2021

Malignant Hyperthermia

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Malignant Hyperthermia

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Topic

Malignant Hyperthermia (MH)

- According to the International Classification of Diseases, MH is a rare, but progressive, and life-threatening hyperthermic reaction following the administration of general anesthesia (Hopkins et. al., 2020)
- With early detection and intervention MH can be treated. Without immediate treatment mortality rate is significantly higher (Yang et. al., 2020).

Why MH?

- MH can happen at any age, but it tends to happen more often in young adults and children (Gupta & Hopkins, 2017).
- MH is a disease process that although rare can become fatal quickly.
- The mortality from MH is approximately 6 to 12% in the United States (Gupta & Hopkins, 2017)

Signs & Symptoms

- The most common diagnostic characteristics of MH include unexplained rise in ETCO2, increase in heart rate, and a rapid increase in temperature.
- Others include masster spasm, muscle rigidity, dark colored urine, and sweating.
- Family history of MH is an important indicator.

(Yang et. al., 2020)

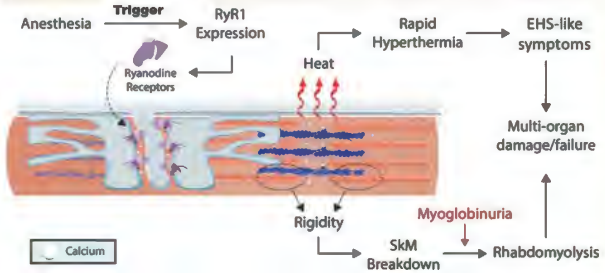
Pathophysiology

MH is an autosomal dominate genetic disorder of the skeletal muscle resulting in a hyperthermic reaction to a trigger such as violate anesthetic gases or the depolarizing neuromuscular blocking agent, Succinylcholine.

- In a patient who experiences MH, there is genetic issues with the calcium channels in skeletal muscle.
- Predominately mutations in the ryanodine receptor type 1 (RYR1) gene.
- There are currently 29 known mutations in the RYR1 gene.
- This mutation causes the actin–myosis–troponin interaction to occur leading to muscle contraction, ultimately being the cause of the hypermetabolic response.
- In MH, the relaxation of muscle is inhibited, but calcium is continuously released causing nonstop muscle contraction.

(Haili & Weant, 2021)

Image 1. Pathophysiology of Malignant Hyperthermia



Laitano et. Al., 2020

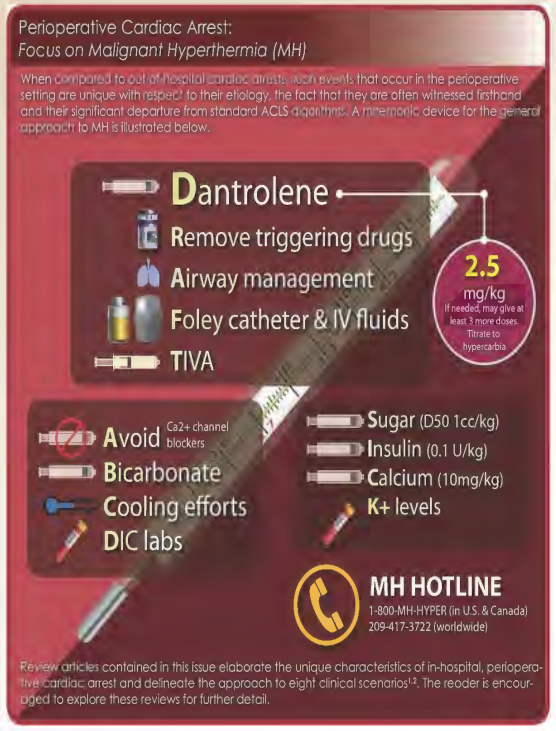
Clinical Significance

Published data of MH incidence is more than likely underreported than what is seen in literature.

