be effective in an emergency. Another obvious treatment of MH is to stop the potentially anesthetic and either abort the procedure or switch to a non-stimulating anesthetic. An increase in oxygenation to 100%. FIO2 will help prevent anesthetic metabolism, and hyperventilation will decrease the oxygen CO2 build up resulting from MH (Seifert et al., 2014, p. 195). Also, sodium bicarbonate can be given to treat metabolic acids, and insulin and calcitonin can be given to treat hypercalcemia (Seifert et al., 2014, p. 197).

The signs and symptoms of malignant hyperthermia usually occur within minutes or up to an hour after the administration of the triggering agent. However, if there are no signs or symptoms, it is possible that it is not MH. It is also possible that the signs and symptoms of MH are not recognized due to lack of education. In emergency situations, it is possible that treatment is given without diagnosis, treatment, and location of MH. The rapid increase in body temperature can exceed 43.3 °C [109.9 °F] every five minutes (Seifert et al., 2014, p. 196). After swift and appropriate treatment, the patient with MH would hopefully revert to a normal state. The second dose of dantrolene is administered 20 minutes after the first dose. The patient with MH should be treated rapidly, the mortality rate is high. The most effective treatment for MH is the administration of dantrolene sodium (Seifert et al., 2014, p. 196). After swift and appropriate treatment, the patient with MH would hopefully revert to a normal state. Education and training for all health care professionals who work with patients receiving volatile anesthetics and depolarizing muscle relaxants is crucial. The patient with MH should be treated rapidly, the mortality rate is high. The most effective treatment for MH is the administration of dantrolene sodium (Seifert et al., 2014, p. 196). After swift and appropriate treatment, the patient with MH would hopefully revert to a normal state. Education and training for all health care professionals who work with patients receiving volatile anesthetics and depolarizing muscle relaxants is crucial. The patient with MH should be treated rapidly, the mortality rate is high. The most effective treatment for MH is the administration of dantrolene sodium. The mortality rate from MH used to be as high as 95%, but since the discovery of dantrolen in 1975, it is now down to 5% (Hirshon et al., 2013, p. 331). The area where MH may occur is the operating room. Many hospitals in the United States have developed plans to handle MH cases. Repeated education and simulation are integral parts of MH preparedness. Education and training for all health care professionals who work with patients receiving volatile anesthetics and depolarizing muscle relaxants is crucial. The patient with MH should be treated rapidly, the mortality rate is high. The most effective treatment for MH is the administration of dantrolene sodium. The mortality rate from MH used to be as high as 95%, but since the discovery of dantrolen in 1975, it is now down to 5% (Hirshon et al., 2013, p. 331). The area where MH may occur is the operating room. Many hospitals in the United States have developed plans to handle MH cases. Repeated education and simulation are integral parts of MH preparedness.