- MH is typically more common in males, with males making up about 68% of cases.
- Any age, race, gender, or ethnicity can be at risk.
- The mean age for reported MH cases is 21 to 23 years old.
- MH tends to occur after more then one exposure of anesthesia but can occur on the first exposure to a triggering agent.
- Patients under the age 15 make up about 52% of the cases of MH.
- Recent studies show that the genetic mutation in the RYR1 gene is about 1 in 2,000 to 1 in 3,000 frequency.

(Malignant hyperthermia (NORD), 2013)

Malignant Hyperthermia Management



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Treatments

Early identification and Intervention is key to patient survival

- Once MH is suspected the anesthesia provider must stop the administration of the inhaled anesthetic and begin to hyperoxygenate the patient at 100% FiO2.
- Begin the administration of the medication Dantrolene following the guidelines.
- Actively being cooling measure to get patient's core body temperature lowered.
- If not already present, establish invasive monitoring devices to monitor for hemodynamic stability.
- Collect routine lab work, watching closely for hyperkalemia, acidosis, and indicators of renal injury.
- Once the patient is medically stable, transfer to the critical care unit for further treatment and observation

(Gupta and Hopkins, 2017)

Nursing Care

Once Malignant Hyperthermia is suspected many nursing interventions need to happen quickly in order to reverse the deadly cascade that can ensue with MH.

- Registered Nurses as well as Certified Registered Nurse Anesthetists (CRNA) should be educated on MH signs and symptoms.
- Nurses working in the Post Anesthesia Care Unit (PACU), the operating room (OR), and the intensive care units (ICU) should be specially trained because these environments are where MH is most likely to occur due to the medications and anesthetic gas administered.
- If a nurse suspects MH, 100% oxygen should be started via a nonrebreather mask if not mechanically ventilated in the OR.
- The provider and anesthesia should be notified immediately, and someone should retrieve the MH chart.
- The primary nurse should stay at bedside with the patient and monitor vitals signs via cardiac monitors.
- The IV lines should be checked to verify patency so that the medications can be administered once available.
- Take measures to reduce body temperature such as removing extra sheets, cool IV fluids, ice packs, or a cooling blanket.
- Place a foley catheter to monitor kidney function.
- Draw frequent labs to monitor electrolytes, pH, and renal function.
- Once the patient has been stabilized and transferred to the ICU, Dantrolene will continue to be administered every 4 to 6 hours for the next 24 to 48 hours to prevent recurrent MH episode.
- Before discharge from the hospital the nurse should educate the patient on their new medical history and explain the importance of making medical providers and family aware to prevent future episodes.
- Provide the patient with written information about MH and resources to learn more.

(Wolter Kluwer, 2006)

Complications

- Complications associated with MH come from the exposure of the triggering agent that leads to uncontrolled release of calcium from the skeletal muscles (Haili & Weant, 2021).
- The continuously muscle contraction causes "increased CO2 production as a by-product of ATP generation in the mitochondria, excess heat production from the rapid consumption of ATP, and increased lactate production as the body attempts to produce energy by anaerobic metabolism " (Haili & Weant, 2021).
- These each lead to cell destruction releasing high levels of potassium and creatine kinase into the blood stream which potentially can cause cardiac arrythmias or renal failure (Haili & Weant, 2021).
- Calcium Channel blockers should be avoided when administering Dantrolene because together they can cause hyperkalemia which can lead to cardiac dysrhythmias or cardiac arrest. (Wolters Kluwer, 2006)
- Another potential complication can be disseminated intravascular coagulation (DIC) (Wolters Kluwer, 2006)

Conclusions

- Since MH is a fast progressing, lethal disease process, "The Malignant Hyperthermia Association of the United States (MHAUS) guidelines state that dantrolene must be available within 10min of the decision to treat MH at all anesthetizing/ sedating locations where MH-triggering agents are used. until adequate response is achieved. MHAUS mandates that each institution stock at least 720mg of dantrolene—sufficient to administer 10mg/kg to a 70-kg patient" (Larach et. al., 2019)
- Any health care provider in an environment where MH is possible, must be educated and aware of MH signs and symptoms and treatment in order to act quickly to save the patient.

References

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